PROGRAMME BOOK

PuG 2021 online

Psychologie und Gehirn 2021

2. – 4. Juni | online

DGPs
Fachgruppe Biologische Psychologie und Neuropsychologie

DGPA

EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

Welcome

Dear colleagues,



It seems a long dark year is finally coming to an end. The Covid-19 pandemic has taken its toll on everybody, and some of you might have endured much more than lockdown-related daily hassles. A lot of meetings we hold very dear were cancelled. Last year's *Psychology and the Brain, PuG*, which had been meticulously planned by Markus Heinrichs and his colleagues in Freiburg, was one of them.

We have tried to rise to the challenge of preparing a meeting that is both epidemiologically fail-safe and catches the spark of previous conferences as far as humanely - and technologically - possible. So, welcome to the **PuG 2021 - online**!

With your help and your amazing contributions, we have compiled a program that reflects the state of the biopsychological and psychophysiological art and gives us ample opportunity to delve into the depths of current research and get together with our scientific friends and colleagues. We are proud to announce that almost 700 participants have registered for a conference that will feature 36 symposia, the presentation of more than 200 posters in six tracks, as well as three keynotes by renowned speakers, Nikolai Axmacher, Ulrike Lüken and Russ Poldrack. Faced with an embarrassment of riches in terms of submissions but planning for a condensed schedule because of the online format, we had to make some tough choices and want to send our apologies (again) to everybody whose contributions could not be included.

The virtual nature of the PuG 2021 means that, on the plus side, you are not obliged to travel to attend the meeting, you may relax in your armchair between (and during) sessions, and you do not even have to wear trousers when presenting. However, this also implies that you will be your own caterer – we do hope you will make the necessary arrangements, particularly for our social evening on Thursday, June 3. This evening will feature a virtual pub quiz organized by the early career scientists (JuWis) and give all of you the possibility to mix with your colleagues in a relaxed setting.

A big thank you goes to the **JuWis** who organized the pre-conference workshops and were a constant source of support and inspiration. Also, all of this would not be possible without our technical staff and lots of support from dear colleagues – THANK YOU!

In 2021, let's come together as bits and bytes while we are looking forward to a return to the joys of normality, and to a real-life meeting in 2022. We wish you all an enjoyable and interesting PuG 2021 – online!

Tübingen, June 2021

Birgit Derntl, Steffen Gais, Manfred Hallschmid

Grußwort des Sprechers der Fachgruppe

Liebe Kolleginnen und Kollegen,

unsere Tagung Psychologie und Gehirn 2021 (PuG) ist etwas ganz Besonderes. Sie findet im Corona-Jahr 2021 statt, nach der schmerzlichen Absage der PuG im letzten Jahr, und es ist unsere erste Online-Tagung. Die Coronazahlen sinken zum Glück, aber die Pandemie ist noch nicht überwunden, und daher war unsere Entscheidung richtig, diesen „sicheren" Weg zu gehen.

Herzlichen Dank an die Organisatoren in Tübingen, Birgit Derntl, Steffen Gais und Manfred Hallschmid und ihr Team, dass Ihr diese Herausforderung angenommen und das „Online-Tagungsland" für uns vorbereitet habt. Wir alle wissen das sehr zu schätzen, denn nur durch Euren Einsatz ist die PuG 2021 möglich.

Diese 46. PuG-Tagung wird sich von allen vorherigen Tagungen unterscheiden, aber gleichzeitig auch viel mit ihnen gemeinsam haben. Uns erwarten sehr interessante Hauptvorträge, spannende Symposien und aktuelle Posterpräsentationen. Ich bin sicher, wir alle werden es nach einem Jahr Abstinenz genießen, biopsychologische Forschung auf höchstem Niveau zu erleben und geschätzte Kolleginnen und Kollegen und liebe Freunde zu treffen. Diese Tagung wird ein Erlebnis!

Herzliche Grüße

Paul Pauli

Sprecher der Fachgruppe Biologische Psychologie und Neuropsychologie der Deutschen Gesellschaft für Psychologie (DGPs)

Grußwort des Präsidenten der DGPA

Liebe Kolleginnen und Kollegen,

im Namen des Vorstands der „Deutschen Gesellschaft für Psychophysiologie und ihre Anwendungen (DGPA)" grüße ich Sie anlässlich der 46. Tagung „Psychologie und Gehirn (PuG)".

Fast 700 Teilnehmer*innen haben sich zur Tagung angemeldet, darunter viele aus dem Ausland. Das sind überwältigende Zahlen und bestätigen das zunehmende Interesse an psychobiologischer Forschung, insbesondere der Jung- und Nachwuchswissenschaftler*innen.

Die PuG ist seit vielen Jahren ein Erfolg der Zusammenarbeit von DGPs-Fachgruppe „Biologische Psychologie und Neuropsychologie" und DGPA. Die hohe wissenschaftliche Qualität der PuG wird aber in erster Linie durch die lokalen Organisatoren garantiert. In diesem Jahr wird die PuG von Birgit Derntl, Steffen Gais und Manfred Hallschmid aus Tübingen ausgerichtet, erstmalig wegen der Covid-19-Pandemie in einem virtuellen Rahmen. Für diese Bereitschaft zur Pionierarbeit sowie die erfolgreiche Gestaltung der Tagung sind wir den Ausrichtern und ihrem Team zutiefst dankbar und freuen uns auf das exzellente wissenschaftliche Programm.

Allen Teilnehmer*innen, den vielen Vortragenden und den Ausrichtern wünschen wir eine inspirierende und spannende Tagung.

Herzliche Grüße

Hartmut Schächinger

Präsident der DGPA

General Information

Hosts & Organizers

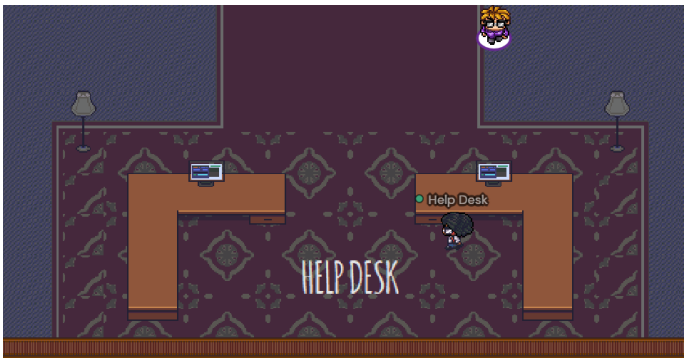
Prof. Dr. Steffen Gais & Prof. Dr. Manfred Hallschmid
Institute of Medical Psychology and Behavioral Neurobiology, University of Tübingen

Prof. Dr. Birgit Derntl
Department of Psychiatry and Psychotherapy, University of Tübingen

Contact

Website (general information):	https://pug2021.de
Conference website (for participants):	https://conftool.org/pug2021
PuG 2021 gather.town: (Coffee Lounge and Poster Rooms open 24/7 during the conference)	Link and password available via ConfTool
Help Desk (during conference):	support@pug2021.de
Zoom Help Desk:	ID: 923 6936 1928 Passcode: 766541
Registration Desk:	registration@pug2021.de
Zoom Registration Desk: (only Wednesday 14:00 – 19:00)	ID: 998 8480 1114 Passcode: 177843
gather.town support:	Link and password available via ConfTool

Contact the Help Desk via Zoom or come and find us in gather.town at the south end of the Entrance Hall



Organizational Matters

Late Online Registration

Participants who have registered only recently and for whom we have not yet received a **confirmation of payment** from our administration are kindly asked to **visit the registration desk** (Wednesday from 14:00 to 19:00) or the help desk (all other times). You may contact the desks via Zoom (→ General Information) to provide your transaction information.

Note that access to the sessions will only be possible for participants with confirmed payments.

Access to the Sessions

Participants may access the **links to the individual sessions** via the ConfTool website https://conftool.org/pug2021. Links will be **available in the conference agenda 15 min before the respective session**. Please access the website with your personal log-in information and click on "Browse Conference Agenda".

Plenary sessions and symposia will take place in Zoom. Access information will be provided as Zoom links.

See also → Tips for Zoom Sessions

The poster sessions and the social programme will take place in gather.town, which allows you to move through our virtual conference venue, read the posters, and approach your colleagues for a video chat.

See also → Tips for gather.town

Certificate of Attendance

A certificate of attendance can be downloaded after the conference from https://conftool.org/pug2021

Read the Tips

This abstract book contains a number of tips for participation. Please read them even if you already feel comfortable with Zoom and gather.town!

Social Programme

Get-together

Wednesday, June 2, from 19:00

As is the habit at the PuG, Wednesday evening provides the excellent **opportunity to mingle** and meet with your colleagues and friends. This year, it is even more important to join us there, because this will be the **test run for the poster session**. During the get-together, you can check if your computer works well with gather.town and familiarize yourself with the app. Should there be any problems, you can **contact out friendly help desk staff**, who will do everything to get things running. Poster presenters might also want to have a quick look over in the poster hall to see whether their poster has safely arrived at our venue.

See also → Tips for gather.town

Social Evening with Award Ceremony and Pub Quiz

Thursday, June 3, 20:00

On Thursday, the social evening gets going with the award ceremony for the **Science Communication Award, Supervisor Award, and Mentoring Award** hosted by the Early Career Researchers. Due to capacity limits, this session will happen **in Zoom**.

At 20:30, those who registered for the **pub quiz** will join another **Zoom** session, where quiz master Jasper Roskilly will get their heads spinning!

Everyone else is invited to join us in the **gather.town ballroom to round off an exciting conference day** with wine, beer, and some pleasant conversation. So, do not forget to chill the drinks!

See also → Tips for gather.town

Coffee Breaks

There will be short breaks between sessions. If you do not feel the need to visit the rest room or get fresh coffee, **please come and visit our gather.town Coffee Lounge,** where you can meet with other participants, have **after-session discussions, gossip, or just hang out**. The Lounge will be open around-the-clock during the conference, so you can arrange meetings here at any time. You will find private spaces there where no one can overhear you!

All participants are kindly asked to provide their own supplies of coffee, soft drinks, and snacks due to the online nature of the conference.

See also → Tips for gather.town

General Tips for Participation

Tips for Your Internet Connection

The most important advice is: **do not use wireless LAN, but use a cable connection**! The wireless connection can drop as soon as your neighbour activates the microwave oven. Also, Bluetooth and wireless headsets interfere with the WiFi signal.

You can still order a simple **USB-to-LAN connector and LAN cable** for around 15 Eur from your favourite online retailer. If you are unsure what to buy, we recommend https://geizhals.de/tp-link-ue300-a1248063.html

So, please remember: when connectivity issues arise, your home internet connection is very likely not the problem. Even an old 8 Mbit DSL connection should be sufficient for several concurrent video conferences. Therefore, if you experience problems, your wireless LAN connection is the most likely culprit. Even if we repeat ourselves here: **Do not use wireless LAN, but use a cable connection!** This is all the more important if you present a poster or have a presentation in a symposium.

Tips for Your Attendance

We are happy to look forward to a packed program! In contrast to on-site PuGs, there will not be any events on Saturday so that you are not obliged to sit in front of your computer for three days in a row. Consequently, since we had to accommodate so many exciting events in the program, there is not much time off during Thursday and Friday. Therefore, prepare for two intense online days.

Please make sure that you have your **log-in information for https://conftool.org/pug2021** ready: all links to the sessions will be distributed in the ConfTool agenda that is only accessible to participants. Also, if you have not yet received a payment confirmation email, please check on Wednesday afternoon whether your **payment has been acknowledged in ConfTool** ("Access Your Participant Registration Details"). If a "No payments received yet." message is displayed, please contact our Registration Desk via email (registration@pug2021.de) or Zoom (ID: 998 8480 1114, PW: 177843) on Wednesday between 14:00 and 19:00 to provide a confirmation of payment. Please allow for some waiting time. On Thursday and Friday, our Help Desk will be able to help you.

- **Use your real name in Zoom and gather.town**. This is the only way your colleagues can recognize and contact you. This is also required for security reasons.
- Make sure your video camera and microphone are ready. If you are in a noisy environment, use a headset, otherwise a desktop microphone works fine.
- Prepare drinks and snacks, and don't forget the coffee! Have your favourite pizza delivery service flyer ready!
- Chairs and speakers: **Please make sure that you do not to overrun your time slot**!
- During breaks, if your program has empty slots, or for scheduled meetings with colleagues, **come to our gather.town Coffee Lounge**, which is open around-the-clock.

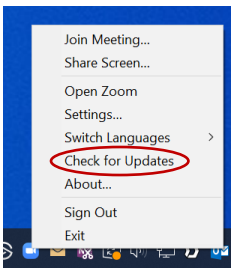
In general, should you encounter any problems during the conference, please contact us via email (support@pug2021.de) or Zoom (ID: 923 6936 1928, PW: 766541).

Tips for Zoom Sessions

In General

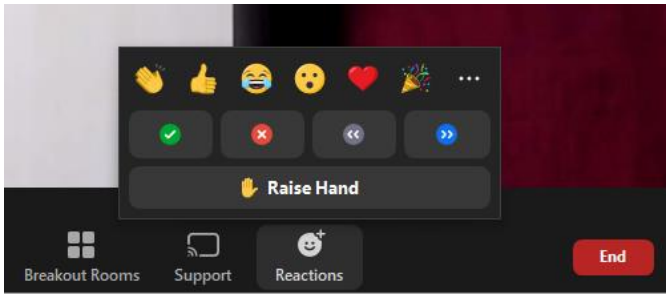
We want to keep the conference as vivid as possible and allow you to interact as much as possible. We have therefore opted for a live online structure of our program rather than for pre-recorded videos.

Although most of us are now more experienced in Zoom than we would have hoped for a year ago, here are some helpful tips:



Please **switch on your cameras**! For the speakers, it is a much more enjoyable experience to see your faces instead of a black screen with names on it. Switch on your videos when you attend a session, but most importantly, switch it on when you participate in the discussion.

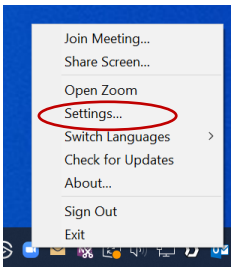
Please **update your Zoom client** before the conference (do it right now!). Just start Zoom, right-click on the Zoom icon and "Check for Updates".



If you want to participate in a discussion and ask a question: **Use the "Raise Hand" feature of Zoom, which you find under "Reactions".** Only this way the chairs have a simple way to identify you and permit you to switch on your microphone.

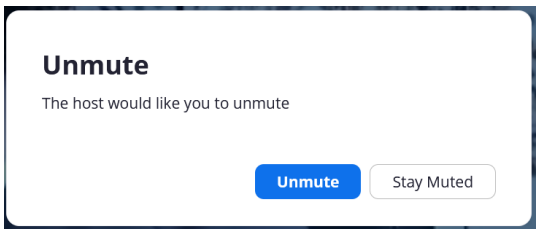
If you have an **old Zoom client**, you will find the "Raise Hand" button at the bottom of the participants list, which you activate with the "Participants" button.

Alternatively, the chairs may invite you to submit questions via the Chat window.



Before you enter a Zoom session, **make sure that your video and audio work**. Start Zoom, right-click the icon, and select "Settings ...". Under "Video" you check whether the video is to your satisfaction. Under "Audio", you find the button "Test Mic" for a sound check.

The sessions are **accessible via Zoom links provided in the ConfTool Conference Agenda** 15 min before the start of the session. The links open an internet browser window which allows you to download the Zoom client, if you have not done so, and launch it. Should you prefer not to install the Zoom client, you can follow the "Join from Your Browser" link to attend in a browser session (not recommended!).



During most sessions, participants will be able to **unmute themselves only when prompted** by the chairs to do so. To ask your question during a discussion, just click on "Unmute" when asked to do so.

In every session, a **Technical Host** will be present. They can be contacted using the Chat window. They can also try to put you in contact with the speakers after a session.

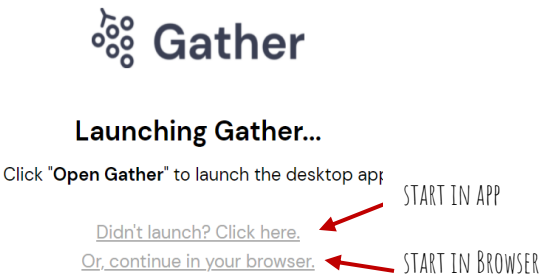
Tips for gather.town: Get Started

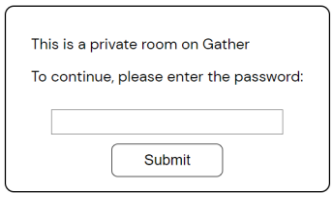
In General

We have chosen gather.town as the main social platform for the PuG because it enables immersive online socialising, almost – we hope – as if you were attending a real social event or a poster session with presenters standing right in front of you. You will be able to bump into colleagues and friends, have chance encounters with other conference attendees, and strike up conversations with your fellow researchers, just like you would at an in-person event.

How to enter gather.town

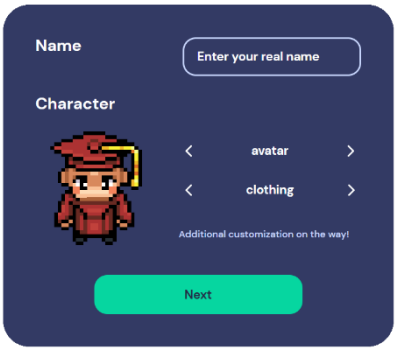
You can run gather.town out of your **browser, or** you can use the **dedicated app** for Windows or Mac. If you use gather.town more frequently, the app can be the better choice.

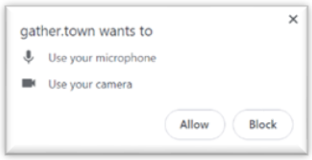




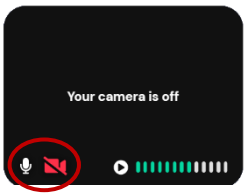
After you have clicked on the gather.town link in the conference agenda, you need to enter the password, which you get from the agenda as well, and then click on the submit button. (The "enter" key does not work here!)

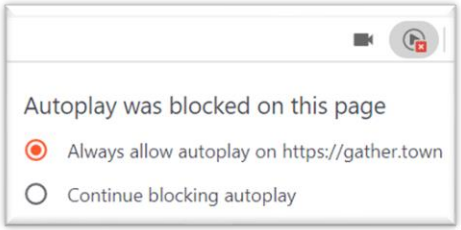
Next, you have to enter your name and choose your avatar's looks. To participate at the PuG, you must **enter your real name here**. Like a conference badge, it allows you to be found by your colleagues, and we require it also for security reasons. When you click "next", you are usually **asked by your browser to switch your camera and microphone on**.





Allow it. After this, you can select the correct camera or microphone, if you need. Make sure that the microphone and camera symbols are white to indicate both are switched on. **You should see an image of yourself now.** If not, make sure you **allow "autoplay"** by clicking on the small symbol with a red mark in the address bar of your browser.

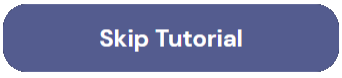




At this point, you should be all set to enter gather.town by clicking "Join the Gathering". If it is your first time around, **follow the short tutorial** to get acquainted with the controls:

1. Use the cursor keys to walk to the blue rectangle.
2. Click the microphone symbol in your small video window to mute and unmute yourself.
3. Walk to the sign and press the "x" key to interact with the signpost.
4. Now walk through the portal.

If it's not your first visit, you may just click on "Skip Tutorial".

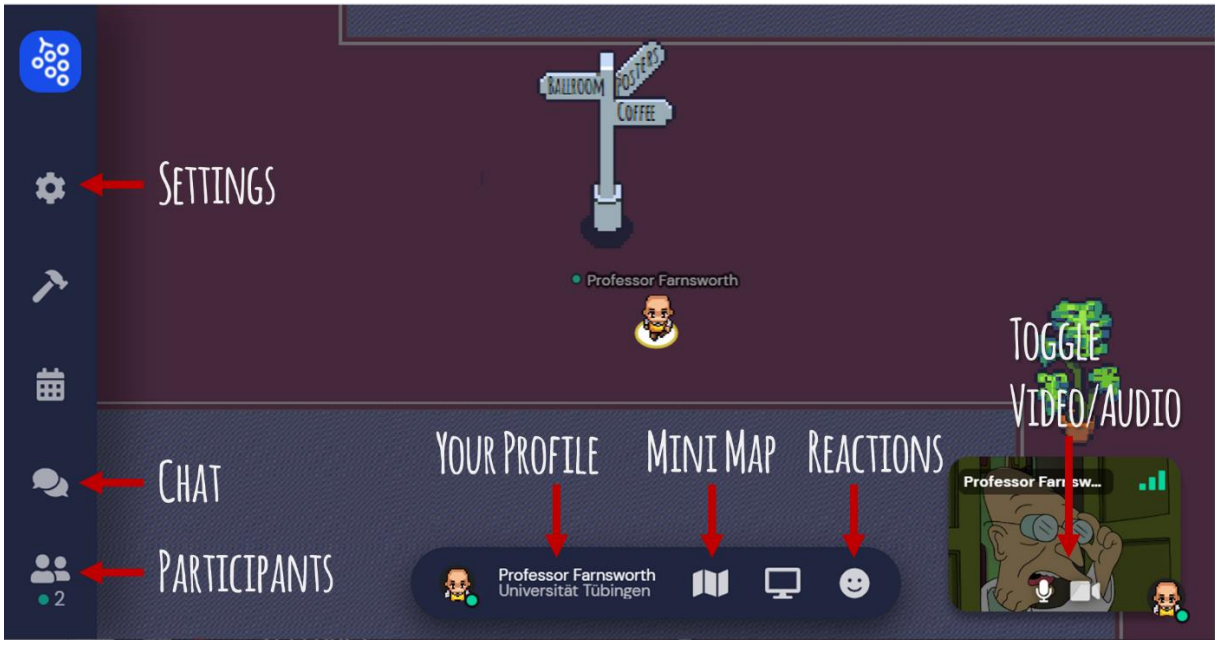


Welcome to gather.town!

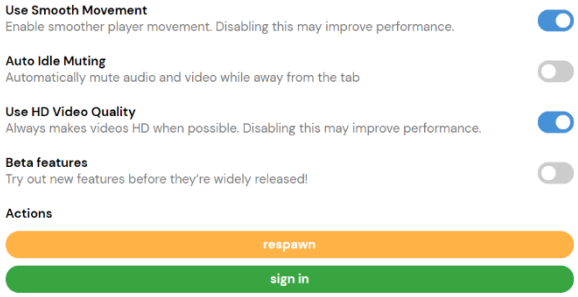
Tips for gather.town: Familiarize Yourself

Basic Controls

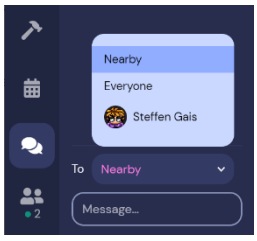
Get yourself familiarized with the controls in gather.town.



First, go to **Your Profile**. Here you can add your affiliation as **status text**. Then, go to **Settings**. We recommend **using HD Video Quality** if you are on a reasonable internet connection. We also recommend switching **Auto Idle Muting off**, because it breaks the audio/video connection as soon as you click outside your browser window. Should you get lost, "respawn" will get you back to the Entrance Hall.



Now, look at "Participants". You see the **list of everybody** who is currently in the same gather.town space as you. (Note: Poster sessions 1-5 are located in a different space for reasons of capacity.) To find someone, just **click on the name** and **"Locate on map"**. If you are slightly pushier, you can also use the "Follow" feature to stalk your victim around the map (not recommended!).



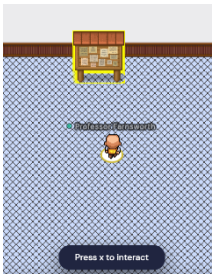
You can also use the "Message…" box to send a chat message to your colleagues, which they will see when they open the **"Chat" window**. In the chat, you can text everyone (not advisable!), the persons near you, or a specific person.

Before you start wandering around, take a quick look at the **Mini Map**, which tells you where you are in the current room. Finally, you can just wander around using your cursor keys. Whenever you encounter someone, an audio/video connection is established and you can – but do not have to – chat away.

Tips for gather.town: Specifics

Private Conversations

To have more private conversations, go to a private space. You find some of different sizes in the Coffee Lounge. When you enter a private space, the outside dims slightly, and no one outside the lighter tiles can listen in, even if they stand right next to you.

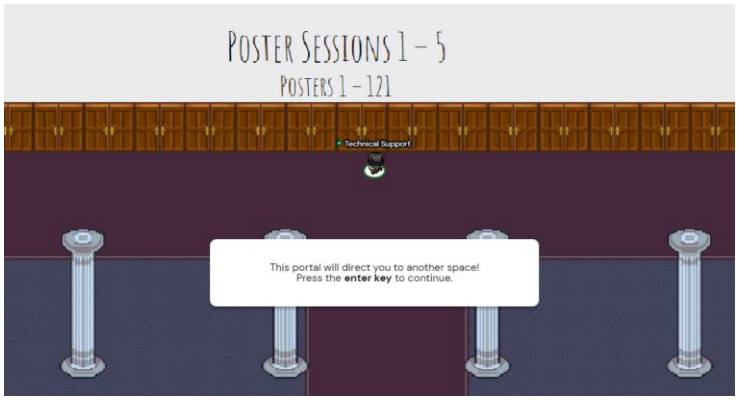


Object Interactions

There are some objects on the map with which you can interact. They glow yellow when you get close. To start the interaction, press the "x" key. For example, we have boards showing the poster session programme near the entrances of the poster halls.

The PuG 2021 Map

Our gather.town consists of the **Entrance Hall**, where you first arrived, the **Coffee Lounge** to the East, the **Ballroom** to the West, which opens for the Social Evening, and the two **Poster Halls** to the North. A **Help Desk** can be found at the south end of the Entrance Hall.



To **get from one room to another, just walk towards the doors and passageways** that you see on the map – it's intuitive. Due to capacity issues, the poster sessions take place in two different "spaces". If you go to the doors that lead to **"Poster Sessions 1-5"**, you will enter the second space. However, unlike regular doors, in order to go through them, you have to **press the "Enter" key**. This is indicated by a display on the screen (see picture). After pressing enter you are directed to a **second gather.town space**, and you are asked to log in again with the **same password**. Use the **same settings** as in the first space and click "Join the gathering". You are immediately directed to the poster lobby of poster sessions 1 – 5, and you can enter the poster rooms from there. You might have to re-enter your settings when switching between spaces, depending on your browser settings. The desktop app might be more convenient when you switch between spaces regularly.

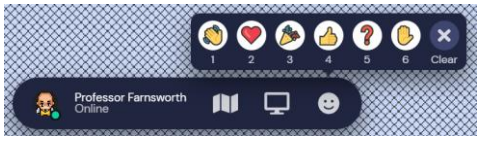
See also → Poster Sessions

Some Other More or Less Helpful Tips

If you are stuck in a crowd, press the "G" key to turn into a ghost and just walk away, or press "E" and be teleported to an open space.

Press the "Z" key and dance!

To show emotions, you can use the reaction button.



If you have **technical problems**, this page might help you: https://support.gather.town/help/gather-102

Symposia

In General

To maximize the opportunity for scientific exchange during the online PuG 2021, all symposia will take place as live online sessions via Zoom. There will be 36 symposia of 90-min with 4–5 presentations, ordered by loosely thematic tracks. There will be opportunities for live questions for all participants. Therefore, make sure that your internet connection is stable, preferably LAN, not WLAN) and that you have the latest Zoom client installed. We also ask the audience to **kindly turn their cameras on, to enhance the feeling of attending a live conference** for both speakers and attendees.

See also → Tips for Your Internet Connection

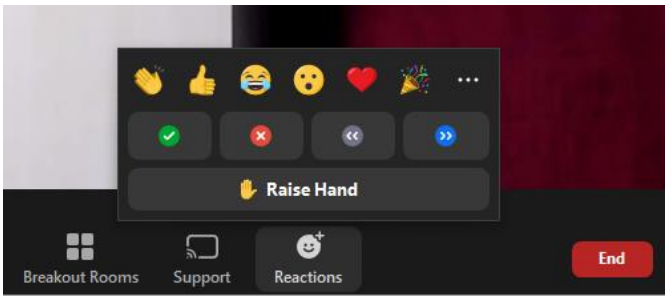
18:00 - 19:00	Mitgliederversammlung DGPA Ort: Mitgliederversammlung DGPA https://zoom.us/j/zoomID?pwd=zoomPassword

The Zoom room opens 15 min before a session. You will find the link to the session in ConfTool at that time. **Make sure that you have your log-in information for ConfTool ready!**

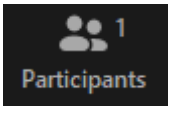
See also → Tips for Zoom sessions

During all sessions, a Technical Host will be present to supervise the symposium. They can be contacted via direct message in the Chat window in case of difficulties.

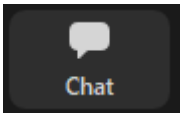
In general, if you want to ask a question during the symposium, please use the **"Raise Hand"** button in Zoom. If you have the **latest version** of Zoom, this feature can be found when you press the "Reactions" button.

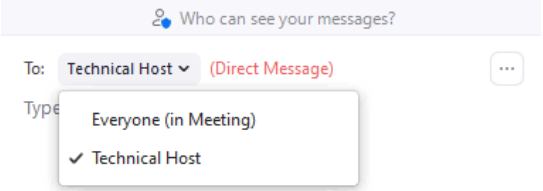


If you have not updated your Zoom client (please do so now!) and still use the **old version**, you will find the "raise hand" button at the bottom of the participants list, which you find by clicking on the "Participants" button:



The symposium chair(s) will moderate the discussion. You will be asked to unmute your microphone when it is your turn to ask a question. If you want to continue the discussion with the speakers after the session, you may inform the **Technical Host by direct message in the Chat window**. They will connect you with the speakers, provided they are still available.





For Symposium Speakers and Chairs

Speakers and Chairs

The symposia will be held live, so it is especially important that you have a stable internet connection. Please **connect your computer via cable to a LAN, do not use WLAN!** There are cheap **USB-LAN adapters available**. An example is the TP-Link UE300, which you can order from many online retailers for around 10 Eur (you can find offers here: https://geizhals.de/tp-link-ue300-a1248063.html). Don't forget to order a LAN cable as well, if you do not have one.

If you are afraid that technical difficulties cannot be excluded, you are welcome to additionally upload a pre-recorded talk as a fallback option. If you wish to do so, please contact the PuG team via info@pug2021.de.

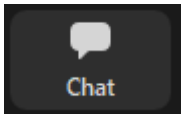
Please **join your session at least 10 minutes in advance of** the scheduled start time so that the Technical Host can give you a quick introduction. For preparations as well as further exchange after the session, all speakers will be placed in a private breakout room before and after the session. If there are requests for further discussions after the session by members of the audience, the Technical Host will contact you and ask whether you are available.

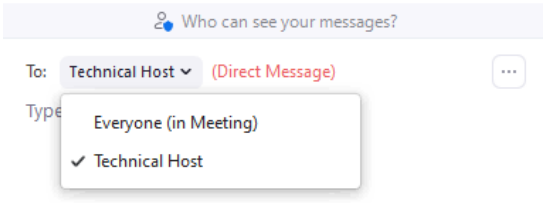
Chairs

At the beginning of each session, the chair(s) will give a short introduction to the audience about the timeline of the symposium and on **how to participate in the discussion**. Preferably, the **"Raise Hand" feature** of Zoom should be used and questions should be asked by the participants themselves directly. The chairs are, however, free to allow other ways of participation, e.g. by use of the chat window. It might, however, be more difficult to locate and unmute participants in the crowd if they did not use the "Raise Hand" feature.

The Technical Host will take care of technical issues that may arise during the session. They will assist with (un)muting microphones or lowering raised hands if needed. The chairs of the symposium will be responsible for moderating the session and for keeping track of questions during the discussion. All speakers will be made co-hosts, thus enabling screen sharing during their presentations.

The Chairs can communicate privately with the Technical Hosts at any time via **direct message in the Chat window**. They are available for any question that arises during the symposium.





The Technical Hosts are also asked to make sure that the Chairs **adhere to the allotted time frame** of the symposium. They will contact you via direct message if you are running over time.

Poster Sessions

In General

We want to keep things as interactive as possible.

Posters will be presented in person in a video chat in the gather.town poster hall. Therefore, make sure that your internet connection is stable (connect by cable, not wireless!).

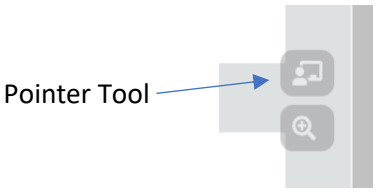
See also → Tips for Your Internet Connection

To view a poster, just walk up to it. You will see a preview of the title. Press "x" to view the poster in full.

Everybody in the lighter shaded 5 × 5 tile private space in front of the poster will connect with you via video chat. People outside this area cannot hear you. (Posters will, however, be accessible to persons standing one row below or above your video chat area.)

See also → Tips for gather.town

During presentations, you can use a pointer. When the pointer tool on the right-hand side has been activated, everybody can click on the poster to make a transient red circle appear.



To leave the full poster view, click the "x" button at the top right or simply press "x" on your keyboard.

The Poster Sessions

There will be two poster sessions (Thu, June 3, 16-18 h and Fri, June 4, 10-12 h) during which all posters will be on display.

Poster presenters are asked to be available near their posters during the whole Thursday session. This is also the session during which the members of the poster prize jury will be making their round.

On Friday, the poster blitz session and the poster prize awards will take place in parallel to the poster session. It is possible to follow the poster blitz and awards in Zoom (switch video off) while keeping an eye open for visitors to one's own poster in gather.town.

For Poster Presenters (1)

Preparation of the Posters

The poster will be presented as one image file, which must be in .**png, .jpg, or .webp** format and may not be larger than **3MB**.

The image must be at least 1000px (**preferably 3000px**) wide and at least 600px (**e.g. 4242px** for standard DIN format proportions) high. It is advisable for it to be higher than wide (**portrait format**). Do **not** use a transparent background.

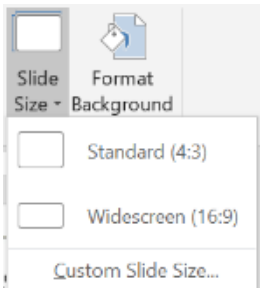
The poster will appear in full screen width. Please try to design your poster so that all its contents are readable and discernible without the need to zoom in: **Make sure that every detail is readable when the image is presented in full screen width.**

Remember that the file must not be larger than **max. 3MB**!

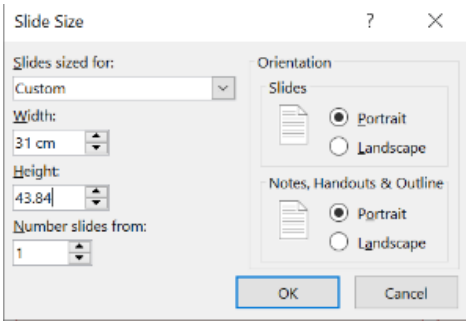
If you create your Poster in PowerPoint

Unfortunately, PowerPoint has no way to control image size when exporting .jpg/.png images. Therefore, you need to adapt your slide size:

1. Select Design → Slide Size → Custom Slide Size …



2. Change to: Custom Slide size with Width 31 cm and an appropriate Height (e.g. 42.3 cm for standard DIN format) → OK



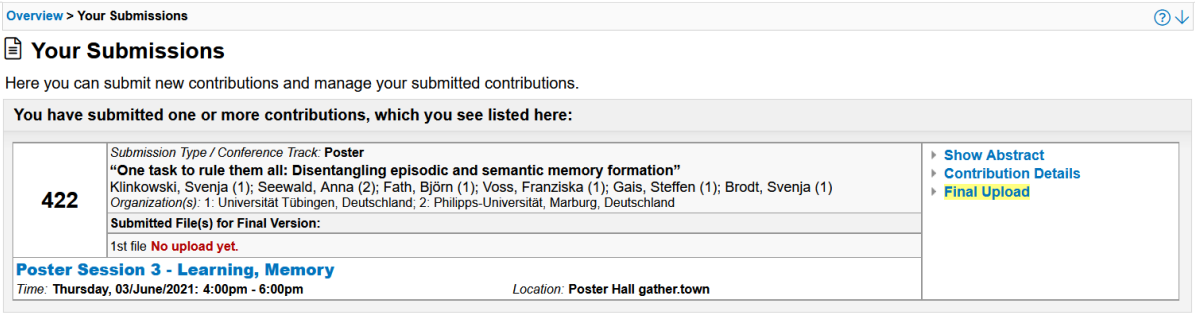
3. Select "Ensure Fit"
4. Select File → Save As → Save as type: PNG Portable Network Graphics Format (*.png)
5. Check if the file size is below **3MB**. If it's too large, repeat with reduced width.
6. Open the new file and check whether all is readable if presented at full screen width.

For Poster Presenters (2)

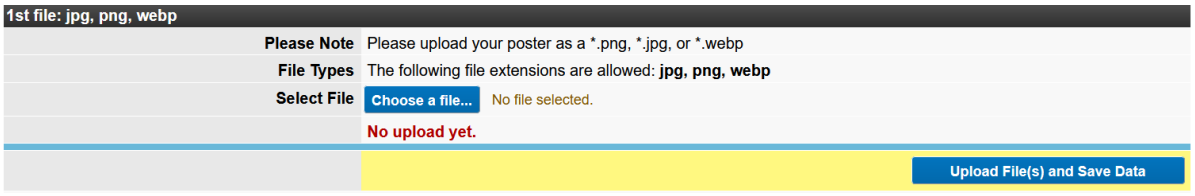
Upload Your Poster

Finally, upload your poster in ConfTool by Monday, 31st May.

1. Log into https://www.conftool.org/pug2021.
2. Click "Your Submissions"
3. Select "Final Upload"



4. At the bottom of the page, select "Choose a file …" and then "Upload File(s) and Save Data".



Keynote Lectures (1)

Towards a culture of computational reproducibility

Russell Poldrack

Standford University

Ensuring that the results of data analysis are both valid and reproducible is a fundamental responsibility of every computational scientist, but both are increasingly difficult in the context of complex analysis workflows and big data. Building off of ideas from software engineering, I will argue that we need to embrace a culture of computational reproducibility. I will outline a set of values that motivate this work and principles that guide the work, and then focus on a set of practices that can help improve reproducibility in computational science. I will conclude by addressing some potential concerns about the impacts of this cultural shift.

Optimizing psychological treatments: from mechanisms to predictions to clinical utility

Ulrike Lüken

Humboldt-Universität zu Berlin

Although psychological treatments including cognitive-behavioral therapy (CBT) work in principle to improve mental health, it appears not to work equally well for everyone: recent evidence shows that nearly every second patient suffering from an anxiety disorder fails to benefit in a clinically meaningful way – with severe consequences for patients and increasing costs for societies. Precision mental health aims to identify patients at risk for non-response already prior to treatment initialization and to improve treatments based on an in-depth mechanistic understanding. During the first part of this lecture, I will give insights into putative mechanisms that may predispose patients not to benefit from CBT, focusing on emotion regulation and its neurobiological underpinnings. In the second part, we will shift to the field of predictive analytics and its application to the prediction of treatment outcome (theranostics). Third, initial evidence and first ideas (including ethical considerations) how to implement such a theranostic pipeline into clinical utility will be discussed.

Keynote Lectures (2)

What we remember from an episode: Memory as reactivation, transformation, and selection

Nikolai Axmacher

Ruhr-Universität Bochum

Experiences are stored in the brain via modifications of synaptic connections, changing the neural representations of specific events. Network-level signatures of these representations – "engram patterns" – can be extracted from patterns of EEG oscillations and fMRI BOLD activity. In the first part of my talk, I will show how reoccurrence of engram patterns supports diverse memory functions from short-term memory maintenance to long-term memory retrieval and consolidation: memory as reactivation. However, it is commonly assumed that memory is not a veridical reproduction of past experiences but involves substantial transformations. In the second part, I will describe a taxonomy of memory transformation processes and discuss some conceptual problems of a generative view on memory: memory as transformation. I will then describe a novel view which assumes that engram patterns consist of multiple representational formats which can be selectively activated during memory processes and quantitatively described via deep neural networks. Some initial evidence for this view of memory as selection is presented, together with ideas for future research.

Schedule (1)

Wednesday, 02/June/2021

5:15pm - 6:00pm	**Welcome - Introduction – DGPA & DGPs Awards 2021** Location: **Plenum**
6:00pm - 7:00pm	**Keynote Lecture - Russell A. Poldrack** Location: **Plenum** Chair: **Maurizio Sicorello**, Central Institute of Mental Health Chair: **Stephan Nebe**, Universität Zürich Towards a culture of computational reproducibility
7:00pm - 8:00pm	**Reproducibility Q&A with Russell A. Poldrack** Location: **Meet the Professor** Chair: **Maurizio Sicorello**, Central Institute of Mental Health Chair: **Stephan Nebe**, Universität Zürich
7:00pm - 11:00pm	**Get-Together** Location: **Coffee Lounge gather.town**

Thursday, 03/June/2021

8:30am - 10:00am	**Reward, punishment, cognitive control and context in decision making** Location: **From (epi)genetics to cognition** Chair: **Johannes Rodrigues**, Julius-Maximilians Universität Würzburg	**Pleasure, joy, and positive feelings – perception, experience, and modulation of positive affective states in healthy women and men** Location: **Hormones and emotions** Chair: **Lydia Kogler**, Universitätsklinikum Tübingen Chair: **Bernadette von Dawans**, Trier University	**Oscillatory contributions to successful memory formation** Location: **Learning, memory, and sleep** Chair: **Marit Petzka**, University of Birmingham Chair: **Sven Paßmann**, Universität Fribourg
	Cognition and plasticity in the aging brain Location: **Clinical challenges and the ageing brain** Chair: **Sandra Martin**, Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig Chair: **Anna Rysop**, Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig	**Reproducibility and transparency in EEG research: current developments** Location: **Perspectives in neuroscience** Chair: **Gisela H. Govaart**, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig Chair: **Mariella Paul**, Georg-August-Universität Göttingen	**Neural representations of task sets and their implications for human multitasking** Location: **Attention and perception** Chair: **Marie Mückstein**, IPU Berlin Chair: **Christine Stelzel**, IPU Berlin
10:00am - 10:15am	**Coffee Break** Location: **Coffee Lounge gather.town**		
10:15am - 11:45am	**Nature meets Nurture: Elucidating the liability for mental disorders through imaging genomics, epigenetics, and gene-by-environment interactions** Location: **From (epi)genetics to cognition** Chair: **Philippe Jawinski**, Humboldt-Universität zu Berlin Chair: **Miriam Schiele**, Universitätsklinikum Freiburg	**Erotic stimuli and sexuality in (biological) psychology** Location: **Hormones and emotions** Chair: **Birgit Derntl**, Universität Tübingen Chair: **Jana Strahler**, Justus-Liebig-Universität Gießen	**Mechanisms of associative learning: From simple habits to sophisticated cognitive maps** Location: **Learning, memory, and sleep** Chair: **Lennart Luettgau**, University College London Chair: **Stephan Nebe**, Universität Zürich
	Pain in the brain - Factors influencing pain perception and its modulation Location: **Clinical challenges and the ageing brain** Chair: **Marian van der Meulen**, University of Luxembourg	**Chances and challenges of non-invasive neuromodulation to improve recovery of function** Location: **Perspectives in neuroscience** Chair: **Christiane Thiel**, Universität Oldenburg Chair: **Christian Grefkes**, Uniklinik Köln	**Naturalistic neuroscience – an emerging field for studying the human brain** Location: **Attention and perception** Chair: **Lisa Mochalski**, Forschungszentrum Jülich
11:45am - 12:00pm	**Coffee Break** Location: **Coffee Lounge gather.town**		

Schedule (2)

Thursday, 03/June/2021

12:00pm - 12:45pm	**Meet the Professor** Location: **Meet the Professor** Chair: **Alexander Lischke**, Medical School Hamburg Chair: **Gesa Hartwigsen**, Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig		
12:00pm - 1:00pm	**Lunch Break**		
1:00pm - 1:15pm	**DGPs & DGPA Awards 2020** Location: **Plenum** Chair: **Gesa Hartwigsen**, Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig Chair: **Martin Herrmann**, Universitätsklinikum Würzburg		
1:15pm - 2:15pm	**Keynote Lecture - Ulrike Lüken** Location: **Plenum** Chair: **Birgit Derntl**, Universität Tübingen Optimizing psychological treatments: from mechanisms to predictions to clinical utility		
2:15pm - 2:30pm	**Coffee Break** Location: **Coffee Lounge gather.town**		
2:30pm - 4:00pm	**Aktuelle methodische Ansätze in der Genetik und Epigenetik - der Nutzen von GWAS, Polygenic Scores und Netzwerkanalysen** Location: **From (epi)genetics to cognition** Chair: **Robert Kumsta**, Ruhr-Universität Bochum Chair: **Erhan Genc**, Leibniz Research Centre for Working Environment and Human Factors Dortmund (IfADo)	**Role of emotion and arousal in shaping our cognition and behavior: Recent methodological developments and emerging perspectives** Location: **Hormones and emotions** Chair: **Michiko Sakaki**, University of Tübingen Chair: **Mathias Weymar**, Universität Potsdam	**Challenges and opportunities of practicing open and reproducible research in biological psychology** Location: **IGOR** Chair: **Gordon Feld**, Zentralinstitut für Seelische Gesundheit - Universität Heidelberg Chair: **Tina Lonsdorf**, University Medical Center Hamburg-Eppendorf
	Neuroimaging, genetic and clinical studies of oculomotor control Location: **Clinical challenges and the ageing brain** Chair: **Ulrich Ettinger**, Universität Bonn Chair: **Christoph Klein**, Universitätsklinikum Freiburg	**Modulation emotionaler Effekte mittels nicht invasiver Hirnstimulation** Location: **Perspectives in neuroscience** Chair: **Stephanie Böhme**, Universität Erlangen-Nürnberg Chair: **Martin Herrmann**, Universitätsklinikum Würzburg	**Do we see what we expect? Implementation of and learning from visual expectations** Location: **Attention and perception** Chair: **Helen Blank**, Universitätsklinikum Hamburg-Eppendorf (UKE) Chair: **Franziska Knolle**, Technical University of Munich
4:00pm - 6:00pm	**Poster Session 1 - Computational and Neuroimaging Methods** Location: **Poster Hall gather.town**	**Poster Session 2 - Individual Differences and (Epi)genetics** Location: **Poster Hall gather.town**	**Poster Session 3 - Learning, Memory** Location: **Poster Hall gather.town**
	Poster Session 4 - Cognition Location: **Poster Hall gather.town**	**Poster Session 5 - Attention, Perception** Location: **Poster Hall gather.town**	**Poster Session 6 - Brain and Periphery / Neuroendocrinology** Location: **Poster Hall gather.town**
	Poster Session 7 - Social and Emotional Neuroscience Location: **Poster Hall gather.town**	**Poster Session 8 - Development and Ageing** Location: **Poster Hall gather.town**	**Poster Session 9 - Disorders and Interventions** Location: **Poster Hall gather.town**
6:00pm - 7:00pm	**General Assembly DGPA** Location: **General Assembly DGPA** Chair: **Hartmut Schächinger**, Universität Trier Chair: **Martin Herrmann**, Universitätsklinikum Würzburg		
7:00pm - 8:00pm	**General Assembly Fachgruppe DGPs** Location: **General Assembly Fachgruppe DGPs** Chair: **Paul Pauli**, Universität Würzburg Chair: **Gesa Hartwigsen**, Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig		
8:00pm - 8:30pm	**Opening of the Social Evening with Award Ceremony by the Early Career Scientists** Location: **Plenum** Chair: **Barbara Schmidt**, Universitätsklinikum Jena Chair: **Maurizio Sicorello**, Central Institute of Mental Health		
8:30pm - 11:00pm	**Social Evening and Pub Quiz** Location: **Ballroom gather.town**		

Schedule (3)

Friday, 04/June/2021

8:30am - 10:00am	**Parsing avenues for future fear conditioning research** Location: **From (epi)genetics to cognition** Chair: **Roland Benoit**, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig Chair: **Tina Lonsdorf**, University Medical Center Hamburg-Eppendorf	**Brain correlates of hormonal contraceptive effects on emotion and cognition** Location: **Hormones and emotions** Chair: **Belinda Pletzer**, Universität Salzburg Chair: **Ramune Griksiene**, Vilnius University	**How robust are the benefits of sleep on learning and memory?** Location: **Learning, memory, and sleep** Chair: **David Philip Morgan**, Central Institute of Mental Health Chair: **Gordon Feld**, Zentralinstitut für Seelische Gesundheit - Universität Heidelberg
	The utility of ERPs in clinical psychology: examples from neural correlates of performance monitoring Location: **Clinical challenges and the ageing brain** Chair: **Julia Klawohn**, Humboldt Universität zu Berlin Chair: **Anja Riesel**, Universität Hamburg	**Advances in laterality research: Towards a better understanding of hemispheric asymmetries** Location: **Perspectives in neuroscience** Chair: **Patrick Friedrich**, Forschungszentrum Jülich Chair: **Sebastian Ocklenburg**, Ruhr-Universität Bochum	**From the heart to the brain: Central nervous effects of cardioafferent signals** Location: **Attention and perception** Chair: **Mauro Larrá**, Leibniz Research Centre for Working Environment and Human Factors (IfADo)
10:00am - 11:30am	**Poster Blitz** Location: **Plenum** Chair: **Christine Blume**, Universität Basel		
10:00am - 11:45am	**Poster Session** Location: **Poster Hall gather.town** All posters will be on display. Poster presenters are not required to be present. The chat function in gather.town might be used to make appointments with the presenters.		
11:30am - 11:45am	**Poster Prizes / G. A. Lienert-Stiftung** Location: **Plenum** Chair: **Martin Herrmann**, Universitätsklinikum Würzburg Chair: **Gesa Hartwigsen**, Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig		
12:00pm - 12:30pm	**Round Table - Doktoranden & Postdocs** Location: **Round Table 1** Chair: **Andrea Kübler**, Universität Würzburg Chair: **Hartmut Schächinger**, Universität Trier	**Round Table - Young Professors** Location: **Round Table 2** Chair: **Gesa Hartwigsen**, Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig Chair: **Alexander Lischke**, Medical School Hamburg	
12:00pm - 1:00pm	**Lunch Break**		
12:30pm - 1:00pm	**Interest Group Open and Reproducible Research (IGOR)** Location: **IGOR** Chair: **Gordon Feld**, Zentralinstitut für Seelische Gesundheit - Universität Heidelberg Chair: **Tina Lonsdorf**, University Medical Center Hamburg-Eppendorf		
1:00pm - 2:30pm	**The role of BDNF in vulnerability to and treatment of stress-related disorders** Location: **From (epi)genetics to cognition** Chair: **Lara Puhlmann**, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig Chair: **Helge Frieling**, Medizinische Hochschule Hannover	**Societal polarization: psychological and neurobiological approaches** Location: **Hormones and emotions** Chair: **Bastian Schiller**, University of Freiburg Chair: **Grit Hein**, Universität Würzburg	**Dynamic shaping of memory representations by physiological and cognitive processes** Location: **Learning, memory, and sleep** Chair: **Svenja Brodt**, Universität Tübingen Chair: **Monika Schönauer**, University of Freiburg
	Neurobiological markers for psychotherapy response Location: **Clinical challenges and the ageing brain** Chair: **Elisabeth Leehr**, Westfälische Wilhelms-Universität Münster Chair: **Miriam Schiele**, Universitätsklinikum Freiburg	**Network neuroscience approaches in psychological science: a connectionist perspective on the biological bases of attention, cognitive ability, and on clinical disease** Location: **Perspectives in neuroscience** Chair: **Kirsten Hilger**, University of Würzburg Chair: **Sebastian Markett**, Humboldt Universität zu Berlin	**Faces in context: Bottom-up and top-down influences on face perception** Location: **Attention and perception** Chair: **Julia Baum**, Humboldt-Universität zu Berlin Chair: **Rasha Abdel Rahman**, Humboldt-Universität zu Berlin

Schedule (4)

Friday, 04/June/2021

2:30pm - 2:45pm	**Coffee Break** Location: **Coffee Lounge gather.town**		
2:45pm - 4:15pm	**Neurophysiology of aversive conditioning and (emotional) memory** Location: **From (epi)genetics to cognition** Chair: **Ursula Stockhorst**, Universität Osnabrück Chair: **Andreas Keil**, University of Florida	**Sex hormones and social emotional processes** Location: **Hormones and emotions** Chair: **Bernadette von Dawans**, Trier University Chair: **Frances Chen**, University of British Columbia	**Sleep, physical, and mental wellbeing in a modern society – relevance of stress, media consumption, and artificial light** Location: **Learning, memory, and sleep** Chair: **Christine Blume**, Universität Basel Chair: **Christian Benedict**, Uppsala University
	The impact of social exclusion and loneliness: neural mechanisms and interventions Location: **Clinical challenges and the ageing brain** Chair: **Dirk Scheele**, Universität Oldenburg Chair: **Alexander Lischke**, Medical School Hamburg	**Neuronale Korrelate kindlicher Kognitionen** Location: **Perspectives in neuroscience** Chair: **Stefanie Peykarjou**, Universität Heidelberg	**Up- and down-tuning in attention: Neuro-cognitive mechanisms of target selection and distractor suppression** Location: **Attention and perception** Chair: **Malte Wöstmann**, Universität zu Lübeck Chair: **Daniel Schneider**, Leibniz Research Centre for Working Environment and Human Factors Dortmund (IfADo)
4:15pm - 4:30pm	**Coffee Break** Location: **Coffee Lounge gather.town**		
4:30pm - 4:45pm	**Brain Products Young Scientist Award / IGOR Prize for Open and Reproducible Science** Location: **Plenum** Chair: **Martin Herrmann**, Universitätsklinikum Würzburg Chair: **Gordon Feld**, Zentralinstitut für Seelische Gesundheit - Universität Heidelberg		
4:45pm - 5:45pm	**Keynote Lecture - Nikolai Axmacher** Location: **Plenum** Chair: **Steffen Gais**, Universität Tübingen What we remember from an episode: Memory as reactivation, transformation, and selection		
5:45pm - 6:00pm	**Farewell** Location: **Plenum**		

SYMPOSIA

** indicates presenting author*

Reward, punishment, cognitive control and context in decision making

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

Chairs: Johannes Rodrigues

Julius-Maximilians Universität Würzburg

Reward and punishment processing have tremendous impact on our behavior and decisions. Yet, contexts and cognitive control may alter their impact on behavior. In this symposium, we bring together studies investigating cognitive control and the impact of reward and punishment processing on behavioral and electrocortical outcomes in different contexts.

The first study investigated electrocortical responses of the receiver in an ultimatum game to social cues of successful, costly punishment. The fairness of the offer was considered as well as the reward of getting an adequate social reaction to costly punishment. Further exploring the interrelation of reward and punishment, the second study used two three-armed bandit tasks to investigate feedback-locked frontal midline theta power in reward gain versus punishment avoidance learning. Additionally, personality traits were considered. Adding the context of a second chance, the third study focused on the impact of a second stage as a receiver and relevant personality traits in the ultimatum game on behavior, fairness related reward processing (FRN) and cognitive control related EEG-signals (midfrontal theta). Centralizing cognitive control, the fourth study investigated the influence of cognitive effort investment in a flanker task with varying demands and payoffs. Behavioral reactions as well as midfrontal theta band activations revealed interactions of cognitive effort investment with reward and demand. Focusing on the meta-cognition of control, the fifth study investigated the impact of need for cognition on metacontrol (switching to accurate but cognitively effortful strategies), in a sequential decision-making task. A computational reinforcement-learning model was used to explore this relation.

Keywords: reward and punishment processing, decision making, cognitive effort investment, midfrontal theta, personality

Pleasure, joy, and positive feelings – perception, experience, and modulation of positive affective states in healthy women and men.

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

Chairs: Lydia Kogler (1), Bernadette von Dawans (2)

1: University Hospital Tübingen, Germany; 2: Trier University, Germany

Perception and experience of positive, pleasurable, or joyful affective states is dysfunctional in many mental disorders. Considering these transdiagnostic reports, the thorough exploration of physiological and neural correlates of positive affective states in healthy women and men is essential to further understand their contribution to mental health and well-being. Our symposium brings together scientists from four international research institutions (Aarhus, Leipzig, Tübingen, Zürich) to present their research on different aspects of positive affective states and to increase the awareness for these states.

In more detail, the symposium discusses insights into sexual functioning in association with the CAG-repeat polymorphism, testosterone, and well-being in men's health (Andreas Walther) as well as the neural correlates of reward processing and their potential modulation by selective-serotonin-reuptake-inhibitors (escitalopram) in women and men (Carolin Lewis). It further outlines the empathy-related concept of kama muta and the physiological correlates of heartwarming feelings and being moved in women and men (Janis Zickfeld). Finally, the effects of positive self-instruction and self-praise on the neural, physiological, and subjective reactions to social evaluation in women will be characterized (Lydia Kogler).

Together, the symposium highlights the relevance of positive, pleasurable, and joyful affective states for mental health and well-being and depicts possible pharmacological and cognitive interventions to modulate their perception. The invited experts will discuss subjective, hormonal, physiological, and neural correlates of positive affective states and potential clinical implications to improve well-being.

Keywords: Positive affective states, mental health, sex hormones, empathy, sexual functioning, well-being, cognitive intervention, pharmacological intervention, kama muta

Oscillatory contributions to successful memory formation

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

Chairs: Marit Petzka (1), Sven Paßmann (2)

1: University of Birmingham, UK; 2: University of Fribourg, Switzerland

Brain oscillations are a necessity to form new memories. They are fundamentally involved in all phases supporting successful memory formation, i.e. maintenance, encoding, transfer and consolidation. To gain a better understanding of successful memory formation, examining the functional role of different frequency bands in all phases of memory formation and across different age groups is essential, as their contribution can differ. For example, theta and gamma band activity are known for their involvement in information transfer, while spindles and delta band activity play important roles in consolidation. The same oscillatory patterns may also serve distinct functions in different phases of memory formation.

We aim to give a coherent picture about the involvement of brain oscillations across phases of successful memory formation by focusing on two experimental approaches: First, examining endogenous brain oscillations and second, manipulating brain oscillations using e.g., transcranial alternating current stimulation (tACS) in which a sinusoidal current oscillating at a specific frequency is applied.

In our symposium, Monika Schönauer will present new findings about oscillatory mechanisms underlying working memory maintenance. Anna Karlsson found that modulations in theta and alpha activity lead to different outcomes in memory formation in older compared with younger adults. Sandrine Baselgia will present a tACS-based study showing a functional role of theta in the encoding of acoustically presented word pairs, and Sven Paßmann will present preliminary results of the same approach during sleep-dependent consolidation. Marit Petzka will present how sleep spindles track encoding patterns in favour of memory consolidation.

Keywords: memory formation, oscillatory activity, tACS, functional role

Cognition and plasticity in the aging brain

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

Chairs: Sandra Martin, Anna Rysop

Max-Planck-Institut für Kognitions- und Neurowissenschaften, Deutschland

Aging is accompanied by a myriad of cognitive changes. A growing body of research addresses the underlying neural reorganization processes at structural and functional levels. Furthermore, the development of non-invasive brain stimulation techniques such as transcranial direct current stimulation (tDCS) has sparked interest in their potential to counteract cognitive decline in aging by inducing neural plasticity. Our symposium examines age-dependent alterations on structural and functional levels with a particular focus on neural network dynamics by presenting novel data from a variety of cognitive domains. Moreover, the potential of non-invasive brain stimulation to attenuate cognitive decline in aging is discussed. Linda Geerligs unravels the interplay of age-related changes in brain structure and function. By using cross-sectional and longitudinal data, she demonstrates how structural and functional connectivity decouple with advancing age and how this relates to cognition. Sandra Martin provides insight on neural aging in the domain of semantic cognition. She shows how the behavioral relevance of functional connectivity within and between domain-general networks is modulated by age. Anna Rysop discusses age-related changes in neural network dynamics during speech in noise comprehension. Using individualized stimuli, she explores commonalities and differences in the use of semantic context to aid comprehension. Friederike Thams provides novel evidence for the potential of a cognitive training accompanied by tDCS in older adults with and without cognitive impairments. Pooling insight from behavioral and neuroimaging data, she discusses possible plasticity-induced effects of the intervention. We envisage a controversial and fruitful discussion of conceptual and methodological links between these approaches.

Keywords: aging, neural networks, cognition, plasticity, non-invasive brain stimulation

Reproducibility and Transparency in EEG research: Current Developments

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

Chairs: Gisela H Govaart (1), Mariella Paul (2)

1: MPI for Human Cognitive and Brain Sciences; Berlin School of Mind and Brain; Einstein Center for Neurosciences Berlin; 2: Georg-August-Universität Göttingen

In electrophysiological research, researchers have to make a myriad of decisions when going from raw data to interpretations ("analytic flexibility"), including many preprocessing steps and possible analysis methods. These decisions are not always transparently reported. In addition, researchers' decisions might be unconsciously biased by seeing the data. In this symposium, we aim to (1) demonstrate how variable preprocessing and analysis pipelines in EEG research are and how this influences study outcomes, and (2) discuss possibilities to increase transparent reporting and decrease bias in making analytic decisions, and, thereby, increase reproducibility of EEG studies. Regarding the first aim, two of the talks in this symposium will demonstrate the high variability of methodological choices in EEG research and how this influences results, using both local and large-scale ("many analysts") approaches. Turning to the second aim, discussing possible solutions, the third talk will focus on how preregistration can help increase transparency in EEG research and reduce researcher biases in analytic choices. The fourth talk will discuss another way to increase transparency, through developing concrete reporting guidelines in the form of checklists. Finally, we will discuss the current state of transparency and reproducibility in EEG research. We will highlight both possibilities and challenges in the adoption of reproducible and transparent practices in the EEG community, as well as the growing role of collaborative efforts in our research field.

Keywords: EEG, reproducibility, transparency, neuroscience, meta-science

Neural representations of task sets and their implications for human multitasking

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

Chairs: Marie Mückstein, Christine Stelzel

International Psychoanalytical University

The capability of the human brain to process multiple tasks simultaneously is limited, as manifested in speed and accuracy decrements for concurrent task performance. Several factors might contribute to this processing limitation, one of which being the representational overlap of the tasks (Klingberg, 1998).

While some fMRI studies provide evidence for the role of overlapping brain activity in multitasking using activation-based univariate analysis approaches, more recently multivariate pattern analysis (MVPA) has been applied to decode activity patterns related to task-set representations in the brain.

In this symposium, we aim to gain an advanced perspective on the role of neural task-set representations for performance decrements during concurrent or sequential task execution with a focus on MVPA. In the first talk, a general perspective will be outlined on how task representations change in the fronto-parietal cortex when the task context, in terms of cognitive demands, task switches, or rewards is being manipulated. The second contribution will focus on how individuals develop the ability to switch between tasks, emphasizing the difference in task representations between children and adults. The remaining two talks will shed light on the relationship between the overlap of task representations and observed dual-task costs in fronto-parietal as well as in sensory processing regions. In the following discussion, we will integrate the various perspectives to conclude with implications for the use of MVPA in multitasking research, and identify perspectives for future research.

Keywords: fMRI, MVPA, task set, multitasking, cognitive neuroscience

Nature meets Nurture: Elucidating the liability for mental disorders through imaging genomics, epigenetics, and gene-by-environment interactions

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Chairs: Philippe Jawinski (1), Miriam Schiele (2)

1: Humboldt-Universität zu Berlin; 2: Uniklinikum Freiburg

Over the past decade, molecular genetic research has seen rapid advances in the identification of replicable variations associated with mental disorders. Although genetic predispositions impact human behavior throughout the lifespan, the development and course of diseases also crucially relies on environmental conditions. This symposium presents four studies using state-of-the-art imaging genomic, epigenetic and gene-by-environment methods to unravel the mechanisms through which genes increase the risk for psychopathology. The first talk focuses on how genetics affect the speed of biological ageing as one of the greatest ubiquitous risk factors for disease vulnerability: Philippe Jawinski (HU Berlin) presents results from N = 42,000 participants of the UK Biobank imaging cohort, suggesting that the biological age of the brain ('brain age') genetically overlaps with various physical and mental health phenotypes. Following this, Lea Sirignano (ZI Mannheim) reports on a longitudinal study that examines genetic response predictors and gene expression changes after therapeutic sleep deprivation in depression. The next talk is held by Miriam Schiele (UKL Freiburg), who reports on gene-by-environment interactions in anxiety and how protective coping abilities may exert a buffering effect on the interplay of genetic disposition and environmental adversity. Finally, Martin Reuter (Uni Bonn) presents on the relation between social cognitive functioning and genetic and epigenetic serotonergic markers, which have been associated with affective processes in the normal and psychopathological range. This symposium seeks to demonstrate, discuss, and disseminate the rapidly growing opportunities to elucidate the liability for mental disorders by applying molecular genetic techniques in our field.

Keywords: mental disorders, psychiatric diseases, molecular genetics, epigenetics, gene-by-environment interactions

Erotic stimuli and sexuality in (biological) psychology

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Chairs: Birgit Derntl (1), Jana Strahler (2)

1: Universität Tübingen, Deutschland; 2: Universität Gießen

Sexual health crucially contributes to mental health as it may complement physical, emotional and social health but can also be associated with distress, pain and dysfunctional reward. Most of our knowledge today on erotic stimuli processing stems from studies on males only. To better understand (dys)functional processes in the realm of sexual health, we need to come up with study designs that involve women and men also by incorporating stimuli that are sexually arousing to all genders.

We will start with a study addressing a very timely aspect, i.e. pornography consumption during the COVID 19 pandemic. Here, Sarah Golder* (Gießen) will introduce the study design and present first data. While in the first talk recipients were mostly watching erotic stimuli alone, Katherine Hertlein (Salzburg) will show data on how collective pornography consumption affects heterosexual partnerships in the second talk of our symposium. Next on, Jana Strahler (Gießen) will present new data on influencing factors on sexual cue responsivity in men such as negative affect, while in our last talk, Ann-Christin Kimmig* (Tübingen) will highlight the neural circuits underlying approach-avoidance behavior to erotic stimuli in naturally cycling women and women taking oral contraceptives.

With this symposium we want to highlight the relevance of investigating sexual health in women and men, as this critical aspect of mental health has far reaching individual, societal and clinical consequences that by now, however, are only poorly understood.

* PhD students

Keywords: Erotic stimuli, sexual health, pornography, sexual cue responsivity, approach-avoidance

Mechanisms of associative learning: From simple habits to sophisticated cognitive maps

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Chairs: Lennart Luettgau (1), Stephan Nebe (2)

1: University College London; 2: Universität Zürich

Associative learning is a fundamental mechanism by which organisms form representations of relationships between stimuli and actions. In recent years, reformulations of well-established concepts of associative learning have shaped our understanding of how higher-order cognitive processes might emerge from simpler cognitive and learning mechanisms. This symposium encompasses five presentations of early-career researchers that highlight recent developments in the investigation of associative learning with a variety of cognitive, computational, and neuroscientific methods, ranging from virtual reality, cognitive-computational modeling, multivariate decoding of neural representations in fMRI data to ecological momentary assessment using cross-platform online applications.

First, Stephan Nebe will introduce new experimental approaches and computational models for the laboratory assessment of habits quantifying the influence of past behavioral frequency on future actions.

Lennart Luettgau will present evidence for cortical reinstatement of outcome representations as a mechanism underlying associative learning transfer, applying cross-session, cross-modality multivariate pattern analyses on fMRI data.

Mona Garvert will highlight a study combining virtual reality, computational modeling, and fMRI to investigate how humans use relational knowledge organized in cognitive maps to generalize value to states that were previously not experienced.

Eric Schulz will follow presenting computational modeling of a compositional bandit task, in which humans entertain compositional representations and a grammar over these structures, to show performance exceeding neural network models.

Finally, Monja Neuser will present longitudinal data of a novel reward learning task complemented by ecological momentary assessment acquired with an open-source cross-platform application, informing the creation of better models of human behavior.

Keywords: Associative Learning

Pain in the Brain - Factors Influencing Pain Perception and its Modulation

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Chairs: Marian van der Meulen

University of Luxembourg, Luxemburg

The way noxious stimuli are perceived is highly dependent on factors, such as the current attentional state or expectations about the painful event. Distraction from pain and placebo analgesia are prominent examples for this cognitive modulation of pain. Although these are generally very powerful mechanisms of pain modulation, prior studies have found considerable interindividual variations in the magnitude of the modulatory effect, while little is known about the influencing factors.

Here, we present a series of studies on cognitive and situational factors influencing pain perception and its modulation on the behavioural and (neuro)physiological level. A special focus is on the role of age-related changes, since little is known about a potentially altered "top-down" control of pain in old age, albeit this population is disproportionately affected by pain and its consequences.

Ana María González Roldán presents a study on age-related changes in pain processing and associated resting-state functional connectivity of regions implicated in pain processing. Turning to cognitive distraction from pain, Katharina Rischer discusses age-related neural changes and the role of executive functions therein. Complementary, Elisabeth Holl reports on the analgesic response and associated changes in heart rate and electrodermal activity in young adults, playing a distracting virtual reality game. The impact of age on the processing of acute pain and on its neural correlates is addressed by Angelika Dierolf. Shervin Vencatachellum discusses the role of mindfulness in shaping expectations about pain, by considering recent neuroimaging insights within the interoceptive predictive coding framework.

Keywords: pain perception, cognitive pain modulation, age, fMRI, EEG

Chances and challenges of non-invasive neuromodulation to improve recovery of function

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Chairs: Christiane Thiel (1), Christian Grefkes (2)

1: Universität Oldenburg, Deutschland; 2: Universität Köln

Non-invasive neuromodulation has gained increasing attention because of its potential to promote recovery of function after damage to the central nervous system. Though electrical and magnetic stimulation or neurofeedback are promising approaches for clinical neuropsychology, they are faced with a number of challenges. These include large interindividual variability and small overall effects as well as insufficient knowledge on the neural mechanisms that co-occur with improvement of function. The current symposium brings together experts from different areas of neuromodulation and cognitive neuroscience. We will discuss recent approaches on how to best implement the different techniques in the context of neurorehabilitation. Maike Mustin (Köln) will present data on how neuromodulatory techniques like transcranial magnetic stimulation (TMS) can be used in stroke patients to unravel the role of different brain areas in the lesioned and contralesional hemisphere for motor performance and recovery. Mareike Daeglau (Oldenburg) will focus on research studying how context factors affect the neural signal used in motor imagery neurofeedback. Gesa Hartwigsen (Leipzig) will present an overview of how electric and magnetic neuromodulation impacts plasticity in the language network in health and disease. Finally, Florian Kasten (Oldenburg) will address how the integration of electrical field modelling and neuroimaging can help to explain interindividual variability in the effects of electrical brain stimulation. We envisage a controversial and fruitful discussion and hope to promote the application of non-invasive neuromodulation techniques in neurorehabilitation research.

Keywords: Neuromodulation, Neurorehabilitation, Stroke, Recovery, Stimulation

Naturalistic neuroscience – an emerging field for studying the human brain

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Chairs: Lisa Mochalski

Heinrich-Heine-Universität Düsseldorf, Deutschland; Forschungszentrum Jülich, Deutschland;

Methodological advances and their resulting observations shape the gain of knowledge on the human brain and behavior. The functional architecture of the brain has been studied extensively using task-based and resting-state fMRI studies, which grant insight into the network organization of the brain. However, these techniques for studying the brain possess limited ecological validity, which may restrict their generalizability.

Recent years have seen rising interest in naturalistic stimuli – such as movies or auditory narratives – to increase the ecological validity of laboratory research. Naturalistic stimuli are complex, dynamic and continuous, which more strongly imitates daily life experiences and allows the study of the brain in a more natural environment.

This symposium will introduce naturalistic stimuli and their advantages compared to more established paradigms (Christian Häusler). We will compare test-retest reliability of movie-fMRI and resting-state fMRI (Dr. Xing Qian). Furthermore, we will explore the usability of movie fMRI for the study of inter-individual differences in functional networks (Jean-Phillipe Kröll) and the general functional topography (Dr. Xuan Li). Lastly, we will present the usage of auditory narratives to map the individual language network (Dr. Martin Wegrzyn). We will end with a plenum-discussion on the interpretation and potential future of this exciting new field.

Keywords: fMRI, naturalistic stimulation, ecological validity, inter-individual differences, movie fMRI

Aktuelle methodische Ansätze in der Genetik und Epigenetik - der Nutzen von GWAS, Polygenic Scores und Netzwerkanalysen

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Chairs: Robert Kumsta (1), Erhan Genç (2)

1: Ruhr-Universität Bochum, Deutschland; 2: IfADo – Leibniz-Institut für Arbeitsforschung an der TU Dortmund

Genomweite Assoziationsstudien (GWAS) sind ein wichtiges Werkzeug in der Erforschung genetischer Grundlagen komplexer Eigenschaften. Neben der klassischen Anwendung, hypothesenfrei Zusammenhänge zwischen genetischen Varianten und psychologischen Eigenschaften herzustellen, bieten neue methodische Ansätze die Möglichkeit, bestehende Studienergebnisse von GWAS für eigene Studien zu nutzen. Ein vielversprechender Ansatz sind sogenannte Polygene Scores - Summenwerte, die über GWAS Statistiken individuell bestimmt werden und als Prädiktoren herangezogen werden können. Erhan Genç wird zeigen, dass der Zusammenhang zwischen Polygenen Scores für Intelligenz und IQ über die Effizienz struktureller Konnektivität insbesondere fronto-parietaler Regionen vermittelt wird. Fabian Streit stellt eine GWAS zur Borderline-Persönlichkeitsstörung vor, und wird anhand von Polygenen Scores und genetischen Korrelationen zeigen, inwieweit sich über ein geteiltes genetisches Risiko auf gemeinsame biologische Grundlagen mit anderen Störungsbildern und Traits schließen lässt.

Eine weitere Betrachtungsebene stellen epigenetische Mechanismen dar. Ungünstige Umwelterfahrungen besonders in frühen Entwicklungsphasen können zu stabilen Veränderungen der DNA Methylierung und der Regulation der Genexpression führen. Linda Dieckmann untersuchte inwieweit sogenannte epigenetic clocks, mittels derer sich Abweichungen zwischen chronologischem und epigenetischem Alter bestimmen lassen, Einblicke in die frühkindliche Entwicklung und die Transmission pränataler Risikofaktoren geben können. Katharina Mattonet wird einen systemorientierten Ansatz darstellen der über die Betrachtung von ko-methylierten Genen die Regulation des gesamten Genoms in Betracht zieht. Der Ansatz wird an Hand einer Studie vorgestellt, die den Zusammenhang zwischen pränataler Schadstoffexposition und genomweiter DNA Methylierung untersucht. Abschließend wird Johannes Zang den Zusammenhang zwischen Therapieerfolg nach stationären Behandlung bei Posttraumatischer Belastungsstörung und Veränderung von genomweiten GenKoexpressionsmustern darstellen.

Keywords: Genetik, Epigenetik, Bildgebung, Intelligenz

Role of emotion and arousal in shaping our cognition and behavior: Recent methodological developments and emerging perspectives

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Chairs: Michiko Sakaki (1), Mathias Weymar (2)

1: University of Tübingen; 2: University of Potsdam

Decades of research have investigated how our emotion and arousal interact with cognition and behavior. Nevertheless, we still have many unanswered questions that span from basic underlying mechanisms to the effects of emotion in real-life social interactions. Recent technological and methodological advances have enabled us to tackle some of these questions with novel and multi-method approaches. This symposium will highlight such methodological advances in research on emotion, arousal and cognition. In five different talks, we will bring together different methods, covering the transcutaneous vagus nerve stimulation, pupillometry, pharmacological manipulation, Virtual Reality, and machine learning in neuroimaging. Mathias Weymar will present research on the vagus nerve stimulation and discuss its effects on emotional memory. Jan Willem de Gee will present cross-species data with mice and humans, and discuss how similarly pupil-linked arousal affects decision making across different species. Ulrike Rimmele will present data on the effects of pharmacological cortisol manipulations on emotional episodic memory. Leon Kroczek will discuss how facial emotions of others alter our social behavior based on his data from Virtual Reality and a computer experiment. Finally, Michiko Sakaki will present machine-learning applications to resting-state fMRI data in understanding individual differences in emotional memory. By bringing those diverse perspectives together, this symposium will aim to provide an opportunity for lively discussions concerning their contributions to our understanding of how emotion and arousal affect human cognitive processing and behavior.

Keywords: emotion, cognition, memory, arousal

Challenges and opportunities of practicing open and reproducible research in biological psychology

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Chairs: Gordon Feld (1), Tina Lonsdorf (2)

1: Zentralinstitut für Seelische Gesundheit - Universität Heidelberg, Deutschland; 2: Universitätsklinikum Hamburg-Eppendorf

This symposium is organized by members of the 'Interest Group for Open and Reproducible Research (IGOR)" within the DGPs Section Biological Psychology and Neuropsychology. It covers empirical evaluations and case reports of preregistration, data sharing, ethical considerations as well as new methods developed to enhance reproducibility of research in Biological Psychology. First, Rachel Sjouwerman illustrates how a single raw data set can give rise to a multitude (i.e., 'multiverse') of processed data sets due to the co-existence of multiple alternative and equally reasonable processing pipelines using skin conductance responses as an example. She demonstrates a novel way of meeting the resulting challenge of unclear comparability and robustness across pipelines by using a multiverse-type of analysis. Second, Gordon Feld introduces a case study of a complex biological psychology experiment submitted as a Registered Report. He demonstrates how a failure to derive the experiment clearly from a sound theoretical basis may impede the probability of success. Third, Christian Paret presents results from an Online Survey on Open Science Practices in Neuroimaging Research. Fourth, Tina Lonsdorf showcases an inventory of 'open data' by using fear conditioning research as a case example to illustrate the status quo, current challenges and prospects of data sharing in psychophysiological research. Finally, Christian Merz discusses ethical considerations for data sharing with a focus on Biological Psychology. This symposium showcases current challenges of introducing open and reproducible practices into our research work-flows, derives clear take-home messages and critically discusses the prospects and opportunities of these for advancing the field.

Keywords: Open Science, Registered Reports, Multiverse Analysis, Data Sharing, Ethical Considerations

Neuroimaging, Genetic and Clinical Studies of Oculomotor Control

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Chairs: Ulrich Ettinger (1), Christoph Klein (2)

1: Universität Bonn, Deutschland; 2: Universität Freiburg, Deutschland

The oculomotor system provides a rich microcosm for the study of perception, cognition and motor control. In this symposium, we will provide a state-of-the-art overview of the neural and genetic correlates of eye movements as well as their disorders in psychiatric and neurological disorders. Rebekka Schröder (Psychology/Bonn) will present fMRI data of the neural networks underlying smooth pursuit eye movements in healthy volunteers. Functional connectivity analysis shows that key oculomotor areas display widespread, but only partly overlapping patterns of connectivity. Mark Greenlee (Psychology/Regensburg) will report on fMRI studies investigating the neural correlates of visually-guided and memory-guided saccades. Comparisons of BOLD response between these types of paradigms will be made. Annabell Coors (DZNE/Bonn) will present molecular genetic data on oculomotor endophenotypes for schizophrenia. In N=3000 adults, higher polygenic risk scores for schizophrenia were associated with higher antisaccade error rate, latency and smooth pursuit velocity gain, but lower antisaccade amplitude gain. Daniela Canu (Child and Adolescent Psychiatry/Freiburg) will talk about microsaccade and saccade generation in neurodevelopmental disorders, including early-onset schizophrenia, autism and ADHD. Results suggest the presence of inhibition deficits across clinical groups, suggesting common (pre-)frontal functional impairments. Finally, Chrystalina Antoniades (Clinical Neurosciences/Oxford) will present data from a movement disorders cohort including Parkinson's disease and progressive supranuclear palsy (N=1400) to illustrate how eye movement parameters have proven a useful translational tool in aiding clinical diagnosis and following disease progression. Overall, this symposium will combine multiple methodological approaches to shed light on human oculomotor control as well as its alterations in disease.

Keywords: Eye movements, fMRI, genetics, ADHD, neurology

Modulation emotionaler Effekte mittels nicht invasiver Hirnstimulation

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Chairs: Stephanie Böhme (1), Martin Herrmann (2)

1: Universität Erlangen-Nürnberg, Deutschland; 2: Universitätsklinik Würzburg, Deutschland

Bildgebende Studien zeigen, dass phylogenetisch ältere Hirnregionen, wie bspw. limbische Strukturen, direkt mit affektiven Reaktionen in Verbindung gebracht werden können und deren Malfunktion mit pathologischen Lernmechanismen und somit mit psychischen Störungen assoziiert ist. Gleichzeitig sind diese limbischen Regionen mit einem weit verzweigten Netzwerk kortikaler Hirnstrukturen verbunden. Die Aktivierungsänderung in einem Teil führt zu weitreichenden Veränderungen im gesamten neuronalen Netzwerk und der nachgeschalteten Verarbeitung emotionaler Reize. Mittels Methoden der nicht invasiven Hirnstimulation kann die Aktivität in solchen Netzwerken beeinflusst werden und perspektivisch so therapeutisch wertvolles Verlernen maladaptiver emotionaler Prozesse positiv beeinflusst werden. Doch die genauen Mechanismen effektiver nicht invasiver Hirnstimulation bedürfen weiterer Erforschung. Im Symposium werden aktuelle Forschungsergebnisse vorgestellt und diskutiert, wie man emotionale Verarbeitungsprozesse durch nicht invasive Hirnstimulation, wie der transkraniellen Gleichstromstimulation (tDCS: Herrmann et al., Böhme & Mühlberger und Roesmann et al.) oder der vergleichsweise noch wenig erforschten transkraniellen Ultraschall-Neuromodulation (TUS: Forster et al.), beeinflussen kann. Nach einem kurzen allgemeinen Überblick der verschiedenen nicht invasiven Hirnstimulationstechniken stellen Herrmann und Kollegen im ersten Vortrag Daten zur positiven Beeinflussung der Extinktion einer konsolidierten Furchtreaktion durch eine frontale tDCS vor. Böhme & Mühlberger diskutieren in ihrem Vortrag den Einfluss unterschiedlicher Applikationszeitpunkte einer frontalen tDCS beim Extinktionslernen. Roesmann et al. präsentieren ihre Ergebnisse des differentiellen Einflusses einer hemmenden vs. aktivierenden tDCS auf die Furchtgeneralisierung und abschließend stellen Forster et al. ihre Ergebnisse zum Einfluss einer frontalen TUS auf die erlernte Hilflosigkeit vor.

Keywords: nicht invasive Hirnstimulation, Extinktion, Furchtgeneralisierung, erlernte Hilflosigkeit

Do we see what we expect? Implementation of and learning from visual expectations

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Chairs: Helen Blank (1), Franziska Knolle (2)

1: University Medical Center Hamburg-Eppendorf, Deutschland; 2: Technische Universitaet Muenchen

Visual perception is an inferential process, in which prior expectations are combined with actual sensory input. How these prior expectations are represented in the brain and how they impact learning or memory of visual stimuli is still debated.

Individuals differ substantially in how they weight prior and sensory input, and the inappropriate weighting of those has been linked to clinical conditions. In autism, for example, studies have found an over-weighting of the sensory input and an inability to appropriately evaluate priors, while the findings for psychosis are more controversial, and may shift with disease progression, from over-weighting sensory input in early to over-weighting prior knowledge in later stages.

In this symposium, we will tackle some of the open questions by bringing together research on how prior expectations influence visual perception in the healthy brain and clinical conditions, using a variety of methods (behaviour, computational modelling, multivariate fMRI, and MEG). First, Helen Blank (UKE, Hamburg) will discuss how expectations of face-identity are represented and weighted during presentation of context cues and how these expectations influence face processing. Second, Franziska Knolle (TUM, München) will discuss how visual priors are used during stimuli disambiguation in psychosis. Third, Janine Bayer, (UKE, Hamburg) will explain how visual category learning relates to autistic traits. Fourth, Alex Clarke (University, Cambridge) will explore how learned contexts shape the neural reactivation of expected sensory details; and finally, Andrea Greve (MRC, Cambridge) will present behavioural evidence supporting a theoretical framework on expectation violations during learning and memory processes.

Keywords: expectation, visual perception, learning, memory, context, psychosis

Parsing avenues for future fear conditioning research

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

Chairs: Roland Benoit (1), Tina Lonsdorf (2)

1: Max Planck Research Group: Adaptive Memory, Max Planck Institute for Human Cognitive and Brain Sciences; 2: Department of Systems Neuroscience, University Medical Center Hamburg-Eppendorf

There is a long tradition of using the experimental paradigm of 'fear conditioning' for studying emotional memory processes in general as well as for modelling the development and treatment of anxiety- and stress-related disorders in the laboratory. This symposium takes on some of the methodological and procedural challenges from the past and showcases recent advances for the future of fear conditioning research. First, Maren Klingelhöfer-Jens will scrutinize the rank-stability of skin conductance responses and fear ratings across multiple experimental days and repeated tests of a fear conditioning paradigm. Ann-Kristin Meyer will then take stock of the emerging literature on categorical fear conditioning by reporting the results of a meta-analysis and a replication study. She will argue that this procedure has the potential to bridge the gap between research on implicit and explicit memory systems. Afterwards, Erik Müller will present behavioral, psychophysiological, and EEG evidence that merely imagined events can induce conditioned fear responses much the same way as real US. Finally, Adrian Wroblewski will highlight the value of adopting a network approach for our understanding of the neural basis of fear conditioning. In particular, he will present effective connectivity analyses that make use of dynamic causal modelling to infer directed relationships between individual brain regions. Together, the symposium will present research that outlines emerging future lines of inquiry for the research on fear conditioning.

Brain correlates of hormonal contraceptive effects on emotion and cognition

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

Chairs: Belinda Pletzer (1), Ramune Griksiene (2)

1: Universität Salzburg, Österreich; 2: Vilnius University

Oral contraceptives just celebrated their 60th anniversary and are used by 150 million women worldwide. First reports that the use of combined oral contraceptives may result in altered mood date back to the 1960s. Yet, the neurobiological correlates of these side effects remain yet to be uncovered. Cognitive effects of oral contraceptives have only been investigated by a handful of studies and came up with inconsistent results due to small sample sizes and a lack of control for the contraceptive formulation used. While most combined oral contraceptives contain the same estrogen (ethinylestradiol), various different progestins are on the market. Some of these progestins act as androgen receptor agonists (androgenic progestins), while others act as androgen receptor antagonists (anti-androgenic progestins). Accordingly, these progestins might elicit different effects in those emotional and cognitive functions, which are influenced by testosterone. Thus, well-powered neuroimaging studies differentiating different contraceptive formulations are needed to understand the neurobiological underpinnings of contraceptive effects on emotion and cognition. Comparing the effects of androgenic and anti-androgenic contraceptives can also help to disentangle those effects that result from the estrogenic actions of contraceptives and those effects that result from the progestin component. In that respect, some light may also be shed by investigating the effects of selective progesterone receptor antagonists on the brain, as these likely oppose the progestagenic effects of hormonal contraceptives. In this symposium, we present current data from various labs involved in contraceptive research aiming to disentangle the various effects of different contraceptive components on the brain.

Keywords: hormonal contraceptives, ethinylestradiol, progestins, androgenicity, progesterone receptor

How robust are the benefits of sleep on learning and memory?

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

Chairs: David Philip Morgan, Gordon Feld

Central Institute of Mental Health, Germany

Although the benefits of sleep for memory are well established, recent findings suggest that these effects may be more variable than expected. This symposium attempts to evaluate the robustness of the enhancing effect of sleep on memory. To this end, Chloe Newbury and Sabrina Berres will present two independent meta-analyses of the impact of sleep deprivation vs. wakefulness and sleep vs. wakefulness on declarative memory respectively. Both meta-analyses find that the meta-analytical effect of sleep on memory is not large but rather small to medium sized (approximately d = 0.4). Due to publication bias meta-analyses can inflate effect sizes making replication attempts of previous research necessary. In line with this, some well-known findings in sleep and memory research have proven difficult to replicate conceptually. For instance, David Morgan will present a large-scale (N = 4,000) registered report using online assessment showing no effect of sleep on recognition memory in an eyewitness identification paradigm. Finally, Gordon Feld will present data on an experiment using different word list lengths, which demonstrates the dependence of sleep-dependent memory consolidation on specific context factors. Taken together these findings demonstrate that the effect of sleep on memory may be less robust than expected from the literature. During the discussion, we will outline developments that could increase the robustness of sleep and memory findings in the future.

Keywords: sleep, memory consolidation, reproducibility

The Utility of ERPs in Clinical Psychology: Examples from neural correlates of performance monitoring.

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

Chairs: Julia Klawohn (1), Anja Riesel (2)

1: Humboldt Universität zu Berlin; 2: Universität Hamburg

Several forms of psychopathology have been shown to be characterized by aberrant neural correlates of performance-monitoring, including reward, inhibition, and error processing. The current symposium will evaluate new findings on performance-monitoring event-related potentials (ERPs) as markers of mechanisms, risk, and change in relation to depression, obsessive-compulsive disorder (OCD), and excessive behaviors. Raoul Dieterich will present single-trial based associations between neural correlates of feedback and inhibition specific to high binge-watchers compared to non-binge-watching controls, supporting the notion that simultaneous outcome insensitivity and inhibitory deficits may facilitate compulsive watching. Then, Julia Klawohn will present data on impaired reward-processing and emotional reactivity in current depression, demonstrating the utility of these indices for classification and prediction of disorder trajectory. Ellen de Bruijn will present results on social mechanisms in performance-monitoring from an error-responsibility paradigm. Her data indicate that participants with high obsessive-compulsive (OC) characteristics show enhanced error signals to harmful mistakes compared to low OC individuals. Anja Riesel will present data suggesting that the ERN predicts perceived risk and stress during the COVID-19 pandemic. Increased stress was in turn associated with a range of psychopathological symptom dimensions including anxiety, depression, and obsessive-compulsive symptoms. Finally, Luisa Balzus will present results from a sham-controlled crossover-study on the efficacy of transcranial direct current stimulation (tDCS) over the medial-frontal cortex applied to target aberrant error monitoring in OCD. Collectively, this symposium highlights the clinical utility of neural correlates of performance-monitoring for improving our understanding of pathomechanisms involved in mental disorders and for identifying targets of innovative intervention approaches.

Keywords: ERP, mental health, error monitoring, reward processing, clinical psychology

Advances in laterality research: Towards a better understanding of hemispheric asymmetries

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

Chairs: Patrick Friedrich (1), Sebastian Ocklenburg (2)

1: Research Center Jülich; 2: Ruhr-Universität Bochum

Cognitive functions are partially lateralized towards the left or right halve of our brain. This so-called functional asymmetry is prominently expressed in language processes, visuospatial attention, face recognition, and handedness. The observation that the extent of asymmetries differs in healthy people and that the absence or reversal of asymmetries is associated with psychiatric disorders (e.g., autism, schizophrenia) makes it an essential avenue for understanding cognitive functions in health and disease.

Since the second half of the 19th century, researchers strive to understand lateralized functions, their link to psychiatric disorders, and the factors that drive functional asymmetries in the first place. Although these questions are not answered unequivocally, recent advances in our research techniques and theories allow for a better understanding of brain laterality.

In this symposium, we will present some of the more recent efforts in laterality research. Starting with the hereditary and environmental factors, we will present studies on the neurogenetic foundation of hemispheric asymmetries (Sebastian Ocklenburg) and the role of stress in atypical laterality of various disorders (Gesa Berretz). Furthermore, we will discuss novel research settings to enhance ecological validity (Julian Packheiser) and utilize machine learning to overcome the limitations of conventional hemispheric comparisons (Patrick Friedrich). Last, we will present a more encompassing view of visual laterality based on the relationship between left-hemispheric and right-hemispheric processes (Sanne Brederoo).

We will follow up with a discussion about the possibilities and future direction of laterality research.

Keywords: laterality, genetic, behavior, neuroimaging, machine learning

From the heart to the brain: Central nervous effects of cardioafferent signals

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

Chairs: Mauro Larrá

IfADo - Leibniz Institut für Arbeitsforschung an der TU Dortmund

Peripheral bodily processes are conveyed to the brain via several mechanisms promoting psychological and behavioral adaptations. Besides humoral pathways, the impact of neural projections originating from receptors located within the cardiovascular system is currently debated. Accumulating evidence indicates that cardiac activity influences central-nervous processes mediating perception, cognition and emotion. This symposium will cover recent neuroscientific research into such heart-brain interactions ranging from basic perception to psychopathology. Michael Gaebler (Leipzig) will present evidence for a modality-specific cardiac phase bias indicating that increased cardioafferent traffic during systole inhibits somatosensory perception while promoting active visual sampling. Mauro Larra (Dortmund) will present behavioral and EEG studies showing that cardiac activity modulates sensorimotor and cognitive processes underlying stimulus-response-compatibility. Although central-nervous effects of phasic variations in cardioafferent traffic can be revealed by analyzing EEG data time-locked to heartbeats, electrical fields propagated from the heart pose a challenge and Stefan Arnau (Dortmund) will discuss methodological approaches to deal with the cardiac field artifact. Conscious and unconscious perception of heartbeats may also contribute to self-related cognitions and emotions. Aleksandra Herman (Warsaw) will identify neural correlates of heart-focused and tactile-focused attention in a study applying fMRI and a novel heartbeat-detection task. André Schulz (Luxemburg) will focus on psychopathological consequences related to the perception of cardioafferent signals and present new results on heart-beat-evoked potentials and interoception in somatic symptoms. Together, these contributions elucidate how cardioafferent signals influence brain activity as well as the way we feel, perceive and interact with our environment.

The role of BDNF in vulnerability to and treatment of stress-related disorders

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Chairs: Lara Puhlmann (1), Helge Frieling (2)

1: Max-Planck Institute for Human Cognitive and Brain Sciences, Germany; Leibniz Institute for Resilience Research, Mainz, Germany; 2: Molecular Neuroscience Laboratory, Department of Psychiatry, Socialpsychiatry and Psychotherapy, Hannover Medical School, Hannover, Germany

During adaption to stressors, the brain coordinates appropriate responses through close interaction with peripheral systems. The brain derived neurotrophic factor (BDNF) has emerged as a potential mediator of long-term stress and adversity effects that bridges central and peripheral pathways. BDNF is an essential facilitator of neuronal plasticity in the developing and adult brain. Following observations that chronic stress reduces BDNF expression and antidepressant administration increases its synthesis, the neurotrophic hypothesis of depression was formulated. Fifteen years later, epigenetic regulation and expression of BDNF are widely researched in pathways from adversity to neurodegeneration and disorder, and conversely, as biomarkers for treatment response. This symposium discusses recent advances in our understanding of the role of BDNF for the development and treatment of stress-related disorders, from basic research to clinical application. Roman Linz will provide insights into serum BDNF dynamics during acute stress, its relation to salivary cortisol and BDNF associations with hippocampal volume. Exploring mechanisms of resilience, Lara Puhlmann will discuss data showing serum BDNF increases following stress-relieving mental training in healthy adults. Subsequently, Eva Unternaehrer will discuss how psychopathological risk factors, symptoms, and psychological treatment relate to BDNF DNA methylation. Jan Engelmann and colleagues will present data on the role of plasma BDNF levels and BDNF exon IV promotor methylation as predictors for antidepressant treatment response, and for memory and executive dysfunctions, in a large cohort of depressed patients. Helge Frieling will present recent data on the clinical usefulness of BDNF exon IV methylation as marker of resistance towards monoaminergic antidepressants.

Keywords: BDNF, BDNF DNA methylation, antidepressant treatment, stress

Societal polarization: psychological and neurobiological approaches

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Chairs: Bastian Schiller (1), Grit Hein (2)

1: University of Freiburg, Germany; 2: University of Wuerzburg, Germany

The past decade has been characterized by increasing polarization which recently has sparked global protests in the course of the "Black Lives Matter" movement. One major symptom of this societal polarization is the consolidation of prejudices and stereotypes against individuals from different social groups, and resulting intergroup conflicts with detrimental effects. Reflecting the urgency of the problem, there is an increasing amount of psychological and neuroscience research that strives to uncover the mechanisms that drive societal polarization and to develop approaches that counteract them. Our symposium brings together scientists from four countries (Canada, China, UK, Germany) and five different universities (Alberta, Peking, Bristol, Freiburg, Würzburg) that investigate different aspects of societal polarization related to intergroup processes. In more detail, our symposium provides insights into the neuroendocrinological basis of intergroup conflict (Bastian Schiller), elucidates how neural activities involved in racial categorization affects racial biases in face perception and altruistic decisions (Yuqing Zhou, junior scientist), and discusses cognitive biases and stereotypes in the context of vicarious interracial contact (Susanne Quadflieg). Exploring the promises and limits of intergroup contact further, we will discuss whether and how intergroup toleration affects basic neural signatures and attitudes towards minorities (Kyle Nash), and how neural learning from positive outgroup experiences shape prosocial motivation and the outcome of clinical treatments (Grit Hein). Together, the presentations of the invited experts provide insights into the psychological and neurobiological mechanisms that contribute to societal polarization, show their effect on perception, cognition, and decision-making, and explore approaches that may counteract these effects.

Keywords: neurobiology, intergroup bias, social behavior, neuroimaging, psychopharmacology

Dynamic shaping of memory representations by physiological and cognitive processes

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Chairs: Svenja Brodt (1), Monika Schönauer (2)

1: Institut für Medizinische Psychologie und Verhaltensneurobiologie, Universität Tübingen; Max-Planck-Institut für biologische Kybernetik, Tübingen; 2: Institut für Psychologie, Abteilung Neuropsychologie, Universität Freiburg

Not only do our memories shape how we perceive and interact with the world, they themselves are influenced by many factors, both internal and external. Innovative experimental designs, analysis approaches and human neuroimaging methods allow us to investigate the dynamics of how memory representations evolve and change in bilateral interaction with other cognitive and physiological processes. In this symposium, we present data from five labs, each focusing on different modulators of internal representations. We will first highlight physiological determinants of hippocampal function in ageing, based on data from various neuroimaging modalities. To these ends, we will show how differences in hippocampal vascularization patterns impact memory and cognitive functioning. Moreover, we will present data showing that Alzheimer's disease pathology differentially affects object and scene memory. Secondly, we will discuss how episodic simulation can shape real-life attitudes: mentally associating existing memory representations can lead to a transfer of affective valence to a previously neutral stimulus, resulting in both behavioral and physiological changes. Finally, we will focus on cognitive factors that support the emergence of neocortical memory representations. A first contribution leverages multivariate pattern analysis to show how the neocortex is able to rapidly acquire content-specific representations through repeated rehearsal. We will also present data on how sleep supports neocortical memory formation by shifting subcortical contributions to mnemonic processing during retrieval.

Keywords: memory, hippocampus, neocortex, ageing, episodic simulation

Neurobiological markers for psychotherapy response

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Chairs: Elisabeth Leehr (1), Miriam Schiele (2)

1: Institut für Translationale Psychiatrie, Universität Münster; 2: Klinik für Psychiatrie und Psychotherapie, Universität Freiburg

Psychotherapy research has shown efficacy for numerous psychotherapeutic interventions, however, about one-third of patients do not respond to psychotherapeutic treatment to a clinically significant degree. Treatment non-response involves severe consequences for patients and confers a high socioeconomic burden. A precise prediction of individual treatment response offers the chance to optimize individual treatment selection and to thus prevent patients from prolonged suffering. Accordingly, the identification of valid (bio)markers as correlates and predictors of clinically meaningful endpoints has become central to the field of psychotherapy. In recent years, research into neurobiological markers of psychotherapy response has yielded promising results. In this symposium, we will present some of the recent advances regarding neurobiological response markers in different mental disorders.

Miriam Schiele will review recent findings on epigenetic mechanisms in anxiety- and stress-related disorders including panic disorder, specific phobia and obsessive-compulsive disorder as well as regarding their potential as predictors and dynamic correlates of clinical response to psychotherapy. Elisabeth Leehr will illustrate the protocol of a proof of principle study investigating the a priori prediction of treatment outcomes in specific phobia and will present preliminary clinical and brain structural data. Kati Roesmann will give insights into electromagnetic signatures of fear generalization in relation to response to exposure therapy in patients with spider phobia. Utilizing electroencephalography, Kathrin Schag will present information processing markers relevant for treatment response to a combined neuromodulation and inhibition training addressing cognitive control in patients binge eating disorder.

Keywords: neurobiological markers, psychotherapy response

Network Neuroscience Approaches in Psychological Science: A Connectionist Perspective on the Biological Bases of Attention, Cognitive Ability, and on Clinical Disease

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Chairs: Kirsten Hilger (1), Sebastian Markett (2)

1: University of Würzburg, Deutschland; 2: Humboldt Universität zu Berlin

Network Neuroscience, a scientific discipline positioned on the border between brain sciences and physical network theory, has recently been introduced as promising approach into psychological research. This symposium presents four studies that apply network neuroscience methods to different brain imaging modalities to gain insights into various aspects of the human mind. After a brief introduction into basics of network theory, Sebastian Markett reports results from a combined task- and resting-state fMRI study (N = 78) that challenges key assumptions of attention network theory. The second talk transitions from specific cognitive processes to individual differences in cognitive ability. Kirsten Hilger presents results from two fMRI studies (N = 281) suggesting brain network dynamics, especially in the dorsal attention network, to be associated with individual variations in general intelligence. Moreover, specific features of network dynamics are derived that allow to predict individual intelligence scores in independent subjects (N = 831) from only 5% of fMRI resting-state data. Erhan Genc demonstrates the predictive power of structural network architecture derived from DTI (N = 324) for individual variations in knowledge. Finally, Urs Braun introduces network approaches to the investigation of clinical populations. Different concepts of network dysfunction are presented with an exemplary focus on schizophrenia and dopamine function. Finally, opportunities and limits of network neuroscience approaches are discussed within an open panel.

Keywords: Network Neuroscience, Connectivity, Brain Networks, MRI, Cognition

Faces in context: Bottom-up and top-down influences on face perception

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Chairs: Julia Baum, Rasha Abdel Rahman

Humboldt-Universität zu Berlin, Berlin School of Mind and Brain

The way we process and evaluate other's faces depends not only on the face alone, but also on the situational context, our goals and experiences, and what we know about the person. In this symposium five talks highlight different aspects of face processing in context, ranging from task-related over knowledge-based effects to encounters in real-life situations. Enya Weidner presents data from intracranial amygdala recordings investigating the mechanisms and time-course underlying the interaction of goal-directed attention and emotional processing. Employing ERPs, the next talks focus on how learning history shapes face processing. Anne Schacht shows how expression-induced salience and learning through conditioning modulate the processing of faces. Next, Julia Baum shows how more complex learning of verbal emotional information influences the processing of faces varying in attractiveness. Zooming out, we ask whether our understanding of face and emotion processing can benefit from putting faces back onto the body – as in real-life situations. Kirsten Stark used videos of real-life intense emotional reactions to show how the affective valence communicated by the body interacts with the recognition of facial expressions. Noga Ensenberg then provides evidence on how strongly the context influences what we read from a face depends on individual differences between perceivers. Taken together, our symposium challenges the traditional assumption that faces are processed in relative isolation, demonstrating a wide range of contextual influences.

Keywords: face processing, emotions, context, event-related potentials

Neurophysiology of aversive conditioning and (emotional) memory

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

Chairs: Ursula Stockhorst (1), Andreas Keil (2)

1: Department of Psychology, University of Osnabrueck, Osnabrueck, Germany; 2: Department of Psychology and Center for the Study of Emotion and Attention, University of Florida, Gainesville, Florida, USA

This symposium addresses the role of aversive conditioning and multisensory associative learning for perception and (emotional) memory in healthy humans, including translational implications.

Keil et al. (Gainesville, USA) show how changes in sensory visuocortical tuning depend on experience. Measuring dense-array EEG and pupillometry, visuocortical responses were selectively sharpened when low-level features (e.g., orientation) had been associated with an aversive outcome whereas using higher-level features (object category) resulted in generalization (in line with top-down control).

Wang et al. (Glasgow/Birmingham, UK) present empirical studies and data from computational modelling. They provide causal evidence that neural synchronization in theta- and gamma-frequencies accounts for formation of visuo-auditory associative memory in declarative-memory tasks.

Plog et al. (Osnabrück) extend this research to (implicit) fear conditioning: Visual conditioned stimuli (CS) and aversive noise (unconditioned stimulus, US) were presented in 4-Hz modulation, phase-synchronized vs. out-of-phase. Phase-synchronization improved CS-US contingency-knowledge and affective stimulus-evaluation, but not steady-state-visually-evoked potentials and skin-conductance responses (SCRs).

Fear-recall and poor extinction-recall characterize anxiety disorders.

To identify conditions improving extinction-recall, Bierwirth et al. (Osnabrück) compared extinction learning immediately after fear-acquisition with 24-h-delayed extinction on fear- and extinction-recall. As expected, delayed-extinction resulted in better extinction-recall in SCRs. EEG (source-localized theta and gamma oscillations) and cardiac responses are currently analyzed.

Sperl et al. (Marburg) examined effects of the noradrenergic alpha-2 adrenoreceptor-antagonist yohimbine, D2-receptor antagonist sulpiride and placebo on long-term fear conditioning and extinction. Yohimbine enhanced fear-recall with potentiated fear bradycardia and larger amplitudes of N170 and LPP ERP-components, elucidating a key role of noradrenaline in strengthening conditioned fear.

Keywords: aversive conditioning, memory, fear-recall, extinction-recall, perception, theta-modulation

Sex hormones and social emotional processes

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

Chairs: Bernadette von Dawans (1), Frances S. Chen (2)

1: Trier University, Deutschland; 2: University of British Columbia, Canada

Sex hormones not only regulate human development from peripheral to central systems but also influence cognitive and emotional processes, as well as sexual and social behaviors. In our symposium we will bring together studies on endogenous (e.g. variations over the menstrual cycle or differences between men and women) as well as exogenous effects (e.g., pharmacological administration studies, users of hormonal contraceptives). Elisa Rehbein (University of Tübingen, Germany) will present a placebo-controlled fMRI study on the effects of estradiol application on emotion regulation in women. Julia Strojny (Trier University, Germany) will then present results on the hormonal modulation of social behavior in oral contraceptive users and naturally-cycling women in a study using paradigms adapted from behavioural economics as well as an empathy task. In the next talk the modulation of moral judgments by oral contraceptive use, testosterone and CAG repeat polymorphisms in the androgen receptor gene will be presented by Diana Armbruster (Technical University of Chemnitz). The final two talks will focus on the health-relevant effects of sex hormones and their variations. Katja Schmalenberger from University Hospital Heidelberg (Germany) will show results on cardiac vagal activity across the menstrual cycle with implications for women's health. Finally, Christine Anderl (Knowledge Media Research Center, Tübingen, Germany) will close the symposium with her study on the long-term associations between use of hormonal contraceptives and risk for depression.

Keywords: testosterone, estradiol, hormonal contraceptives, menstrual cycle, social interaction

Sleep, physical, and mental wellbeing in a modern society – relevance of stress, media consumption, and artificial light

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

Chairs: Christine Blume (1), Christian Benedict (2)

1: Universität Basel, Schweiz; 2: Universität Uppsala, Schweden

Sleep is critical for physical health and mental well-being and sleep disturbances have been associated with a range of adverse health effects. At the same time, sleep disturbances are very common in modern societies. In Germany, about 30% of the population reported clinically relevant sleep problems in the past four weeks in a representative survey conducted between 2008 and 2011. The overall increase in numbers over the past 20-30 years suggests that several factors related to modern lifestyle may negatively affect sleep. In this symposium, we would like to revisit different aspects of such a modern lifestyle and discuss their relationship to sleep, physical health, and mental wellbeing. Specifically, Johanna Schwarz's presentation will focus on the effect of sleep deprivation on the response to psychosocial stress. Next, Sandrine Baselgia will show how arousing effects of cliff-hangers and binge-watching of Netflix series modulate sleep. Christine Blume will present findings on how artificial light exposure before sleep affects neuroendocrinology, sleep quality, and basic human brain functions. The symposium will be concluded by Christian Benedict, who will present research on how acute sleep loss affects weight control as an important health factor. Altogether, this symposium highlights the effects of several characteristics of a modern lifestyle on sleep and investigates their relevance for mental and physical health. The symposium will be concluded with a broader discussion on how the research findings might translate into societal efforts to promote better sleep.

Keywords: sleep, health, modern society, stress

The impact of social exclusion and loneliness: neural mechanisms and interventions

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

Chairs: Dirk Scheele (1), Alexander Lischke (2)

1: University of Oldenburg, Deutschland; 2: University of Greifswald

Humans have evolved as an essentially social species. Positive social relationships promote physical and mental well-being, whereas loneliness and social isolation increase the risk of premature mortality comparable to established risk factors such as obesity, physical inactivity, and substance abuse. Surprisingly, however, the impact of social exclusion and loneliness on the structure and function of the brain is still not well understood. In the current symposium, we present recent studies examining the functional and structural brain correlates of social exclusion and loneliness and how they might be modulated by behavioral interventions. Shuyan Liu explores the association between modern urbanicity, social exclusion, and mental health. Jana Lieberz reveals the neural link between loneliness and biased trustworthiness decisions in a pre-stratified sample of healthy lonely and non-lonely individuals. Federica Riva presents the relationship between loneliness and interoception at both behavioral and brain level. Alexander Lischke shows that social network size affects the structural integrity of the amygdala. Zoé Bürger investigates the effects of social exclusion and cognitive stress on the neural functional connectivity in women and men.

Neuronale Korrelate kindlicher Kognitionen

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

Chairs: Stefanie Peykarjou

Universität Heidelberg

In der frühen und mittleren Kindheit wird die Basis für spätere kognitive Fähigkeiten gebildet. Ein entscheidender Prozess besteht dabei darin, auditorische und visuelle Information zu verarbeiten und zu integrieren. In diesem Symposium werden 5 Beiträge präsentiert, die neuronale Grundlagen dieser Lernprozesse mittels Ereigniskorrelierter Potentiale (EKPs) und Frequenzmessungen erfassen. Die Beiträge befassen sich mit Reaktionen auf auditorische, visuelle und crossmodale Oddballs sowie mit Objekt-Wort-Verknüpfungen und intermodalem Handlungsverständnis bei Säuglingen und Kindern.

Der erste Beitrag untersucht unter Verwendung des Oddball-Paradigmas die auditorische Diskriminationsfähigkeit bei 7 – 12 Monate alten Säuglingen. Selten präsentierte Klaviertöne lösten eine P3a-ähnliche Komponente aus, welche sich mit dem Alter verstärkte (Wienke et al.).

Der zweite Beitrag misst kategoriales Lernen unvertrauter Stimuli bei 7 Monate alten Säuglingen. Gewöhnungseffekte während einer EKP-Familiarisierung waren mit späterer Kategorisierungsleistung in einem Fast Periodic Visual Stimulation Paradigma verbunden und reflektieren eine high-level visual processing (Peykarjou et al.).

Der dritte Beitrag demonstriert, dass 18 Monate alte Kleinkinder verbale Cues mit visueller Handlungsinformation integrieren (Patzwald et al.). An somatosensorischen Messpunkten war Mu reduziert für kongruente verglichen mit inkongruenter verbaler und visueller Information.

Im vierten Beitrag werden Gedächtnisprozesse während des Wortlernens bei 4-jährigen untersucht (Brehm et al.). Hierbei wurde die Stärke des Theta-Rhythmus kurz vor Benennung eines neuartigen Objektes mit dem späteren Lernerfolg assoziiert.

Im fünften Beitrag wurden EKPs bei 5- bis 6-jährigen Kindern für häufig auftretende audiovisuelle Reizkombinationen mit selten auftretenden Rekombinationen dieser Reize verglichen (Schlesinger-Zweckerl et al.). EKP-Effekte für seltene crossmodale Reizkombinationen wurden unabhängig von der Aufgabenrelevanz der statistischen Regelmäßigkeiten gefunden.

Keywords: EEG, Entwicklung, auditorische Verarbeitung, visuelle Verarbeitung

Up- and down-tuning in attention: Neuro-cognitive mechanisms of target selection and distractor suppression

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

Chairs: Malte Wöstmann (1), Daniel Schneider (2)

1: University of Lübeck; 2: IfADo, TU Dortmund

In theory, selective attention is the net result of target selection and distractor suppression. The way in which the human neuro-cognitive system implements both mechanisms has remained contested. Recent insights from cognitive neuropsychology support the view of attention as a dynamic set of filters rather than a static spotlight. In a series of five talks, this symposium will bring together researchers approaching the mechanics and the neural implementation of the attention filter from different angles, using behavioral psychophysics and electroencephalography (EEG). Malte Wöstmann (University of Lübeck) will provide evidence from EEG that distractor suppression is independent of target selection and operates in a rhythmic manner. Anna-Katharina Bauer (University of Oxford) will demonstrate that the rhythmic sampling of visual target stimuli is subject to cross-modal entrainment. Bojana Mirkovic (University of Oldenburg) will focus on one of the most important sensory stimuli in our environments – human speech – to show that degraded acoustics and hearing-loss affect the neural segregation of target and distractor speech. Daniel Schneider (IfADo Dortmund) will present evidence for attentional filtering on the level of visual working memory, where temporarily stored target items are enhanced while distractors are suppressed. Finally, Dirk van Moorselaar (Vrije University, Amsterdam) will show that neural effects of learned expectations critically depend on task relevance (targets vs. distractors) and the dimension of predictions (spatial, feature). In sum, this symposium will establish a comprehensive account of target selection and distractor suppression on different levels of neural processing by a set of filters to implement selective attention.

Keywords: attention, target selection, distractor suppression, EEG, psychophysics

SYMPOSIUM PRESENTATIONS

** indicates presenting author*

Neural correlates of social cues that indicate successful costly punishment

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

Martin Weiß* (1), Johannes Rodrigues (2), Juliane Boschet (2), Andre Pittig (2), Patrick Mussel (3), Johannes Hewig (2)

1: Translational Social Neuroscience Unit, Center of Mental Health, Department of Psychiatry, Psychosomatic and Psychotherapy, University of Würzburg, Würzburg, Germany; 2: Department of Psychology I, Institute of Psychology, University of Würzburg, Würzburg, Germany; 3: Division Personality Psychology and Psychological Assessment, Freie Universität Berlin, Berlin, Germany

Costly punishment is the attempt to punish interaction partners for deviant behavior, such as violating fairness rules, at personal costs. We examined interaction processes in which a counterpart showed a socio-emotional response to punishment, which indicates whether the punishment was successful or not. In a modified ultimatum game, emotional facial expressions of the proposer in response to the receiver's decision served as feedback stimuli. We focused on the neural correlates of this response and its influence on subsequent decision making. Results from a series of experiments are consistent with the concept of costly punishment as an intentional action following norm-violating behavior, in our case unfair offers by the proposer. Socio-emotional stimuli were found to have a significant influence on perception and behavior in economic negotiations. Especially, smiling facial expressions in response to an accepted offer consistently led to an increase in acceptance rates. Moreover, both rewarding reactions following the acceptance of an offer (smiling compared to neutral facial expression) as well as reactions indicating successful punishment (sad compared to neutral facial expression) elicited a reward positivity in the time frame of the Feedback-related Negativity, indicating that punishment was the intended outcome. Individual differences in depression showed that the reward positivity for smiling facial expressions as feedback stimuli decreased with higher depression scores.

Keywords: facial expression, reward, social neuroscience, ultimatum game

Frontal theta oscillations reflect positive prediction error processing which is amplified in threat avoidance learning and modulated by trait neuroticism/anxiety in monetary reward learning

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

Christopher Stolz* (1,2), Alan D. Pickering (2), Erik M. Mueller (1)

1: University of Marburg, Germany; 2: Goldsmiths, University of London, UK

Frontal midline theta (FMθ) has been associated with prediction error processing and trait anxiety and thus has been hypothesized to reflect unspecific cognitive control processing, such as in threat scenarios that elicit state fear and negative affect. However, most studies in reinforcement learning on FMθ and the influence of negative affective personality traits have used paradigms involving reward- rather than threat-related reinforcer. Accordingly, the role of FMθ in threat-related reinforcement learning and its associations with personality traits from fear and anxiety domains is widely unknown. Here n = 105 participants underwent one reward-related and one punishment-related three-armed bandit task. Feedback in the reward task signalled monetary reward (+10 Cent) versus nonreward (+0 Cent) and feedback in the punishment task signalled nonpunishment (no noise burst) vs. punishment (noise burst titrated to match aversiveness of monetary nonreward). While FMθ was amplified following negative vs. positive valent feedback in both tasks, there were task-dependent differences in the processing of positive prediction errors (PE+) which indicated the initiation of subsequent behavioural exploitation. Single-trial regression analyses demonstrated that FMθ scaled with a computationally derived PE+ that was calculated using a state-action value function. This effect was significantly stronger in the punishment vs. reward task but only modulated by trait neuroticism/anxiety in the reward but not punishment task. In line with the adaptive control hypothesis, our results suggest that FMθ as an index of PE+ processing was particularly sensitive for threat avoidance learning and linked to trait neuroticism/anxiety in non-threatening reward learning scenarios.

Keywords: frontal theta, prediction error processing, threat avoidance learning, reward learning, trait anxiety

Play it again Sam! The influence of a second offer in the ultimatum game on decision making of the receiver and their offer related EEG responses.

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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In economic neuroscience, the ultimatum game is often used to investigate bargaining behavior. We used an ultimatum game and a two-stage ultimatum game with 92 participants to determine the influence of an additional offer after a previous rejection on the acceptance rates and the electro-cortical responses of the receivers to fair and unfair offers. Additionally, the influence of traits including greed and anxiety on the decisions were investigated.

The results led to the conclusion that higher offers lead to more acceptance in general, but a second stage in the ultimatum game influences the behavioral responses with higher rejection rates if a second offer is available.

Concerning the electrophysiological measurements, the (single-trial) reward positivity as an indicator of fairness evaluation was higher if the offer was more generous. If a second offer was available, this effect was not present. In the final stage of the two-stage ultimatum game, the effect was present again. Midfrontal theta as an indicator of cognitive effort was lower for higher offers in the ultimatum game, while it was higher for more generous offers, if a second stage was still available in the two-stage ultimatum game. There, it could be used as a predictor for the behavioral responses.

Interestingly, the investigated traits only moderated the behavioral responses of the two-stage ultimatum game.

The study shows differences in trait relation and electro-cortical correlates of behavior when a second bargaining stage is added to the ultimatum game. It provides insights about electro-cortical correlates and trait moderations of bargaining responses.

Keywords: two-stage ultimatum game, midfrontal theta, reward positivity, bargaining behavior, fairness evaluation vs. cognitive effort

The relationship of cognitive effort investment and reward processing under varying demand

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Traits related to dispositional differences in cognitive effort investment (CEI) like need for cognition (NFC) and self-control have been shown to be related to effort-based decision making. Based on previous findings, we assumed that CEI, as an integrative measure of the willingness and tendency to exert effortful control, would be related to behavioral and psychophysiological indices of effort investment in a typical cognitive control task under varying demand and payoff. Specifically, performance and midfrontal theta power (FMθ) in the electroencephalogram are sensitive to cognitively demanding tasks and were shown to exhibit different patterns for individuals with high vs. low NFC as one core aspect of CEI: performance decreased more strongly for individuals with low vs. high NFC, and high NFC individuals showed a demand-congruent increase in FMθ, pointing to a more efficient allocation of cognitive resources. In the present study (N ~ 145), we examined the relationship of CEI and behavioural measures, i.e., reaction time (RT), error rate (ER) and FMθ, during a flanker task with varying demand and payoff. Whereas the analysis of the behavioral data revealed significant effects for demand (RT, ER), demand x payoff (RT, ER) and payoff x CEI (RT), significant effects regarding FMθ emerged for demand and demand x CEI. Taken together, we mapped CEI onto objective markers of the willingness to exert cognitive effort. Our result may further our understanding of person x situation interactions with regard to effort investment in goal-directed behavior. Open data and reproducible analysis scripts will be available at OSF.

Keywords: cognitive effort investment, need for cognition, personality, midfrontal theta

Need for cognition does not account for individual differences in metacontrol of decision making

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Humans show metacontrol of decision-making towards different reward magnitudes. Specifically, when higher rewards are at stake, individuals increase their reliance on a more accurate but cognitively effortful, model-based reinforcement-learning strategy. We investigated whether the personality trait Need for Cognition (NFC) explains individual differences in metacontrol. NFC reflects an individual's intrinsic motivation for cognitively demanding activities and previous studies showed that individuals low in NFC are more strongly affected by different reward magnitudes in how much they engage in cognitively effortful activities. Based on these findings, we expected more reward-based metacontrol in individuals low in NFC. In two independent studies (N = 126 and N = 205), we assessed reliance on model-free and model-based reinforcement-learning strategies by means of a decision making task. Across trials, the magnitude of available rewards was manipulated. We found that participants showed metacontrol, i.e. they relied more strongly on a model-based strategy when rewards were amplified. In contrast to our expectations, NFC did not account for individual differences in metacontrol of decision making in both studies. In fact, a Bayesian analysis provided moderate to strong evidence against a relationship between NFC and metacontrol. Beyond this, NFC was also not related to the overall reliance on model-based reinforcement learning. Our findings show that while individuals differed in their intrinsic motivation to exert cognitive effort, extrinsic rewards modulated their engagement in an effortful decision-making strategy in a similar way. This suggests a differential role of NFC for the regulation of cognitive effort in decision making and executive functions.

Keywords: reinforcement learning, personality, cognitive effort

Preservation of high sexual function into old age: Examining psychobiological protective factors in healthy middle-aged and older men

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Background: Sexuality is an important quality-of-life consideration until late life in both sexes (Hyde et al., 2012). Men, however, often exhibit an elevated sex drive as compared to women, which has been related to their elevated testosterone levels as well as psychological and cultural factors (Baumeister et al., 2001). Longitudinal changes in male-specific biological and psychological factors and their relation to sexual function have never been examined in parallel.

Methods: One hundred healthy middle-aged and older men were examined with regard to sexual function, testosterone levels, CAG-repeat length polymorphism of the androgen receptor, body composition, and psychosocial factors at baseline (2014-2015) and in a three-year follow-up (2017-2018). As relevant psychosocial factors related to sexual function in men, we measured self-identified masculinity, relationship satisfaction, body-related and general self-esteem, social support, trait resilience, and general mental health.

Analysis and expected results: Prediction models will be computed to evaluate psychobiological protective factors (baseline and change scores) preserving high sexual function in aging men. It is expected that testosterone change scores, but not baseline levels will predict maintenance of sexual function over a three-year period in men, while CAG-repeat length may emerge as important moderator of this association. Psychosocial factors will be examined in an exploratory way. Results will be presented at the conference.

Keywords: sexual function, men, masculinity, testosterone, CAG repeat length, body composition, relationship satisfaction, mental health

A single dose of escitalopram blunts the response in neural correlates of punishment processing

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Psychological and neurocognitive approaches to depression consider negative biases of information processing to play a key role in maintaining symptoms of depression. Selective serotonin reuptake inhibitors (SSRIs) show acute effects on the neural processing of negative bias in emotional processing in health and depression. Importantly, these effects on emotional processing are seen much earlier than changes in mood, which substantiates the hypothesis that reducing negative biases contributes and eventually leads to improvements in mood. A blunted hedonic response to rewards as well as enhanced sensitivity to punishment similarly describes a negative bias which is common in depression. Whether and how SSRIs also affect reward and punishment processing on a similarly rapid time-scale, however, remains unclear. Here, we investigated the effects of an acute and clinically relevant dose (20 mg) of the SSRI escitalopram on brain response during reward and punishment processing in healthy volunteers (9 women, 10 men). In a double-blind, placebo-controlled study using functional magnetic resonance imaging (fMRI), participants performed a well-established monetary reward task. Acute escitalopram administration reduced blood oxygen level dependent (BOLD) response during punishment feedback in the right thalamus and the right caudate head as compared to placebo. We did not detect any significant BOLD changes during reward feedback. Our findings extend theories of rapid SSRI-action on the neural processing of rewarding and aversive stimuli and suggest a specific and acute effect of escitalopram in the punishment neurocircuitry.

Keywords: reward, punishment, SSRI, fMRI, depression

Tears of joy, aesthetic chills and heartwarming feelings: Physiological correlates of Kama Muta

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Situations involving increased closeness or exceptional kindness are often labeled as moving or touching and individuals often report bodily symptoms, including tears, goosebumps, and warmth in the body. Recently, the kama muta framework has been proposed as a cross-cultural conceptualization of these experiences. Prior research on kama muta has mostly relied on subjective reports. Thus, our main goal of the present project was to examine the pattern of physiological responses to kama muta inducing videos and compare it to the patterns for the similar, though distinct emotions of sadness and awe. One hundred forty-four Portuguese and Norwegian participants were individually exposed to all three emotion conditions. Several psychophysiological indexes of the autonomic nervous system were collected continuously during exposure, including cardiovascular, respiratory, and electrodermal activity, facial EMG, skin temperature, as well as piloerection and lachrymation using cameras. Overall, the results partly replicated previous findings on being moved experiences and self-report studies. Strong self-reported experiences of kama muta were associated with increased phasic skin conductance, skin temperature, piloerection, and zygomaticus activity, while they were associated with reduced heart rate, respiration rate, and tonic skin conductance. The physiological profile of kama muta was successfully distinguished from sadness and awe, partly corroborating self-report evidence. We obtained no clear evidence of a kama muta association with the occurrence of lachrymation or heart rate variability. Our findings provide a systematic overview of psychophysiological response to experiences of kama muta, and help to inform future research on this emotion and positive emotions in general.

Keywords: ANS, kama muta, goosebumps, being moved, tears, positive emotions

Yes, I can – effects of positive self-instruction on the subjective and neural correlates during social evaluation

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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In our daily lives we are permanently confronted with social evaluation, which might evoke anger, frustration and decrease self-esteem. Inner speech is a cognitive function with self-regulatory effects, for controlling e.g., affective reactions. However, the inner speech is often negative and evaluative, thereby inducing low self-esteem, and fostering anxiety and depression. With the current study we applied a cognitive intervention for positive self-instruction and self-praise to modulate subjective and neural reactions to positive and negative social feedback in 63 healthy women.

Results indicate an increase in social self-esteem in the intervention-group (n=33) compared to the control-group (n=30) and less subjective arousal during the social feedback paradigm after the intervention. This was accompanied by decreased anterior cingulate cortex activation in the intervention group. Furthermore, sex-of-evaluator-specific activation appeared for negative and positive evaluation: Following the intervention, amygdala activation was higher for negative evaluation by men in the control-group, which was not apparent in the intervention-group. Additionally, higher activation in the hippocampus appeared for positive evaluations by women in the intervention-group compared to the control-group after the intervention.

Thus, positive self-instruction and self-praise significantly improve self-esteem and subjective reactions to social evaluations. Furthermore, activation of neural regions associated with fear regulation and affective processing was altered, potentially reflecting self-regulatory processes. The intervention is a promising tool to increase self-esteem and beneficial subjective reactions to positive and negative social evaluations and seems to prompt neural self-regulatory processes.

Keywords: self-esteem, self-praise, positive self-instruction, social evaluation

Decoding retrieval success and memory content during short-term memory maintenance

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Apart from coding the particular content of a learning episode, a memory representation must permit successful memory retrieval. Using multivariate pattern classification, we tested whether electrical brain activity recorded during short-term memory maintenance satisfies these conditions, and where identified short-term memory representations reside. In our experiment, participants learned two short-term memory tasks, encoding either pictures of faces or houses, or sequences of digits or letters while brain activity was recorded with EEG. It was possible to decode retrieval success from electrical brain activity during the delay period of both short-term memory tasks. Moreover, we could distinguish whether participants kept pictures of faces or houses in memory, and classifier performance on this problem correlated with successful memory maintenance. Using spatial as well as frequency-based searchlight analyses, we found that distinct brain areas and frequency bands coded for the success versus the content of short-term memory. Frontal and parietal higher frequency bands and alpha activity predicted retrieval success, whereas memory content was represented in temporal and parietal higher frequency ranges, as well as theta activity. We propose that frontal cortex supports memory-related control processes, whereas temporal cortex shows a sensory reinstatement of material content and is part of the wider activated network during memory retention. Interestingly, the only overlap between electrodes coding for retrieval success and memory content was found over medial parietal regions, indicating that a dedicated short-term memory representation resides in medial posterior cortex.

Imprecise theta-gamma coupling underlies age differences in associative memory

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Neural oscillations reflect rhythmic fluctuations in neural synchronization and supports episodic memory formation by shaping synaptic connectivity. The cross-frequency coupling of gamma power to the phase of the theta rhythm has been proposed to support the formation of item-context associations via the precise temporal regulation of synaptic activation. A hallmark of aging is the decline in memory for associative information. However, little is known about whether the associative deficit seen in older age can be associated with alterations in theta-gamma coupling during memory formation. In the current study, younger (n=59) and older (n=54) adults performed an object-scene association task while being monitored with EEG. In a subsequent memory test, old and new objects were presented whit an old or new scene and participants responded if the object was old or new and if the specific object-scene pair was old or new, thus allowing us to separate object from pair memory. We demonstrate that theta-gamma coupling supports the formation of object-scene associations in both age groups. While coupling closer to the peak of the theta rhythm was beneficial for subsequent pair memory, objects later remembered without their associated scene showed a reliable deviation from the optimal coupling phase. Furthermore, older adults' reduced pair memory was accompanied by a shift in coupling phase in comparison to younger adults. Thus, we show that neural synchronization as regulated by theta supports associative memory formation and that senescent changes in the precision of such synchrony underlies the associative deficit seen in older age.

Keywords: associative memory, ageing, theta-gamma coupling

Theta's functional role in the encoding of declarative memory traces

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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The formation of declarative memory occurs in a three-stages process (encoding, consolidation and retrieval). The bi-directional interaction between the prefrontal cortex (PFC) and the hippocampus (HPC), organised by different frequency bands, is of particular importance. Specifically, a positive correlation has been shown between oscillatory activity in the theta band (4-7 Hz) during the encoding and memory performance, implying a role for theta in the communication between PFC and HPC. However, a functional relevance of theta for the encoding of memory has not been shown.

In this study we investigated whether transcranial alternating current stimulation (tACS) delivered during encoding in the range of theta frequency band is able to improve the memory performance in a Dutch-German word pair learning paradigm. For this purpose, 30 healthy subjects joined two sessions where they learned two lists of word-pairs in each. TACS was delivered via four stimulation electrodes (target: FP1 & P7; return: FP2 & P8; phase difference: intrahemispheric 0°, interhemispheric 180°; 2mA) with either individually determined theta or 15 Hz as control (one per session). The first list was encoded under tACS (online), while the second list was not (offline). Delayed recall after a 30-minutes break serves to collect measures of long-term effects of successful encoding.

We present tACS-related findings on memory performance with respect to online and offline encoding and neurophysiological measures to show changes in brain activity induced by the stimulation. The discussion will highlight implications of those findings in the light of the current knowledge on memory formation.

Keywords: declarative memory, theta activity, tACS

Theta's functional role during nocturnal consolidation of declarative memory traces

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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The (nocturnal) consolidation of previously encoded information is one of the important steps to stabilize memory engrams. Newly collected information are reactivated spontaneously in the Hippocampus during non-REM sleep episodes, transferred back to the neocortex and integrated into already existing memory traces. Given that a successful consolidation of those reactivated information is accompanied by increased theta activity (as it is during their encoding), this study aimed to prove the functional role of theta during this process as well. We examined whether transcranial alternating current stimulation (tACS) applied at individual theta frequency (ITF) during early nocturnal non-REM sleep episodes altogether with targeted memory reactivations is able to improve the overnight performance compared to a control stimulation (23 Hz). Note that the protocol shares many features from the study presented before, mainly the encoding of two different lists of Dutch-German word pairs and parameters of tACS (target: FP1 and P7; return: FP2 and P8; phase difference: intrahemispheric 0°, interhemispheric 180°; 2mA). We applied one stimulation condition in the first sleep cycle, while one of two individually created lists of Dutch words (one for each tACS-condition) was played under hearing threshold. To equal parts, the newly created lists contain words indicated as remembered before sleep and completely new words (2nd sleep cycle: 2nd stim condition, randomized order). Here, we present the current state of results (collected data of 16 subjects) with respect to behavioural and neurophysiological measures and discuss the outcomes in the light of the findings of the study presented before.

Keywords: memory formation, oscillatory activity, tACS, functional role

Sleep spindles track cortical learning patterns for memory consolidation

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Memory consolidation, the transformation of labile memory traces into stable long-term representations, is facilitated by post-encoding sleep. Computational and biophysical models suggest that sleep spindles play a key mechanistic role for consolidation, igniting structural changes at cortical sites involved in prior encoding. Here we tested the resulting prediction that spindles are most pronounced over encoding-related cortical areas and that the extent of this encoding-spindle overlap predicts behavioural measures of memory consolidation. Using high-density scalp Electroencephalography (EEG) and Polysomnography (PSG) in healthy volunteers, we first identified cortical areas engaged during a temporospatial associative memory task (power decreases in the alpha/beta frequency range, 6-20Hz). Critically, we found that participant-specific topographies of post-encoding sleep spindle amplitude directly correlated with participant-specific encoding-task topographies. The extent to which spindles tracked encoding patterns predicted memory consolidation across participants. Our results provide empirical evidence for a role of post-learning sleep spindles in tracking encoding networks, thereby facilitating memory consolidation.

Keywords: sleep, memory consolidation, sleep spindles

Functional brain networks and their structural underpinnings in the aging brain

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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For adequate cognitive function, it is essential that there is efficient and effective communication between various brain regions and systems. By investigating coherent signal changes in different brain regions, we can disentangle functional networks; brain regions that tend to show high connectivity to each other and less connectivity to other regions. In this presentation I will use both cross sectional and longitudinal data to show how functional networks change with aging and how these changes are related to differences in structural connectivity. A hallmark of the age-related changes in functional networks, is that different functional networks become less segregated with age, caused by a decrease of within network connectivity and an increase in between network connections. This loss of segregation has implications for cognitive abilities in older adults. Previous studies have shown that functional connectivity is party, but not fully dependent of structural connectivity. And indeed our results show a weak but significant association between segregation and white matter integrity. We also investigated regional differences in the coupling between structural and functional connectivity and how they differ with age. Several clusters of brain regions show prominent age-related structure-function uncoupling, suggesting a gradual divergence between brain structure and function with advancing age. Together, these findings show that there is a complex interplay between age-related changes in brain structure, function and cognition.

Keywords: Aging, functional connectivity, structural connectivity, networks

The role of domain-general networks in semantic processing in the young and the aging brain

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Aging is characterized by a decline of cognitive control functions (Hedden & Gabrieli, 2004). In semantic cognition, this leads to the paradox that older adults usually show poorer task performance than young adults despite their greater semantic knowledge (Verhaegen, 2003). So far, it is poorly understood which neural changes in task-related activity and functional connectivity underlie these behavioral differences. We investigated the age-dependent contribution of domain-general networks to a verbal semantic fluency task in a neuroimaging study. Generalized and modified psycho-physiological interaction (PPI) analyses were applied to examine functional connections between the strongest task-related activation peaks. Furthermore, the relationship between functional connectivity and behavior was investigated. While univariate analyses revealed activation in the multiple-demand system and deactivation in the default mode system during semantic fluency, functional connectivity results demonstrated a strong interaction of these domain-general networks in both groups. This finding suggests that the functional coupling of usually anti-correlated networks is critical for successful task processing, independent of age, when access to semantic memory is required. Strikingly, we found differences in the predictive behavioral relevance of within- and between-network connectivity between groups. Only young adults capitalized on the positive integration of task-relevant networks. This was evident in the form of better processing efficiency during semantic fluency and improved semantic memory. Our results lend novel support to the notion of reduced efficiency due to neural dedifferentiation with age. We demonstrate that an age-related performance decline in semantic cognition is associated with reduced flexibility in the goal-directed functional coupling of task-relevant networks.

Keywords: aging, language, multiple-demand network, functional connectivity, production

Age-related differences at the neural network level underlying the semantic predictability gain under challenging listening conditions

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Speech comprehension is often challenged by increased background noise, but can be facilitated via the semantic context of a sentence ('predictability gain'). Previous work demonstrated the contribution of specialized semantic areas as well as domain-general support regions under challenging listening conditions. The recruitment of these areas may change with age. However, the functional interplay between semantic and domain-general areas during challenging listening conditions remains elusive. In young listeners, we could show that the predictability gain was associated with increased inhibition in the cingulo-opercular network. Here, we investigate age-related differences in network interactions under challenging listening conditions.

26 healthy young (19-29 years) and 26 healthy middle-aged and older participants (50-77 years) listened to and repeated sentences with varying semantic predictability and intelligibility during functional neuroimaging. Signal-to-noise ratio was tailored to individual hearing abilities. Psychometric curves, reflecting the behavioural predictability gain across intelligibility levels, did not differ between age groups. Task-related neural activity largely overlapped for both groups. Both groups exhibited increased effective connectivity from left anterior insula to left posterior middle temporal gyrus when highly predictable sentences became more intelligible. However, only young participants showed increased connectivity from left posterior middle temporal gyrus to pre-SMA when low predictable sentences became more intelligible. These findings show that, after controlling for individual hearing abilities, younger and older participants largely recruit the same brain regions. The observed differences in effective connectivity between semantic and domain-general areas may suggest less efficient coupling between networks in the aging brain.

Keywords: predictability gain, cingulo-opercular network, semantic network, aging, speech comprehension

Behavioral and neural effects of tDCS assisted cognitive training interventions in older adults with and without cognitive impairment

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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The older population worldwide is growing, therefore the prevalence of age-related diseases such as Alzheimer's disease increases. Thus, the development of non-invasive, cost-efficient interventions against age-associated cognitive decline is highly important. Non-invasive brain stimulation techniques, especially in combination with cognitive training interventions, may present a promising means to modulate cognitive functions and encourage neural plasticity. Addressing this matter, I will introduce a multi-session intensive cognitive training intervention combined with transcranial direct current stimulation in healthy older adults and patients with prodromal Alzheimer's disease. I will present data from our group, exploring direct training effects, transfer to non-trained domains and long-term effects of the intervention. Moreover, I will discuss possible plasticity-inducing effects of combined brain stimulation and visuo-spatial memory training by presenting structural and functional MRI data. I will further discuss the data in relation to possible factors predicting efficiency of combined training and tDCS interventions in age-related cognitive decline. As an outlook I will present possible home-based applications of tDCS plus training interventions. Taken together, understanding the effects of tDCS and cognitive training in populations with age-related cognitive decline and investigating underlying neural effects may valuably contribute to developing novel approaches to counteract cognitive decline in healthy and pathological aging.

Comparing the effects of different methodological decisions on the reliability of the error-related negativity and its association with individual differences

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Psychophysiological researchers make a number of methodological decisions when quantifying event-related potentials (ERP) and these decisions vary across studies. It is not well understood how each of these methodological choices—let alone the combinations of all of them—affect the psychometric properties of ERPs, nor their associations with individual differences. To illustrate the impact of these choices, this talk focuses on the error-related negativity (ERN), an ERP component that is widely used to study human performance monitoring. Specifically, we compared 72 distinct processing pipelines to quantify the ERN and examined their effects on the component's measured amplitude, psychometric properties, and association with individual differences, specifically behavior and gender. We collected ERN data from 263 young adults during a Flanker task and again in a subsample of 33 participants five months later. The means, internal consistencies, and test-retest reliabilities of the ERN were compared across different reference schemes (mastoid and average), baseline correction periods (-100 to 0, -200 to 0, and -500 to -300 ms), amplitude scoring approaches (area, peak, and peak-to-peak), and electrode site selections (Cz and region-of-interest). We found that these data processing choices affected not just the measured amplitude of the ERN, but also measures of internal consistency and test-retest reliability, as well as its associations with individual differences. Together, these results highlight the importance of considering methodological influences on ERP measurement, and we discuss steps to obtain more reliable and robust measurement of the ERN.

Keywords: Event-related potential, Error-related negativity, Methodology, Internal consistency reliability, Test-retest reliability

EEGManyPipelines: Mapping the diversity of EEG analysis pipelines and their impact on results

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Electroencephalography (EEG) is widely used in psychophysiological research. However, the analytical flexibility of EEG has challenged the robustness of EEG findings. Since there are so many various ways to process and analyze EEG data, analysis pipelines vary greatly between studies. It is currently unclear to what extent alternate, plausible pipelines produce various findings and assumptions. The EEGManyPipelines project is inspired by other recent projects involving many independent analysis teams to investigate a) how different analysts approach a given data set and b) how analysis approaches affect the obtained results. EEGManyPipelines extends this novel initiative to EEG research. Participants in this project will get access to an EEG dataset and are invited to analyze the data with an analysis pipeline they deem sensible and representative of their research. Participants will then report their results and a detailed description of the analysis pipeline back to us. We will use these reports to map the diversity of analysis pipelines and the effect of pipeline parameters on obtained results. Thereby, EEGManyPipelines will help assessing the robustness of EEG findings across alternative analyses, identifying (sub)optimal analysis pipelines, and informing guidelines for reporting EEG analyses in publications. Thus, we expect that EEGManyPipelines will help improving the credibility of EEG research and the quality of analyses, and will inspire new standards for conducting and reporting EEG studies. Given the widespread use of EEG in human cognitive neuroscience and psychology, this project represents a timely and crucial endeavour that will benefit the cognitive neuroscience community at large.

Keywords: EEG, Open Science, meta-science, pre-processing

Preregistration: Increasing transparency in electrophysiological research

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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In this talk, we will discuss how preregistration can be used to increase transparency in electrophysiological research. We will start by discussing how confirmation bias (looking for information that supports prior beliefs), hindsight bias (overestimating in how far past events predicted a current outcome), and pressure to publish can lead to (unconscious) data exploration after which only (statistically) significant results are reported. We will highlight some of the problems associated with this *undisclosed analytic flexibility*, focusing on EEG research, in which complex multidimensional data can be preprocessed and analyzed in many possible ways. We argue that transparently disclosing analytic choices can mitigate confirmation and hindsight bias and make EEG research more verifiable. One possible tool for transparent reporting is preregistration: providing a time-stamped, publicly accessible research plan with hypotheses, a data collection plan, and the intended pre-processing and statistical analyses, written before the data were accessed. We will provide examples on how to create preregistrations for EEG studies that are specific, precise and exhaustive, focusing on data pre-processing and analysis steps. Finally, we will highlight the benefits and critically discuss the limitations of adopting preregistration for EEG researchers.

Keywords: EEG, Preregistration, Open Science, Reproducibility, Transparency

Transparency in reporting on ERP research and how we can improve it

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Given the complexity of ERP pre-processing and analysis pipeline, it is challenging to incorporate all information needed for a replication attempt or adequate critical assessment of the study when writing a paper. In a recent systematic review on methodology and reporting in ERP studies (Šoškić et al., in press), we have demonstrated that verbal descriptions of methods in journal articles are not optimal for this task due to susceptibility to information omission and ambiguous wording. This talk will discuss (1) which are the principle areas in which improvements in reporting on ERP methods are necessary, (2) a proposal to improve transparency and reduce reporting errors by designing a supplementary ERP metadata template to be filled with methodology information necessary for study evaluation, replication, metaanalysis and data reuse, and (3) ARTEM-IS (Agreed Reporting Template for EEG Methodology - International Standard, https://osf.io/pvrn6/), a project to create such a template through a collaborative process that would gather stakeholders across the entire ERP community, ensuring ease of use, clarity and relevance of the template contents.

Keywords: event related potentials, methodology, open science, reproducibility, ARTEM-IS

Context-dependence of task representations in fronto-parietal cortex

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Every day, we flexibly adapt our behavior to ever changing external demands. This ability is supported by a set of fronto-parietal brain regions, the so called multiple demand (MD) network. MD regions are known to encode task sets, but it remains unclear whether and how coding of task-related information changes when external demands / contexts change. While some studies have shown context-dependent task representations (i.e. task coding changes across contexts), other have shown context-invariant task representations (i.e. unaltered task coding across contexts). In this talk, I will first outline an analysis approach of how multivariate pattern analysis of fMRI data can be used to study context-dependence, and present results from some of our studies in which we use this approach. We tested whether task representations differ when e.g. cognitive control demands are high vs low, or when tasks can be freely chosen vs are externally cued. In a more recent study, we refined our analysis approach, and I will present preliminary findings of how representational similarity analysis can be used to test hypotheses about context-dependence of task representations that cannot be tested using multivariate decoding methods. Overall, we find evidence for largely context-invariant coding. I will discuss how such context-invariant representations might impair multitasking, and might even help explain performance detriments observed in multitasking situations.

Keywords: task-set, fMRI, MVPA, RSA

The development of task switching: Age differences in task set representations between children and adults

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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The ability to flexibly switch between tasks is critical for adapting behavior to changing environmental demands. Over the course of childhood, two types of improvement are commonly observed. First, children become increasingly better at switching to another task relative to repeating the same task within mixed blocks. Second, they show less pronounced performance decrements in blocks of trials comprising different tasks relative to blocks of trials of a single task. In parallel, fronto-parietal regions involved in task switching continue to develop across childhood and adolescence. Here, we used fMRI to examine the extent to which age differences in task switching are related to differences in the differentiation of neural task set representations between children (N=88, 8-11 years) and adults (N=53, 20-30 years). As expected, children showed lower performance than adults, especially when switching to another task. The inferior frontal junction (IFJ) and superior parietal lobe (SPL) showed enhanced sustained activation during mixed relative to single blocks in adults, but no such modulation was observed in children. Transient activation increases associated with switching were similar across age groups in IFJ as well as in the anterior insula, thalamus, and putamen. Building on these univariate results, ongoing analyses aim to test whether multivariate patterns of activity in IFJ and SPL associated with different task sets are less differentiated in children than in adults, and contribute to age differences in performance.

Keywords: task switching, childhood, brain development, task set representations

Understanding the neural mechanisms that give rise to multitasking costs: the role of shared task representations

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Amongst earliest findings of cognitive psychology was the observation that when individuals attempt to perform multiple, simple sensory-motor tasks concurrently these typically interfere with one another; leading to at least one of them being performed more slowly, and with less accuracy (Telford, 1931; Welford, 1959). Interestingly, among these early observations, it was also shown that such multitasking performance costs could be attenuated with practice / training (Telford, 1931), suggesting there is malleability in how the constituent tasks are undertaken after they are learned. Understanding how practice pushes the boundaries of multitasking limitations remains a great mystery for both psychology and neuroscience, and carries consequence for both theory and application. Here, I combine modeling and neuroimaging work to argue that multitasking costs are inevitable in a non-random environment, and occur due to representational limitations in frontoparietal and subcortical (FP-SC) brain regions. I present a theoretical framework for future investigations into the neural underpinnings of task representations and their implications for multitasking limitations.

Keywords: multitasking, tasks, MVPA, modelling, practice

Modality-specific overlap of single-task representations and their relation to dual-task performance

Date & time: Thursday, 3 June 2021 - 08:30 - 10:00

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Dual-task costs depend on the pairing of stimulus and response modalities in the respective component tasks. Recent evidence suggests that this is related to interference between stimulus processing and the sensory consequences of the responses, called action effects (Schacherer & Hazeltine, 2020). In modality compatible tasks (e.g. visual-manual, auditory-vocal), sensory action effects are compatible with the stimulus modality *within* component tasks but not in so-called modality incompatible tasks (e.g. visual-vocal, auditory-manual), where stimulus modality and action effects (e.g. auditory modality) overlap *between* tasks.

In this fMRI study, we used multivariate pattern analysis to provide further evidence for the idea that the degree of overlap between single-task representations in sensory brain regions is associated with dual-task performance. We expected lower decoding accuracy for modality incompatible tasks in sensory regions and corresponding associations with dual-task performance.

We tested this hypothesis in a group of 29 healthy adults who completed both, modality compatible and incompatible single and dual one-back working memory tasks. Within every region of interest (visual, auditory, manual, vocal, and DLPFC), we applied a searchlight analysis with a support vector machine algorithm to decode between the single tasks within the modality compatible mapping and the modality incompatible mapping, respectively. We found that higher decoding accuracy between the two modality incompatible single tasks in the auditory region was associated with better dual-task performance for modality compatible and modality incompatible mappings. This suggests that action effects are more pronounced in auditory modality and that dual-task interference can be reduced by distinct neural representations.

Keywords: fMRI, MVPA, multitasking, modality compatibility

The ageing brain: Identification of 25 associated genomic loci and evidence for a shared genetic basis with mental and physical health

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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From a biological perspective, humans age at different speeds. A growing body of research suggests that the biological age of the brain is linked to major cognitive and affective disorders. Here we investigated the molecular genetics of brain age gap, i.e., the difference between an individual's brain-predicted and chronological age, and examined its genetic overlap with over 1,200 mental and physical health phenotypes. We used structural MRI data and supervised machine learning to estimate brain age in a discovery sample of 32,634 UK Biobank individuals. We show that brain age gap is under substantial genetic control, with a SNP-based heritability of about 30%. We identify 25 independent genome-wide significant variations, of which 21 showed consistent effect directions and 18 replicated at $p < 0.05$ in a multi-ancestry follow-up meta-analysis of 6,703 individuals. The strongest contributing locus covers the gene MAPT (discovery p = 2E-52), which encodes the tau protein associated with Alzheimer's disease. Further, we demonstrate that brain age gap genetically correlates with various neurological, psychological and psychiatric phenotypes, and we use Mendelian Randomization to derive evidence for a putative causal role of cardiovascular and metabolic syndrome conditions on accelerated brain ageing. Due to a relatively low degree of polygenicity, we predict that the number of genomic regions discovered for brain age gap will rapidly rise with increasing sample size when compared to other complex traits. In this light, brain ageing has great potential to evolve into a genetically well-understood phenomenon with broad implications for physical and mental health.

Keywords: ageing, mental health, genetics, GWAS, MRI, machine learning

Longitudinal assessment in therapeutic sleep deprivation to unravel the genetics of depression

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Therapeutic sleep deprivation (TSD) rapidly induces robust, transient antidepressant effects in a large proportion of major mood disorder patients suffering from a depressive episode, but underlying biological factors remain poorly understood. We conducted a naturalistic study which aimed to examine clinical and genetic factors predicting response to TSD.

The present study examined 15 healthy controls and 78 patients experiencing an episode of major depression undergoing TSD, consisting of a period of ~36 hours without sleep (6:00 to 18:00 the following day). Before and after TSD and after recovery sleep, biomaterials were collected and depressive symptoms/therapy response were assessed. We assessed polygenic risk scores (PRS) for major depressive disorder (MDD) and their association with therapy response and investigated transcriptome-wide gene expression changes caused by TSD in MDD.

The comparison across disease states showed significantly higher PRS in non-responders than in healthy controls. Descriptively, non-responders showed higher PRS than responders. Transcriptome-wide gene expression showed differential gene expression after TSD between responders and non-responders. Gene Set Enrichment Analysis showed differential expression in gene sets involved in immunological function, inflammatory response, and sleep regulation. The examination of longitudinal gene set trajectories showed that those gene sets were upregulated in responders after TSD. In non-responders, strong downregulation in the majority of gene sets was observed after TSD, with upregulation in immunological gene sets after recovery sleep.

We will discuss the results, and present the comprehensive framework for the ongoing phase 2 of the investigation, with an extended ambulatory and biomaterial assessment.

Keywords: sleep deprivation therapy, depression, longitudinal, genetics

Risk or resilience? Gene-environment interactions in anxiety

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Genetic and environmental factors are assumed to interactively influence the pathogenesis of anxiety disorders and related phenotypes. However, protective influences such as functional coping ability may exert a buffering effect on the interplay of genetic disposition and environmental adversity in the conferral of risk or resilience to anxiety-related traits and, ultimately, the manifestation of disease.

In the present talk, coping ability will be explored as an additional dimension in an extended gene-environment-coping (G x E x C) model. Exemplarily, functional variants in select candidate genes associated with anxiety, i.e. in the serotonin transporter gene (5-HTTLPR/rs25531) and the neuropeptide receptor S gene (NPSR1 rs324981) will be highlighted regarding their interplay with environmental adversity by example of childhood trauma as well as coping characteristics that, depending on their individual constellation, can either increase or decrease disorder risk.

Taken together, these results provide novel insights for clinical practice, particularly with regard to the development, improvement, and application of preventive therapeutic interventions.

Keywords: gene x environment, anxiety disorders, biomarkers, coping

Genetic and epigenetic serotonergic markers predict theory of mind abilities

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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The serotonergic (5-HT) system is related to affective and cognitive processes and explains behavioral variability in the normal and psychopathological range. For this reason, the hypothesis was put forward that genetic and epigenetic markers related to 5-HT metabolism predict individual differences in social cognitive functioning. Social cognitions are complex mental processes necessary for perceiving, interpreting and reacting to the behaviors of others. In order to test this hypothesis one of the most prominent theory of mind tasks, the reading the mind in the eye test (RMET), was administered to N = 435 participants and measures of performance were related to the functional MAO-A VNTR polymorphism (relevant for 5-HT catabolism) and to epigenetic markers in the promoter of the TPH-2 gene (relevant for 5-HT synthesis). It was postulated that genetic and epigenetic markers of high 5-HT activity are positively related to RMET performance. Results show that the MAO-A high activity allele, together with the degree of methylation at a promoter CpG site on the TPH-2 gene explain significant proportions of variance in the RMET performance even after controlling for age and sex effects. Present findings yield evidence for the importance of 5-HT for social cognition. Based on additional findings, the role of a TRP-rich diet for theory of mind functions is discussed.

Keywords: Theory of Mind, genetics, epigenetics, 5-HT

Pornography consumption during Corona

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At the beginning of the Corona pandemic, Pornhub recorded an increase of pornography consumption between 4 % and 24 % in 27 countries. Patterns of online pornography use (OPU) seemed to be changing in terms of time and frequency. Possible explanations for this increase may be to cope with social isolation, to reduce boredom, and to regulate stress and negative emotions. Aims of this study were to examine longitudinal changes in time, frequency, and problematic consumption behaviors of OPU and how this relates to perceived stress levels.

Eighty subjects (55 women, 22 men, 3 diverse gender), primary students, answered questions about their OPU, problematic consumption behaviors (Problematic Pornography Consumption Scale, PPCS), and perceived stress (Perceived Stress Scale, PSS) at a two-month interval (T1/T2).

Men showed a significant increase of frequency but not in time of pornography consumption and on the PPCS subscale withdrawal. Women showed a significant decrease on the PPCS subscales salience and relapse. Stress level were unchanged and not related to OPU by men. By women Stress and frequency were correlated at T2. Stress at T1 were correlated with overall PPCS at T1 and T2 by women and PPCS subscales salience and mood modification at T2 by men.

Results indicate only a small change in patterns of OPU. Men seem to experience an increase in unpleasant feelings and emotional states when they cannot consume pornography. In contrast, PPC behaviors decreased in women. Stress seems to be related with changes of PPC by men and women.

Keywords: online pornography use, Corona pandemic, stress

The advantages of collaborative porn in heterosexual relationships

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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As the accessibility of pornography has increased through technological advances, the concern over the impact of sexually explicit media on intimate relationships has also increased. Past research has focused mainly on the negative impacts couples experience based on individual perceptions of their partner's pornography use. Our study focuses on the effects of pornography viewing on individual relationship satisfaction, sexual satisfaction, trust, closeness, and communication after watching pornography together over 8 weeks of time. Findings of both the quantitative and qualitative data revealed collaborative pornography viewing had a positive effect in many areas of the participants' lives. Specifically, in the quantitative portion, we tested the perception of individual relationship satisfaction, sexual satisfaction, trust, closeness, and communication after watching pornography together for in 28-minute segments once a week for eight weeks. We found that couples who watched collaborative pornography reported increased trust, relationship satisfaction, sexual satisfaction, and improved communication. Qualitative results revealed that participation in the study enabled practice in negotiation, relationship, normalized pornography viewing in their relationship, created a boundary around the couple, and increased conversations. Implications and future directions are discussed.

Keywords: collaborative pornography, couples

The impact of negative mood on event-related potentials when viewing pornographic pictures

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Negative affective states may increase the risk for problematic pornography use. Underlying neurophysiological mechanisms are, however, not completely understood. The aim of this study was to investigate neural correlates of negative affect-induced alterations in sexual cue reactivity in healthy men. The moderating effects of trait sexual motivation and symptoms of cybersex addiction were also examined.

Sixty-four men engaged in a sexual cue reactivity task (passive viewing of explicit sexual pictures and neutral pictures depicting scenes of social interaction) in negative or neutral mood, induced via tailored feedback on a performance task. Self-reported sexual arousal and event-related brain potentials indicated cue reactivity and motivated attention. The short Internet Addiction Test adapted to online sexual activities and the Trait Sexual Motivation Questionnaire were filled in.

Negative performance feedback increased negative affect. While sexual pictures compared to neutral pictures elicited significantly larger P300 and late positive potential (LPP) amplitudes, there was no general effect of negative feedback on P300/LPP amplitudes. In the negative feedback group, men with higher solitary sexual motivation levels showed higher P300/LPP difference amplitudes for sexual stimuli. The opposite effect was found in the neutral feedback group. There was no association with other sexual attitudes.

Results suggest that higher levels of solitary sexual motivation may enhance motivated attention towards sexual stimuli among men receiving negative performance feedback. Future studies extending onto men suffering from compulsive sexual behavior disorder will have to closer look at the neurophysiological basis of why and when some men develop an addictive pornography consumption.

Keywords: Event-related potentials, Motivated attention, Negative affect, Sexual cue reactivity, Pornography addiction

Neural circuits underlying female sexual appetence: An integrative account.

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Sexual arousal is a fundamental and evolutionary important affective state. Next to sexual arousal, endogenous as well as exogenous sex hormones seem to also influence also other facets of female sexual behaviour such as sexual urge and mating preferences. The aim of this study was, to examine whether hormonal status also impacts female sexual appetence, operationalized as sexual arousal and approach-avoidance behaviour.

A total of 111 heterosexual women with varying hormone profiles (i.e. naturally cycling women in (1) the early follicular phase, n = 37, (2) the periovulatory phase, n = 28, and (3) women taking oral contraceptives (OC) during the active intake phase, n = 46) participated in a fMRI-based erotic approach avoidance task (AAT). The AAT contained images displaying couples in three different conditions: erotic, non-erotic positive and aversive. Next to the BOLD signal, other physiological measures such as heart rate and skin conductance as well as the behavioural responses were recorded.

Preliminary analysis of neural, physiological as well as behavioural correlates of sexual appetence and potential hormonal group differences will be presented. Next to their influence on mate preferences and sexual desire, hormone induced alterations (especially long-term as with OC use) in actual female sexual approach avoidance behaviour could have far reaching individual as well as societal consequences and underlines the importance of further investigation in this area of research.

Keywords: oral contraceptives, menstrual cycle, sexual appetence, approach avoidance behavior, fMRI

Studying human habits in the lab: A novel experimental paradigm reveals inter-individual differences

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Habitual behavior is characterized by responses elicited by stimuli without deliberation or reliance on the predicted value of the outcome. Thus, habits reduce cognitive load in everyday life, but they also dominate behavior in psychopathologies like substance use or obsessive-compulsive disorders. Due to the ubiquity and clinical importance of habits, it is essential to study them in the lab. Current operationalizations require that outcome values and contingencies are no longer considered when defining behavior as habitual but neglect that habit strength should be proportional to the past frequency of performance.

We developed a new experimental task realigning the empirical operationalization with the theoretical, frequency-based foundation of habits. This task assesses habit strength as a function of previous choice frequency while controlling for the impact of reinforcement. In two initial studies with 34 participants in total, we tested the influence of previous choice frequency on preferences in binary decisions. The development of habits was facilitated by five training sessions on consecutive days. Mixed-effects regression showed an effect of past choice frequency on behavior during test on the fifth study day. Computational modeling of participants' behavior allowed a more detailed understanding showing inter-individual differences in choice strategies. Half of the participants combined reinforcement-based and frequency-based values to inform their choice during test. The other half ignored past choice frequency and solely relied on expected outcome values. Thus, our method quantifies individual propensity to show habits and has potential to identify subgroups of the population prone to a pathological overexpression of habits.

Keywords: habit, goal-directed control, value-based decision making, behavioral repetition

Reinstatement of cortical outcome representations during second-order conditioning

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Naturalistic learning scenarios are characterized by sparse and infrequent experience of external feedback to guide behavior. Higher-order learning mechanisms like second-order conditioning (SOC) may allow stimuli that were never experienced together with reinforcement to acquire motivational value. Despite its explanatory potential for real-world learning, surprisingly little is known about the neural mechanism underlying such associative transfer of value in SOC. Here, we propose that during SOC, cortical patterns representing outcomes are reinstated by first-order conditioned stimuli (CS) to establish associative links between second-order CS and outcomes. During functional magnetic resonance imaging (fMRI), we presented healthy human subjects with appetitive and aversive gustatory outcomes (orange juice and quinine solution). On a separate day, participants underwent first-order conditioning (outside fMRI), establishing associations between visual CS and gustatory outcomes, followed by SOC (during fMRI). Multivariate cross-session, cross-modality searchlight classification during SOC showed reinstatement of cortical patterns representing previously paired gustatory outcomes in the lateral orbitofrontal cortex (OFC) during presentation of the (visual) first-order CS. During SOC, this OFC region showed increased functional covariation with amygdala, where neural pattern similarity between second-order CS and outcomes increased from early to late stages of SOC. Our data suggest a mechanism by which motivational value might be conferred to stimuli that were never paired with reinforcement.

Keywords: Second-order conditioning; Decision Making; Orbitofrontal Cortex; Amygdala; fMRI

Stimulus-reward learning and generalization in structured environments

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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It has been suggested that the brain organizes knowledge about the relationships between positions in space and non-spatial regularities in a cognitive map. Such a representation of events and knowledge may facilitate goal-directed behavior by enabling the generalization of information across related states, but the neural and computational mechanisms underlying such map-based generalization are not known. Here, we combine a virtual reality task with computational modeling and functional magnetic resonance imaging (fMRI) to investigate how humans generalize across related states to infer reward values that were never directly experienced. In this task, spatial relationships between stimuli predict reward relationships in a subsequent choice task. We find that participants not only update the stimulus-reward associations they experience directly, but they also use their knowledge about the relationships between stimuli to predict values of stimuli which were not directly sampled. This behavior can be captured by a generalizing Gaussian process model which operates over a cognitive map emerging from individual exploration behavior rather than a cognitive map reflecting true Euclidean distances. Using fMRI adaptation, we further demonstrate that an experience-based, but not a Euclidean cognitive map, is represented in the hippocampal-entorhinal system. Together, this demonstrates that relational knowledge organized inhippocampal maps can be used to extrapolate across related states and thereby facilitate novel inference.

Compositional generalization in multi-armed bandits

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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To what extent do human reward learning and decision-making rely on the ability to represent and generate richly structured relationships between options? We provide evidence that structure learning and the principle of compositionality play crucial roles in human reinforcement learning. In a new multi-armed bandit paradigm, termed the compositionally-structured multi-armed bandit task, we found evidence that participants are able to learn representations of different latent reward structures and combine them to make correct generalizations about options in novel contexts. Moreover, we found substantial evidence that participants transferred knowledge of simpler reward structures, to make informed, compositional generalizations about rewards in complex contexts. We also provide a computational model which is able to generalize and compose knowledge of complex reward structures using a grammar over structures and show how such compositional inductive biases can be learned by meta-reinforcement learning agents.

Keywords: Compositionality, Generalization, Cognitive Maps, Reinforcement Learning

Influenca: gamified smartphone-based assessment of reward learning and momentary states

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Reinforcement learning is a core facet of reward processing and alterations have been associated with various mental disorders. To build better models of individual behavior, repeated measurement of reward learning and value-based decision-making is crucial. However, the focus on lab-based assessments has limited the number of consecutive measurements and the test-retest reliability of many learning parameters is therefore unknown.

Here, we present our open-source, cross-platform application *Influenca* that provides a reward learning task optimized for repeated testing and complemented by ecological momentary assessment (EMA) of metabolic and mood states for extended assessments over weeks (up to 31 runs).

Using an initial validation sample of 127 players (2904 runs), we found that parameters of reinforcement learning, such as the learning rate and reward sensitivity, show low to medium intra-class correlations (ICCs: 0.147-0.665; maximum likelihood estimation per run). Notably, most state items showed comparable ICCs, indicating substantial fluctuations of behavioral indices over time.

To conclude, our innovative app provides an open framework that facilitates repeated assessments of reward learning and value-based decision-making across various states. Parameter estimates from our online assessment showed comparable reliabilities as other lab-based paradigms in the literature, suggesting that one run may not be sufficiently representative of typical behavior. The presented longitudinal format may help better quantify intra- and inter-individual differences in value-based decision-making and enable early identification of risk factors such as reward-related alterations that characterize many mental disorders.

Keywords: Reinforcement Learning, Reliability, EMA, Online Assessment, Decision Making

Resting-state brain activity and pain alterations in aging

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Aging affects pain experience and brain functioning. However, how aging lead to changes in pain perception and brain functional connectivity have not yet been completely understood. In a series of studies, we analyzed imaging data (EEG and fMRI) to investigate resting-state and pain perception changes in old and young adults. Thirty-seven older and 38 younger healthy participants underwent 10 minutes' eyes-closed fMRI scanning. Moreover, part of these participants underwent a resting-state EEG recording followed by a painful stimulation paradigm with different levels of attention to pain. We examined the relationship between resting-state functional connectivity parameters with pressure pain thresholds as well as with pain intensity and unpleasantness ratings elicited by painful stimulation. Older participants showed higher pain thresholds and pain ratings than younger. Older adults displayed increased connectivity between pain-related sensory brain regions and reduced connectivity among descending modulatory areas in comparison to younger participants. Correlational analyses showed that functional connectivity between the primary and secondary somatosensory area was positively associated with pressure pain thresholds in older participants. Moreover, beta 3 activity from anterior cingulate cortex (ACC) was positively correlated with pain intensity and unpleasantness ratings in older adults; and ACC-precentral/postcentral gyrus connectivity was positively correlated with unpleasantness ratings in older and younger adults. Altogether, these studies offer new insights into the evolution of cortical networks in normal aging and its relevance to pain perception. Furthermore, these results could explain the greater vulnerability to chronic pain disorders in older individuals. Supported by the Spanish Ministry of Science and Innovation (PID2019-110096GB-I00AEI/FEDER-UE).

Keywords: aging, pain, resting-state, electroencephalography, functional magnetic resonance

Cognitive distraction from pain: An fMRI study on the role of age and executive functions

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Completing a cognitive task has been shown to be a powerful strategy to reduce concurrent pain. This reduction in pain is assumed to result from a competition between the painful stimulus and the distractive task for attentional and executive resources mediated by the prefrontal cortex (PFC), a region that is particularly affected by age-related grey matter atrophy. In the present study, we investigated the role of age-related changes in gray matter volume and executive functions in modulating the efficacy of distraction from pain.

In a first session, young and older adults completed a battery of neuropsychological tests. In a second session, we acquired functional brain images while participants completed a working memory task with two different levels of cognitive load (low vs. high load) and concurrently received individually adjusted heat stimuli (innocuous vs. painful) to their lower arm.

While we found no age-related differences in the distraction effect size on the behavioural level, young adults showed a larger neural distraction effect in several regions involved in pain processing, including the insula, caudate and midcingulate cortex. Interestingly, older adults with better executive functions, particularly, better inhibitory control abilities, showed a larger neural distraction effect in the insula, thalamus and primary somatosensory cortex, and more activation in frontal clusters during the high load task.

Altogether, these findings suggest that age alters the neural mechanisms underlying cognitive distraction from pain, and that the magnitude of these changes may be dependent on the preservation of executive functions.

Keywords: pain modulation, fMRI, age, executive functions

Analgesic effects of interacting with a VR game and associated psychophysiological responses

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Introduction: Virtual reality (VR) has been shown to be an effective tool for pain distraction by redirecting attention away from painful stimuli. Although VR therapy has been successfully implemented in clinical settings, little is known about the underlying factors that modulate analgesic responses, such as cognitive load, executive functions and VR or gaming experience.

Methods: A final sample of N = 90 healthy participants played the VR game *Subnautica* in a high and a low cognitive load condition. In the low load condition, participants explored the VR along a predefined route. In the high load condition, participants had to additionally memorize eight digits presented along the route. Pain heat thresholds as well as psychophysiological measures (ECG, EDA) were recorded during a non-interactive resting state period prior to playing as well as during the two VR sessions. Furthermore, participants completed questionnaires (e.g., pain attitude) and executive functioning tasks (e.g., go/nogo task).

Results: Pain thresholds did not differ for high versus low demand. However, participants achieved higher threshold for the interactive playing sessions compared to the resting state period. Psychophysiological markers (e.g., HRV) indicate lower sympathetic activity during the resting state compared to the playing session (resting state < low load < high load). Moreover, pain catastrophizing and fear of pain were significant predictors of pain thresholds.

Discussion: Results shed light on the role of inter-individual differences and psychophysiological markers of VR-based pain sensitivity and indicate factors that facilitate/impair distraction effects. This may have important implication for the use of VR-therapy.

Keywords: virtual reality, gaming, pain, psychophysiological measures, heart rate variability

Pain processing in older age – evidence from event-related potentials

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Aging is known to affect neurobiological and physiological aspects of pain perception and has been associated with reduced pain sensitivity and a deterioration of descending pain inhibitory mechanisms. To investigate age differences in neural electrophysiological correlates of pain processing, we induced acute pain in healthy older (60 yrs+) and younger adults (18 to 35 yrs), using short transdermal electrical pulses administered to the inner forearm, with individually adjusted stimulation intensities. Participants received alternating blocks of painful and non-painful control stimulation and rated the intensity and unpleasantness of each stimulus on two visual analog scales. Pain-related evoked potentials were recorded with a 64-channel EEG.

Preliminary results indicate that younger and older participants rated painful stimuli more intensive and unpleasant compared to the control stimulation, with older adults showing a slight habituation over time. In younger adults, ERP amplitudes (N2, P2 P3) of painful stimulation were enhanced compared to non- painful stimulation. In contrast, older participants showed generally reduced ERPs, no difference between pain and non-painful stimulation and by tendency longer latencies for painful stimulation.

This suggests that nociceptive neural processing is altered in aging, while the reported pain perception is unaffected. Given that aging is also associated with a decline of cognitive functions and PFC volume and activity changes, this could have implications for the efficacy of cognitive pain modulation. Altogether, our results highlight the need for a deeper understanding of the mechanisms underlying pain processing in older adults, and how these age-related changes affect (cognitive) pain treatments in this population.

Keywords: aging, acute pain processing, electric pain stimulation, EEG, nociceptive ERPs

Reduced sensitivity to pain expectations in mindfulness? Evidence from a pain-cueing paradigm

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Recent insights from neuroimaging studies suggest that mindfulness-based interventions may alleviate pain via a unique neural mechanism, involving increased sensory processing and reduced memory-driven evaluative processing. These findings raise the intriguing possibility that mindfulness may mitigate the well-documented biasing influence of prior cognitive and emotional expectations on pain perception. We tested this hypothesis across two separate studies, using a classical pain cueing paradigm which has been shown to reliably elicit conditioned hypoalgesic and hyperalgesic effects.

In the first study, healthy non-meditators were assigned to listen to either brief mindfulness or suppression instructions, in between the conditioning and testing phases of an implicit pain-cueing task. In the second study, we compared high vs. low trait mindfulness scorers during an explicit pain conditioning task. Throughout both studies, participants were asked to rate the level of anticipatory anxiety, pain intensity and pain unpleasantness that they experienced during each trial.

Findings from the first study revealed that instructed use of a mindfulness strategy resulted in reduced conditioned hypoalgesia relative to the suppression instructions. For the second study, we found evidence of reduced conditioned hyperalgesia in the high trait mindfulness group. Altogether, these findings are consistent with the notion that mindfulness-induced pain relief relies on distinct, and possibly counteracting, neuropsychological mechanisms to those involved in expectancy-driven pain modulation. I will discuss our results in light of existing neuroimaging evidence and recently formulated predictive processing models of mindfulness which posit that mindful attention leads to a prioritization of incoming sensory information over prior beliefs.

Keywords: mindfulness, pain, conditioning, suppression

The use of non-invasive brain stimulation for investigating post-stroke motor rehabilitation

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Ischaemic stroke leads to a destabilization of the functionally highly-specialized and densely interconnected architecture of the brain. The resulting structural and functional alterations are not limited to brain regions within or adjacent to the ischemic area, but may extend over a broad range of remote areas. To date, the underlying processes determining the neuronal reorganization after stroke and the factors that lead to better or worse recovery outcomes are still poorly understood. The impact of a specific brain region seems to be affected by a broad number of factors, such as the temporal progress of the rehabilitation process, the lesion size or the intensity of the initial impairment, which complicates the development of effective therapeutic procedures and demands for individualized diagnostic and therapeutic approaches.

In recent years, transcranial magnetic stimulation (TMS) has been considered as a promising tool for the identification and potential therapeutic modulation of pathological network configurations in post-stroke motor rehabilitation. The presentation will focus on the usefulness of repetitive and double-pulse TMS protocols to provide information about the functional role of ipsilesional and contralesional brain areas as well as interhemispheric interactions in stroke.

Keywords: Stroke, TMS, Neuromodulation, Motor Recovery

Retrospective declarative interference and sleep as context factors for motor imagery EEG neurofeedback induced event-related desynchronization

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Retrospective declarative interference and sleep have already been identified as key factors for motor execution (ME) and motor imagery (MI) induced motor learning. MI practice combined with neurofeedback (NF) is a promising complement for the acquisition as well as the recovery of impaired motor abilities following brain injuries. However, the ability to control MI NF is subject to a wide range of inter-individual variability. A substantial number of users experience difficulties in achieving reliable results, which limits their chances to profit from MI NF in a learning or rehabilitation context. Here, we investigate whether retrospective declarative interference in a MI NF practice schedule leads to adverse effects on the MI NF event-related desynchronization (ERD) and whether subsequent sleep compensates for these presumed adverse effects.

Three groups underwent three blocks of MI NF practice each on two subsequent days. In two of the groups MI NF blocks were followed either immediately or with several hours delay by declarative memory tasks. The control group performed only MI NF and no specific interference tasks. Two of the MI NF blocks were run on the first day of the experiment, the third in the morning of the second day. Significant within-block NF gains in mu and beta frequency ERD where evident for all groups. However, we observed no significant effects of sleep or declarative interference on MI NF ERD. Potential reasons for this outcome will be discussed.

Keywords: neurofeedback, EEG, motor imagery, declarative interference, sleep

Plasticity in the healthy and lesioned language network

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Gesa Hartwigsen*

Lise Meitner Research Group Cognition and Plasticity, Max Planck Institute for Human Cognitive and Brain Sciences

Language is organized in distributed neural networks in the human brain. In this talk, I will discuss how neurostimulation can provide insight into the potential for rapid short-term reorganization and adaptive plasticity in the healthy and lesioned language network. Evidence from combined neurostimulation and neuroimaging or electroencephalography studies shows that focal perturbation of key language areas with inhibitory neurostimulation may be compensated for by a stronger contribution of homologous right-hemispheric regions, neighbouring regions for other specialized language functions or domain-general areas for cognitive control. These mechanisms of adaptive systems plasticity are summarized in a model on the flexible redistribution in the language network. I will also show how the simultaneous combination of neurostimulation and neuroimaging elucidates the neural and electrophysiological correlates of facilitatory neurostimulation. Such approaches may be particularly relevant for rehabilitation purposes. Finally, I will outline how network stimulation may be used in future studies to improve language functions after brain lesions. Here, stimulation of domain-general networks may have a strong potential to facilitate recovery of function. Recent neuroimaging data from our group show that candidate areas may include densely connected nodes in domain-general networks, especially in the default mode network or multiple-demand network. Multivariate analyses provide evidence for process-specific overlap and dissociation in the larger inferior parietal lobe region of the default mode network for key cognitive domains in the human brain, including semantic processing, attention and social cognition. These data provide hints that network stimulation may have the potential to modulate cognitive functions across domains.

Keywords: neurostimulation, functional neuroimaging, aphasia, language, cognition

Explaining inter-individual variability of transcranial electrical stimulation with combined electric field modelling and neuroimaging

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Florian Kasten*

University of Oldenburg, Deutschland

Non-invasive techniques to electrically stimulate the brain such as transcranial direct and alternating current stimulation (tDCS/tACS) are increasingly used in neuroscience as flexible tools to investigate the functional roles of brain regions or activation patterns (e.g., neuronal oscillations) in cognition. They may also offer new pathways to treat various neurological and psychiatric disease or aid neurorehabilitation. However, in recent years these methods received considerable criticism for their often weak and variable effects, with some authors going as far as to claim that the currents induced during stimulation are too weak to elicit neuro-modulatory effects. In the study presented here, we investigated to what extent individual differences in brain anatomy and endogenous brain activity account for variability of stimulation effects in a combined tACS-MEG experiment. Although all participants received stimulation using the same montage and intensity, we observed differences in the intensity and spread of the individual electric fields inside the brain. We found that measures of individual stimulation intensity and precision derived from these electric field simulations and recordings of oscillatory brain activity in the MEG were strong predictors of the tACS aftereffect. Our results directly link the effect of tACS to the electric field in the brain. I will discuss the potential of individualized stimulation protocols to increase the reliability of non-invasive brain stimulation and highlight the benefits of combining neuroimaging and simulations for the analysis of brain stimulation effects.

Keywords: transcranial alternating current stimulation (tACS), magnetoencephalography (MEG), brain stimulation, individual variability

Naturalistic stimuli in neuroscience: a gentle introduction

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Naturalistic stimuli are defined as „a class of stimuli that aim to evoke more naturalistic patterns of neural responses than traditional controlled artificial stimuli" (Vanderwal et al., 2019). For example, the reproducible timecourses of audio-visual movies or auditory narratives offer a continuous and rich stimulation, and thus better mimic our everyday environment that we, and our brains, are accustomed to. On the one hand, the talk will address advantages of naturalistic stimuli like improved validity, better compliance and higher data quality. On the other hand, challenges like the unknown confound structure of naturalistic stimuli will be discussed. The talk will illustrate solutions to these challenges and introduce methodological advances as employed and developed further by the following speakers of the symposium. For that reason, the talk will give an overview of seminal studies in the field that stimulated current research: most importantly, studies have shown that naturalistic stimuli evoke time-locked and synchronized spatiotemporal responses across multiple subjects in large parts of the brain. Lastly, the talk will cover potential future, clinical applications, and introduce publicly available datasets that can be downloaded and used by anybody to investigate independent research questions.

Keywords: fMRI, neuroscience, movies, narratives, perception, cognition, intersubject correlation, data sharing

Studying brain functional organization with naturalistic viewing: reliability and cognitive relevance

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Resting-state functional connectivity (rsFC) using fMRI is a leading method to study human brain function. However, its unconstrained nature often introduces unwanted behavioural confounds such as excessive motion and sleep, challenging data reliability. Naturalistic viewing paradigm has been proposed to improve compliance and reduce variability, but to what extent it could improve FC reliability remains unknown. To this end, we compared the test-retest (TRT) reliability of FC derived from RS and three different videos re-watched over three sessions. We found that videos with high level of engagement improved TRT reliability in terms of increased subject-wise reproducibility. Videos with low engagement did not necessarily have better reliability than RS. These results supported the use of naturalistic stimuli with stronger cognitive engagement when examining FC.

Naturalistic stimuli also differ in narrative structure, which may recruit different cognitive processes and brain functional organization. To better understand this relationship, inter-subject FCs (ISFCs) of each video were derived from each session separately. Analysis of the longitudinal changes in ISFC showed that video with minimal plot (Inscape) yielded widespread decrease in ISFC, while those with stronger plot yielded more widespread increase. These divergent changes in inter-subject synchrony may stem from the recruitment of memory and comprehension-related processing in narrated videos during re-watching, gradually aligning event representation and anticipation across individuals; videos without a plot instead invite more idiosyncratic interpretations or mind wandering. Together, proper use of naturalistic paradigm may improve the quality of FC metrics and enrich their functional interpretations.

Intra- and inter-individual differences in network connectivity during naturalistic stimuli

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

Jean-Philippe Kröll* (1,2), Kaustubh R. Patil (1,2), Xing Qian (3), Juan Helen Zhou (3), Simon B. Eickhoff (1,2), Susanne Weis (1,2)

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Recent work on naturalistic viewing (NV) paradigms has investigated if the complex and dynamic processing of movie clips can evoke individually unique patterns, that are robust across sessions. By reducing the intrasubject variability, movies could potentially increase the reliability of fMRI measurements and facilitate their use as a biomarker for various neuropsychological diseases. A previous study by Vanderwal et al. 1 showed that movie watching increased intra- as well as inter-subject functional connectivity (FC) correlations in comparison to resting state. While this study, as well as the majority of related studies, has focused on a whole-brain atlas, little attention has yet been paid to the influence of NV on the FC variability in single networks. During this talk, FC patterns of various selected functional networks under movie stimulation and resting-state will be explored. The focus will be on the ratio of intra- to inter-individual variability. The ultimate goal is to select a paradigm that decreases intra-subject variability and therefore increases the reliability of the measurement, but still remains significant inter-subject variability, and is, therefore, able to capture individual differences. Since brain networks differ in their functions and are consequently expected to differ in their level of engagement in the processing of movie clips, it is of special interest to see how NV influences the intra- and inter-subject variability on a single network level.

1. Vanderwal T, Eilbott J, Finn ES, Craddock RC, Turnbull A, Castellanos FX. Individual differences in functional connectivity during naturalistic viewing conditions. NeuroImage. 2017;157:521-530. doi:10.1016/j.neuroimage.2017.06.027

Keywords: Naturalistic Viewing, brain networks, functional connectivity, variability, movie

Commonality and idiosyncrasy in responding to naturalistic stimulus during movie watching

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Research Centre Juelich, Germany

When exposed to a naturalistic stimulus, different individuals have both commonality and idiosyncrasy in responding to the same complex stimulus. Previous studies have shown that the similarity of brain activity across individuals during movie-watching, which is typically characterized by inter-subject synchrony, varies across different brain areas. However, to what extent the brain activity is driven by the naturalistic stimulus and to what extent individuals respond differently to the stimulus have not been systematically examined yet. This study aims to establish a robust topography for the stimulus-driven response and the idiosyncrasy in response to the naturalistic stimulus during movie-watching. A principal component analysis (PCA) was employed to disentangle the stimulus-evoked response from the observed BOLD signals of multiple individuals and quantify its contribution to each brain region. In the meantime, the individual differences in response to the stimulus was captured in terms of subject loadings. Movie fMRI data of 178 subjects from the Human Connectome Project acquired at 7T with three different movie clips were analyzed. We show that the movie stimulus has the most influence on the sensory areas and the Wernicke's area, and areas in the frontal cortex exhibit highest inter-subject variability in response to the movie stimulus. Furthermore, we show that the individual differences in response to the stimulus have great potential in predicting cognitive phenotypes. This study provides novel insights into how naturalistic stimulus influences the brain activity and how individual responses to the stimulus could be used to investigate human behaviour for future studies.

Keywords: Naturalistic viewing, fMRI, Individual differences, PCA, movie watching

Mapping activity in language areas during listening to a naturalistic audio stimulus

Date & time: Thursday, 3 June 2021 - 10:15 - 11:45

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Auditory narratives are engaging stimuli which allow to acquire rich data of brain function. However, in the case of language, passive listening is less able to depict the common left-lateralization of language functions. The present work uses naturalistic fMRI to map language areas in individual participants and to characterize which stimulus features can predict activity in the language network.

An audio version of the movie Forrest Gump was presented to 19 participants while collecting fMRI data (studyforrest.org). A training set of the data was used to identify a language network and fit different features (e.g. syntactical properties of sentences) to the network's time course. The weights of these features were then applied to transcripts of held-out segments of the stimulus, to predict each participant's pattern of language-related brain activity.

Group-ICA of the training data revealed a network of left inferior frontal and posterior temporal areas, shared by most participants. This network followed a common time course, allowing to model its rise and fall through a weighted combination of different syntactic features. Applying this model to each participant's fMRI data from previously held-out runs, produced individual maps which were most similar to each participant's respective training data.

The analyses illustrate how language functions can be mapped by using a naturalistic stimulus and its annotation. While mapping networks on the level of individual participants is potentially useful for clinical applications, important next steps will be to test the approach in participants with atypical language representations, as well as in patients.

Keywords: fMRI, language, lateralization, prediction, naturalistic stimuli

Der Zusammenhang zwischen Polygenen Scores und Intelligenz wird durch die Netzwerkeffizienz und das Volumen parieto-frontaler Hirnregionen mediiert

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Interindividuelle Unterschiede in kognitiven Fähigkeiten gehen zu großen Teilen auf einen genetischen Ursprung zurück. Auch Intelligenz ist ein hochgradig polygenes Konstrukt, dessen Ausprägung durch die kumulativen Effekte zahlreicher Allele beeinflusst wird. Polygene Scores (PGS), die sich durch großangelegte genomweite Assoziationsstudien bestimmen lassen, bieten eine innovative Möglichkeit, um die komplexe Verbindung zwischen genetischer Varianz und einer bestimmten Eigenschaft zu quantifizieren. Es ist jedoch unklar, welche Variablen an der Kaskade zwischen genetischer Varianz und kognitiven Leistungsunterschieden beteiligt sind.

In der vorliegenden Studie untersuchten wir daher, ob die Assoziation zwischen PGS und allgemeiner Intelligenz durch das Volumen bzw. die Vernetzung des Gehirns mediiert wird. Unsere Stichprobe umfasste 325 gesunde Individuen, deren allgemeine Intelligenz erhoben wurde. PGS für Intelligenz wurden aus aktuellen genomweiten Assoziationsstudien entnommen. Zudem wurden das Gehirnvolumen, die strukturelle und die funktionelle Netzwerkkonnektivität jedes Teilnehmers bestimmt. Mediationsanalysen auf der Ebene des gesamten Gehirns zeigten, dass der Zusammenhang zwischen PGS und Intelligenz lediglich durch die Effizienz der strukturellen Netzwerkkonnektivität mediiert wird. Allerdings zeigten nachfolgende Mediationsanalysen für einzelne Hirnregionen, dass sowohl das Volumen als auch die strukturelle und funktionelle Netzwerkkonnektivität einzelner Hirnregionen aus fronto-parietalen Bereichen den Zusammenhang zwischen PGS und allgemeiner Intelligenz mediieren.

Diese Ergebnisse deuten darauf hin, dass die Netzwerkeffizienz und das Volumen spezifischer parieto-frontaler Hirnregionen einen Schlüsselmechanismus für polygenetische Effekte auf Intelligenz darstellen, ein Befund mit wichtigen Implikationen für das Verständnis der biologischen Grundlagen menschlicher Intelligenz.

Genomweite Assoziationsstudie zur Borderline-Persönlichkeitsstörung - Identifizierung genetischer Risikofaktoren und geteiltes genetisches Risiko mit anderen Störungen und Traits

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Die Borderline-Persönlichkeitsstörung (BPS) umfasst ein heterogenes Spektrum von Symptomen, darunter Beeinträchtigungen der Affektregulation und der zwischenmenschlichen Beziehungen. BPS zeigt häufig eine Komorbidität mit anderen psychischen Störungen, wie Depression, bipolarer Störung oder Substanzmissbrauch. Zwillings- und Familienstudien deuten darauf hin, dass genetische Faktoren zur BPS beitragen, und dass diese teilweise mit den Faktoren überlappen, die Persönlichkeitsmerkmale und andere psychiatrische Störungen beeinflussen. Wir berichten über die Ergebnisse der ersten genomweiten Assoziationsstudie (GWAS) der BPS in einer deutschen Kohorte und über die ersten Ergebnisse einer internationalen Untersuchung in einer wesentlich größeren Stichprobe. GWAS und gen- und pathwaybasierte Analysen wurden durchgeführt, um genetische Risikofaktoren zu identifizieren. Der genetische Overlap mit anderen Störungen und Eigenschaften wurde anhand von polygenen Scores (PGS) und genetischen Korrelationen untersucht. Wir konnten erste genetische Risikofaktoren für BPS identifizieren, welche teils etablierte Risikofaktoren für andere psychiatrische Störungen darstellen. Die Ergebnisse der genetischen Korrelationen und PGS-Analysen legen eine geteilte genetische Architektur mit anderen psychiatrischen Störungen wie Depression, bipolarer Störung und Schizophrenie nahe, und zeigen eine positive Assoziation von BPS mit Persönlichkeitsmerkmalen wie Neurotizismus, Offenheit für Erfahrungen und Borderline-Persönlichkeitsmerkmalen in der Allgemeinbevölkerung.

Keywords: GWAS, Genetik, Borderline-Persönlichkeitsstörung, Persönlichkeit, Komorbidität

Anwendungen von epigenetic clocks bei der Erforschung frühkindlicher Entwicklung

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Eine detaillierte Kenntnis menschlicher Alterungs- und Entwicklungsprozesse ist von zentraler Bedeutung, um die Prävention und Behandlung einer Vielzahl von Krankheiten zu optimieren. Das chronologische Alter ist dabei nicht der einzige Indikator für fortschreitende Alterung, denn Personen mit dem gleichen chronologischen Alter können sich in biologischen Reifungsprozessen stark unterscheiden. Aus diesem Grund haben Biomarker für Alterung in den vergangenen Jahren an Bedeutung gewonnen. Sie haben das Potential, Variationen im biologischen Status zwischen Individuen gleichen Alters aufzudecken.

Ein Ansatz für einen solchen Biomarker sind die sogenannten epigenetic clocks, bei denen DNS Methylierungsmuster genutzt werden, um das chronologische Alter vorherzusagen. Abweichungen zwischen dem epigenetischen und dem chronologischen Alter könnten dabei einen Indikator für den gesundheitlichen Zustand oder Entwicklungsgrad darstellen. Im Erwachsenenalter wurde insbesondere eine Altersbeschleunigung, d.h. ein höheres epigenetisches als chronologisches Alter, mit altersbedingten Erkrankungen in Verbindung gebracht. Studien in frühen Entwicklungsphasen sind bisher seltener, obwohl die Sensitivität für Umgebungseinflüsse und langfristige Programmierungseffekte im pränatalen und frühkindlichen Alter besonders hoch ist.

In diesem Projekt wurde das epigenetische Alter in pränatal entnommenen Chorionzottenbiopsien, sowie in Plazentagewebe und Nabelschnurblut bestimmt. Ziel war es zu untersuchen, welche Charakteristika von Mutter und Kind eine relativ höhere oder niedrigere Abweichung zwischen epigenetischem und chronologischem Alter in den verschiedenen Geweben erklären können, als auch die Übereinstimmung im relativen epigenetischen Alter zwischen verschiedenen Gewebeproben des gleichen Individuums zu untersuchen.

Keywords: epigenetic clocks, early development, epigenetic age, perinatal tissues

Effekte pränataler Schadstoffexposition auf genomweite DNA Ko-Methylierungsmuster

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Pränatale Exposition gegenüber Umweltschadstoffen ist mit späteren sozialkognitiven und gesundheitlichen Beeinträchtigungen assoziiert. Expositionsassoziierte Veränderungen der DNA-Methylierung (DNAm) werden als möglicher Mediator für diesen Zusammenhang angenommen. Die vorliegende Studie untersuchte ob die pränatale Schadstoffbelastung mit epigenomweiten Veränderungen der DNAm assoziiert ist. Von 142 Mutter-Kind-Paaren aus der Duisburger Geburtskohorte wurden die Konzentrationen von PCBs und PCDD/Fs im mütterlichen Blut im dritten Schwangerschaftstrimester gemessen und mit den, mittels des Illumina EPIC beadchip quantifizierten, DNAm-Leveln im Nabelschnurblut assoziiert. Es konnten 32 differenziell methylierte Positionen (DMPs) und acht differenziell methylierte Regionen (DMRs) identifiziert werden, die mit sechs Kongeneren von PCB (# 126, 169) und PCDD (# 66, 67, 70, 75) in weiblichen oder männlichen Neugeborenen signifikant assoziiert waren (FDR korrigierte p´s < 0.05). Die DMPs und DMRs wurden Genen zugeordnet, die an neuronalen Entwicklungsprozessen (*DISC1, LFNG, TPD52L1, PAQR4*), der Genregulation (*SMC1A, H2BC5*) und der Immunfunktion (*ALOX5, HSPA1B*) beteiligt sind. Mittels gewichteter Netzwerkanalysen (WGCNA) zur systemorientierten Betrachtung waren darüber hinaus 31 komethylierte Module signifikant mit PCDF # 130 in weiblichen Neugeborenen assoziiert (FDRs < 0.05). Die CpGs dieser einzelnen Module waren signifikant überrepräsentiert für Genpfade, die an neuronalen Entwicklungsprozessen und Immunfunktionen involviert sind (FDRs < 0.05). Die Ergebnisse weisen darauf hin, dass die pränatale Exposition gegenüber PCBs und PCDD/Fs mit veränderten DNAm-Leveln im Nabelschnurblut assoziiert ist. Folgestudien dieser Kohorte können zur Beantwortung der Frage beitragen, ob epigenetische Veränderungen eine mediierende Rolle im Zusammenhang zwischen Schadstoffbelastung und langfristigen Entwicklungsfolgen aufweisen.

Keywords: Umweltschadstoffe (PCB, PCDD/F), epigenomweite DNA-Methylierung, Assoziationsstudie, Netzwerkanalyse, Nabelschnurblut

Effekte von Psychotherapie auf genomweite Genexpression und Koexpression in PTSD Patientinnen.

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Posttraumatische Belastungsstörungen (PTBS) sind prävalent und mit hohen Kosten für den Einzelnen und die Gesellschaft assoziiert. Psychotherapeutische Intervention stellt die effektivste Möglichkeit dar mit PTBS umzugehen - die Mechanismen, die Veränderungen nach Therapie vermitteln, sind jedoch noch wenig verstanden. Studien, die Therapieeffekte auf molekularer Ebene untersuchen fokussieren bisher vorwiegend auf DNA-Methylierung, basieren meist auf der Analyse heterogenen Zellmaterials und zielen oft darauf ab hypothesengeleitet Effekte in isolierten Elementen von Interesse zu identifizieren. Netzwerkanalysen versprechen an dieser Stelle die Komplexität molekularer Prozesse verstärkt abzubilden. Die hier vorgestellte Studie fragt nach den Auswirkungen psychotherapeutischer Intervention auf Genexpression und Koexpression von PTBS-Patientinnen (N = 51). Differentielle Analysen und gewichtete Netzwerkanalysen (WGCNA) erfolgten auf Basis genomweiter RNA-Expressionslevel (RNA-Seq). Als RNA-Quelle dienten $CD14^+$ Monozyten, die vor und nach psychotherapeutischer Intervention isoliert wurden. Die Identifikation von Koexpressionsmodulen erfolgte vor und nach Therapie, sowie ausgehend von einem zeitübergreifenden Netzwerk.

Patientinnen, die nach Therapie eine deutliche Symptomverbesserung zeigten (n = 32), wiesen schon vor Therapie vergleichsweise höhere Werte in der Expression zweier Module auf, die inflammatorische und hämostatische Prozesse repräsentieren. Nach Therapie erwies sich die Expression eines inflammatorischen Moduls als erhöht und die Expression eines hämostatischen Moduls als verringert. Diese Ergebnisse stützen berichtete Zusammenhänge von PTBS und der Dysregulation inflammatorischer und hämostatischer Prozesse. Sie deuten darüber hinaus an, dass erfolgreiche psychotherapeutische Intervention bei PTBS-Patientinnen möglicherweise mit einer verstärkten inflammatorischen Responsivität von $CD14^+$ Monocyten einhergeht.

Keywords: PTBS, Therapieeffekte, Monozyten, genomweite Genexpression, Netzwerkanalysen

Recollection of emotional events is mediated by vagus nerve activation: Evidence from non-invasive taVNS

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Emotional events are better remembered than neutral ones, but the mechanisms leading to this memory advantage are not well understood in humans yet. Based on animal research, it is suggested that the memory enhancing effect of emotion is related to noradrenergic activation in the brain (via LC-arousal system), which is triggered by afferent fibers of the vagus nerve. To test the causal link between vagus nerve activation and emotional memory in humans, we applied transcutaneous vagus nerve stimulation (taVNS), a novel non-invasive stimulation technique, which targets the auricular branch of the vagus nerve. In a within-subject, 3-session design, healthy participants viewed a series of unpleasant and neutral pictures while receiving continuous taVNS or sham stimulation, and one week later performed a recognition memory task. We found that taVNS, compared to sham, improved recollection memory for emotional, but not neutral, material as reflected by behavioral and electrophysiological indices (parietal ERP Old/New effect). Furthermore, brain potentials recorded during encoding also revealed facilitated attentional discrimination between emotional and neutral scenes. Our results suggest an important modulatory influence of the vagus nerve in emotional memory formation in humans. Through its putative activation of afferent vagal projections to distinct brain systems (e.g. via the LC-NA system) taVNS may be a useful method to modulate various affective and cognitive processes, which could also be of special relevance for clinical application (e.g. as adjunct treatment option for disorders associated with altered memory functions).

Keywords: Emotion, Memory, Neurostimulation, taVNS, ERPs

Pupil dilation tracks neuromodulatory responses and predicts a reduction of choice bias across species and decision domains

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Decisions are often made by accumulating ambiguous evidence over time. The brain's arousal systems are activated during such decisions. With simultaneous pupillometry and brainstem fMRI we show that rapid dilations of the pupil track responses of a number of neuromodulatory brainstem centers involved in the control of cortical arousal state, including the noradrenergic locus coeruleus, the (partly) cholinergic basal forebrain, as well as the dopaminergic substantia nigra and ventral tegmental area. The functional impact of these pupil-linked arousal responses was a reduction of decision bias. We show that the arousal-related suppression in decision bias acts on both conservative and liberal biases, and generalizes from humans to mice, and from perceptual to memory-based decisions. Our results point to a general principle of interplay between phasic arousal and decision-making, and reveal that phasic arousal accounts for a significant component of the variability of choice behavior.

Keywords: pupil, brainstem, fmri, decision, bias

Effects of pharmacological cortisol manipulations on emotional episodic memory

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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In pharmacological studies using administration of hydrocortisone to increase cortisol levels or metyrapone, to lower cortisol levels, we examined the role of the stress hormone cortisol on emotional episodic memories in humans.

Administration of the pharmacological agents varied across memory phases (encoding/consolidation vs. retrieval/reconsolidation).

Encoding under increased cortisol levels altered later memory. In contrast, encoding under suppressed cortisol levels abolished the emotional memory enhancement.

Acute administration of metyrapone decreased emotional memory recall. This decrease in recall was still evident days later when metyrapone had been washed out. At the brain level, in the placebo condition, amygdala, hippocampus and ventromedial prefrontal cortex were associated with emotional memory recall. In contrast recall of emotional memories under acute cortisol suppression did not engage these regions.

In addition, we show that metyrapone affects memory reconsolidation when it is used to suppress cortisol levels after the reactivation of a memory.

Keywords: cortisol, pharmacology, emotion, memory, encoding, consolidation, recall, reconsolidation

How facial emotions affect action understanding during social interactions: Insights from action recognition and experience in Virtual Reality

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Face-to-face social interaction requires fast and adaptive responses to other persons' actions. Previous studies found that observers exploit cues such as gaze or hand preshaping to infer action intentions. Importantly, facial emotions are fundamental social cues, which might allow generating adaptive responses to actions. We implemented an interactive Virtual Reality paradigm in order to investigate the influence of facial emotions on the processing of interactive actions. Virtual agents displayed either happy or angry facial emotions while they performed appetitive and aversive actions towards the participant. Participants directly interacted with the virtual agents by reacting to these actions via hand movements. We found that angry compared to happy facial emotions increased arousal ratings, heart rate, and perceived unpleasantness. Interestingly, the latter effect was greater for appetitive compared to aversive actions, highlighting the influence of facial emotions on action processing. These results were complemented by another study using an action recognition task. Using video clips of the same agents, emotions and actions while varying action completeness, we observed an emotional bias effect. Angry compared to happy facial emotions increased participants' likelihood to judge an action as aversive. This effect was most pronounced when video clips were short and therefore hard to recognize, but was retained for video clips of intermediate length which were easy to recognize. These findings demonstrate an influence of facial emotions on action processing during social interaction. More specifically, our data suggest that facial emotions are used to infer action intentions in order to generate fast and adaptive responses.

Keywords: Emotion, Action, Virtual Reality, Physiology, Social Cognition

How effective is predicting emotional memory by resting-state functional connectivity in the brain?

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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There have been increased interests in using BOLD signals during rest to understand brain mechanisms underlying individual differences. Research has shown that individual differences in functional connectivity during rest are correlated with individual differences in psychopathological conditions (Veer et al., 2010) and cognitive performance in old age (Nashiro et al., 2018). Recent research has extended this approach and attempted to use individual's functional connectivity during rest in predicting individual differences in behavioral phenotypes, such as age (Liem et al., 2017), intelligence (Dubois et al., 2018a), and personality (Dubois et al., 2018b). However, it remains unclear whether it is useful to predict individual differences in emotional memory. To address this issue, we analyzed data from 303 adults (aged between 18 and 87) from the Cambridge Centre for Ageing and Neuroscience and tested whether resting-state functional connectivity can predict emotional memory enhancement effects (i.e., enhanced memory for emotional vs. non-emotional information). We also explored predictions for episodic memory for neutral information, intelligence and age. Using data from all participants, age emerged as the only reliably predicted phenotype. Follow-up analyses done for each age group (younger adults, middle aged and older adults) revealed that resting-state connectivity significantly predicted individual differences in intelligence and episodic memory for neutral information but only for younger adults. These results suggest that resting-state connectivity would be less useful in predicting individual differences in emotional memory than other characteristics, such as age or intelligence.

Keywords: resting state, emotional memory, fMRI, machine learning

Navigating the multiverse of skin conductance response quantification approaches

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Scientific work rests fundamentally upon data, their measurement, processing, analysis, illustration and interpretation. Raw data inevitably have to be processed to be ready for statistical analyses and interpretation. While these processing pipelines can be well defined and standardized, they are often characterized by substantial heterogeneity. Already in 1971, Lykken & Venables raised attention to the „[...] disconcerting diversity of electrodermal measurement technique which, at best, make it difficult to compare one set of results with another and sometimes even casts real doubt on the interpretation of the findings." (cf. Lykken D & Venables P, 1971, p. 656). Now, exactly half a century later, basically everything has changed with respect to the equipment and techniques used to record skin conductance response (SCRs), while on the other hand, the problem of disconcerting methodological diversity identified in 1971 still persists. Here, we first present an inventory on different response quantification approaches for SCRs based on a systematic literature search using fear conditioning research as a case example. Second, we present a set of multiverse-type of analyses (partly pre-registered) in which we applied the different identified approaches to two existing data-sets with N=118 and N=38. We discuss the results in terms of robustness and replicability and provide insights into challenges and potential solutions including the introduction of a recently-developed tailored R package allowing for an effortless implementation of (model) multiverse-type-of studies in a single line of code.

Keywords: skin conductance, multiverse analysis, specification curve analysis

Lessons learned from submitting a Registered Report in the field of sleep and memory

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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In the wake of the replication crisis, several research practices have been suggested to improve experimental research. One such practice is the preregistration of study details before conducting the experiment to delineate clearly, which hypotheses and data analysis decisions were made a priori and which were post hoc. Importantly this does not limit the exploration of data sets, but allows other scientists to weigh the evidence presented in a report, since, e.g., tight control over α-error-levels in null-hypothesis-significance-testing is only possible for confirmatory analyses. There are different approaches to preregistration that vary in the required amount of detail given. The Registered Reports format is the most detailed form of preregistration, where the introduction, methods and planned analysis are submitted to a journal for peer-review before data collection. In case of an in-principle acceptance, the journal commits to accept the full paper later, if the experiment is carried out as specified in the preregistration. In my talk, I will present our recent attempt to write and submit such a Registered Report on an innovative large-scale clinical study in the field of sleep and memory. I will show our approach and give insights into our ultimate failure of securing in-principle acceptance at a prestigious journal. This case report may be extremely insightful to scientists in the field of biological psychology planning to submit Registered Reports in the future.

Keywords: Sleep, memory, open science, preregistration

Results from an online survey on open science practices in neuroimaging research

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Although Functional Magnetic Resonance Imaging (fMRI) is widely used in the generation and testing of biological models of behavior, open science practices are slow to be adopted. This study takes a snapshot of the field and shows, how much scientists endorse data standards, data sharing and study preregistration.

283 authors from human fMRI papers listed on PubMed participated in an online survey (age, M/SD: 44/10, female: 34 %). While 35 % have been using the Brain Imaging Data Structure (BIDS), an established organization scheme for neuroimaging data, 91 % were likely or extremely likely to adopt BIDS in the future. The leading reasons why scientists did not use BIDS before, besides unfamiliarity with BIDS (42%), was limited time to implement it (36 %) and to learn more about it (28 %). About half of the participants have preregistered at least one study before, while complexity (64 %) and lack of reward (53 %) were major barriers for preregistration. 67 % have shared data outside their research department before. Again, major barriers to share data were limited time (67 %), followed by lack of funding (61%) to prepare data for sharing.

The results suggest a trend towards a common data standard in the MRI field. In my talk I try to elucidate inter-individual differences in experiences as well as barriers and fears to prevent transparency. Conclusions may be limited, as scientists thinking positive about open science may have been more inclined to respond to the survey invitation.

Keywords: Reproducibility, Replicability, Neuroimaging, MRI

Opening pandora's box: an inventory of open data in psychophysiology

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Data sharing is increasingly being advocated by stakeholders, politics, funders, scientific societies and researchers alike and mandated by an increasing number of journals and funding agencies. The (potential) advantages of making data publicly available are multifold (e.g., optimal use of resources, facilitating data aggregation and scientific advance, transparency and credibility). Yet, the advantages of publicly sharing data can only be utilized when the shared data are indeed functional and a number of practical challenges currently hamper re-usability. Consequently, re-using publicly available data for secondary analyses is often highly time-consuming to an extent that it has been claimed that publicly sharing data might merely create big data graveyards. It is currently difficult to know how many open datasets there are in a specific field of research, what they contain and how to (re-)use them. Here, I present an inventory of >70 publicly available datasets of psychophysiological data by using the field of fear conditioning research as a case example. These were evaluated with respect to their adherence to the FAIR principles of open data: being findable, accessible, interoperable and reusable. I will present the results of this inventory, outline the challenges identified and provide a detailed outlook into the future by suggesting and discussing specific solutions on how to use publicly available data in psychophysiological research to their full potential. To this end, I will showcase an approach we are currently following which may serve as a blue-print for future attempts.

An ethical perspective on the value and challenges of research data sharing

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Christian J. Merz*

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Increasing interest in and necessity of sharing research data pose critical questions regarding related ethical considerations. Which information can be easily shared and which must not be shared with others? What exactly means others by the way? Of course, providing exact details in the consent form are a prerequisite for successful data sharing, but what about already completed or running studies, in which this issue was not mentioned? Can anonymized data always be shared or not, what about risks of re-identification - in Biological Psychology and Neuropsychology particularly relevant for genome-wide data or anatomical scans? What should I consider when I think of a data repository, who should have access and who should not? While these questions cannot be fully answered in each and every detail, they still need to be considered and discussed. A brief overview of do's and don'ts will be given in order to facilitate research data sharing practices from an ethical point of view.

Keywords: anonymized data, ethical aspects, research data sharing

Functional connectivity during smooth pursuit eye movements

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Smooth pursuit eye movements (SPEM) hold the image of a slowly moving stimulus on the fovea. The neural system underlying SPEM primarily includes visual, parietal, and frontal areas. In the present study, we investigated how these areas are functionally coupled and how these couplings are influenced by target motion frequency. To this end, healthy participants (N=57) were instructed to follow a sinusoidal target stimulus moving horizontally at two different frequencies (0.2Hz, 0.4Hz). Eye movements and blood oxygen level-dependent (BOLD) activity were recorded simultaneously. Functional connectivity of the key areas of the SPEM network was investigated with a psychophysiological interaction (PPI) approach. How activity in five eye movement-related seed regions (lateral geniculate nucleus, V1, V5, posterior parietal cortex, frontal eye fields) relates to activity in other parts of the brain during SPEM was analyzed. The behavioral results showed clear deterioration of SPEM performance at higher target frequency. BOLD activity during SPEM versus fixation occurred in a geniculo-occipito-parieto-frontal network, replicating previous findings. PPI analysis yielded widespread, partially overlapping networks. In particular, frontal eye fields and posterior parietal cortex showed task-dependent connectivity to large parts of the entire cortex, whereas other seed regions demonstrated more regionally focused connectivity. Higher target frequency was associated with stronger activations in visual areas but had no effect on functional connectivity. In summary, the results confirm and extend previous knowledge regarding the neural mechanisms underlying SPEM and provide a valuable basis for further investigations such as in patients with SPEM impairments and known alterations in brain connectivity.

Keywords: eye movements, fMRI, functional connectivity, psychophysiological interactions, smooth pursuit

Neural correlates of visually guided and memory guided saccades

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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We propose a new way to compare visually guided and memory guided saccades where visual processing is comparable in both types of task. On each trial of the visually guided task, a coloured bar is flashed at central fixation. After a brief delay, four stimuli were presented peripherally, one in each quadrant. The participants are instructed to saccade to the stimulus that matches the previously viewed target on both colour and orientation. In memory guided condition, the order of stimulus presentation is reversed: first four eccentric stimuli were presented and after a delay the central target. In the memory guided condition, the participant is instructed to execute a saccade to the remembered location of the stimulus that matched the central target in colour and orientation. The behavioural results indicate that the memory guided task is associated with prolonged saccadic reaction times. A general linear model of fMRI BOLD responses revealed regions in prefrontal cortex (left anterior insula, right superior and middle frontal gyrus, anterior medial cingulum), and the intraparietal sulcus extending into surrounding areas (precuneus, superior and inferior parietal lobe) that were more activated when participants performed the memory – compared to the visually – guided task. Multivariate pattern analysis revealed voxel clusters in the ventral visual pathway and the frontal eye fields that correctly classify the target location in both tasks. Our findings identify a cortical network that underlies the programming of visually and memory guided eye movements.

Keywords: Visually guided saccades, memory guided saccades, fMRI BOLD, eye movements

Polygenic risk scores for schizophrenia are associated with oculomotor endophenotypes

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Background:Schizophrenia is a heterogeneous disorder with substantial heritability. The use of endophenotypes can help clarify its aetiology. Measures from the smooth pursuit and antisaccade eye movement tasks have been identified as endophenotypes for schizophrenia in twin and family studies. However, the genetic basis of the overlap between schizophrenia and these oculomotor markers is largely unknown. Here, we tested whether schizophrenia polygenic risk scores (PRS) were associated with oculomotor performance in the general population.

Method:Analyses were based on data of 2,956 participants (aged 30-95) of the Rhineland Study, a community-based cohort study in Bonn, Germany. Genotyping was performed on Omni-2.5 exome arrays. Using summary statistics from a recent meta-analysis based on the two largest schizophrenia genome-wide association studies to date, we quantified genetic risk for schizophrenia by creating PRS at different p-value thresholds for genetic markers. We examined associations between PRS and oculomotor performance using multivariable regression models.

Results:Higher PRS were associated with higher antisaccade error rate and latency, and lower antisaccade amplitude gain. PRS showed inconsistent patterns of associations with smooth pursuit velocity gain and were not associated with saccade rate during smooth pursuit or performance on a prosaccade control task.

Conclusions: There is overlap between genetic determinants of schizophrenia and oculomotor endophenotypes. Our findings suggest that the mechanisms that underlie schizophrenia also affect oculomotor function and, therefore, support the stronger linkage of the two research fields.

Keywords: genetic risk score, eye movement, cohort study, saccade, smooth pursuit

Eye movement-based process analysis: a simultaneous comparison of patients with schizophrenia, ADHD, ASD and healthy controls

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Despite their phenotypic differences, schizophrenia, Attention-Deficit/Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) share similarities at many levels of investigation. Coherently, based on the Neurodevelopmental Continuum model, neurodevelopmental disorders, including schizophrenia, should be re-conceptualised as lying on an aetiological, neurodevelopmental and clinical continuum. This concept requires their simultaneous comparison, which has not yet been accomplished.

Four groups of late adolescents were included: 26 ASD, 28 ADHD, 20 schizophrenia, 29 with typical development (TD). Eye movements were recorded while basic ocular-motor tasks (prosaccade, antisaccade, memory-guided saccade, fixation) and a visual-search task were administered.

Patients with schizophrenia manifested generalised deficits across tasks and domains of inhibition, processing speed and intra-subject variability (ISV) of response time and saccade dynamics, while sharing with ADHD and ASD deficits in inhibition, ISV of search initiation and fixation duration during search, only with ASD increased microsaccade frequency, ISV of saccade dynamics and post-search duration. In parallel, ASD presented the most speeded and least variable performance during search. Despite dissociations, similar profiles of impairments between clinical groups were revealed by vector correlations. If impairment is interpreted as a qualia, results could suggest the existence of one common neurodevelopmental continuum of performance for the three disorders, while quantitative differences appear in the level of impairment. Along such continuum, schizophrenia presented the greatest level of impairment, while the position of ASD and ADHD was interchangeable, depending on the group of tasks considered. Given the relevance of cognitive impairments in these three disorders, we argue in favour of overlapping pathophysiological mechanisms.

Keywords: Schizophrenia, Attention-Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), eye movement

Quantification of eye movements and their use as a translational marker in clinical diagnosis

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Parkinson's disease (PD) is a progressive neurological disease and along with Alzheimer's, one of the most common types of movement disorders. It primarily presents with motor symptoms such as bradykinesia, rigidity and tremor and has as part of its core pathology the degeneration of dopaminergic neurons in the substantia nigra pars compact. The pathways affected by Parkinson's are also involved in the generation of eye movements and specifically in saccades.

For this talk, I will present saccadic data from both patients and healthy controls, part of the OxQUIP (Oxford Quantification in Parkinsonism study); this trial aims to identify and validate novel neurophysiological and cognitive biomarkers that have the potential to provide quantitative measures of disease state, supplanting the present need of clinical evaluation using rating scales.

Although oculomotor pathways have been extensively studied, PD treatment-induced changes in their parameters are not well known. There is currently no disease-modifying treatment for PD. Most cases are treated symptomatically with medication or surgery (such as Deep Brain Stimulation). One of the factors limiting the rate of development of new treatments, is the reliance on clinical rating scales which are subjective, insensitive and non-linear.

I will present data from a movement disorders cohort N=1400 datasets (focusing on Parkinson's and Progressive Supranuclear Palsy - a tauopathy (atypical Parkinsonism) to illustrate how eye movement parameters have proven a useful translational tool especially in aiding clinical diagnosis and following disease progression.

Keywords: movement disorders, Parkinson's disease, saccadic eye movements

Nicht invasive Hirnstimulation zur Modulation eines konsolidierten Furchtgedächtnisses

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Mit einer Lebenszeitprävalenz von mehr als 15% (Jacobi et al., 2014) gehören Angststörungen zu den häufigsten psychischen Erkrankungen. Den Goldstandard in der Behandlung stellt die expositionsbasierte kognitive Verhaltenstherapie dar, die ein sehr hohe Effektivität zeigt (Carpenter et al., 2018), aber dennoch nicht für alle Patienten ausreichend ist (Gloster et al., 2011). Um die Expositionstherapie weiter zu optimieren, wurde in bisherigen Studien überprüft, ob Methoden der nicht-invasiven Hirnstimulation (NIBS) therapierelevante Lernprozesse, wie das Extinktionslernen, verstärken können. In einer unserer früheren Studie (Dittert et al., 2018) konnten wir dies mittels einer frontalen transkraniellen Gleichstromstimulation (tDCS) unmittelbar nach der Furchtkonditionierung nachweisen. Um die Ergebnisse dieser Stimulationslokalisation zu replizieren und auf das konsolidierte Furchtgedächtnis zu erweitern, wurde folgende Studie durchgeführt. In einem zweitägigen Furchtkonditionierungsparadigma wurden 61 gesunde Probanden, die eine erfolgreiche Furchtkonditionierung zeigten, zufällig und doppelt verblindet in eine Schein- und eine Verum-Stimulationsgruppe eingeteilt. Die Stimulation des ventromedialen präfronalen Kortex begann zehn Minuten vor dem Extinktionslernen am Tag nach der Furchtkonditionierung. Für die Hautleitfähigkeit zeigte sich eine signifikante Interaktion Zeit x Bedingung x Gruppe ($F(1,59) = 4.35$, $p < .05$). Die anschließenden post-hoc t-Tests ergaben eine signifikant stärkere Abnahme der CS+/CS- Diskriminierung in der realen Stimulationsgruppe im Vergleich zur Kontrollgruppe. Die Ergebnisse zeigten, dass das von uns gewählte Stimulationsprotokoll auch zur Modulation eines konsolidierten Furchtgedächtnisses und damit zur Verbesserung therapierelevanter Lernprozesse eingesetzt werden kann. Zukünftige Studien sollten die Anwendbarkeit des Paradigmas an einer klinischen Stichprobe im Rahmen einer Expositionstherapie untersuchen.

Keywords: tDCS, Hirnstimulation, Extinktionslernen, Expositionstherapie

Zeitliche Aspekte nicht invasiver Hirnstimulation auf das Extinktionslernen

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Durch die Applikation von Gleichstrom über Elektroden an der Kopfhaut kann die Aktivierung in kortikalen Hirnregionen derart beeinflusst werden, dass dies sich im Verhalten niederschlägt. Unter anderem wurde sowohl eine veränderte Konditionierung als auch Extinktion von Furchtreaktionen nach einer sog. transkraniellen Gleichstromstimulation (tDCS) nachgewiesen. Aus diesem Grund ist die tDCS im Rahmen verhaltenstherapeutischer Interventionen interessant, bspw. zur Augmentation beim Verlernen phobischer Reaktionen innerhalb einer Exposition. Bisherige tDCS-Studien weisen allerdings eine große Vielfalt bezüglich des Applikationsortes und des -zeitpunktes auf. Um die tDCS effektiv im Rahmen psychotherapeutischer Interventionen einsetzen zu können, müssen diese Einflussgrößen auf die Effektivität der tDCS genauer untersucht werden. In der vorliegenden Studie wurde der differentielle Effekt zweier Applikationszeitpunkte untersucht. Die tDCS des ventromedialen präfrontalen Kortex (vmPFC) wurde entweder direkt im Anschluss an eine Furchtkonditionierung an Tag 1 durchgeführt, wodurch der Einfluss der tDCS auf die Konsolidierung des Furchtgedächtnisses untersucht werden kann, oder direkt vor der Extinktion an Tag 2. Mit letzterem Stimulationszeitpunkt soll der hemmende Einfluss gesteigerter vmPFC-Aktivität auf die Amygdalaaktivität analysiert werden. Als Maß der Furchtreaktion wurde die elektrodermale Aktivität (EDA) in Reaktion auf den CS+ und CS- während der Extinktion gemessen. Unabhängig vom Stimulationszeitpunkt zeigte sich eine verringerte Reaktion auf den CS+ vs. CS- bei beiden tDCS-Gruppen verglichen mit der sham-Gruppe. Demnach sind sowohl die Beeinträchtigung der Furchtgedächtniskonsolidierung als auch die Hemmung der Furchtreaktion (über Regulation der Amygdalaaktivierung) mögliche Wirkmechanismen einer tDCS über dem vmPFC. Was dies für die Anwendung der tDCS innerhalb psychotherapeutischer Interventionen bedeutet, wird diskutiert.

Keywords: Gleichstromstimulation, Furchtkonditionierung, Extinktion, vmPFC

Transkranielle Gleichstromstimulation des Ventromedialen Präfrontalkortexes Moduliert Perzeptuelle Diskrimination und Neuronale Korrelate der Furchtgeneralisierung

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Furchtgeneralisierung spielt eine wichtige Rolle in der Genese und Aufrechterhaltung von Angst- und Traumafolgestörungen. Defizite in der perzeptuellen Diskrimination, verminderte Furchtinhibition und präfrontale Hypoaktivierung auf Sicherheitssignale sind Prozesse, die mit Furchtübergeneralisierung und Psychopathologie assoziiert sind. Ziel dieser Studie war es, Furchtgeneralisierung mittels non-invasiver Hirnstimulation des „Furcht-inhibierenden" ventromedialen präfrontalen Kortexes (vmPFC) zu modulieren. Dabei sollte eine inhibitorische Stimulation verglichen mit exzitatorischer oder Placebostimulation zu einem maladaptiveren Generalisierungsmuster führen. Gesunde Probanden erhielten nach einer differentiellen Konditionierungsphase und vor einer Generalisierungsphase eine entweder inhibitorische (N=26), exzitatorische (N=27) oder eine Placebostimulation (N=26) des vmPFC mittels transkranieller Gleichstromstimulation (tDCS). Als abhängige Variablen wurden danach in Reaktion auf konditionierte (CS+, CS-) und Generalisierungsstimuli (GS) Furcht- und UCS-Erwartungsratings, die perzeptuelle Diskriminationsperformanz, Pupillendurchmesser und evozierte Felder mittels Magnetenzephalographie (MEG) gemessen. Nach inhibitorischer Stimulation des vmPFC (verglichen mit exzitatorischer und Placebostimulation), zeigten sich eine verschlechterte perzeptuelle Diskrimination der Generalisierungsstimuli sowie verringerte inhibitorische Generalisierungsmechanismen in frontalen Hirnregionen. Auf die Bewertungen der CS und GS sowie auf den Pupillendurchmesser konnte dagegen kein Einfluss der Stimulation nachgewiesen werden. Die vorliegenden Ergebnisse legen einen kausalen Beitrag des vmPFC in der Modulation von Generalisierungsmechanismen nahe. Dabei kann eine inhibitorische Stimulation des vmPFC als Modell für eine maladaptive Verarbeitung von furchtbezogenen Reizen (verringerte Diskriminationsleistung; beeinträchtige Inhibition bei Sicherheitssignalen, d.h. CS- und GS, in frontalen Regionen) dienen. In zukünftigen grundlagenorientierten und klinischen Studien sollte das Potenzial nicht-invasiver Hirnstimulation frontaler Regionen zur Beeinflussung (pathologischer) Furchtgeneralisierung weiter untersucht werden.

Keywords: tDCS, MEG, Furchtgeneralisierung, vmPFC

Transkranielle fokussierte Ultraschall-Neuromodulation beeinflusst die Entstehung von erlernter Hilflosigkeit durch Inhibition der Theta-Aktivität an zentralen Elektrodenpositionen

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Hintergrund: Depressionen gehen mit starkem und oft anhaltendem psychischem Leid einher. Obwohl effiziente Behandlungen zur Linderung der Belastung während akuten Zuständen zur Verfügung stehen, sind Rezidive auf lange Sicht sehr wahrscheinlich. Vor diesem Hintergrund könnte vor allem die Prävention initialer Episoden besondere Relevanz haben. Daran anschließend wurde in der vorliegenden Studie untersucht, inwiefern sich die Neuromodulation des cingulären Kortex (CK), der mit ängstlicher Erregung, Konflikterleben, und Hilflosigkeit assoziiert ist, eignet, um die Entstehung erlernter Hilflosigkeit zu beeinflussen.

Methode: Durch direkte Manipulation des rechten DLPFC mittels transkraniell-fokussierten Ultraschall (tFUS) wurde die Aktivität in CK-assoziierten elektrophysiologischen Maßen während einer erlernten Hilflosigkeitsaufgabe verändert. tFUS wurde dabei in einer randomisiert-kontrollierten und doppelblinden Versuchsanordnung mit 54 Teilnehmern appliziert. Die Versuchspersonen wurden angewiesen 8 Partien Schach gegen einen Computer zu spielen, der für sie unschlagbar war. Währenddessen wurde ein 32-Elektroden EEG aufgezeichnet.

Ergebnisse: Die Ergebnisse zeigen einen inhibierenden Einfluss von tFUS auf die Theta-Aktivität an den Elektrodenpositionen Fz und Pz, sowie positive Effekte auf Selbsteinschätzungsdaten zu erlebten Emotionen, Kognitionen und Erregung sowie auf die Zugqualität (Verhalten) während der Aufgabe.

Diskussion: Es ergibt sich ein deutlicher Hinweis darauf, dass die Entwicklung von erlernter Hilflosigkeit/Hoffnungslosigkeit positiv in ihrem Verlauf beeinflusst werden konnte. In Übereinstimmung mit früheren Ergebnissen ist insbesondere die Elektrodenposition Pz ein interessantes Ziel für weitere Forschung, da die Theta-Aktivität an dieser Elektrode mit Kontrollerleben und motiviertem, zielgerichteten Verhalten korrelierte. Unseres Wissens nach ist dies die erste Studie, die Neuromodulation zur Überwachung und Manipulation eines elektrophysiologischen Endophänotyps bei der Entwicklung von Hilflosigkeit im Labor untersuchte.

Keywords: Depression, Transkranieller Ultraschall, Theta, Emotion, Neuromodulation

The representation of face-prior precision in the human brain

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Perception is an active inference in which perceptual priors are combined with sensory input. It is still unclear how the precision of prior expectations about upcoming percepts is represented in the human brain. Prior precision could be represented with prior content itself in sensory regions. Alternatively, there could be distinct, specialized brain regions that represent precision separately from the content of the prior. Here, we used multivariate functional resonance imaging to test whether the precision of face priors can be measured together with expected face identity in face-sensitive regions. Participants were trained to relate images of scenes and faces. Each scene predicted three faces: one with low, one with intermediate, and one with high probability (10, 30, or 60 %). Behavioural results showed that participants correctly associated the three scenes and faces with the corresponding low, intermediate, and high probabilities. An independent functional localizer run was recorded before the training to define face-sensitive regions of interest. We used representational similarity analysis (RSA) to test whether multivariate pattern similarity between presented and expected faces depends on the prior strength. During face anticipation, representations of expected face identity increased with prior precision in the face-sensitive anterior temporal lobe. In contrast, during face presentation, representations of face identity increased with surprise in the hippocampus. Our findings suggest that precision of face priors is represented in higher-level face areas.

Keywords: predictive coding, face perception, expectation, prior, fMRI, RSA

Neural and temporal disambiguation of two-tone images in early psychosis

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Common psychotic symptoms are hallucinations (aberrant perceptions), and delusions (irrational-persistent beliefs). Within the predictive processing framework, these symptoms arise from an imbalance in integrating incoming, bottom-up sensory information with top-down prior knowledge. Our previous behavioural work shows that the use of prior knowledge varies with illness phase and the prior's composition. Consistent across our previous work is the over-reliance on prior information during perception of sensory information. The current study aims at investigating the neural and temporal effects of the integration of prior knowledge during visual disambiguation.

Using combined magnetoencephalography (MEG) and electroencephalography (EEG), we measured neural and temporal responses associated with perceptual processing underlying visual disambiguation after the integration of specific prior knowledge. We used a simple two-tone-disambiguation tasks in which participants were first presented with ambiguous two-tone images, followed by template exposure-phase (specific prior knowledge), and a disambiguation phase in which the two-tone images were presented again. The study was conducted in early psychosis patients (n=14) and healthy controls (n=20).

Our preliminary results show a significant amplitude reduction (EEG) in patients compared to controls for an early (~150ms) disambiguation effect, as well as for a late (>500ms) content specific disambiguation effect. These effects are localised in both lateral occipital areas (MEG).

Our results suggest that patients show a the stronger disambiguation effect as more precise predictions are generated. This might be possible due to the stronger reliance on a more precise prior. Although advantageous in this particular task, during natural perception this ability may induce perceptual alterations.

Keywords: Prior knowledge, psychosis, predictive processing, visual perception

How the degree of subclinical autistic traits affects visual category learning

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

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Categorization is a vital cognitive skill that enables us to structure the world, deduct expectations from our experiences, and apply them to new situations. While some category structures allow abstracting verbalizable rules, others are easier defined by the overall similarity among category members. A particularly efficient strategy for similarity-based categorization is the 'prototype strategy', where category knowledge is represented in the form of a statistical average of category members (the prototype). Individuals with autism spectrum disorder (ASD) and subclinical individuals high in autistic traits tend to focus on details and pay less attention to contextual information. This detail-oriented style could impair prototype abstraction, as it requires focusing on category-dependent similarities and to ignore actual perceptual differences among category members. Evidence exists that individuals with ASD have more difficulties abstracting prototypes than those without ASD, but it is unclear whether this difficulty is also presented by individuals with a subclinically above-average degree of autistic traits. In these individuals, the detection of impaired prototype-abstraction could be hampered by the potential compensatory use of an 'exemplar strategy', where category knowledge is represented through memorization of category members as separate instances. I will present behavioral and functional magnetic resonance imaging (fMRI) data from N = 63 young healthy individuals characterized for autistic traits, who performed a visual categorization task. Computational modeling of behavioral data will be combined with univariate and multivariate fMRI analyses to investigate the relationship between autistic traits, neural correlates of category knowledge as well as representational strategies.

Keywords: autism, category learning, prototype-distortion, exemplar, representational similarity analysis

Contextual expectations shape cortical reinstatement of sensory representations

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Alex Clarke*

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When making a turn at a familiar intersection, we know what will come into view. Such perceptual expectations are derived from knowledge of the context, however it's currently unclear how memory systems use contextual knowledge to reactivate sensory details in cortex. To address this, human participants learned the spatial layout of animals in two cross maze contexts. During fMRI, participants navigated between animals to reach a target, and in the process saw a predictable sequence of five animal images. Importantly, identical sequences could be seen in both contexts. In order to isolate activity patterns related to item predictions, rather than bottom-up inputs, a quarter of navigation trials ended early, instead presenting a blank screen. Employing multivariate pattern similarity analysis, our data revealed activity patterns in early visual areas showed greater similarity when seeing the same item compared to different items, and critically, activity patterns when seeing an item were related to activity patterns when an item was expected, but omitted from the sequence. Testing regions related to contextual processing, these item expectation effects were also seen in posterior medial (PM) cortex. We next tested how contextually driven expectations were related to the hippocampus, finding that activity patterns in the hippocampal body at one point in the sequence were related to patterns in early visual cortex and PM regions at a later point in the sequence. Together, our results reveal how hippocampal representations might reactivate sensory and contextual details of expected items, providing mechanistic insight into the nature of perceptual expectations.

Keywords: Prediction, context, fMRI, MVPA, memory

How violations of real-world expectations modulate memory encoding

Date & time: Thursday, 3 June 2021 - 14:30 - 16:00

Andrea Greve*

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The discrepancy between what we expect and what we experience, e.g. prediction errors (PE), has important implications for learning and the formation of future predictions. Over the past decade many studies have highlighted the importance of PE in non-declarative domains, such as conditioning or reward learning. Recent investigations, however, suggest PE might also play a critical role in declarative learning. In this talk I will focuses on the role of expectancy and how we learn from prediction errors by outlining a theoretical framework, the 'Predictive Interactive Multiple Memory Signals' (PIMMS), which predicts violations of expectations enhance episodic memory. I will showcase empirical evidence in support of this framework which focuses on visual expectations derived from real-world knowledge. Overall, I will discuss recent insight in understanding the mnemonic role of expectancy and outline theoretical approaches how to link prior expectations to episodic learning.

Assessing performance adjustments in and test-retest reliability of fear conditioning

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Fear conditioning paradigms are an important tool and used frequently to investigate fear and anxiety disorders in the laboratory. However, stability of fear responses across experimental phases and repeated measurements are investigated scarcely. The former is relevant to the common practice to control responding in later experimental phases for previous responding while the latter provides information about test-retest reliability of fear conditioning experiments. In our preregistered assessment (https://osf.io/cqpkw/?view_only=b4a1c42545774ob5bc46o1fa8ffeea8a), we analyzed stability of fear responses (i.e., CS discrimination, responses to CS+ and CS-) in two common outcome measures (i.e., SCRs and fear ratings) collected within a longitudinal fear conditioning experiment (day 1: acquisition; day 2: extinction, reinstatement, reinstatement-test). The experiment was conducted at a baseline (To; n=107) and a 6-months follow up (T1; n=71) measurement. At To, stabilities of responding in SCR and fear ratings were weak to moderate between acquisition, 24h fear recall and extinction, but less stability was observed between responding in these phases and responding at the reinstatement-test. CS discrimination in SCR was generally less stable than responses to the CSs. Longitudinally, stability was weak in SCRs and weak to moderate in fear ratings across all experimental phases with higher stability of CS responses as compared to CS discrimination. The empirical basis for performance adjustments in certain experimental phases might depend on the experimental phase at hand. The poor to moderate test-retest reliabilities leave room for individual variability, but might also hamper replicability of group-based results. Further implications will be discussed.

Keywords: Fear conditioning, Response stability, Performance adjustments, Test-retest reliability, Replicability

Category conditioning put to the test: A meta-analysis and successful replication

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

Ann-Kristin Meyer* (1), Tatjana Schmidt (2), Davide F. Stramaccia (1), Philipp C. Paulus (1), Roland G. Benoit (1)

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Emotional events form complex memories that engage both episodic and Pavlovian memory systems. However, these systems have largely been studied separately of each other, presumably also due to methodological challenges. Episodic memory is typically tested with a large number of stimuli (e.g., lists of words), whereas in fear conditioning, these are typically confined to just a couple (e.g., CS+ and CS-). The category conditioning procedure by Dunsmoor et al. (2012) has the potential to overcome this challenge. Here, several exemplars from one semantic category (e.g. animals; CS+) are paired with an aversive stimulus, whereas exemplars from another category (e.g. objects; CS-) are not. Intriguingly, after learning, also novel exemplars of the CS+ category - that had not previously been presented - elicit a threat response. However, so far only few research groups have used the procedure and employed methods in conditioning research have been quite heterogeneous. We thus aimed to establish the replicability of this effect. First, a meta-analysis of 13 published effect sizes (n = 234) revealed a moderate difference in skin conductance between the CS+ and CS- categories. This effect remained significant after initial attempts to adjust for publication bias. Second, in a replication study (n = 30), we assessed skin conductance and heart period response. Both measures showed significant differences during fear conditioning, extinction, and reinstatement. Our results thus corroborate the extant literature and confirm the potential of this procedure. It will allow us to study how suppression affects both episodic memory and conditioned fear.

Keywords: fear conditioning, episodic memory, meta-analysis, replication

Fear conditioning with an imagined unconditioned stimulus

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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In classical fear conditioning, neutral conditioned stimuli that have been paired with aversive physical unconditioned stimuli eventually trigger fear responses. Here, we test whether aversive mental images systematically paired with a CS may also cause de novo fear learning in the absence of any external aversive stimulation. In the first two experiments, N=45 and N=41 participants were first trained to produce aversive, neutral, or no imagery in response to one of three different visual imagery cues. In a subsequent imagery-based differential conditioning paradigm, each of the three cues systematically co-terminated with one of three different neutral faces. Although the face that was paired with the aversive imagery cue was never paired with aversive external stimuli or threat-related instructions, participants rated it as more arousing, unpleasant, and threatening and displayed relative fear bradycardia and fear-potentiated startle. In a third experiment, two groups underwent fear conditioning with an imagined (N=24) vs. a real (N=24) electric shock while EEG and ECG were recorded. In general, the pattern of electrophysiological and cardiac fear responses was qualitatively similar for both groups, suggesting partially overlapping neurobiological mechanisms of imagery-based and classical fear conditioning. These results could be relevant for understanding the development of fear and related disorders without trauma.

Keywords: fear conditioning, imagery, anxiety, EEG

Network perspective on neural activation during fear acquisition and extinction training: theoretical considerations and future directions

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Fear conditioning paradigms serve as a translational model for the development and treatment of anxiety disorders. In the past years, the neural correlates of fear conditioning have been investigated intensively, but the clinical benefit remains sparse. One possible explanation could be a lack of methodological variety to extend our theoretical framework about underlying neural mechanisms of fear and extinction learning. Existing models of threat-processing and the interplay between brain regions of the fear network in humans, in which the amygdala is thought to play a central role, are mainly based on verbal theories, but an experimental validation is still missing.

Thus, I will discuss theoretical considerations about the potential of computational connectivity analyses, to parse precisely the finely balanced interactions of brain structures associated with fear and extinction learning. Specifically, I will present a planned project in which we aim to use effective connectivity analyses (Dynamic Causal Modelling; DCM) to shed light on information processing during fear acquisition and extinction training. Using a two-day fear conditioning paradigm, we plan to apply regression DCM to study whole-brain directed connectivity during fear acquisition and extinction training, and combine it with model-based classical DCM to test specific hypotheses about the interactions within the fear network. This network approach allows to experimentally validate current hypotheses about neural mechanisms of threat processing and regulation (e.g., regulative function of the ventral PFC), by means of computational modelling.

Finally, I will give an outlook on possible extensions and applications of effective connectivity for future fear conditioning research.

Keywords: fear conditioning, effective connectivity, fMRI, Dynamic Causal Modelling

Progesterone antagonism beneficial for

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Premenstrual dysphoric disorder (PMDD) is a psychiatric condition characterized by late luteal phase affective, cognitive, and physical symptoms, causing significant distress in about 3-5% of women of reproductive age. Progesterone is posited to be implicated in the symptomatology, thus we tested the efficacy of a selective progesterone modulator (SPRM) for PMDD. In a multicentre, double-blind, placebo-controlled clinical trial, we demonstrated that half of the women receiving the treatment improved completely, while the corresponding proportion of women receiving placebo was 21 per cent. Furthermore, SPRM treatment was associated with enhanced reactivity in the dorsal anterior cingulate cortex and dorsomedial prefrontal cortex during aggressive response to provocation stimuli, as assessed by functional magnetic resonance imaging. The mechanism of action of the study drug provides insights into the potential molecular mechanisms underlying this psychiatric disorder and its treatment, suggesting a beneficial effect of progesterone receptor antagonism on top-down emotion regulation.

Keywords: aggression, brain, hormones, women

The predictive role of (synthetic) sex hormones in hippocampal and amygdala grey matter volumes

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Worldwide oral contraceptives (OC) are one of the most prescribed medication with millions of female users. OC use suppresses endogenous hormone levels (i.e., estradiol (E2) and progesterone (P)) by creating a negative feedback loop with the addition of synthetic hormones. Endogenous and synthetic sex hormones can pass the blood brain barrier and bind to brain regions with high densities of E2 and P receptors such as the hippocampus and the amygdala. Previous studies reported a generally reduced grey matter (GM) volume in these areas in OC users. However, findings are mixed. The aim of our study was to test the potential predictive role of endogenous and synthetic sex hormones, as well as of intake duration and OC androgenicity in GM volume of hippocampus and amygdala.

The GM volumes of hippocampus and amygdala of 48 OC users were compared to 66 naturally cycling (NC) women (i.e., early follicular: n = 36, peri-ovulatory: n = 30) using Freesurfer software on the collected MP2Rage images. OC women had a significantly smaller hippocampal GM volume compared to NC women, but there was no difference for the amygdala. Interestingly, preliminary regression analyses showed that for the hippocampus OC intake duration was a positive predictor for GM volume, whereas for the amygdala there was a significant interaction between intake duration and OC androgenicity. Potential implications of these results for previously found mixed findings regarding the influence of OCs on hippocampal and amygdala GM volumes will be discussed.

Keywords: oral contraceptives, sex hormones, hippocampus, amygdala, brain volume

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Women's ability to regulate emotions: relationship with personality, sex steroids and hormonal contraceptives

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Background:

Emotion regulation plays a key role in everyday life: it can impact our health, personal relationships and psychological well-being. How people experience and regulate emotions is strongly connected with various psychological and biological factors, such as personality traits, emotion regulation strategies, hormones. In this study we examined how use of hormonal contraceptives is related to emotion regulation as a trait and a state.

Methods:

57 women (27±4.38 years) participated in the study (9 oral contraceptive users, 9 intrauterine device users, 27 women in follicular and 11 women in luteal phase of their menstrual cycle). In emotion regulation task participants were instructed to simply view the pictures or use reappraisal strategy to down-regulate or up-regulate emotions towards low and high intensity negative images. The electroencephalogram (EEG) was recorded. The late positive potential (LPP) and global field power (GFP) were calculated for each group and condition. Participants rated perceived negativity after each stimulus. Resting state EEG was used to assess frontal alpha asymmetry (FAA). Saliva samples were collected to determine sex steroid concentrations.

Results:

Perceived negativity was lower in down-regulation and higher in up-regulation compared to viewing condition. High and low intensity negative pictures induced higher LPP amplitude than neutral images. LPP amplitude was higher for all emotion regulation conditions in comparison to viewing condition. LPP amplitude did not differ between hormonal contraceptive users and naturally cycling women. Oral contraceptive users tended to have higher GFP versus naturally cycling women. FAA analysis revealed that higher left frontal activity was related to better emotion down-regulation.

Keywords: Emotion regulation, sex steroids, EEG

Effects of oral contraceptive intake duration on verbal fluency and navigation

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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In this study, we investigated whether the current intake duration and prior use of combined oral contraceptives (COC) have an impact on grey matter volume, neuronal activity and performance during a navigation and verbal fluency task depending on the androgenicity of the progestin contained in the COC. We report preliminary results from thirty-one women taking androgenic COC (Levonorgestrel & Ethinylestradiol), thirteen women taking anti-androgenic COC (Drospirenone/Chlormadinone acetate & Ethinylestradiol) and 60 women with natural cycle (NC), who performed a verbal fluency and navigation task in the fMRI during the active intake phase (COC) or during menstruation (NC).

Both current and previous intake duration of COC was found to be related to GM volumes, brain activity and performance in the verbal fluency and navigation task. Importantly, opposite effects were observed depending on the androgenicity of the progestin. Unexpectedly, particularly anti-androgenic COC seem to have a positive impact on navigation, but a negative impact on verbal fluency. These findings suggest that the effect of COC use on brain and cognition accumulates over time, with some effects still visible after discontinuation of contraceptive treatment.

The impact of sleep deprivation on memory: A meta-analysis

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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A substantial number of studies suggest that acute sleep deprivation both before and after encoding has a detrimental effect on memory for newly learned material. However, there is as yet no quantitative analysis of the size of these effects. We conducted two meta-analyses of studies published between 1970 and 2020 that investigated effects of sleep deprivation on memory, one for deprivation occurring before and one for deprivation occurring after encoding. We found 55 effect sizes investigating sleep deprivation before encoding, which showed that sleep deprivation impairs encoding with a medium effect size (g = 0.62). However, there was evidence of publication bias, with a trim-and-fill procedure yielding an estimated g = 0.47. A post-hoc power analysis of each study found a mean power of 55% to detect the meta-analytic effect size. We found 117 studies showing a small effect (g = 0.30) of sleep deprivation after encoding impairing memory. The mean power to detect the meta-analytic effect was 16%. Our analyses suggest acute sleep deprivation may have an impact on memory, but both direct replications and better powered conceptual replications are needed to increase our ability to estimate the true effect size.

Keywords: Sleep, memory, meta-analysis

The benefits of sleep on episodic memory: A meta-analysis

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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People remember more previously learned information after sleep than after an equally long period of wakefulness. Although the positive effect of sleep on episodic memory is well established, its size is still unclear. In the present meta-analysis, we analyzed 824 effect sizes from 271 independent samples reported in 177 articles published between 1967 and 2019 to quantify the sleep benefit in episodic memory and to investigate potential moderator variables. We found a moderate overall sleep benefit in episodic memory ($g = 0.45$). Evidence for publication bias was ambiguous. However, when accounting for possible selective reporting, the effect is approximately half the size but still significant. For moderator analyses, we applied multilevel meta-regressions with robust variance estimation on the main dataset and on a subset containing only single words and word pairs as stimuli. According to these analyses, the sleep benefit increases when stimuli are studied multiple times compared to once. Another moderator is the memory task: The sleep benefit is largest in free recall, followed by cued recall and recognition tasks. Finally, the sleep benefit is more pronounced when controlling for memory performance right after learning. More specifically, using a direct measure of forgetting (memory performance right after learning - performance in a delayed memory task) yields a higher sleep benefit than when the memory performance in a delayed memory task is considered only. We discuss theoretical implications and provide guidance to increase the robustness of the sleep benefit in episodic memory in future research.

Keywords: episodic memory, sleep, meta-analysis

Drawing conclusions from null findings in sleep research: An investigation of the impact of sleep on eyewitness identifications, a registered report.

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Sleep is largely considered a brain state that is optimal for memory consolidation due to reactivation of memories encoded during preceding wakefulness. Given the importance of sleep in consolidating memories, we investigated the impact of sleep on eyewitness identification performance. Indeed, there is opportunity for sleep, and therefore consolidation, to occur between witnessing a crime and making a line-up identification. A line-up procedure is a recognition memory test that contains the police's innocent or guilty suspect and fillers, who are known innocents. In our large-scale registered report (N = 4,000), we manipulated the presence and absence of sleep between witnessing a video of a mock crime and making a decision on a line-up. We predicted that sleep would improve discriminability (i.e., more identifications of the guilty suspect and fewer identifications of the innocent suspect). We did not have strong predictions about the impact of sleep on reliability (i.e., the probability that the identified suspect is guilty). Our results did not bore out our predictions, sleep did not benefit discriminability. Sleep also had no impact on reliability. These results are counter to the evidence pointing towards beneficial effects of sleep on memory. We discuss whether our findings indicate that the benefit of sleep on memory is smaller than is stated. Moreover, had we not taken the registered report route, these results may not have been published because of publication bias or they may not have been presented as originally intended because of pressure to conduct and present post-hoc analyses.

Keywords: Registered Report, Sleep, Memory Consolidation, Eyewitness Identification

Does sleep-dependent memory consolidation depend on information load?

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Sleep has been shown to benefit the consolidation of declarative memories. Many studies have used word-pair lists and cued recall procedures to elicit a robust benefit of sleep on long-term memory. Here, I will show a series of experiments, where manipulating the lengths of these word-pair lists affected this effect of sleep on memory. Specifically, a medium list-length of 160 word-pairs showed a robust effect of sleep on memory, whereas lists of length 40, 320 and 640 showed no benefit of sleeping during retention. I will demonstrate how theories of sleep dependent memory consolidation can be used to explain these counterintuitive results. Next, I will argue that many patterns of results from this research could have been aligned with theories of sleep and memory research. This theoretical flexibility needs to be tackled, e.g., by modelling approaches, to allow a better understanding of the processes underlying sleep-dependent memory consolidation.

Keywords: Sleep, memory, theory

Loss of control over binge-watching: Interactions of inhibitory and feedback processing

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Binge-watching may involve a maladaptive interplay of low self-regulation and sensitivity to action consequences such that dysfunctional inhibition and outcome processing might facilitate problematic binge-watching. We examined whether decreased inhibitory and attenuated feedback-related brain activity are coupled in binge-watchers. High (n = 32) and non-binge-watchers (n = 31) performed go/nogo and stop signal tasks and a flanker paradigm with performance feedback during electroencephalography. We assessed the temporo-spatial relationship of inhibition and stopping with outcome processing in each group using a single-trial regression approach. High binge-watchers, but not non-binge-watchers, who differentiated less between gains and losses (feedback-P3b) also recruited less brain activity during both inhibition and stopping (inhibition-P3 and stopping-P3). Additionally, this was specific to individuals with low control over watching. We thus observed a potentially problematic interaction between inhibitory and outcome processing in binge-watchers. Insensitivity to behavioral consequences along with inhibitory impairments may confer a long-term risk for compulsive watching. Our multi-modal approach may be particularly suited to detect such an underlying risk marker.

Keywords: binge-watching, EEG, P300, inhibition, feedback processing

Social performance monitoring: Obsessive-compulsive symptoms and processing of harmful mistakes

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Errors are usually associated with affective distress and errors made in a social context are often even more distressing, as they may not only be noticed by others but may also have consequences for them. They may thus be linked to one's self-image and self-esteem or increased sense of responsibility for others and may elicit feelings of embarrassment. These social performance-monitoring processes, however, have received relatively little attention in research so far. This is surprising as many disorders are characterized by both severe social dysfunctions and aberrant neural correlates of performance monitoring. The general starting premise of research in our lab is therefore that we can only advance our understanding of neurocognitive alterations in psychopathology by including a social perspective and examining individual differences. Over the past years, we have been developing experimental paradigms to investigate relevant social performance-monitoring processes, such as observing others' errors (e.g., highly relevant for psychopathy), making mistakes in the presence of others (e.g., the greatest fear of socially anxious individuals), or making harmful mistakes (e.g., a massive worry for patients suffering from obsessive-compulsive disorder). I will present recent findings from one of these paradigms, the so-called error-responsibility task, and will specifically focus on error-related ERP components following harmful mistakes in healthy volunteers scoring high on obsessive-compulsive symptoms.

Keywords: performance monitoring, social, ERN, obsessive-compulsive, harmful mistakes

Efficacy of transcranial direct current stimulation in modulating aberrant error monitoring in obsessive-compulsive disorder

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Overactive performance monitoring, as indexed by enhanced electrophysiological correlates of error processing, is discussed as a biomarker for obsessive-compulsive disorder (OCD) and may provide a promising target for novel treatment approaches. Non-invasive stimulation of the medial frontal cortex has been found to modulate neural error signals (error-related negativity, ERN; error positivity, Pe) in healthy participants and has promising potential to reduce obsessive-compulsive symptomatology, but no study has yet investigated its efficacy in modulating neural correlates of performance monitoring in OCD.

We conducted a preregistered, double-blind, sham-controlled, crossover study to investigate the modifiability of event-related potentials (ERPs) of error processing using transcranial direct current stimulation (tDCS) in 28 patients with OCD and 28 healthy control participants. Following application of either cathodal or sham tDCS over the medial frontal cortex, EEG was recorded while participants performed a flanker task.

Results indicated that one session of cathodal tDCS reduced ERN and correct-response negativity (CRN) amplitude, albeit the stimulation effect on the ERN was only marginally significant, as were general group differences in these ERPs. Additionally, cathodal tDCS increased Pe amplitude. These ERP modifications were not accompanied by behavioral changes. We found no evidence that the stimulation effect on neural error signals was more pronounced in OCD patients compared to the control group.

Our findings provide tentative evidence that cathodal tDCS over the medial frontal cortex has the potential to modulate neural correlates of performance monitoring, leading to the conclusion that its efficacy to target aberrant error processing in clinical populations deserves further investigation.

Keywords: OCD, performance monitoring, tDCS, event-related potentials, ERN

The predictive validity of ERN and CRN for perceived risk, stress, and internalizing symptoms during the COVID-19 pandemic

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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The COVID-19 pandemic is a major life stressor posing serious threats to physical and mental health and has been linked to increased levels of depression and anxiety. This raises the question of vulnerabilities that make some individuals particularly susceptible to internalizing symptoms following stress. The ERN has been discussed as a neural risk marker for various forms of psychopathology and the present study examined its predictive validity for perceived risk, stress, and psychopathological symptoms during the COVID-19 pandemic. One hundred thirteen individuals who had participated as healthy participants in previous EEG studies (2014-2019) completed a follow-up online survey during the first COVID-19 wave in Germany. Mediation models were used to examine the association of pre-pandemic ERN and CRN with perceived risk, stress, and internalizing symptoms during the pandemic. Results indicate that pre-pandemic ERN and CRN were associated with increased perceived risk for a COVID-19 infection and a severe outcome. Moreover, this perceived COVID-19 risk functioned as mediator for indirect effects of pre-pandemic ERN and CRN on stress during the pandemic. Finally, mediated by perceived risk and increased stress levels ERN and CRN, were associated with increased internalizing symptoms during the pandemic (anxiety, depression, obsessive-compulsive symptoms). This suggests that pre-pandemic ERPs of performance monitoring (ERN, CRN) are useful to predict risk perception, stress, and exacerbation of internalizing symptoms during a real-world stressor such as the COVID-19 pandemic. This further strengthens the assumed role of ERN as a transdiagnostic neural risk marker and highlights the importance of stress for symptom development.

Keywords: performance monitoring, ERN, CRN, psychopathology, prediction

Neural markers of depression - reward processing and attentional allocation as predictors of symptom status, disorder trajectories, and symptom development under stress

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Reward processing and attentional allocation have repeatedly been shown to be associated with clinical depression. In this talk, findings regarding event-related potentials (ERPs) of reward processing (i.e., RewP), sustained attention to emotional stimuli (i.e., LPP), and attentional allocation to task-relevant stimuli (i.e., P300) from two studies will be presented. In the first study, RewP and LPP were assessed in participants with a current affective disorder (n=83) and healthy individuals (n=44). Results indicated that the RewP and LPP were differentially associated to clinical characteristics and both represented independent predictors of depression status, so that employing both ERPs together improved classification accuracy. Moreover, as longitudinal data from that study indicated, both ERPs could be used to predict likelihood of a full remission from depression during a 9-month follow-up, showing that deficits in either reward processing or sustained attention to emotional stimuli could be indicative of a more severe course of depressive disorder. In another investigation in healthy adults, we explored the P300 as a predictor of increases in symptoms during a real-live stressor. Participants of previous EEG studies (n=113) were recontacted during the initial phase of the COVID-19-pandemic in Germany. Results indicated that the P300 measured from a flanker task before the pandemic predicted increases in depressive symptoms during the pandemic, controlling for pre-pandemic symptoms. Altogether, this talk highlights the utility of ERP indices of reward processing and attentional allocation for improved characterization of depression status and prediction of depressive disorder trajectories; implications for clinical application and future studies will be discussed.

Keywords: ERPs, mental health, reward processing, depression, attention

Advances in neurogenetic research on hemispheric asymmetries

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Hemispheric asymmetries represent a major organizational principle of human brain structure and function. Despite their ubiquity in the vertebrate brain, we only begin to understand the complex relationships between ontogenetic influence factors and asymmetries in brain structure and behavior. In the talk, I will highlight recent advances regarding the neurogenetics of hemispheric asymmetries. On the one hand, recent studies using novel structural imaging approaches like neurite orientation dispersion and density imaging (NODDI) and myelin water fraction imaging (MWF) allow for a deeper understanding of microstructural asymmetries. Most previous in-vivo studies have focused on macrostructural asymmetries but often did not find any asymmetric structure-function relationships. Including neurite structure asymmetries as assessed with NODDI may provide an important step for a better understanding of how asymmetries in brain structure generate asymmetries of behavior and brain activity. On the other hand, the use of polygenic scores allows the integration of the results of well-powered large-scale GWAS in smaller neuroimaging studies. This approach has several advantages over the use of single candidate genes. Together, these advances will provide the tools for a better understanding of the ontogenesis and neurophysiology of hemispheric asymmetries.

Keywords: neurogenetics, hemispheric asymmetries, neuroimaging, laterality, asymmetry

The influence of acute stress on frontal alpha asymmetries in EEG

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Stress influences every aspect of the information processing stream – from attention to perception and decision making. Recent studies have demonstrated that stress also influences a fundamental organizational principle of the human brain, namely functional hemispheric asymmetries. Frontal EEG asymmetry has been associated with emotional regulation and the processing of affective states. In the present study, we investigated the influence of acute stress during the Trier Social Stress Test (TSST) and a control condition on asymmetries in alpha band power across the scalp. To this end, we calculated asymmetry scores across frontal, central and occipital regions and compared the stress and control condition. During the control condition, neither frontal, central nor occipital sites demonstrated significant asymmetries in the alpha band power. During the stress condition, frontal alpha power decreased over the right hemisphere indicating a stronger right-hemispheric activation. For central electrodes, there was an increase in right-hemispheric alpha power indicating a stronger left-hemispheric activation. No differences were found at occipital sites. This demonstrates that acute stress induces stronger functional hemispheric asymmetries. These results indicate that acute stress could specifically stimulate the right hemisphere as stress evokes negative emotions, which are predominantly processed by the right hemisphere. Since some studies postulate that the right hemisphere is especially involved in the regulation of the HPA-axis, it could be speculated that frontal alpha asymmetries play a role in the endocrinological stress response. This dysregulation may play a vital role in the development of several mental disorders.

Keywords: Stress, Cortisol, Asymmetry, mental Disorders, frontal alpha, EEG

Increasing ecological validity in laterality research using mobile EEG

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Laboratory research is a fundamental requirement for advancing research in controlled environments. However, the question often remains how much external validity experimental findings have that were conducted in lab conditions. Recent advancements in the field of mobile neural recording techniques such as EEGs have allowed for transporting laboratory research back to the field. In my talk, I will present findings on emotional and motor asymmetries that were tested in real-life conditions such as kissing of romantic partners, playing football or being in virtual reality scenarios to investigate the neural basis of fear.

Keywords: MoBi, mobile EEG. lateralization, asymmetry, emotion, handedness, footedness

Is it left or right? A classification approach for investigating hemispheric differences

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Differences between the hemispheres can be summarized as asymmetries in structure or function. Structural asymmetries are often depicted as local hemispheric differences in gray matter areas or white matter tracts. However, investigating hemispheric differences with conventional strategies comes with several limitations, including the effect of the chosen brain parcellation and the need for big sample sizes. Additionally, local asymmetries do not reflect potential differences in the general hemispheric architecture. Here, we tested a new machine learning-based framework for investigating hemispheric differences, applicable to both high- and low-dimensional data.

Using symmetrical voxel-based morphometry data from two open-access databases (AOMIC; n=226, n=216), we split the brain images along the midline and flipped the left onto the right hemisphere. Subsequently, we tested the classifiability of hemispheres based on their high- (voxelwise) and low-dimensional (UMAP) representations using LASSO and SVM. In addition, Boruta feature selection was applied to find voxels that accurately differentiate the two hemispheres.

Results indicate that hemispheres are classifiable based on morphometric data in both low- and high-dimensional space, with very high accuracy in the latter (low-dim: sample1 ≈ .838; sample2 ≈ .850; high-dim: sample1 ≈ .966; sample2 ≈ .959). Voxels that were important for accurate classification showed high laterality indices and were situated in regions that have been reported to be asymmetric in previous studies.

Our study indicates the feasibility of the classification framework for identifying hemispheres and its potential for detecting hemisphere-determining features, which makes it useful for laterality researchers. Scripts will be made available via Github.

Keywords: Brain asymmetry, hemispheres, classification, machine learning, voxel-based morphometry

Towards a unified view of lateralized vision

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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While functional lateralization of the human brain has been a widely studied topic in the past decades, few studies to date have gone further than investigating lateralization of single, isolated processes. With the present study, we aimed to arrive at a more unified view of how lateralization of face processing and of word processing relate to each other and to that of associated lower-level processing, that is, of lateralization patterns. We tested a large and heterogeneous participant group, and used a number of tasks that had been shown to produce replicable indices of lateralized processing of visual information of different types and complexity. Following Bayesian analyses, group-level analyses showed the expected right hemisphere (RH) lateralization for face, global form, low spatial frequency processing, and spatial attention, and left hemisphere (LH) lateralization for visual word and local feature processing. Compared to right-handed individuals, lateralization patterns of left-handed and especially those who are RH-dominant for language deviated from this 'typical' pattern. Our results support the notion that face and word processes come to be lateralized to homologue areas of the two hemispheres, under influence of the RH- and LH-specializations in global form, local feature, and low and high spatial frequency processing. As such, our data provide evidence for the input asymmetry and causal complementarity principles of lateralized visual information processing. The absence of correlations between spatial attention and lateralization of the other processes supports the notion of their independent lateralization, conform the statistical complementarity principle.

Keywords: laterality, visual perception, handedness, face processing, word processing

Somatosensory perception and active visual sampling vary across the cardiac cycle

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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The processing of signals in the environment is influenced by spontaneous activity not only in the brain but also in the heart. During each cardiac cycle, when the ventricles contract and eject blood into the arteries (i.e., systole), stretch-sensitive baroreceptors signal blood pressure changes to the brainstem and (sub)cortical brain regions. During diastole, the ventricles relax and baroreceptors remain inactive.

In two independent studies with healthy adults (total n=70, 26±4 years), passively presented near-threshold somatosensory stimuli were more likely to be perceived when they were presented during later (i.e., diastole) compared to earlier phases (i.e., systole) of the cardiac cycle. Using simultaneous EEG, we found higher heartbeat-evoked potential amplitudes over somatosensory electrodes to be associated with lower detection rates and lower somatosensory-evoked potential amplitudes.

Instead of passively receiving signals that coincide with certain neural or cardiac states, animals actively explore their environment and interact with it. Movement-based sensory sampling (i.e., active perception) can align sensory inflow to time points that are optimal for information processing. This was shown for eye movements, which are preferentially generated at specific phases of oscillatory activity in the brain and the heart (i.e., systole). In study 3, healthy adults (n=47, 26±4 years) actively prompted the onset of briefly presented pictures, which they had to memorise, by self-paced button press. Pictures were preferentially displayed during systole, while recognition memory was not affected by the heartbeat.

In conclusion, how we perceive the world and engage with it also depends on the state of our heart.

Keywords: brain, heart, perception, action, interoception

How cardioafferent traffic modulates the processing of response conflicts

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Neural projections originating from peripheral receptors within the cardiovascular system have been shown to impact on central nervous processing of exteroceptive stimuli. Cardioafferent signals are processed mainly in the insula and anterior cingulate cortices, areas that are also critically involved in conflict and error monitoring. Indeed, recent evidence suggests that these processes may be influenced by cardioafferent signaling. Here, we will present electrophysiological and behavioral data on how cardioafferent traffic modulates the processing of response conflicts. In a series of experiments, lateralized tactile, auditory and visual stimuli were presented synchronized to the ECG during either high (systole) or low (diastole) cardioafferent traffic. Participants were asked to respond to the stimuli with either spatially compatible or incompatible manual button presses. Along with behavioral parameters, event-related lateralizations (ipsi-contra differences, ERLs) were analyzed time-locked to stimulus and response onset in the EEG. We found that spatially compatible responses to auditory but not tactile stimuli were speeded during systole, whereas incompatible reactions were slowed. Moreover, this was also reflected in the EEG by a distinct modulation of compatibility effects in ERLs at frontocentral recording sites during systole but not diastole. Finally, in a visual Simon task we found speeded reactions and increased ERLs during systole, however, this effect was not moderated by spatial stimulus-response compatibility. In sum, these results suggest a role of cardioafferent traffic in the processing of spatial stimulus-response conflicts but the effects also seem to depend on stimulus modality and task parameters.

Keywords: cardiovascular, conflict processing, electrophysiology, body-brain interactions

Removing the cardiac field artefact from the EEG using neural network non-linear regression

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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When measuring EEG, the electric field generated by cardiac activity is captured by the scalp electrodes as the cardiac field artifact (CFA). In most experimental setups CFA related variance is unsystematic and therefore diminished by averaging procedures when parameterizing the EEG signal. This is not the case, however, when the variance of interest happens to be time-locked to cardiac activity. In studies investigating heartbeat evoked potentials or in studies deploying stimulation at certain phases of the cardiac cycle, the CFA might become a dominant feature and a confound in averaged measures like the ERP or time frequency decompositions. We present a non-linear regression approach deploying neural networks to remove the CFA from the EEG signal. The core concept of the approach is to use R-peak centered episodes that are free of systematic variance elicited by experimental stimulation to train neural network models to predict the EEG signal from the ECG signal. In a second step, these trained models can then be used to predict the EEG from ECG during episodes with experimental stimulation (i.e. during trials). We show for lateralized visual stimuli presented time-locked to the ECG, that removing these predictions from the signal effectively removes the CFA from the signal without affecting stimulus-related variance.

Keywords: EEG, ECG, neural networks, regression, artifact removal

Neural divergence and convergence for attention to and detection of interoceptive and somatosensory stimuli

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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Body awareness is constructed by signals originating from within and outside the body. How do these apparently divergent signals converge? We developed a signal detection task to study the neural convergence and divergence of interoceptive and somatosensory signals. Participants focused on either cardiac or tactile events and reported their pres- ence or absence. Beyond some evidence of divergence, we observed a robust overlap in the pattern of activation evoked across both conditions in frontal areas including the insular cortex, as well as parietal and occipital areas, and for both attention and detection of these signals. Psycho-physiological interaction analysis revealed that right insular cortex connectivity was modulated by the conscious detection of cardiac compared to somatosensory sensations, with greater connectivity to occipito-parietal regions when attending to cardiac signals. Our findings speak in favour of the inherent convergence of bodily-related signals and move beyond the apparent antagonism between exteroception and interoception.

Keywords: Interoception, Exteroception, MRI, Attention, Heartbeat Detection Task

Enhanced responsiveness of heartbeat-evoked potentials to attention focused on heartbeats in high somatic symptom distress: a neurophysiological explanation for medically-unexplained symptoms

Date & time: Friday, 4 June 2021 - 08:30 - 10:00

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The psychobiological mechanisms underlying somatic symptom generation remain unclear. In the perception filter model, it is posited that (1.) enhanced bodily signal transmission and (2.) decreased CNS filter function promote (3.) increased perception physical symptoms. As there is a scarcity of empirical evidence to support this model, we addressed this issue in the current project. In Study 1, we identified extreme groups of high (HSR; n=29) and low symptom reporters (LSR; n=29). In Study 2, we recruited 23 patients with somatic symptom disorder (SSD), 24 clinical control patients with major depression (MDD) and 25 healthy control individuals. Heart rate (HR), heart rate variability (HRV) and diurnal cortisol release were assessed as indicators of (1.) signal transmission. Heartbeat-evoked potentials (HEPs) served as indicators of (2.) CNS filter functions. Interoceptive accuracy (IAc) in heartbeat perception tasks may reflect (3.) perception of physical signals. Individuals with high symptom distress showed (1.) higher resting HR and lower RMSSD HRV, but no differences in cortisol release. In contrast to our expectations, (2.) higher HEP reactivity to attention focused on heartbeats reflect higher filter function in individuals with higher symptom distress. Finally, we did not observe differences in (3.) IAc between groups. The model assumptions could only be partially confirmed: SSD may be associated with (1.) stronger bodily signals, but (2.) higher CNS filter function. As more attentional resources are mobilized to process heartbeats, but perception accuracy remains unchanged (3.), this overspill could be responsible for detecting minor bodily changes contributing to somatic symptom generation.

Keywords: heartbeat-evoked potentials, heart rate variability, interoception, somatic symptoms, stress

Brain-derived neurotrophic factor (BDNF) in acute stress settings: exploring associations to cortisol and hippocampal volume as neuro-endocrine markers of stress and health

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Antagonistic long-term effects of BDNF and cortisol on neuroplasticity are well-described: While BDNF facilitates neuronal differentiation and survival, excess cortisol downregulates BDNF and can cause neuronal atrophy. We recently investigated the acute crosstalk of serum BDNF (sBDNF) and salivary cortisol during the Trier Social Stress Test (TSST) and found that sBDNF levels were stress-sensitive. While sBDNF post-stress increases were uncorrelated with cortisol reactivity, results indicated acute inverse relationships of sBDNF peak with cortisol recovery, and of post-stress sBDNF decline with cortisol reactivity. Resembling their long-term antagonism, the acute sBDNF-cortisol pattern potentially reflects integrity and functionality of stress-regulatory circuits.

Pivotal in this regard, the hippocampus facilitates timely downregulation of the stress response and is particularly sensitive to the opposing effects of BDNF and cortisol. Building on our previous findings, we hypothesized stress-reactive sBDNF increases to be associated with hippocampal volume (HCV) in the same healthy participants, reflecting adaptive stress-responding. Additionally, we hypothesized that basal. (non-reactive) BDNF levels would predict HCV. While studies in vulnerable populations suggest that peripheral BDNF levels correlate with HCV, their relationship in healthy adults is only insufficiently characterized.

To address both hypotheses, we conducted a registered report investigating the relationships of basal and stress-reactive sBDNF levels with HCV. Contrary to our preregistered hypotheses, both basal sBDNF and stress-reactive sBDNF changes were unassociated with hippocampal (subfield) volumes of healthy individuals.

These null-results suggest that sBDNF may only signal HCV differences in individuals at increased risk for neurodegeneration, thus providing initial evidence for their relation in healthy mid-aged adults.

Keywords: BDNF, cortisol, acute stress, hippocampus, neuroplasticity

Serum BDNF increase and the role of cortisol reduction following contemplative mental training

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Lara Puhlmann* (1,2), Veronika Engert (1,3), Roman Linz (1), Ioannis Papassotiriou (4), George Chrousos (5), Pascal Vrticka (1,6), Tania Singer (7)

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Chronic stress reduces expression of the brain derived neurotrophic factor (BDNF), and the stress-hormone cortisol in particular has been implicated in BDNF downregulation. Alleviating subjective stress load and cortisol exposure may thus enhance BDNF expression. Growing evidence shows that contemplative mental training interventions, such as mindfulness-based stress reduction, can reduce self-reported and physiological stress indices. As part of the ReSource Project, we therefore investigated whether a nine month long contemplative mental training intervention increases circulating serum BDNF levels in 332 healthy adults. Participants were randomly assigned to either a control group or one of three intervention cohorts. Training consisted of three distinct 3-month long modules focusing on 1) attention and interoception, 2) socio-affective skills or 3) socio-cognitive skills, which were trained in counterbalanced order. The first three months of attention and interoception-based training increased BDNF levels. This change was associated with individual decreases in self-reported stress. At six and nine months of training, BDNF remained relatively stable in the cohort training first socio-affective, then socio-cognitive skills, and continued to increase for the reverse sequence. BDNF levels in the control cohort were comparatively unstable. In the combined training cohorts, mediation analyses revealed an indirect effect of training on BDNF via lowered cortisol levels in hair. These data suggest that mental training may enhance BDNF expression by reducing participants' perceived stress load and long-term cortisol exposure. Non-pharmacological BDNF-boosting could be a promising approach for translational treatment or to enhance resilience against the development of stress-related mood disorders in non-clinical populations.

Keywords: serum BDNF, contemplative mental training, cortisol, stress

BDNF DNA methylation following narrative exposure therapy in former female child soldiers from the Eastern Democratic Republic of Congo

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Brain-derived neurotrophic factor (BDNF) acts on the central and peripheral nervous system and plays a prominent role in long-term memory, which is often disorganized in trauma-related mental disorders. Moreover, BDNF DNA methylation and expression are sensitive to stress and are associated with trauma-related disorders. The aim of this study was to examine the association between BDNF DNA methylation and stress-related symptom improvement in response to an evidence-based trauma treatment compared with control treatments in a sample of severely traumatized women.

Former female child soldiers from the DR Congo (N=82) were randomly assigned to either receive narrative exposure therapy (NET, n=42), or treatment as usual (TAU, n=40). DNA methylation of 126 CpGs located on the BDNF gene was measured in salivary DNA samples collected at baseline and 6 months following treatment using the Illumina EPIC array. Symptoms of PTSD and depression were measured before and after treatment using the Posttraumatic Stress Symptoms Scale-Interview and the Patient Health Questionnaire-9, respectively.

Compared to TAU, NET substantially improved the mental health of the survivors. Change in BDNF DNA methylation in 7 CpGs also depended on treatment group (NET vs TAU). Moreover, change in methylation of several CpGs was correlated with changes in PTSD and depressive symptom severity (PTSD: 10 CpGs; depression: 4 CpGs), five of these CpGs were associated with stress and mental health in previous studies.

Our findings show a relation between epigenetic modification of BDNF and improvement of stress-related mental disorders, indicating that NET may initialize a sequence of physiological changes.

Keywords: brain-derived neurotrophic factor, depression, epigenetics, posttraumatic stress disorder, psychotherapy

BDNF plasma levels and BDNF exon IV promotor methylation as predictors for antidepressant treatment response

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Although the currently available antidepressants are well established and safe, treatment outcomes are poor, highly unpredictable and there is a strong variability in treatment response of individual patients. To date, there is no no biological marker of sufficient clinical utility to inform the selection of specific antidepressant compound for an individual patient. Previous studies have linked the neurotrophin BDNF with both the pathophysiology of depression and the mode of action of antidepressants. Here, we present findings of a large cohort of MDD patients (N=561), which all participated in the Early Medication Change trial. We measured BDNF exon IV promotor and p11 gene methylation at baseline as well as repeated measurements of plasma BNDF during the course of antidepressant treatment and related them to treatment outcome. We could show, that patients with severe depression (Hamilton Depression Rating Scale [$HAMD_{17}$] ≥ 25] and hypermethylation at CpG-87 of BDNF exon IV promotor had significantly higher remission rates than patients without methylation (p=0.032). We also found that the combination of clinical outcome parameters (e.g. early improvement; defined as a ≥ 20% $HAMD_{17}$ reduction after two weeks) in combination with an increase of pBDNF led to a higher specifity of response prediction. In addition, we will report data of a subgroup of MDD patients, suffering from cognitive impairment (memory and executive dysfunctions), and the potential role of pBDNF in the normalization of these impairments.

Keywords: BDNF, antidepressant response, response prediction, cognitive impairment

BDNF IV methylation and antidepressant treatment response - from bench to bedside

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Medizinische Hochschule Hannover, Deutschland

Treatment of patients with depressive disorders normally includes monoaminergic antidepressant medication like serotonine reuptake inhibitor (SSRI). Only one in three patients sufficiently responds to this therapy. We have recently shown that methylation of one single CpG dinucleotide within the promoter region of exon IV of the BDNF gene predicts non-responsiveness towards monoaminergic antidepressants. In the talk, most recent data from different clinical cohorts will be presented, as well as data on the putative molecular mechanisms behind this biomarker. Furthermore, first experiences with the clinical use of the biomarker will be presented and a biomarker based therapy algorithm for acute depression will be discussed.

Oxytocin changes behavior and spatio-temporal brain dynamics underlying inter-group conflict in humans

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Inter-group conflicts drive human discrimination, mass migration, and violence, but their psychobiological mechanisms remain largely unknown. In my talk I will present research investigating whether the neuropeptide oxytocin modulates behavior and spatio-temporal brain dynamics in naturalistic inter-group conflict. Eighty-six male members of natural rival social groups received either oxytocin or placebo intranasally. In a decision-making paradigm involving real monetary stakes, participants could sacrifice their own resources to modulate the monetary gains and losses of in- and out-group members. Oxytocin eliminated the reduction in out-group gains – particularly in individuals with low emotional empathy, whereas those given placebo exhibited this negative social behavior. Our spatio-temporal analysis of event-related potentials elicited by outcome valuation revealed that oxytocin replaced a neurophysiological process associated with the negative valuation of out-group gains via a process associated with positive valuation between 200-500ms after outcome presentation. Oxytocin thus seems to modulate inter-group behavior in humans via a specific alteration of valuation-related brain dynamics.

Keywords: inter-group conflict, EEG, social behavior, oxytocin

Neural dynamics of racial categorization predicts racial bias in face recognition and altruism

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Yuqing Zhou*

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The classification of individuals into different racial groups provides a precondition for racial bias in cognition and behaviour, but how the brain enables spontaneous racial categorization is not fully understood. Here using multimodal brain imaging measures, including electroencephalography and magnetoencephalography, we probe the neural dynamics of racial categorization by quantifying the repetition suppression of neural responses to faces of different individuals of each racial group (that is, Asian, black or white). We show that categorization of other-race faces engages early two-stage dynamic activities in neural networks consisting of multiple interactive brain regions. Categorization of same-race faces, however, recruits a different and simple network in a later time window. Dynamic neural activities involved in racial categorization predict racial biases in face recognition and altruistic intention. These results suggest that there are distinct neural dynamics by which the brain sorts people into different racial groups as a social ground for cognition and action.

Keywords: racial bias, EEG, MEG, neural dynamics

Promises and perils of vicarious interracial contact

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Susanne Quadflieg*

University of Bristol, Vereinigtes Königreich

Vicarious contact theory postulates that people's prejudice against racial outgroups weakens upon witnessing positive inter-racial contact between members of their own and another racial group. At this point, however, it remains uncertain how such inter-racial contact is interpreted and evaluated from a third-person perspective. To overcome this empirical lacuna, the current talk provides both behavioural (Study 1) as well as neuroscientific (Study 2) evidence that Black as well as White observers respond less favourably toward positive third-party contact that involves Black and White individuals rather than solely Black or White individuals. Study 1 uses a sequential priming paradigm to show that participants (regardless of their ethnicity) associate negative concepts more quickly with images of inter-racial than intra-racial contact, but positive concepts more quickly with intra- than interracial contact. Study 2 replicates this finding and complements it by demonstrating that watching inter- compared to intra-racial contact is associated with systematic neural differences in the brain's mentalizing and social reward networks, indicative of different impression formation strategies for both types of contact. In combination, the data point towards the existence of racial prejudice at the dyadic level. Implications of this finding for vicarious contact theory are discussed.

Keywords: dyad perception, contact theory, mentalizing, prejudice, social evaluation

Intolerant of being tolerant? The impact of intergroup toleration on relative left frontal EEG activity and outgroup attitudes

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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1: University of Alberta, Canada; 2: University of Canterbury; 3: Utrecht University

Increases in cultural and religious diversity have led to calls for toleration of differences, although it is unclear how toleration impacts affective and attitudinal responses. The current research examines if calling for toleration of Muslim minority practices elicits a backlash against the group amongst those relatively more conservative. We also indexed relative left frontal EEG activity to examine the underlying motivational processes. Non-Muslim participants from New Zealand (N = 172) self-reported their political orientation before being randomly assigned to a toleration condition or a control condition involving reflection about Muslim practices. Participants then evaluated various groups including Muslims while EEG was recorded. Results showed that among those relatively more conservative, toleration produced higher levels of relative left frontal EEG activity, indicating an angry or defensive response, which in turn led to more negative evaluations of Muslims (relative to control participants). However, for those relatively more liberal, toleration had no impact on neuropsychological or attitudinal responses relative to controls. Collectively, these findings suggest that intergroup toleration may backfire amongst those relatively more conservative, undermining its intended purpose.

Keywords: toleration, political orientation, intergroup attitudes, EEG, relative left frontal EEG activity

How learning from outgroups affects prosocial motivation and health

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Grit Hein*

Universität Würzburg, Deutschland

In globalized societies, contact with individuals from different social groups (outgroup members) are the rule rather than the exception. In my presentation, I will discuss recent evidence on how experiences with outgroup member shape prosocial motivation, and responses to aversive events such as pain. The presented studies use a computational learning framework that allows for modelling the effect of individual outgroup experiences over time. Combining learning models and functional magnetic resonance imaging (fMRI) revealed that a relatively small number of unexpected positive experiences with outgroup individuals can increase empathy towards other individuals of the same group. Moreover, unexpected positive effects of outgroup treatment can enhance learned placebo analgesia, reflected by a decrease in subjective and neural responses to pain. Together, the presented results show that classical learning mechanisms can shape outgroup prejudices and intergroup relations, with important consequences for individuals' well-being and health.

Keywords: fMRI; ingroup; learning models; pain

Hippocampal vascularization as a potential reserve factor

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Niklas Vockert*

Deutsches Zentrum für Neurodegenerative Erkrankungen

The hippocampus within the medial temporal lobe (MTL) is highly vulnerable to age-related pathology such as vascular disease. Technical advances in MRI recently enabled the visualization of hippocampal blood vessels at an unprecedented resolution, permitting the classification of hippocampal vascularization patterns (HVP) in vivo. Dual-supply hemispheres with a contribution of the anterior choroidal artery to hippocampal blood supply can be distinguished from single-supply ones with a sole dependence on the posterior cerebral artery. In an older cohort of 47 patients with cerebral small vessel disease and controls, a dual vascular supply was positively associated with measures of cognition and brain structure. Notably, structural differences associated with the HVP were observed specifically in the anterior MTL, but also in relation to total grey matter volumes, indicating that the HVP has more far-reaching structural implications beyond the MTL. Hence, an augmented hippocampal vascularization might contribute to maintaining structural integrity in the brain and preserving cognition despite age-related degeneration.

Keywords: hippocampus, vascularization, brain reserve

Anterior medial temporal lobe networks and memory for objects are affected in early stages of Alzheimer's disease

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

David Berron*

Deutsches Zentrum für Neurodegenerative Erkrankungen, Deutschland

Memory networks in the human medial temporal lobe and the neocortex support different types of memory. On the other hand, Alzheimer's disease pathology affects these memory networks differentially in early disease stages. This holds the promise to identify cognitive markers for early identification of Alzheimer's disease related memory impairment. I will show data demonstrating that tau neurofibrillary tangle pathology predominantly affects brain regions in the anterior medial temporal lobe that have been reported to support critical memory functions. Using functional magnetic resonance imaging and a memory paradigm comparing memory for objects and scenes, I will show that brain regions that are primarily involved in memory for objects overlap with the spatial distribution of early tau pathology in AD and show aberrant activity in healthy ageing. Finally, I will show that in particular memory performance for objects, but not scenes, is associated with measures of tau pathology in patients with preclinical Alzheimer's disease. This work suggests that cognitive measures targeting mnemonic functions related to the anterior medial temporal lobe might be particularly suitable to detect the earliest cognitive impairment in Alzheimer's disease.

Keywords: memory networks, fMRI, Alzheimer's disease

Simulation-induced learning: Episodic simulations shape real-life attitudes

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Humans can vividly simulate prospective episodes. This ability draws on our existing knowledge (e.g., of people and locations) to create an imaginary parallel to actual experience (e.g., of meeting a person at a location). Recent evidence suggests that we learn from such simulated experiences much as from actual experiences. In an initial study, we showed that merely simulating familiar people (serving as unconditioned stimuli; UCS) at known locations (conditioned stimuli; CS) changes people's attitudes towards the locations. Here, we further test the hypothesis that such simulation-based learning entails a merging of the representations of the UCS and CS and thus a transfer of value from the UCS to the CS. Consistent with this account, we first show that (i) repeated simulations strengthen the associations between the paired CS and UCS and that (ii) – compared to a neutral baseline – positive UCS lead to an upward shift and negative UCS to a downward shift in people's attitude towards the respective CS. Notably, simulations featuring liked and disliked people were characterized by increased levels of skin conductance and the transfer of value can be accounted for by the affective experience during the simulations. The data thus support the hypothesis that we can learn from affective episodic simulations much as we learn from actual experience.

Keywords: Long-term memory, learning, episodic simulation, attitude change, transfer of value

The neocortex rapidly acquires a content-specific representation of naturalistic learning material

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Katja Kleespies* (1), Madeleine W. Sumner (2), Elizabeth A. McDevitt (2), Christopher Baldassano (3), Uri Hasson (2), Kenneth A. Norman (2), Monika Schönauer (1)

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Traditional theories of long-term memory formation assume that the neural traces which encode new memories are rapidly formed in the hippocampus and then slowly shifted to the neocortex, where acquired memory contents become integrated and semanticized over the course of weeks or months. However, recent studies emphasize the importance of neocortical areas such as posterior medial cortex (PMC) or medial prefrontal cortex already early in memory formation. We tested whether the neocortex not only functionally contributes to encoding and retrieval, but also quickly represents the specific content of learning material when participants engage with new and complex naturalistic stimuli. Participants (N=40) encoded and freely recalled audio-visual movies depicting either restaurant or airport scenes. They repeated this multiple times while their brain activity was measured with functional magnetic resonance imaging. Using multivariate pattern analyses, we identified brain regions involved in the learning and retrieval of the movie material by representing the content of the narratives. Here, a comparison of the similarity of neural activation patterns within and between movies set in restaurants or airports revealed that only in the PMC and inferior parietal lobule, patterns within movie conditions were more similar than between movie conditions. Because movie content could be reliably separated in the parietal cortex, we suggest that it harbors a memory trace. Together with other recent studies on rapidly formed engrams in the parietal cortex, our results challenge traditional assumptions on long-term memory formation. The neocortex can acquire complex, content-specific memory representations already early in the learning process.

Keywords: systems memory consolidation, long-term memory, parietal cortex, representational similarity analysis, naturalistic stimuli

Sleep benefits memory retention by stabilizing functional activity and enhancing hippocampal independence in the posterior medial memory network, thalamus and striatum

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Svenja Brodt*

Universität Tübingen, Deutschland

Sleep has robustly been shown to benefit declarative memory consolidation on a behavioral level, the underlying mechanisms in terms of functional activation of mnemonic brain networks however remain unclear. While most report an increase in cortical activation across sleep, results on subcortical involvement diverge (Gais et al 2007; Himmer et al 2019; Takashima et al 2009). Here, we aimed to assess the role of sleep on memory-related brain activity in cortical and subcortical networks.

Participants repeatedly learned object-place associations in two sessions spaced 13 hours apart. The wake group (n=19) encountered task session 1 in the morning, spent the day awake and returned for session 2 in the evening. The sleep group (n=20) completed session 1 in the evening, slept at home with mobile polysomnography and returned the next morning. Task-related functional brain activity was recorded via fMRI.

Behaviorally, sleep benefitted memory retention. This effect was accompanied by a stabilization/decrease of functional brain activity during recall across sleep/wake in the precuneus, striatum and thalamus. Upregulation of activity in these areas was associated with behavioral benefits. Furthermore, the three regions displayed reduced connectivity to the hippocampus specifically across sleep, with lower hippocampal connectivity of the thalamus and striatum relating to better memory performance in addition to the effect of activation increase.

Together, our analyses show that sleep might benefit memory retention by stabilizing memory-related brain activity and increasing hippocampal independence of a mnemonic network encompassing posterior medial cortex as well as subcortical regions like the thalamus and striatum.

Keywords: memory, sleep, neocortex, striatum, thalamus

Patho- and therapyepigenetics of anxiety and stress-related disorders

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Epigenetic mechanisms such as DNA methylation are biochemical modifications of the DNA or its spatial structure. They regulate gene function, can be modified by environmental influences and are temporally dynamic. Altered DNA methylation patterns are not only implied in the mediation of environmental factors towards increasing – or decreasing – the risk for mental disorders, but have moreover been suggested as predictors and signatures of treatment response.

Here, recent findings on DNA methylation in candidate genes (*MAOA*, *SLC6A4*, *OXTR*) will be reviewed with regard to categorical diagnoses of mental disorders such as panic disorder, specific phobia and obsessive-compulsive disorder (OCD). Also, the role of DNA methylation as a predictor or dynamic correlate of psychotherapeutic treatment response applying a 'therapy-epigenetic' approach in anxiety disorders and OCD will be discussed.

Epigenetic research carries great potential for clinical application and is hoped to in the future move the field towards more targeted, personalized and innovative treatment options in line with a 'precision medicine' approach.

Keywords: DNA methylation, epigenetics, psychotherapy, treatment outcome

Predictive value of clinical data, process variables and brain imaging data for treatment outcome in spider phobia

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Elisabeth Leehr* (1), Kati Roesmann (2,3), Kevin Hilbert (4), Ramona Leenings (1), Joscha Böhnlein (1), Jonathan Repple (1), Fabian Seeger (5), Hanna Schwarzmeier (5), Bettina Gathmann (6), Martin Herrmann (5), Niklas Siminski (5), Markus Junghöfer (3), Thomas Straube (6), Ulrike Lüken (4), Udo Dannlowski (1)

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Evidenced-based psychotherapeutic interventions, e.g. exposure therapy, for anxiety disorders are available. Still, knowledge about theranostic markers for personalized therapy is missing. Identifying bio-behavioral markers of treatment (non-)response for exposure therapy might advance individual treatment selection in terms of precision medicine and improve response rates.

Clinical features, treatment process variables and brain imaging data were used to identify markers for treatment outcome. Data at baseline and post-treatment is available from n=187 patients with spider phobia receiving a one-session virtual-reality exposure treatment (VRET). An external cross-validation protocol based on a bi-centric study design was used to evaluate the robustness and generalizability of predictors identified.

One session of VRET was highly effective on a group-level and showed long-term stability (~6 month). Within-session fear reduction, but not expectancy violation and initial fear activation showed significant association with treatment outcome. Clinical data predicted individual short-term symptom reductions above chance, but accuracies dropped to non-significance in the between-site prediction and for predictions of long-term outcomes. Treatment process variables were predictive regarding combined long-term reduction of symptoms and behavioral avoidance. Preliminary analysis regarding the brain data revealed smaller left amygdala volumes and larger gray matter volumes in the left medial superior frontal gyrus in responders as morphometric moderators of treatment outcome (Münster site).

The study offers the exceptional possibility to investigate theranostic markers for a model disorder of fear circuitry dysfunctions. Results of this study might further bridge the gap between basic and clinical research and – as a long-term goal – bring stratified therapy approaches into reach.

Keywords: treatement outcome, prediction, anxiety disorders

Overgeneralization of fear is associated with later non-response to virtual reality exposure therapy in spider phobia – evidence from magnetoencephalography

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

Kati Roesmann* (1,2), Elisabeth J. Leehr (3), Joscha Böhnlein (3), Christian Steinberg (2), Fabian Seeger (4), Hanna Schwarzmeier (4), Bettina Gathmann (5), Niklas Siminski (4), Martin J. Herrmann (4), Udo Dannlowski (3), Ulrike Lueken (6), Tim Klucken (1), Kevin Hilbert (6), Thomas Straube (5), Markus Junghoefer (2)

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As overgeneralization of fear is considered a crucial pathogenic marker of anxiety disorders, we investigated associations of pre-treatment fear generalization and treatment success. 90 patients with spider phobia (SP) completed a One-Session Virtual Reality Exposure Therapy, a clinical and a magnetoencephalography (MEG) assessment before, and a clinical assessment after therapy. Based on self-reported symptom reductions in the Spider Phobia Questionnaire, patients were categorized as responders (> 30% reduction) or non-responders. The MEG-assessment consisted of baseline, conditioning, and subsequent generalization phases. In the conditioning phases, aversive unconditioned stimuli (US) were either paired or never paired with differently tilted Gabor gratings (CS+, CS-). In the subsequent generalization phase, fear ratings, US expectancy ratings and event-related fields to CS+, CS- and seven different generalization (GS) stimuli that ranged on a perceptual continuum from CS+ to CS- were obtained. Non-responders compared to responders showed behavioral overgeneralization indicated by more linear generalization gradients in fear ratings. Analyses of MEG source estimations revealed that linear generalization gradients in frontal clusters also differentiated between (later) non-responders and responders. While stronger (inhibitory) frontal activations to safety-signaling CS- and GS compared to CS+ declined over time in non-responders, responders maintained these activations at early and late processing stages. Results provide initial evidence that pre-treatment differences of behavioral and neural markers of fear generalization may hold predictive information regarding later responses to behavioral exposure. Our findings demonstrate the relevance of inhibitory learning functions and their spatio-temporal neural reflections in this interplay.

Keywords: exposure therapy, treatment outcome, fear generalization, MEG, anxiety disorders

Brain activity predicting behavioural outcomes in a combined neuromodulation and inhibitory control task in patients with binge eating disorder

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Background: Impaired inhibitory control, particularly towards food stimuli, might represent a risk factor for Binge Eating Disorder (BED). Inhibitory control means the ability to suppress a dominant behaviour and is localized in the dorsolateral prefrontal cortex (dlPFC). We are developing a computer-based training programme to increase inhibitory control that is supported by transcranial direct current stimulation.

Methods: We assess food-related inhibitory control in patients with BED in a double blind study with a so-called antisaccade task via eye tracking at baseline with electroencephalography (EEG, T0) and anodal stimulation of the right dlPFC (1mA vs. 2mA) vs. sham stimulation in a crossover design (T1, T2). The aim of this study is to explore, if neurological markers for inhibitory control from the EEG (ERN, P3, N2) are involved in the execution of the antisaccade task and if they are predicting outcomes at T1 and T2.

Results: There was a stable learning effect in the antisaccade task over time and over stimulation conditions. Additionally, patients in the 2 mA vs. sham condition improved in the task and in binge eating frequency in the 2 mA condition, but not in the 1 mA condition. All EEG markers differed at erroneous antisaccade trials from right antisaccade trials and especially P3 predicted task outcomes at T1 and T2.

Conclusion: Inhibitory control and attentional processes are involved in this task and related to improvements, which suggests that a direct training of food-related inhibitory control constitutes a promising treatment approach in patients with BED.

Keywords: binge eating disorder, inhibitory control, neuromodulation

Attention networks and the intrinsic network structure of the human brain

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Attention network theory states that attention is not a unified construct but consists of at least three independent and distributed networks: an alerting network to deploy attentional resources in anticipation of upcoming events, an orienting network to direct attention to a cued location, and a control network to select relevant information at the expense of concurrently available information. While ample behavioral and neuroimaging evidence supports the dissociation of the three attention domains, it remains elusive whether the domains are actually realized by separable networks. Our understanding of brain networks has advanced majorly in the past years due to the increasing focus on brain connectivity. It is well established that the brain is intrinsically organized into several large scale networks whose modular structure persist across task states. Existing proposals on how the presumed attention networks relate to intrinsic networks rely mostly on anecdotal and partly contradictory arguments. We addressed this issue by mapping different attention networks with highest spatial precision at the level of cifti-grayordinates in N = 78. Resulting group maps were compared to the group-level topology of 23 intrinsic networks which we reconstructed from the same participants' resting-state fMRI data. We found that all attention domains recruited multiple and partly overlapping intrinsic brain networks. At the same time, we also observed a preference of each attentional domain for its own set of intrinsic networks. These networks, however, did not match well to those proposed in the literature. Our results indicate a necessary refinement of the attention network theory.

Keywords: attention, connectome, network neuroscience; resting-state fMRI

Intrinsic brain network dynamics and general intelligence

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Intelligence predicts important life outcomes such as educational and occupational success. Recent advances in network neuroscience suggest variations in the modular organization of resting-state brain networks as promising neural marker of general intelligence. However, while intelligent behavior implies flexibility in adaption to changing demands, it has so far been an open question whether and how flexible changes in the configuration of brain networks relate to variations in general intelligence. In a first study we modeled subject-specific time-varying intrinsic connectivity networks from fMRI time series (N = 281) with a sliding-window approach. Higher intelligence (WASI) was associated with higher stability of brain network modularity – reflecting the balance between segregated and integrated information processing. Subjects with higher intelligence scores engaged in fewer periods of very high modularity characterized by disconnection of task-positive from task-negative networks. Regions of the dorsal attention network contributed most to the observed effect. In the second study we temporally resolved functional connectivity and developed a new machine learning-based prediction framework to show that individual intelligence scores can be predicted from only 5% of resting-state fMRI data. These time-points correspond to the highest minima and the lowest maxima of whole-brain connectivity strength. We replicate these prediction results in an independent sample (N = 831) demonstrating the generalizability of or approach to different preprocessing and other measures of cognitive ability (g-factor). In summary, our studies demonstrate that the investigation of intrinsic temporal dynamics of brain networks can enhance our understanding of the biological bases of individual differences in general intelligence.

Keywords: Intelligence, Network Neuroscience, Connectivity, MRI, Individual Differences

The neural architecture of general knowledge

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Cognitive performance varies widely between individuals and is highly influenced by structural and functional properties of the brain. In the past, neuroscientific research was principally concerned with fluid intelligence, while neglecting its equally important counterpart crystallized intelligence. Crystallized intelligence is defined as the depth and breadth of knowledge and skills that are valued by one's culture. The accumulation of crystallized intelligence is guided by information storage capacities and is likely to be reflected in an individual's level of general knowledge. In spite of the significant role general knowledge plays for everyday life, its neural foundation largely remains unknown. In a large sample of 324 healthy individuals we used standard MRI along with diffusion-weighted imaging (DWI) to examine different estimates of brain volume and brain structural network connectivity and assessed their predictive power with regard to general knowledge. Our results show that test scores obtained by general knowledge inventories are reflected in the efficiency of structural brain networks and not brain volume. These effects were robust and not confounded by the effects of age, sex or fluid intelligence. Our findings indicate that structural brain network efficiency might be regarded as a valuable predictor of the amount of general knowledge held by an individual.

Network neuroscience perspective on schizophrenia - from brain maps to network mechanisms

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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In the past decade, network neuroscience has greatly contributed to establishing the view of mental disorders as dysfunctions of distributed circuits and networks, providing a biologically meaningful way of mapping large-scale abnormalities in the architecture of brain networks. However, traditional network approaches are static and therefore rather descriptive, often failing to identify (patho-)physiological mechanisms that link system-level phenomena to the multiple hierarchies of brain function. Recently, a novel set of methodological tools stemming from advances in complex systems and network science has been introduced to the field of brain imaging. These methods explicitly model dynamical aspects of brain networks and thereby have the potential to overcome said shortcomings.

In my talk, I will shortly review the main insights gained by traditional network approaches for clinical populations. In particular, I will concentrate on emerging concepts of network dysfunction such as altered rich club connectivity or altered integration/segregation balance in schizophrenia. I will highlight the limitation of these traditional approaches and provide an example how dynamical approaches can address some of these challenges. Specifically, building on the framework of network control theory, I will show how the brain controls dynamic transitions between brain-wide activity patterns during working memory and how these network control properties are related to the underlying structural network and how they influenced by multiple levels of dopamine function. In closing, I will demonstrate how network control properties are altered in schizophrenia and discuss potential future therapeutic applications/directions.

Task-driven modulations of electrophysiological responses to facial expressions. Insights from intracranial EEG recordings.

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Emotional facial expressions profit from their biological salience in visual processing. It is assumed that, via connections to the object recognition system, the amygdala rapidly modulates processing in favour of emotional objects. This effect, termed emotional attention, is often assumed to be independent of task-driven attention. To test this, we used an emotion-attention interaction task and analysed intracranial event-related potentials recorded from the healthy right human amygdala of one patient undergoing pre-surgical epilepsy monitoring. Random sequences of angry, neutral and happy faces were presented in three different blocks, one expression being denoted as the target. Data indicate an early (~50 ms) differentiation of angry faces when neutral faces were the target. A mid-latency (~200-300 ms) negative deflection in the "attend to happy block" indicated the differentiation of happy targets from angry and neutral faces. In a late time-window (~600 ms) a positive deflection for target expressions was found. It was most pronounced for emotional targets, angry and neutral faces exhibiting a more similar response profile than happy ones. So far, results suggest temporal differences in the goal-driven modulation of processing of different facial expressions. The earliest differentiation was shown for angry faces from neutral targets, followed by a differentiation of happy targets. Angry targets elicited the latest differential signal. These results reveal an influence on attention orientation on the timing of emotion effects in the processing of facial expressions. Earliest responses to angry, potentially threatening faces seem most pronounced under conditions of ambiguity, when the target category is neutral.

Keywords: emotion, attention, amygdala, iEEG, iLFP

How associated relevance and inherent salience shape human face processing: time-resolved evidence from event-related brain potentials

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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To support adaptive behaviour in complex environments, the human brain developed efficient selection mechanisms that bias perception in favour of salient information. The present study aimed at investigating whether associated motivational salience causes preferential processing of inherently neutral faces similar to emotional expressions by means of event-related brain potentials (ERPs) and changes of the pupil size. To this aim, neutral facial expressions were implicitly associated with monetary outcome, while participants (N = 44) performed a face-matching task with masked primes that ensured performance around chance level and thus an equal proportion of gain, loss, and zero outcomes. During learning, motivational context strongly impacted the processing of the fixation, prime and mask stimuli prior to the target face, indicated by enhanced amplitudes of subsequent ERP components and increased pupil size. In a separate test session, previously associated faces as well as novel faces with emotional expressions were presented within the same task but without motivational context and performance feedback. Most importantly, previously gain-associated faces amplified the LPC, although the individually contingent face-outcome assignments were not made explicit during the learning session. Emotional expressions impacted the N170 and EPN components. Modulations of the pupil size were absent in both motivationally-associated and emotional conditions. Our findings demonstrate that neural representations of neutral stimuli can acquire increased salience via implicit learning, with an advantage for gain over loss associations.

Keywords: emotion, faces, ERPs

Beautiful is good, moral is better: Social judgments based on facial attractiveness and affective information

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Social-emotional impressions are formed based on the attractiveness of a person's face, and we tend to judge beautiful people more positively. Further, knowing about the good or bad deeds of persons strongly influences how we perceive and judge others. Here, we investigated the interplay between attractiveness and person-related information on social judgments, employing event-related brain potentials. Participants associated negative, neutral or positive information with attractive or less attractive persons. In a separate test phase, they judged the persons based on the information. Attractiveness had an influence on social judgments only in the neutral but not in the positive or negative information condition. Reaction times reveal a congruency effect in the emotional knowledge conditions: positive information lead to faster judgments of attractive faces, and negative information to faster judgments of less attractive faces. Modulations of early brain responses associated with reflexive emotional processing (early posterior negativity, EPN) showed independent effects of affective information and attractiveness. Whereas later brain responses associated with more reflective emotional processing (late positive potential, LPP) reveal an interaction of person information and attractiveness, with stronger effects in the congruent conditions. Our findings suggest that social judgments are predominantly based on affective information, but may also be modulated by facial attractiveness.

Keywords: face processing, attractiveness, emotional person knowledge, social judgments, event-related potentials

Negative-appearing faces boost positive emotion perception

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Growing evidence suggests that isolated intense facial expressions often convey misleading affective valence information, and that the body and other types of context play a crucial role in emotion recognition. This poses a puzzle: How is the affective information of faces and bodies integrated, especially if contradicting? We present results of three experiments (N_{total}=431; 199 female) investigating the role of the face and body in emotion recognition, using a novel set of stimuli—authentic home videos documenting sports fans reacting ecstatically to their winning teams. In Experiment 1A, participants viewed videos of faces, bodies, or faces with bodies and rated the affective valence of the fans' reactions. As expected, people easily identified the target's valence as positive from the body, but not the facial reactions. Intriguingly, negative-appearing faces boosted the perception of positive bodies: the presentation of full images (faces and bodies) was rated more positively than isolated bodies, even when the isolated faces themselves were incorrectly rated as negative. Experiment 1B demonstrated that the existence of such negative-appearing faces actually increased confidence in the respective rating. Evidence from Experiment 2 showed that the integration did not emerge from a consciously controlled process. Rather, participants automatically read-in valence information from the task-irrelevant body into the face, resulting in an illusion of facial positivity. We suggest that, instead of being averaged with the body, intense facial expressions amplify the amplitude of valence read from the body, and undergo a contextual disambiguation process, thereby contributing to an accurate perception of the entire gestalt.

Keywords: emotion recognition, facial expressions, context, body, real-life videos, online experiments

Do you see what I see? Individual differences in contextualized emotion recognition

Date & time: Friday, 4 June 2021 - 13:00 - 14:30

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Recent evidence suggests that real life facial expressions are often more ambiguous than previously assumed. Accordingly, context plays an indispensable role in communicating emotion. In fact, even the recognition of stereotypical, exaggerated facial expressions can be shifted by context. For example, previous reports suggest that the body context in which a face is presented can bring to a categorical shift in recognition from the face. This effect has been studied extensively at the group level but are we all effected in a similar way? Our results suggest the answer is no. Using a multiple-choice categorization task, 101 participants were presented with still presentations of incongruent facial and bodily emotional expressions. We asked whether individuals differ in their susceptibility to the bodily context when categorizing the face and if so whether effects are consistent over time. Striking differences were found, these were stable over two sessions ($r = 0.84$, $p<0.001$). Our second study suggests that this phenomenon is not bound to the method used and holds also when using an open question paradigm. Testing 83 participants we show a robust correlation between the methods ($r = 0.63$, $p<0.01$). Our third study shows that individual differences in the susceptibility to context hold even across modalities, presenting participants with dynamic audio-visual expressions (43 participants, $r = 0.7$, $p < 0.001$). We conclude that different people exposed to identical affective stimuli may perceive strikingly different emotions as a function of highly stable individual differences.

Keywords: emotion, perception, individual differences

Aversive learning in the visual brain: Generalization across feature dimensions

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Processing capabilities for many low-level visual features are experientially malleable, aiding sighted organisms in adapting to dynamic environments. In this presentation, we discuss how visuocortical responses change as human observers learned to associate exemplars drawn from a given feature dimension with aversive outcomes. Using classical aversive conditioning together while recording dense-array EEG and pupillometry, we tested the pre-registered hypotheses of either sharpening or generalization for a range of feature dimensions, including orientation, motion direction, object category, and spatial location. Models of gaussian (generalization) or difference-of-gaussian (sharpening) changes after, compared to pre-conditioning were directly compared in a Bayesian framework. We found that visuocortical responses were selectively heightened when viewing aversively paired features for all feature dimensions. In the case of orientation, motion direction, and spatial location, effects displayed a non-linear, difference-of-gaussian profile across neighboring exemplars on a feature gradient, consistent with suppressive surround modulation of non-prioritized features. Measures of alpha band (8 – 12.8 Hz) activity and pupil diameter showed evidence of generalization. These results indicate that aversive conditioning of low-level visual prompts sharpened tuning in visual cortex. By contrast, aversive conditioning of higher-level features such as object category prompts linearly graded (generalization) modulation in visual cortex. These effects mirror the effects seen for top-down influences indexed by alpha power reduction and autonomic responses, also showing generalization. We summarize these changes in a simple computational model of adaptive population tuning as a function of experience.

Keywords: EEG, EEG-fMRI, aversive learning, visual cortex

Externally induced cross-regional synchronisation modulates human associative memory: empirical and computational evidence

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Neural synchronisation between sensory brain regions has been suggested as a mechanism to bind multisensory information into long-term memory. Using a multisensory entrainment paradigm, we demonstrated a causal role of theta synchronisation between sensory regions in enhancing human associative memory. EEG data reveals that this externally induced theta phase synchrony supports associative memory on a trial-by-trial basis. Furthermore, a computational model that implements two key hippocampal learning mechanisms found in animal studies, spike-timing-dependent-plasticity (STDP) and theta-phase-dependent learning, successfully simulates our findings. In the model, hippocampal weight changes depend on the timing between spikes of pre-synaptic and post-synaptic neurons, which is also modulated by the phase of an ongoing theta oscillation. Stretching the temporal window for plasticity in our simulated learning rule fails to corroborate the empirical data, emphasising the importance of neuronal frequency working in tandem with plasticity windows (~25 ms). To experimentally test this hypothesis, we modified our paradigm by changing the modulation frequency to gamma. Indeed, participants' recall accuracy was best in the 0° phase offset condition and was significantly better than the 270° condition, which has the longest delay between sensory stimuli. These results can be seen as direct support for the role of STDP in human multisensory memory association, which restricts associative binding largely to a narrow time window. In conclusion, our findings provide causal evidence for neural synchronisation in human memory. The empirical evidence, together with the computational evidence, links circuit-level mechanisms described in the animal literature with data from human associative memory studies.

4 Hz phase-synchronized stimulus presentation improves contingency knowledge and affective evaluation in a fear conditioning task

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Most memory traces combine information from multisensory input. Animal studies show that theta-synchronized neuronal activity (4-8 Hz) binds multimodal associations. Recent human data revealed improved declarative memory for video-tone pairings when the input was presented in theta-phase synchronization. Since classical fear conditioning, a non-declarative, emotional memory paradigm, is mostly based on associating a conditioned stimulus (CS) in one modality with an aversive unconditioned stimulus (US) in another modality, the present study examines the effects of theta-band stimulus synchronization on fear memory formation in humans.

Using a fear generalization procedure, one of five visual gratings (that only varied in orientation) was paired with an aversive auditory US, and thus served as the CS+. Both, luminance of the visual CS (one CS+, four CS-) and the volume of the auditory US were modulated at 4 Hz. To manipulate the synchrony between visual and auditory input during fear acquisition, one group (N = 20) received 12 trials of synchronous CS-US pairing, whereas the control group (N = 20) received the 12 CS-US pairs out-of-phase (90°, 180°, and 270° shift).

Phase-synchronized input improved the CS-US contingency knowledge and the subjective valence and arousal ratings, leading to a narrower generalization around the CS+ compared to out-of-phase input. Physiological arousal (skin conductance) and visuocortical engagement (steady-state visually evoked potentials, ssVEP) were unaffected by the synchronization manipulation, although both measures were increased for the CS+. Our data suggest that theta-phase synchronization aids declarative aspects of fear memory formation, such as learned affective evaluation and contingency knowledge.

Prefrontal oscillations and the immediate extinction deficit in healthy men

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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The interval between fear acquisition and extinction learning is thought to influence extinction recall. In most fear-conditioning studies, short intervals (e.g. 10 min) were shown to impair extinction recall compared to long intervals (e.g., 24 hours), while fear recall was unaffected. This phenomenon is known as Immediate Extinction Deficit (IED). Rodent studies suggest that stress-induced inhibition of the medial prefrontal cortex (mPFC) during immediate extinction learning causes the IED. However, studies examining the neural correlates of the IED in humans are missing. We used a well-established fear-conditioning paradigm covering habituation, fear acquisition, extinction learning, and recall. 40 healthy men were randomly assigned to extinction learning either 10 min after fear acquisition (immediate extinction learning) or 24h afterwards (delayed extinction learning). Four pictures of male faces were used as conditioned stimuli (CS). During fear acquisition, two CS (CS+) were paired with an aversive unconditioned stimulus (US), whereas the other two were not (CS-). During extinction learning, only one CS+/CS- pair was presented. Fear recall (responses to the not-extinguished CS+N and CS-N) and extinction recall (responses to the previously extinguished CS+E vs. CS-E) were assessed 24h after extinction learning. EEG oscillations in the theta and gamma range were source-localized during all learning phases. On the peripheral level CS-related skin conductance responses (SCRs) and cardiac responses were assessed. First SCR results show the expected better extinction recall in the delayed extinction group. EEG and cardiac-response analysis are still under progress and will be presented.

Noradrenergic modulations of fear conditioning: Yohimbine potentiates fear-conditioned bradycardia, N170, and late positive potential amplitudes

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Fear conditioning is an important model for understanding the etiology and maintenance of anxiety disorders, while fear extinction is considered to reflect a central learning mechanism underlying exposure therapies. Hyperconsolidation of aversive conditioned associations and poor extinction consolidation have been hypothesized to be crucial in the acquisition of pathological fear. Previous animal and human research has pointed to a potential role of catecholaminergic neurotransmitters, particularly noradrenaline and dopamine, in acquiring emotional memories. Here, we investigated whether the noradrenergic alpha-2 adrenoreceptor antagonist yohimbine and the dopaminergic D2 receptor antagonist sulpiride modulate human consolidation of conditioned and extinguished fear conditioning and extinction. Fifty-four participants received yohimbine (10 mg, n = 18), sulpiride (200 mg, n = 18), or placebo (n = 18) between fear acquisition and extinction. The yohimbine group showed increased alpha-amylase activity, confirming a successful manipulation of central noradrenergic release. We assessed recall of conditioned (non-extinguished CS+ vs. CS-) and extinguished fear (extinguished CS+ vs. CS-) 24 hours later. Importantly, potentiated fear bradycardia and larger amplitudes of the N170 and LPP ERP components indicated that noradrenergic yohimbine treatment (compared to placebo and sulpiride) enhanced fear recall on day 2. These results suggest that yohimbine potentiated cardiac and central electrophysiological signatures of fear memory consolidation. In conclusion, our findings elucidate the key role of noradrenaline in strengthening conditioned fear.

Keywords: fear conditioning/extinction; noradrenaline; dopamine; yohimbine; sulpiride

Estradiol administration modulates neural emotion regulation

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Variations of sex hormones during the menstrual cycle can lead to changes in emotion processing. The ability to successfully regulate one's emotions is associated with better social abilities and mental health. While women show better performance in fear extinction learning under high estradiol (E2) compared to women under low E2 levels, little is known about the effect of E2 on emotion regulation. We explored whether E2 modulates emotion regulation in a functional magnetic resonance imaging paradigm and administered E2 valerate and placebo to 32 young naturally cycling women during their early follicular phase in a double-blind, within-subject, repeated-measures design. This standardized experimental control allowed us to explore the specific effect of E2 on emotion regulation while controlling for other hormones varying throughout the menstrual cycle. On the behavioral level, women reported less negative affect in the E2 condition. On the neural level, E2 administration was associated with lower activation in the right lingual- and left calcarine gyrus, right orbitofrontal cortex and left hippocampus relative to placebo. With respect to the main effect of down-regulation higher activation of the right superior frontal gyrus and left dorsomedial prefrontal cortex was seen. An interaction between drug condition and emotion regulation appeared for the left inferior frontal gyrus extending into the middle frontal gyrus indicating lower activation during down-regulation in the E2 condition than the placebo condition. The results fit well to a previously described psychoneuroendocrinological model in which E2 plays an important modulatory role in emotion regulation and thereby impacts mental health.

Keywords: fMRI, estradiol, emotion regulation, OFC, IFG

The modulation of social behavior in oral contraceptive users and naturally cycling women

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Oral contraceptives (OC) and sex hormones in naturally cycling women (NC) are related to a wide range of psychological variables eg, cognition and affect. With respect to social behavior, research is scarce. A first study from our lab documented a trend towards more prosocial behavior in NC compared to OC users but the underlying neuroendocrine mechanisms are still unknown. Potential candidates may be the sex hormones progesterone and estradiol. The present study investigated differences in social behavior in NC and OC users and measured estradiol and progesterone levels.

We used a paradigm adapted from behavioral economics as well as the Social Value Orientation (SVO) to assess prosocial and antisocial behavior and nonsocial risk behavior in 83 healthy women (38 OC users and 45 NC). In addition, we measured empathy (MET) and collected saliva samples to measure the basal levels of the hormones estradiol and progesterone.

Our analyses revealed higher levels of prosocial behavior in NC compared to OC users. This is validated by the SVO angle and type where NC showed a broader angle and are more often categorized as prosocial type than OC users. Moreover, NC showed more emotional empathy. Progesterone and trust were negatively correlated on a trend level, while progesterone was higher in NC than OC users. Our findings document a modulation of social behavior by OC that might be modulated by the sex hormone progesterone. Further research is needed to replicate our findings and extend them to other social behaviors.

Keywords: women, oral contraceptives, social behavior, SVO, progesterone, estradiol

Choosing right from wrong: Association of moral judgements with oral contraceptive use, testosterone, and the CAG repeat polymorphism in the androgen receptor gene

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Differences in moral judgements are associated with various factors, including biological parameters. Previous studies have—albeit inconsistently—reported a stronger tendency towards utilitarian judgements in men. *Utilitarian* judgements are situation-dependent, outcome-based, and favor the 'greater good'. In contrast, *deontological* judgements are based on situation-independent moral norms and principles of right and wrong. Available findings support the assumption of a connection between testosterone and utilitarian tendencies, particularly in women. We investigated differences in decisions in moral dilemmas between men, free cycling women, and women using combined oral contraceptives (COC) in a sample of N = 157. The used dilemma set allowed in addition to the traditional moral score the independent estimation of underlying deontological and utilitarian tendencies (cf. Conway & Gawronski, 2013). Significant effects of sex (p = .009) and endocrine status (p = .011) on utilitarianism were found with the highest levels in men and the lowest in free cycling women while COC users fell in between. Salivary testosterone correlated with utilitarianism in free cycling women (r = .303) and with reduced deontology in men (r = -.263). Furthermore, there was an interaction effect between endocrine status and the functional CAG repeat polymorphism in the androgen receptor gene in women (p = .001). COC users who carried two short alleles had reduced levels of deontology compared to carriers of long alleles. The findings underscore the role of androgens in moral judgements but also point to specific associations depending on sex and oral contraceptive use.

Keywords: Moral Judgement, Gender, Oral Contraceptive Use, Testosterone, AR CAG Polymorphism

Within-person changes in cardiac vagal activity across the menstrual cycle: Implications for female health and future studies

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Interest in cardiac vagal activity (CVA; e.g., parasympathetically-mediated heart rate variability) as a biomarker of physical and mental health has increased exponentially; however, the association between the menstrual cycle and CVA remains unclear. In a first step, we therefore conducted a meta-analysis of 37 within-person studies on CVA change across different menstrual cycle phases in a total of 1004 naturally-cycling females (study 1). The meta-analysis revealed a significant CVA decrease from the follicular to the luteal cycle phase (d=−0.39, 95% CI [−0.67, −0.11]). As these cycle phase comparisons do not answer the question which of the ovarian hormones is primarily associated with CVA changes, we conducted two studies with repeated measures of CVA and salivary estradiol (E2) and progesterone (P4) in naturally-cycling females (study 2: N=40; study 3: N=50) to investigate hormonal mechanisms. Both study 2 and study 3 revealed that only P4 and not E2 was correlated with CVA, such that higher-than-usual P4 significantly predicted lower-than-usual CVA within a given woman. In conclusion, we found compelling meta-analytic evidence for a significant decrease in CVA from the follicular to the luteal cycle phase. In line with this, two follow-up studies suggest that these CVA fluctuations are mainly associated with P4. Future female health studies should investigate individual differences in these effects and potential consequences of cyclical CVA changes on daily functioning. Future studies involving CVA should control for cycle phase.

Keywords: menstrual cycle, estradiol, progesterone, cardiac vagal activity, vagally-mediated heart rate variability

Adolescent oral contraceptive use and future major depressive disorder

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Because of the widespread use of oral contraceptives (OCs) and the devastating effects of depression both on an individual and a societal level, it is crucial to understand the nature of the previously reported relationship between OC use and depression risk. Insight into the impact of analytical choices on the association may help to reconcile previous conflicting findings. For the present study, we tested in a specification curve analysis whether adolescent OC use was associated with a higher likelihood to experience an episode of major depressive disorder (MDD) in early adulthood in a 12-year prospective study among young women aged 13 years at baseline (N = 725). Across 818 models, overall, there was a significant association of adolescent OC use and MDD in early adulthood (median odds ratio [OR] $_{median}$ = 1.41; OR_{min} = 1.08; OR_{max} = 2.18, p < .001), which was primarily driven by the group of young women with no prior history of MDD (OR_{median}=1.72; OR_{min}=1.21; OR_{max}=2.18, p < .001). Understanding the potential side effects of OCs will help women and their doctors make informed choices when deciding among possible methods of birth control.

Keywords: oral contraceptives, depression

Binge-watching in the sleep laboratory - effects of cliffhangers on sleep

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Binge-Watching -the consumption of multiple episodes of a series in a rapid succession- is a widespread phenomenon, especially among young adults. To engage viewers into continuous watching, series consist of interesting characters and story lines with open ending that abruptly end during critical scenes ("cliffhangers"). Such unfinished narratives are believed to create arousal and cognitive engagement beyond the viewing activity. Empirical studies indicate that binge-watching can impair subjective measures of sleep, mediated by pre-sleep arousal. However, the effects of binge-watching and cliffhangers on objective sleep parameters are still unknown.

56 healthy young participants either watched 3-4 episodes of a suspensful series or a neutral control series before sleep in the sleep laboratory, in a within-subject design. In one group of participants, the suspensful series ended with a cliffhanger; in the other group, the same series ended before the cliffhanger. As expected, binge-watching session with cliffhangers did result in higher cognitive and physiological pre-sleep arousal as compared to series without cliffhangers and control series. In contrast to our expectation, neither subjective nor objective sleep parameters were impaired. Objective sleep onset latency was even significantly shorter in the series condition compared to control. Fine-grained power analysis revealed increased alpha power during rapid-eye-movement (REM) sleep and lower power in the slow oscillations band during Non-REM sleep in the cliffhanger condition.

Our results speak against large impairments of binge-watching and cliffhangers on sleep quality and architecture. However, unfinished narratives might induce more subtle changes in oscillatory power during sleep, possibly reflecting ongoing cognitive processing.

Keywords: binge-watching, cliff-hangers, sleep quality, slow oscillations

Bad sleep makes it harder to keep your waistline down

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Do you know this feeling when you had an insufficient night of sleep, and the first thought is where the cookies and chocolate are? According to epidemiological research, there is a strong association between short sleep duration and the risk of being either overweight or obese. As we all know, correlation does not imply causation. Thus, together with colleagues from Germany and Sweden, I performed a series of human experiments in metabolically healthy young adults to investigate whether acute sleep loss alters central nervous and peripheral pathways involved in body weight regulation in favor of weight gain. Some of these results will be presented in my talk.

Keywords: Schlafmangel, Übergewicht, Sleep loss, Obesity

Pre-sleep artificial light exposure does not alter basic cognitive processing during sleep

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Introduction: Short ("blue") wavelength artificial light is known to increase alertness in the evening and negatively affect sleep. Whether the alertness-promoting effects also alter basic sensory processing is however unknown. Here, we investigated the acute (wake) and delayed (sleep) effects of pre-sleep light exposure (LE) on the brain's ability to generate top-down predictions about forthcoming events and compare them to bottom-up sensory input. We specifically hypothesised that short-wavelength enriched LE would increase alertness and thereby render sensory processing during sleep more "wake-like".

Methods: Twenty-nine healthy participants (23.2±2.8 years) were exposed to two metameric light sources for one hour starting 1h50min prior to an 8-h sleep episode. Light sources differed only in their effect on melanopsin-expressing retinal ganglion cells (mel-high vs. mel-low, contrast 208%). During LE and the ensuing night, volunteers underwent a hierarchical auditory stimulation paradigm. Sensory processing was evaluated on the basis of event-related potentials (ERPs) and time-frequency responses (TFRs, 1-15Hz) using cluster-based permutation statistics.

Results: As hypothesised, high-melanopic LE suppressed melatonin secretion more effectively than low-melanopic LE. However, we found no evidence of a differential modulation of the relationship between top-down predictions and (omitted) bottom-up sensory input during wakefulness or any sleep stage. Likewise, neither subjective sleepiness and behavioural alertness during wakefulness nor sleep parameters differed between the LE conditions.

Conclusions: The results suggest that sensory processing during wakefulness and sleep is not differentially altered by 1-h exposure to a high- (vs. low-) melanopic light source. Basic cognitive processing thus does not seem to become more "wake-like".

Keywords: sleep, artificial light

The effect of sleep deprivation on the response to acute psychosocial stress in young and older adults

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Introduction

Sleep loss and psychosocial stress have negative consequences for well-being, health and performance ability. Despite the intuition that sleep and stress are linked in both directions, little research has focused on the effect of sleep deprivation on the response to acute psychosocial stress.

Methods

In this study 124 young (18–30 years) and 94 older (60–72 years) healthy adults participated in one of the following conditions: i. normal night sleep & Placebo-Trier Social Stress Test (TSST), ii. normal night sleep & TSST, iii. sleep deprivation & Placebo-TSST, iv. sleep deprivation & TSST. Subjective stress ratings, salivary cortisol, heart rate variability (HRV) and salivary alpha amylase (sAA) were repeatedly measured as indicators of the stress response.

Results

Already at the pre-TSST baseline measurement, sleep deprived participants rated their stress levels higher and had higher cortisol values than rested participants. However, sleep deprivation did not significantly change the reactivity to and recovery from the TSST for any of the outcome measures. Age did not moderate the effect of sleep deprivation. In older adults, subjective stress ratings and sAA levels were higher, and HRV lower at baseline. Cortisol trajectories and HRV differed across the test session between the two age groups.

Discussion

The results suggest that while self-reported stress and cortisol levels are increased after sleep deprivation, the response to an acute psychosocial challenge is not markedly changed after one night without sleep.

The study was funded by Riksbankens Jubileumsfond.

Keywords: sleep deprivation, stress, TSST, cortisol, age

Social exclusion, poverty and mental health

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Urbanization can increase the prevalence of mental disorder due to a variety of factors including higher levels of poverty. Social participation promotes resilience against mental health problems, while social stress (such as exclusion) facilitates mental disorders. There is increasing evidence that vulnerable populations (e.g. those that are socio-economically disadvantaged, ethnic minorities and low-income) are more susceptible to a range of mental disorders. Such vulnerability is predicated on the stresses and risks to which individuals and groups are subjected, including lack of social support as indicated by the so-called ethic density effect; here it was repeatedly shown that minority patients show higher rates of schizophrenia when living relatively isolated in their neighbourhoods. Our research group showed that an increasing mental health burden was associated with increasing neighbourhood poverty, independent of individual-level differences in socio-economic status. This effect was more pronounced in inhabitants with migration backgrounds. Regarding potential mechanisms mediating the effects of urbanicity and social stress on individual mental health, both currently living in a city and experiencing an urban upbringing can affect neural processing of stress exposure. Stress effects on dopaminergic and serotonergic neurotransmission modulate neural processing of affective stimuli and thus may explain interactions between urbanicity, stress exposure, and limbic brain activation. These findings suggest that income inequality and minority status may interact with further urban risk factors and increase the mental health burden. Thus, there is a need to integrate social sciences, neurosciences, and public policy to respond to the major health challenges of urbanization.

The neural underpinnings of altered interpersonal trust in loneliness

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Loneliness is a painful condition associated with increased risk for premature mortality. The formation of new, positive social relationships can alleviate feelings of loneliness, but requires rapid trustworthiness decisions during initial encounters and it is still unclear how loneliness hinders interpersonal trust. Here, we use a multimodal approach including behavioral, psychophysiological, hormonal, and neuroimaging measurements to probe a trust-based mechanism underlying impaired social interactions in loneliness. Pre-stratified healthy individuals with high loneliness scores (n = 42 out of a screened sample of 3678 adults) show reduced oxytocinergic and affective responsiveness to a positive conversation, report less interpersonal trust, and prefer larger social distances compared to controls (n = 40). Moreover, lonely individuals are rated as less trustworthy compared to controls and identified by the blinded confederate better than chance. During initial trust decisions, lonely individuals exhibit attenuated limbic and striatal activation and blunted functional connectivity between the anterior insula and occipitoparietal regions, which correlates with the diminished affective responsiveness to the positive social interaction. This neural response pattern is not mediated by loneliness-associated psychological symptoms. Thus, our results indicate compromised integration of trust-related information as a shared neurobiological component in loneliness, yielding a reciprocally reinforced trust bias in social dyads. The analysis plan of this study was preregistered and the data that support the findings of this study are openly available.

Keywords: interpersonal trust, loneliness, oxytocin, social brain, social interaction

Lonely hearts: an fMRI study on interoception in loneliness

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Interoception refers to the sensing of internal bodily states. According to a widely accepted model, interoception encompasses three dimensions: interoceptive accuracy (IAcc), the ability to track your own physiological states; interoceptive sensibility (IS), the perception of one's own ability to appraise interoceptive signals; interoceptive awareness (IAwa), the relationship between (objective) accuracy and (subjective) sensibility. Recent studies have shown the relevance of interoception for social connectedness. Higher IAcc was found to be associated with better emotion regulation following negative social situations, while temporary social exclusion resulted in an acute decrease in IAcc. However, no studies have so far investigated the relation of interoception with loneliness, an extreme case of poor social connectedness. Loneliness is defined as the negative subjective feeling that one's needs of social companionship are not being met. Thus, the aim of the present study was to investigate how interoception and its neural correlates are related to loneliness. To this purpose, 63 participants performed a heartbeat counting task while in the MR scanner. Heartbeats were measured with a pulsemeter. Two control conditions were included: exteroceptive (counting tones) and time estimation (counting seconds). For each condition, accuracies were computed. IS was measured with confidence ratings during the task and with the Multidimensional Assessment of Interoceptive Awareness. Loneliness was measured with the UCLA loneliness scale. Results will be discussed in light of the relationship of loneliness with the three dimensions of interoception, controlled for the other conditions. This study will shed more light on the relevance of interoception in social connectedness.

Keywords: interoception, loneliness, fMRI, heartbeat

Sex- and subregion-specific associations between amygdala structure and social network indices – a community based imaging study with more than 900 individuals

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Since the dawn of humankind, human individuals have been living in groups. Group living was highly adaptive because it increased the chances for survival. However, survival chances only increased for individuals who were able to navigate these groups. Navigation of groups depends on social skills, implying that evolution facilitated the development of neural circuits that are necessary for the expression of these skills. Most of these circuits are centered on the amygdala, an evolutionarily conserved structure that is associated with a plethora of social skills. Previous studies revealed associations between amygdala structure and social skills that are relevant for social contacts and social networks. These associations emerged in simple analyses that were based on small and unrepresentative samples, leaving open whether these findings can be replicated and extended in analyses that are more sophisticated. To address this issue, we performed a structural imaging study in a representative sample of over 900 individuals. After asking for the number of social contacts and social networks, we analyzed the structural integrity of the amygdala. In contrast to previous studies, we considered different amygdala subregions in our analyses. These analyses revealed sex- and subregion-specific associations of amygdala structure with the number of social networks but not with the number of social contacts. Given that more skills are needed to navigate social networks than social contacts, may explain why amygdala structure was exclusively associated with the number of social networks.

Keywords: social network, social contact, amygdala, imaging, social cognition

The impact of social exclusion and cognitive stress on resting-state functional connectivity of amygdala–frontal cortex networks in healthy women and men

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Social exclusion (EXC) and cognitive stress (STRESS) are two different stressors occurring in everyday life. They affect behaviour, physiology and neural functional connectivity. Based on a recently postulated neural model on stress regulation, we investigated the effect of EXC and STRESS on resting-state functional connectivity (rsFC) of the amygdalae with medial and lateral frontal regions in healthy women (n=40) and men (n=37). Resting-state, subjective, and hormonal data were assessed before and following social exclusion and cognitive stress in all participants. Subjective data indicates increased anger after both paradigms, with higher levels after STRESS compared to EXC. Further, positive affect decreased while negative affect increased after STRESS, apparent in both, women and men, with no such effect for social exclusion. Cortisol levels showed an increase after EXC in women, while STRESS did not yield cortisol changes in both sexes. Results on rsFC indicate stressor-dependent sex differences: Before EXC, men had higher rsFC between left amygdala and left dorsal anterior cingulate cortex (dACC), whereas after EXC, they showed higher rsFC between left amygdala and right ventro-medial prefrontal cortex (vmPFC) than women. For STRESS, women had higher rsFC between left amygdala and right medial prefrontal cortex (mPFC) before than afterwards compared to men.

Higher rsFC between left amygdala and right mPFC indicates an increased stress reactivity, whereas rsFC between left amygdala and left dACC was associated with better stress recovery. These results show stressor-dependent sex differences in rsFC of the amygdalae with the frontal cortex, supporting the assumption of the stress regulation model.

Keywords: social exclusion, cognitive stress, resting state functional connectivty, sex differences, neuroframework for regulation expectation

Elektrophysiologische Verarbeitung akustischer Reizänderung von Säuglingen

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Diese Studie untersucht die entwicklungsbedingten Aspekte akustischer Verarbeitung sich wiederholender Töne für gesunde Säuglinge zwischen sieben und zwölf Monaten durch den Einsatz ereigniskorrelierter Potentiale (EKPs) in einem passiven auditorischen Oddball. Die neuronale P3a-Komponente steht im Zusammenhang mit dem unwillentlichen Lenken der Aufmerksamkeit auf abweichende, seltene Reize und indiziert eine Diskrimination dieser Reizkategorie.

Als Teil-Stichprobe der BRISE-Studie (Bremer Initiative zur Förderung frühkindlicher Entwicklung) wurden 71 wachen Säuglingen wiederholt Klaviertöne mit 466,6Hz als häufigen Standardton (N=200) und 550,5Hz als abweichenden, seltenen Ton (N=48) präsentiert. Die Amplitude einer P3a-ähnlichen Komponente wurde 280-330ms nach Stimuluspräsentation für die zentrale Gehirnregion gemessen.

Es zeichnete sich ein Verarbeitungsunterschied beider Reizkategorien über die gesamte Altersspanne ab ($F_{1,69}=19,1$, $p<0,001$). Eine lineare Regression legt einen Anstieg der prominenten P3a-ähnlichen Amplitude bei Verarbeitung der abweichenden Reizkategorie mit dem Alter dar ($F_{1,69}=8,8$, $p=0,004$).

Die Ergebnisse verdeutlichen, dass Säuglinge bereits mit sieben Monaten Tonunterschiede wahrnehmen und eine deutliche P3a-ähnliche Komponente generieren. Diese neuronale Antwort verstärkt sich mit dem Alter. Dies kann auf strukturelle Veränderungen des Gehirns mit dem Alter zurückzuführen sein, welche eine koordiniertere Verarbeitung durch eine zeitlich präzisere neuronale Kommunikation ermöglichen. Es verbessert sich - vermutlich im Zusammenhang mit diesen neuronalen Entwicklungsprozessen - auch die Fähigkeit der Säuglinge der Aufmerksamkeitskontrolle.

Einfache Paradigmen, wie ein akustischer Oddball, sind vielversprechende Werkzeuge zur längsschnittlichen Untersuchung basaler kognitiver Fähigkeiten. Sie bieten Möglichkeiten, beispielsweise im Rahmen von BRISE, den Einfluss des sozioökonomischen Status auf Entwicklungsprozesse von Kindern zu untersuchen.

Keywords: EEG, neuronale Korrelate, EKP, P3a, Oddball, Säuglinge

Frühkindliche neuronale Kategorisierung unvertrauter Reize: Kombinierte EKP und FPVS Reaktionen

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Kategorisierung hilft, Erfahrungen zu strukturieren, doch bisher ist wenig über neuronale Grundlagen der Entwicklung dieser Fähigkeit bekannt. In dieser Studie wurden Ereigniskorrelierte Potentiale (EKPs) und Frequenzreaktionen auf Fast Periodic Visual Stimulation (FPVS) während der Kategorisierung bei 7 Monate alten Säuglingen gemessen. Säuglinge sahen unvertraute Stimuli, die sich in der Form einzelner Teile (rund/eckig) und der Farbe (rot-gelb/blau-grün) unterschieden. Die Kategorisierungsleistung wurde mithilfe eines FPVS Paradigmas (Rossion, 2014) gemessen. In Experiment 1 sah eine Gruppe nur die Kategorisierungsaufgabe (N = 26), eine andere Gruppe nahm vorher an einer EKP-Familiarisierung statt (N = 32). Während der Familiarisierung wurden 50 Exemplare der eckig-roten Stimuli für 1 Sekunde präsentiert. Die Amplitude der Nc Komponente (Aufmerksamkeit) nahm von der ersten zur zweiten Präsentationshälfte ab, BF = 3.71. Im FPVS Paradigma wurden eckig-rote Standard Stimuli mit einer Frequenz von 6 Hz präsentiert. An jeder 5. Position erschien ein rund-blauer Oddball (1.2 Hz). Starke Kategorisierungsreaktionen bei 1.2 Hz und Harmonischen (2.4, 3.6...) auf okzipitalen Elektroden wurden in beiden Gruppen gemessen (SNRs > 1.4, Z-scores > 3.74). Eine Bayes ANOVA bestätigte, dass die Kategorisierungsstärke sich nicht unterschied (BF = 1.02). Nc Amplitude in der 2. Präsentationshälfte war negativ mit Kategorisierung korreliert, r = -.43, BF = 1.9. Experiment 2 (N = 20) bestätigte, dass die Kategorisierungsleistung high- und low-level Prozesse reflektierte: Es wurde eine stärkere Kategorisierung der original im Vergleich zu Kontrollstimuli (phase-scrambled) beobachtet, BF = 2.94. Habituations- und Kategorisierungsstärke hingen also zusammen, obwohl unvertraute Stimuli aufgrund ihrer Gestalt auch ohne Vorerfahrung kategorisiert wurden.

Keywords: EEG, Entwicklung, Kategorisierung, Säuglinge, FPVS/SSVEP

Kontext-sensitive Handlungsverarbeitung beeinflusst motorische Aktivierung im zweiten Lebensjahr: die Rolle verbaler Hinweisreize

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Patzwald und Elsner (2019) konnten in einer Imitationsstudie zeigen, dass Kleinkinder zielbezogene behaviorale und verbale Hinweisreize integrieren und dabei deren Kohärenz berücksichtigen: 18-Monatige imitierten eine objekt-gerichtete Handlung häufiger, wenn diese mit einer vorab geäußerten verbalen Handlungsintention übereinstimmte, als wenn sie ihr widersprach. Jedoch ist vergleichsweise wenig über die elektrophysiologischen Korrelate der Integration sozialer Hinweisreize bekannt, z.B. auf Ebene der motorischen Aktivierung. Basierend auf Patzwald und Elsners Paradigma haben wir in einer EEG-Studie mit 18-Monatigen (N=38) untersucht, inwiefern deren motorische Aktivierung (d.h. Stärke des Mu-Frequenzbandes (6-9 Hz) über C_3, C_4) während der Beobachtung einer identischen Handlung in Abhängigkeit davon variiert, ob die Handlungsdemonstration mit einer vorab verbal kommunizierten Handlungsintention übereinstimmt oder dieser widerspricht. In einem Innersubjektdesign wurden den ProbandInnen Videos einer Erwachsenen präsentiert, die an einem neuen Objekt dieselbe von zwei möglichen Handlungen demonstrierte. Vor jeder Handlungsdemonstration kündigte die Erwachsene je nach Bedingung eine damit übereinstimmende Handlungsintention (kongruent; z.B. „hoch" und Aufwärtsbewegung) oder eine konfligierende Intention (inkongruent; z.B. „runter" und Aufwärtsbewegung) an. Basierend auf elektrophysiologischer Forschung, die einen positiven Zusammenhang zwischen motorischer Aktivierung während der Handlungsbeobachtung und anschließender Imitationsneigung zeigte (Filippi et al., 2016; Frey & Gerry, 2006), sowie aufgrund des Imitationsbefundes von Patzwald und Elsner, erwarteten wir vergleichsweise stärkere motorische Aktivierung (geringere Stärke des Mu-Frequenzbandes) während der Beobachtung der kongruenten als der inkongruenten Handlung. Diese Hypothese wurde über C_4 bestätigt. Unsere Befunde deuten darauf hin, dass Kleinkinder zielbezogene soziale Hinweisreize integrieren und sich deren Kohärenz auf der Ebene der motorischen Aktivierung widerspiegelt.

Keywords: frühkindliche kognitive Entwicklung, Handlungsverarbeitung, verbale Hinweisreize, motorische Aktivierung, mu Aktivität

Theta-Oszillationen beim selektiven Wortlernen im Vorschulalter

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Selektives Lernen bezeichnet das Phänomen, dass Kinder besser von einer Person lernen, die sie als kompetent wahrnehmen als von einer, die sie als inkompetent wahrnehmen. Welche neuronalen Mechanismen hierbei eine Rolle spielen, ist jedoch noch weitgehend unbekannt. Eine mögliche Erklärung ist, dass sich die Gedächtnisprozesse beim Verarbeiten von Informationen von inkompetenten Personen, von denen in anderen Lernsituationen unterscheiden. Kurz bevor neue Informationen erwartet werden, bereitet sich das Gehirn üblicherweise darauf vor, diese zu enkodieren. Dieser antizipatorische Prozess wird im EEG häufig mit einem Anstieg rhythmischer neuronaler Aktivität im Theta-Frequenzbereich (4-8 Hz) über frontalen Regionen assoziiert.

In der aktuellen Studie wurde untersucht, ob antizipatorische frontale Theta Aktivität den Lernerfolg eines neuen Wortes im Vorschulalter anzeigt und von der Kompetenz des Modells abhängt. Hierzu wurden 4-jährigen Kindern (n = 80) neue Wort-Objekt-Paare entweder von einem kompetenten oder inkompetenten Modell präsentiert. Währenddessen wurde EEG mit 128 Elektroden gemessen und der Lernerfolg mittels Touchscreens erfasst. Theta Aktivität wurde von -2 bis 0s vor Wortbeginn mittels wavelet-basierten Zeitfrequenzanalysen bestimmt.

Entgegen der Hypothesen zeigte sich kein Unterschied im Lernerfolg zwischen den Modellen ($t = -0.39$, $p = 0.7$). Wurden die Wort-Objekt-Paare von einem inkompetenten Modell präsentiert, stand die antizipatorische Theta Aktivität in Zusammenhang mit dem Lernerfolg des Wortes ($t(479) = 2.36$, $p = 0.04$). Dieser Effekt fand sich nicht, wenn die Wort-Objekt-Paare von einem kompetenten Modell präsentiert wurden.

Trotz ähnlichem Lernerfolg auf der Verhaltensebene zeigten sich Unterschiede in der Verarbeitung von Wort-Objekt-Paaren. Diese Resultate zeigen, dass die Kompetenz eines Modells Prozesse während des Wortlernens beeinflusst.

Keywords: Wortlernen, Vorschulalter, Theta, EEG, Gedächtnisprozesse

Crossmodales Statistisches Lernen im Alter zwischen 5 und 6 Jahren

Date & time: Friday, 4 June 2021 - 14:45 - 16:15

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Säuglinge erwerben komplexe multisensorische Objektrepräsentationen durch implizites Extrahieren von crossmodalen statistischen Regelmäßigkeiten. Erwachsene hingegen scheinen diese Regelmäßigkeiten nur dann zu erlernen, wenn ihnen eine Aufgabe gestellt wird, für deren Lösung die Regelmäßigkeiten relevant sind. Die vorliegende Studie ergründete, wann der Übergang von implizitem zu explizitem statistischen Lernen stattfindet. Mithilfe ereigniskorrelierter Potentiale (EKPs) untersuchten wir, welche Lernmechanismen 5- bis 6-jährige Kinder für das Erlernen von crossmodalen Regelmäßigkeiten nutzen.

Es wurden audiovisuelle Stimuluspaare mit unterschiedlichen Wahrscheinlichkeiten präsentiert: „Häufige Standardkombinationen" (A_1V_1 und A_2V_2, jeweils $p = 0.3$) und „Seltene Rekombinationen der Standardkombinationen" (A_1V_2 und A_2V_1, jeweils $p = 0.1$), sowie „Seltene Abweichler" (A_3V_3, $p = 0.1$) und „Rein Visuelle Stimuli" (V_4, $p = 0.1$) mit jeweils neuen sensorischen Elementen. Mögliche Unterschiede zwischen Lernmechanismen wurden durch Implementierung zweier Lernbedingungen (Zwischengruppendesign) adressiert: eine, bei der die crossmodalen Statistiken für die Aufgabe irrelevant, und eine, bei der sie aufgabenrelevant waren.

Unterschiede in den EKPs zwischen „Häufigen Standardkombinationen" und „Seltenen Abweichlern" wurden in beiden Lernbedingungen gefunden – ein Hinweis darauf, dass die Kinder die Gesamthäufigkeit der sensorischen Elemente erlernten. Ebenfalls fanden wir in beiden Lernbedingungen Unterschiede in den EKPs zwischen „Häufigen Standardkombinationen" und den „Seltenen Rekombinationen der Standardkombinationen", die ein Erlernen der crossmodalen statistischen Regelmäßigkeit anzeigen.

Unsere Ergebnisse weisen darauf hin, dass 5- bis 6-Jährige crossmodale Regelmäßigkeiten aus dem sensorischen Input nicht – wie Erwachsene – nur dann erlernen, wenn diese aufgabenrelevant sind. Statistisches Lernen in diesem Alter scheint noch in deutlich geringerem Maße von expliziten Lernmechanismen abzuhängen als im Erwachsenenalter und der Übergang erst im späteren Entwicklungsverlauf zu erfolgen.

Keywords: Crossmodales Statistisches Lernen, Ereigniskorrelierte Potentiale (EKPs), Lernen im Entwicklungsverlauf

Distractor suppression is independent of target selection and fluctuates rhythmically across time

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Although well-established models of attention rest on the assumption that irrelevant sensory information is filtered out, the neural implementation of such a filter mechanism is unclear. I will present behavioural and electroencephalography (EEG) data of two recent studies that support the autonomy of neural distractor suppression mechanisms and the rhythmic modulation of distractor suppression across time. First, in a pre-registered auditory spatial attention study (https://osf.io/bv7zs), we decoupled target selection from distractor suppression. In line with pre-registered hypotheses, we found two sign-reversed lateralized alpha oscillatory responses (~10 Hz) reflecting target selection versus distractor suppression. Critically, these alpha responses were reliable, independent of each other, and generated in more anterior, frontal regions for suppression versus selection. These results suggest that the neurobiological foundation of attention implies a selection-independent alpha oscillatory mechanism to suppress distraction. Second, in a pitch comparison task, we systematically varied the onset time of a task-irrelevant 25-Hz modulated tone sequence, which was presented in-between two to-be-compared target tones. Two metrics of distraction were utilized: On the level of behaviour, perceptual sensitivity (d') in pitch comparison inversely relates to the degree of distraction, with decreasing sensitivity signifying increasing distraction. Second, on the neural level, the 25-Hz amplitude in the EEG response to the distractor reflects distractor encoding. We found that distractor onset time rhythmically modulated both metrics of distraction at frequencies 3–5 Hz. I will discuss how and to what extent results of these studies advance our understanding of the neural and psychological basis of distractor suppression.

Keywords: attention, target, distractor, neural oscillation

Rhythmic modulation of visual perception through cross-modal entrainment

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Our sensory environment is filled with rhythmic structures to which neural activity can become synchronised to guide adaptive behaviour. In natural settings, sensory signals are rarely restricted to one sensory modality. It has been suggested that the synchronisation between the incoming sensory streams in different modalities and brain rhythms is important to facilitate information transfer across sensory modalities. Here, we investigated the cross-modal influences of a continuous auditory frequency-modulated (FM) sound on visual perception and visual cortical activity. In a human electroencephalography (EEG) study (N = 28), participants listened to a 3-Hz FM stimulus of 2 second duration and discriminated the orientation of a Gabor grating presented at threshold. Grating onset varied according to the phase of the auditory modulation and visual performance was found to co-vary accordingly. We further show that this rhythmic modulation in visual perception is related to an accompanying rhythmic modulation of neural activity recorded over visual areas. Importantly, in our task, perceptual and neural visual modulations occurred without any abrupt and salient onsets in the energy of the auditory stimulation and without any rhythmic structure in the visual stimulus. The current work suggests that continuous auditory fluctuations in the natural environment can provide a pacing signal for neural activity and thereby influence behavioural performance across sensory modalities.

Keywords: multisensory perception, neural entrainment, rhythmic attentional sampling, cross-modal influences

EEG insights into neural tracking of target and distractor streams in continuous, naturalistic auditory scenes

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Listening to speech in adverse, noisy environments can be a difficult task for listeners with normal-hearing (NH), but significantly more so for hearing-impaired (HI) individuals. Here we investigate selective attention to speech and how different factors may influence it in normal-hearing and hearing-impaired individuals. In our investigation we use electroencephalography (EEG) and auditory attention decoding approach which relies on the fact that neural signals synchronize to continuous, running auditory stimulus, more so to attended than to ignored one. Our NH and aided HI participants listened to an audiobook presented in noise. We manipulated noise level (easy vs. hard listening), but also participants' motivation by providing a monetary reward. Both participant groups performed better in easier listening condition, which was reflected in faster EEG impulse responses to speech. NH participants behaviorally performed better than HI, but increase in motivation indeed improved performance of HI group. In a separate study we also showed on neural level that selective attention abilities of HI participants improve with help of visual cues, such as speaker's lip movements. On behavioral level we showed that this increase is related to the amount of hearing loss. We suggest that auditory selective attention should be investigated in context of cues and scenarios that are common in every-day life as we do observe their influence on cortical speech tracking. In HI individuals these effects are even stronger than in NH and ecological approaches are needed to fully explain stream segregation and selective attention mechanisms.

Keywords: Hearing impairment, EEG, Auditory neuroscience, Speech, Auditory attention tracking

Target selection and distractor suppression in visual working memory

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Prioritization of information stored in working memory facilitates performance. However, there is an ongoing debate on the attentional sub-processes underlying this behavioral benefit. We investigated respective electrophysiological correlates of by means of a retroactive cuing task and oscillatory EEG parameters. In order to disentangle target- vs. distractor-related attentional processes, the to-be-memorized information was presented in a way that posterior hemispheric asymmetries in oscillatory power could be unambiguously linked to the processing of laterally presented visual stimuli. A retroactive cue indicated a subset of visual objects stored in working memory as task relevant. A contralateral increase of posterior alpha power (8-13 Hz) was evident when the non-cued working memory content was presented laterally. Furthermore, posterior alpha was decreased contralateral to the position of cued contents, but this effect was also evident when a neutral cue indicated all working memory representations as further on task-relevant. This indicates that retroactive attentional orienting is largely based on an inhibitory control process for withdrawing the focus of attention from irrelevant locations.

Keywords: selective attention, distractor inhibition, working memory, neural oscillations

Learning to ignore: Expectation-dependent distractor suppression

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Much insight has been gained into how selective attention may filter information processing at the neural level, by directly boosting relevant information (target facilitation), and/or by suppressing irrelevant information (distractor inhibition). Yet, there is still debate as to whether target facilitation and distractor inhibition are simply two sides of the same coin or whether they are controlled by distinct neural mechanisms. Recent work indicates that distractor suppression only emerges when distractor information can be (implicitly) predicted, suggesting that distractor suppression is in particular expectation dependent. I will discuss recent findings from behavioral and EEG studies examaning how expectations about upcoming target or distractor locations and/or features influence facilitatory and inhibitory effects of attention on visual information processing and representation using ERPs, multivariate decoding analyses, and inverted encoding models. Collectively, these confirm an important role for alpha oscillatory activity in top-down biasing of attention to, and tuning of representations of target locations. Yet, they also show that target facilitation and distractor suppression are differentially influenced by expectations, and rely at least partly on different neural mechanisms. Specifically, we did not find any changes in preparatory neural activity as a function of spatial distractor expectations, but a strongly reduced Pd, an ERP index of inhibition. Also, the expected distractor features could not only be decoded pre-stimulus, but their representation differed from the representation of that same feature when part of the target. These results demonstrate that neural effects of expectations critically depend on the task relevance and dimension (spatial, feature) of predictions.

POSTERS

** indicates presenting author*

A Kalman filter extension for hybrid models of the two-step sequential decision task

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Introduction: Reinforcement Learning (RL) tasks map onto a wide range of real-world scenarios and play a central role in decision-making research. One prominent example is the two-step task (a sequential Markov decision task; Daw et al., 2011) which is widely employed to study model-based (MB) and model-free (MF) influences on human choice behavior. While findings from other paradigms with fluctuating reinforcement schemes have stressed the influence of uncertainty (e.g. Daw et al., 2006, Chakroun et al., 2020), computational accounts of behavior on the two-step task thus far lack an incorporation of uncertainty. Methods: Here we extended the standard hybrid model of MB and MF control (Daw et al., 2011; Otto et al., 2013) by incorporating uncertainty-based updating via the Kalman-Filter (Kalman, 1960). Further model variants included parameters for directed exploration as well as perseveration. Models were evaluated using data from n=39 healthy participants who completed 300 trials of the two-step task. Results: The Kalman Filter extension with additional parameters for directed exploration and perseveration outperformed standard hybrid models. Model parameters exhibited associations with corresponding indices from traditional model-free analyses. Discussion: Our results converge with recent criticism regarding a simplistic demarcation of two competing learning systems (MB vs. MF) and instead stress the central role of uncertainty in guiding human choices in volatile environments. Results extend findings from other paradigms (Daw et al., 2006, Chakroun et al., 2020) and reveal evidence for directed exploration in two-step task behavior. Conceptual and methodological implications are discussed.

Keywords: reinforcement learning, computational modeling, uncertainty, exploration, two-step task

A preregistered proof-of-concept study of motor imagery-based fMRI neurofeedback training in stroke survivors

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Introduction: Motor imagery-based functional magnetic resonance imaging neurofeedback (fMRI-NF) training for potential new therapeutic techniques that aim to improve motor impairment. In this proof-of-concept study, we translated an fMRI neurofeedback paradigm previously studied in healthy participants to stroke survivors using Open Science principles.

Methods: Real-time fMRI analyses were completed in TurboBrain Voyager. Visual feedback was provided from the supplementary motor area (SMA) targeting two different neurofeedback target levels (low and high) and presented to patients via customised Python scripts. The study introduced a Bayesian sequential sampling plan, which allows 1) flexible stopping, 2) providing evidence for a null effect, and 3) incorporating prior knowledge to yield higher sensitivity. The sampling plan, a priori hypotheses, and all planned analysis were preregistered to mitigate potential publication/researcher biases, all data and code were made available to allow for reproducibility (https://osf.io/y69jc/).

Results: At the group level, we found only anecdotal evidence for the preregistered hypotheses. At the individual level, we found anecdotal to moderate evidence for the absence of the hypothesized graded effect for most subjects.

Discussion: The presented null findings are relevant for future attempts to employ fMRI-NF training in stroke survivors. Unforeseen difficulties in the translation of our paradigm to a clinical setting required well documented deviations from the preregistered protocol. Taken together, this work provides new insights about the feasibility of motor imagery-based graded fMRI-NF training in MCA stroke survivors and it can serve as a template for a comprehensive study preregistration of a complex neuroimaging experiment in a clinical population.

Keywords: neurofeedback, fMRI, motor imagery, preregistration, Open Science

A workflow for open and reproducible fMRI studies

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Achieving computational reproducibility and accessible data sharing can be challenging, in particular for neuroimaging research that involves large amounts of heterogeneous data and code. Here, we showcase a workflow that combines several software tools to allow reproducibility and transparent sharing of code and data of a human fMRI study. We recently published an open-access paper (Wittkuhn & Schuck, 2021, Nature Communications) together with the code, data and computational environments needed to reproduce the reported results. We shared > 10 datasets via GIN (G-Node Infrastructure) as modular version-controlled units, including fMRI data organized in BIDS format and derived data, such as pre-processed fMRI data and data quality metrics. Research data was version-controlled using DataLad. Following the DataLad YODA principles, we nested datasets as modular units, allowing to better establish data provenance, i.e., a clear overview which code used which input data to produce which output data. Code that reproduced the analyses was integrated with additional documentation using RMarkdown notebooks. The notebooks were automatically executed using continuous integration on GitLab. In this process, data was retrieved from GIN using DataLad, the notebooks were rendered and deployed to a website (https://wittkuhn.mpib.berlin/highspeed/). Code execution was performed using software containers (Docker and Singularity) and virtual environments, allowing to reproduce the computational environment. We will discuss ongoing improvements of this approach, including the combination of software containers, code recipes using Makefiles and the role of documentation.

Keywords: data sharing, reproducibility, open science, version-control, fMRI

Automating the Construction of Scientific Models to Explain Human Information Processing

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Introduction: Various empirical sciences, including psychology and neuroscience, are in the midst of a replicability crisis. This crisis is fueled by limited temporal and monetary resources to test and integrate an increasingly large number of theories and experimental phenomena, as well as a lacking standardization of scientific methods. We seek to overcome these limitations by integrating existing machine learning techniques into a closed-loop system for the generation, estimation and validation of interpretable scientific models.

Methods: We introduce and evaluate a novel method for recovering quantitative models of human information processing using differentiable architecture search (DARTS)—a technique that led to breakthroughs in the automated construction and parameterization of models in machine learning (e.g. computer vision) but that has not yet been applied to the discovery of models of brain function. This method treats scientific models as computation graphs, and leverages automatic differentiation to derive such models from empirical data. We evaluate the performance of this method based on its ability to recover three quantitative models of human information processing from synthetic data.

Results: Our results indicate that this method is capable of recovering basic quantitative motifs from models of psychophysics and decision making. We also identify weaknesses of this method in recovering models of exponential learning.

Discussion: Findings of this study highlight the utility of DARTS for the automated discovery of quantitative models of brain function. We invite interested researchers to evaluate this method based on other scientific models, and provide open access to a documented implementation of our evaluation pipeline.

Keywords: computational modeling, machine learning, autonomous empirical research

Dynamics of fMRI patterns reflect sub-second activation sequences and reveal replay in human visual cortex

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Neural computations are often fast and anatomically localized. Yet, investigating such computations in humans is challenging because non-invasive methods have either high temporal or spatial resolution, but not both. Of particular relevance, fast neural replay is known to occur throughout the brain in a coordinated fashion about which little is known. We develop a multivariate analysis method for functional magnetic resonance imaging that makes it possible to study sequentially activated neural patterns separated by less than 100 ms with precise spatial resolution. Human participants viewed five images individually and sequentially with speeds up to 32 ms between items. Probabilistic pattern classifiers were trained on activation patterns in visual and ventrotemporal cortex during individual image trials. Applied to sequence trials, probabilistic classifier time courses allow the detection of neural representations and their order. Order detection remains possible at speeds up to 32 ms between items (plus 100 ms per item). The frequency spectrum of the sequentiality metric distinguishes between sub- versus supra-second sequences. Importantly, applied to resting-state data our method reveals fast replay of task-related stimuli in visual cortex. This indicates that non-hippocampal replay occurs even after tasks without memory requirements and shows that our method can be used to detect such spontaneously occurring replay.

Keywords: replay, reactivation, fMRI, decoding, sequences

Effects of single-session transcranial direct current stimulation on reactive response inhibition

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Transcranial direct current stimulation (tDCS) is widely used to explore the role of various cortical regions for different cognitive processes. Reactive response inhibition refers to the process of stopping an already initiated response, which is crucial for efficient everyday performance. In recent years, tDCS studies reported polarity- and time-dependent effects on response inhibition. Given the rapid increase in tDCS application across disciplines, it is crucial to systematically explore the existing tDCS literature to increase the current understanding of potential modulatory effects and limitations of different approaches. Consequently, we performed a systematic review according to PRISMA guidelines on the modulatory effects of tDCS on response inhibition as measured by the Stop-Signal Task, a standard measure for response inhibition. The final dataset includes 31 studies which show a large variation in methodology, resulting in heterogenous effects of tDCS on task performance. Further, methodological reporting procedures and data availability vary drastically which makes replication of studies or confirmation of results partially impossible in up to 2/3 of studies. As a main finding, results show that anodal tDCS over the right prefrontal cortex has the potential to enhance response inhibition when applied before a performance measurement. We note that partially sub-optimal choices in study design and methodology as well as lacking consistency in reporting procedures may impede valid conclusions and may have obscured the effects of tDCS on response inhibition in some previous studies. Finally, we outline future directions to improve tDCS research in studies of cognition in general and response inhibition in particular.

Keywords: non-invasive brain stimulation, tDCS, response inhibition, cognitive control, review

Effects of transcranial alternating current stimulation on spontaneous, transient brain states – A Hidden Markov Model approach

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Non-invasive techniques to electrically stimulate the brain are increasingly used in human neuroscience and offer new avenues to treat brain disorders. However, their often weak and variable effects have raised concerns in the scientific community. A possible factor influencing the efficacy of these methods is the dependency on brain-states. This state-dependency is usually investigated by experimentally inducing states for long periods of time, which is in stark contrast to the timescales the brain usually operates at. Here, we utilized a novel Hidden Markov Model (HMM) framework to decompose magnetoencephalography (MEG) data of participants who received 20-min of transcranial alternating current stimulation (tACS) at alpha frequency or sham stimulation into transient brain-states with distinct spatial, spectral and connectivity profiles. We compared the change in power from a 10-min baseline period before stimulation and a post-stimulation period immediately after tACS. We found that only one out of the four spontaneous brain-states was susceptible to tACS. No or only marginal effects were found in the remaining states. TACS did not influence the time spent in each state. Our results suggest that effects of tACS may be mediated by a hidden, spontaneous state-dependency and provide novel insights to the changes in oscillatory activity underlying effects of tACS.

Keywords: transcranial alternating current stimulation (tACS), magnetoencephalography (MEG), brain stimulation, brain states

Exploration behavior in recurrent neural networks during reinforcement learning in volatile environments.

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Introduction: Recurrent neural networks (RNNs) are a promising model of human cognition (Gershman & Ölveczky, 2020; Botvinick et al., 2020). Past research showed that RNNs with computation noise show resilience to adverse conditions in reinforcement learning (Findling & Wyart 2020). The multi-armed restless bandit task is a non-stationary reinforcement learning problem, thus options must be continuously explored to increase cumulative reward (Daw et al., 2006). Here, human subjects show evidence for both random and directed (uncertainty-based) exploration (Chakroun et al., 2020). We investigated the performance of noisy vs. non-noisy RNNs in restless bandit problems and compare it to human performance.

Methods: We trained RNNs (48 units, Findling et al. 2020) using the REINFORCE algorithm on binary four-armed restless bandit problems with fixed training volatility, and examined their performance on the same task structure across a range of test volatilities. In a second step, we trained and tested on gaussian restless bandits (Daw et al., 2006, Chakroun et al., 2020) to directly compare RNN and human performance.

Results: RNNs with and without computation noise solved the four-armed restless bandit problem equally well across a range of test volatilities. A direct comparison to human performance revealed an overall similar accuracy, with some human participants significantly outperforming the networks.

Discussion: We discuss effects of computation noise in RNNs during reinforcement learning in volatile environments. Further analyses examine signatures of random and directed exploration. Furthermore, we discuss neural implications of this result and potential future research.

Keywords: Reinforcement Learning, Neural Networks, Computational Neuroscience, Explore-Exploit

Functional decoding of thalamic nuclei: a database driven characterization of brain function.

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The thalamus is a heterogeneous structure that consists of several distinct nuclei with unique connectivity patterns. Consensus views the thalamus as a relay station for brain-wide communication and studies have implicated the thalamus in sensorimotor as well as various cognitive functions. However, a precise characterization of thalamic nuclei from a cognitive neuroscience point of view is still missing.

We analyzed task-evoked data from a large amount of imaging studies as provided by the complementary databases BrainMap and Neurosynth for a functional decoding of thalamic function. The decoding was based on a novel thalamic parcellation which we obtained from a task-constraint meta-analytic connectivity based parcellation (CBP) in the BrainMap database.

The CBP resulted in a four and three clustering solution for the left and right hemisphere respectively, that showed reasonable accordance with cytoarchitectonic and anatomical maps of the thalamus. The post-hoc decoding through Bayesian reverse inference modeling, however, did reveal only a highly limited degree of specificity for cognitive terms across thalamic regions.

The surprising lack of specificity leaves the thalamus as a 'cognitive blackbox' for now. Next to methodological reasons such as the limited spatial resolution of functional MRI studies that blur boundaries of thalamic nuclei and reporting biases in the literature that omit thalamic activations, an isolated view on thalamic function might be disadvantageous: As a putative network hub, the thalamus might reveal its functional profile only in conjunction with interconnected brain areas. We will therefore discuss strategies for a systems-level decoding towards a network account of thalamic function.

Keywords: structure-function relationships, neuroimaging, thalamus, BrainMap, Neurosynth

High-quality ERPs in repsonse to everyday sounds - captured with a smartphone

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Introduction: Mobile electroencephalography (EEG) technology allows studying brain processes in everyday life. One challenge in this emerging field is to relate brain activity to events in the environment. Here we describe how we use smartphone apps (developed by us) to record audio and EEG simultaneously with high temporal precision. The audio information is decomposed into features so that the recording complies with the legal requirements of recording audio in public. We show how to use this approach to study event-related potentials in relation to everyday sounds. We relate audio information in the from of spectral, amplitude, and onsets features to brain activity.

Methods: For validation, one participant was equipped with a mobile EEG amplifier and EEG cap, and microphones at the ears. EEG and audio were recorded concurrently on a smartphone. The participant listened to sounds played on a piano, to a story read by another person, and to a complex soundscape of a coffee shop. The sounds were recorded by the smartphone, turned into event codes, and saved together with the EEG. Based on these event codes, event-related potentials (EPR) were computed.

Results & Discussion: Formal timing tests show that EEG and audio are synchronized. For all conditions, clear auditory evoked potentials (P_1, N_1, P_2) could be computed based on the auditory events. Using spectrum information, frequent and rare tones could be separated. ERPs in response to rare tones show a clear P_3 component. Our approach demonstrates the feasibility of a pocketable lab: Real-world sensory-processing ERPs captured with smartphones.

Keywords: mobile EEG, auditory, real world

Linear mixed models are superior to the arithmetic mean for stimulus norming

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Introduction. Stimuli are one of the most important tools for psychologists. The more you know about the stimuli you are presenting in your experiment, the better your control over the experimental manipulation and the better your predictions about the dependent variable. This is especially crucial for biological psychology, where experiments are often resource-intensive and tight control over non-experimental variance is desired. Information about the properties of a given stimulus pool are commonly collected in norming studies (e.g. participants rate the valence of pictures). Usually, the stimulus properties of interest are extracted as the arithmetic mean across all participants. However, this estimate is biased in the scenario where individual participants are presented with only part of the stimulus pool (e.g. because the stimulus pool is very large). Linear mixed models explicitly take into account the variance that is introduced by the participants. Methods. We simulate stimulus norming data with varying degrees of participant, stimulus and error variance. Stimulus properties estimated by linear mixed models and the arithmetic mean are then compared to the true simulated stimulus properties. Results. Linear mixed models are superior in extracting the true stimulus properties, especially in the case where not every participant is presented with the whole stimulus pool. Discussion. Linear mixed models provide a more accurate rating of stimulus properties and should be preferred over the arithmetic mean.

Keywords: linear mixed models, stimulus norming, simulation

Low-intensity transcranial focused ultrasound targeting the right prefrontal cortex leads to electroencephalographic midfrontal theta decreases which significantly predict approach behavior in a virtual T-maze task

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Introduction: Low-intensity transcranial focused ultrasound (LITFUS) is a relatively new form of non-invasive neuromodulation with high precision for target selection and energy dosage, while avoiding side effects like headaches or skin irritations. Recent reviews highlighted its potential for basic research as well as clinical applications (Beisteiner & Lozano, 2020; Blackmore et al., 2019; Landhuis, 2017).

Methods: This double-blind within-subjects study (N = 155) utilized LITFUS targeting the right prefrontal cortex, which was found to positively enhance self-reported global mood (Hameroff et al., 2013; Reznik et al., 2020; Sanguinetti et al., 2020). The present study expanded these findings by using more specific self-report, and by adding a virtual T-maze task to measure approach behavior while recording electroencephalographic midfrontal theta (MFT), which has been associated with conflict experiences and behavior (Cohen & Donner, 2013). We hypothesized LITFUS would positively enhance self-reported mood, increase approach behavior and decrease MFT.

Results: Although no specific self-report changes were found, LITFUS led to significant MFT decreases, which significantly predicted increases in approach behavior.

Discussion: The LITFUS-induced MFT decreases and approach behavior increases confirmed our hypotheses. The absence of self-report effects might be due to our study's focus on a task rather than self-reflection. This study expands the evidence for the impact of LITFUS on behavior and physiology, suggesting the promise of further basic and applied research, such as emotional and motivational disorders.

Keywords: Low-Intensity Transcranial Focused Ultrasound Neuromodulation, Electroencephalographic Theta in Association with Behavioral Measures, Comparison of Subjective and Objective Measures

The gamma model analysis

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Research using the event-related potential (ERP) method to investigate cognitive processes has usually focused on the analysis of either individual peaks or the area under the curve as components of interest. These approaches, however, cannot analyse the substantial variation in size and shape across individual waveforms. The *gamma model analysis* (GMA) addresses these specific restrictions of the usually applied methods and enables the analysis of additional time-dependent and shape-related information on ERP components by fitting mathematically computed gamma probability density function (PDF) waveforms to an ERP.

The advantage of the GMA is demonstrated in a simulation study and a force production task. The different gamma model parameters were sensitive to various experimental manipulations across the empirical studies. Moreover, the GMA revealed several additional interrelated but non-redundant parameters compared to the classical methods, which were predictive of different aspects of behaviour, allowing for a more nuanced analysis of the cognitive processes. The GMA provides an elegant method for extracting easily interpretable indices for the rise and decline of the components that complement the classical parameters. This approach, therefore, provides a novel toolset to better understand the exact relationship between ERP components, behaviour, and cognition.

Keywords: Event-Related Potentials, Action Monitoring, Gamma function, Mathematical model

Training Factors for Tactile P300 Brain-Computer Interfaces

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Introduction: Brain-Computer Interfaces (BCIs) enable their users to interact with the environment based on *brain activity*, without relying on intact muscular function. Potential end-users thus include severely paralyzed patients.

Many BCIs are based on *visually evoked* P300 event-related potentials, leading to usability issues when eyesight or gaze control are impaired. Because of this limitation, vision independent alternatives have recently been developed. Specifically, a tactile paradigm originally intended for wheelchair control has been shown to be feasible and trainable for healthy users. Training is vital to ensure successful translation to potential end-users. This study aimed to confirm the trainability and explore which factors contribute to training effects.

Methods: We analyzed performance and EEG data from 21 healthy participants across five tactile BCI sessions. Two experiments were included to identify potential training factors: Somatosensory sensitivity was assessed with a tactile discrimination task. A dual task condition explored whether training improved the BCI's robustness against workload increase. Subjective workload was assessed via questionnaire.

Results: We found a highly significant training effect on BCI accuracies (M = 78.7 % to 91.2 %) and on P300 amplitudes. No conclusive evidence for a role of workload was observed in the dual task condition, but the somatosensory sensitivity increased highly significantly between the first and last sessions. Notably, participants were able to discriminate between much smaller stimulus intensities after training.

Discussion: The present study confirmed the trainability of the tactile BCI and provided first evidence of the importance of somatosensory sensitivity for training success.

Keywords: Brain-Computer Interface, P300, Event-Related Potential, Tactile, Somatosensory, Training

CD38 and susceptibility to the influence of live events on life satisfaction – a gene x environment interaction

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CD38 is known to influence oxytocin secretion, which in turn is connected to numerous socioemotional processes such as reactivity to both stressful and positive experiences.

On a genetic level, the CD38 rs3796863 C-Allele has been regarded as a potential risk factor for autism. Because of associated lower social sensitivity, a higher risk for other psychological disorders has been assumed as well. Recently, however, there have been findings that the *A*-Allele associated *heightened* social sensitivity could be a predictor of anxious and depressive symptoms following chronic interpersonal stress.

To further explore this possible gene x environment interaction, its direction, and extension to different types of stressors as well as positive experiences, we measured the CD38 rs3796863 genotype, 55 life events typically relevant for student samples, and their effect on life satisfaction in N=576 undergraduates.

The results show that participants, who have had predominantly positive life events, experience greater life satisfaction than those who have had predominantly negative events. We also observed a significant gene x environment interaction. A-homozygotes showed the greatest differences in life satisfaction between predominantly negative vs. positive life events. AC-carriers displayed only a small difference and there was almost no difference between life events in C-homozygotes. In post-hoc-tests only the difference in A-homozygotes was significant.

These results support the assumption that A-carriers, presumably because of their heightened sensitivity, are more susceptible to the influence of live events – both negative and positive.

These findings have to be replicated and should be observed both long-term and in experimental settings.

Keywords: Life-events, CD38, Life satisfaction, Gene-environment interaction

Consistency in sex classification analyses across independent datasets

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Introduction: There is an ongoing debate on whether features of functional brain organization as captured by resting-state functional connectivity (RSFC) are sexually dimorphic or overlapping between males and females. Machine-learning (ML) approaches can address this question: The level to which the biological sex of a person can be predicted by a ML-algorithm based on spatially specific RSFC features can indicate whether the features in the respective regions are rather sexually dimorphic than overlapping.

Methods: Within five independent big datasets; CamCAN (N=622), eNKI (N=458), 1000BBRAINS (N=1042), GSP(N=870) and HCP (N=966), spatially specific RSFC among 436 Parcels covering cortical as well as subcortical regions was assessed by correlating each parcel's activation time course with those of the other 435 parcels. Based on these features, a Support Vector Machine classifier with radial basis function kernel was used to perform classification analyses in each dataset separately.

Results: The classifier achieved highest average classification accuracy on HCP (73.59%), followed by 1000BRAINS (72.51%) and GSP (71.22%). Slightly lower accuracies were achieved for CamCAN (68.72%) and the eNKI (64.34%). Across datasets, highly predictive parcels were consistently located in the temporal lobe, cingulate cortex, inferior frontal gyrus and insula.

Discussion: While classification accuracies varied slightly across the datasets, highly classifying regions were consistent, indicating that especially the cingulate cortex, temporal lobe, insula and inferior frontal gyrus show more sex-specific FC patterns. However, the accuracies were only moderately high, indicating that RSFC patterns are not fully sexual-dimorphic but rather overlapping features.

Keywords: sex classification, machine learning, sex differences, big data

Cortical hyperarousal in individuals with frequent nightmares – trait or state?

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Introduction: Nightmares are common among the general population and in psychiatric but hard to study in the sleep lab environment. Previous studies associated signs of nocturnal arousal with nightmares such as increased heart rate, reduced slow wave sleep (SWS) and increased high-frequency EEG activity. However, it is still unclear, whether these characteristics are more of a trait of (chronic) nightmare sufferers or rather indicators of the nightmare state.

Methods: We compared participants with frequent nightmares (NM) and healthy controls who spent four nights in the sleep laboratory. In order to disentangle trait and state effects of nightmare experience, sleep architecture and spectral power during NREM and REM periods was compared i) between nightmare participants and healthy controls and ii) between nights of nightmare occurrence and nights without nightmare occurrence in the group of NM participants.

Results: NM participants showed increased sleep latency, reduced sleep efficiency and a higher number of movement arousal during REM as well as increased beta (16.25–31 Hz) and gamma (31.25–45 Hz) power during NREM and REM periods compared to healthy controls. Nightmare occurrence was associated with increased movement arousal in NW participants.

Discussion: Our findings suggest that nightmare participants show signs of increased arousal during sleep that is independent from immediate nightmare occurrence. Neurophysiological alterations associated with cortical hyperarousal might represent a trait factor underlying frequent nightmare occurrence.

Keywords: sleep, eeg, nightmares, cortical hyperarousal, trait or state

Does Porn Make Impatient? The Association between Pornography Consumption and the Discounting of Delayed Monetary Rewards

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Pornography is a highly accessible, affordable and anonymous primary rewarding stimulus, with considerable potential to exert both temporary and lasting influence on human decision-making and neurobiological functioning. One such behavioral adjustment is, that humans discount future rewards stronger, both when confronted with pornography directly during decision-making, or when consuming pornography regularly over a prolonged time-period. However, data on recreational users is either unavailable or inconclusive. The present study applied a cross-sectional online-survey, on a German sample of recreational pornography users, inquiring about pornography consumption patterns and impulsivity. Both frequentist and Bayesian statistical data analysis approaches were used to test the hypothesized positive relationship between pornography consumption and impulsivity. A total of N = 337 participants provided complete datasets. Correlation indices for associations between pornography consumption and impulsivity, yielded only marginal sup- port for the hypothesized relationship, with most indices below r = .20. A multiple stepwise regression model extracted attitude towards pornography, years since consumption onset and the share of pornography consumed during partnered sex as significant predictors of intertemporal choice behavior. Further exploratory analyses employing MCMC-sampling could not detect any substantial positive relationships between the hypothesized measures. These results yield only marginal support for both our hypothesized associations and past findings regarding impulsivity in individuals with problematic use of pornography. Still, our results do not yet permit to fully refute assumptions regarding causality, with further research needed on social and situational factors mediating between recreational pornography use and everyday decision-making.

Keywords: intertemporal choice, impulsivity, pornography, sexuality, frontostriatal connectivity

Estimating the prevalence of atypical footedness and its relation to handedness across 164 studies

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Human lateral preferences have interested researchers for decades due to their pronounced asymmetries at the population level. To this day, there is no large-scale estimation on the prevalence of footedness. Furthermore, the relationship between footedness and handedness still remains elusive. Here, we conducted a large-scale meta-analysis totaling 145,135 individuals across 164 studies including new data from the ALSPAC cohort. The study aimed to determine a reliable and reproducible point estimate of footedness, to conclusively determine the association between footedness and handedness, and to investigate moderating factors influencing footedness. We showed that the prevalence of atypical footedness ranges between 12.10% using the most conservative criterion of left-footedness to 23.7% including all left- and mixed-footers as a single non-right category. As many as 60.1% of left-handers were left-footed whereas only 3.2% of right-handers were left-footed. Males were 4.1% more often non-right-footed compared to females. Individuals with psychiatric and neurodevelopmental disorders exhibited a higher prevalence of non-right-footedness. Furthermore, the presence of mixed-footedness was higher in children compared to adults and left-footedness was increased in athletes compared to the general population. Finally, we showed that footedness is only marginally influenced by cultural and social factors, which play a crucial role in the determination of handedness. Overall, this open-access publication provides new and useful reference data for laterality research that is openly available at OSF including code for analyses. Furthermore, the data suggest that footedness is a valuable phenotype for the study of lateral motor biases, its underlying genetics and neurodevelopment.

Keywords: asymmetry, lateralization, meta-analysis, footedness, handedness

Influences on the association between heart rate variability and measures of executive control

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Introduction: Different psychophysiological frameworks (e.g. Polyvagal Theory Neurovisceral Integration Model, Attentional Network Theory) predict that tonic heart rate variability (HRV) and the strength of executive functions are associated, however, empirical evidence so far has been mixed. Thus, we investigated the association between HRV and indices from both an affective and a non-affective go/no go paradigm together with a set of possible confounding variables (registered prior to analyses at osf.io/k79aq).

Methods: Commission errors were used as a measure of behavioural inhibition, reaction time as a measure of orientation speed and subsequent behavioural execution. Gender, trait anxiety and impulsiveness were tested as confounding variables. The statistical analysis consisted of two sets of linear mixed models of increasing complexity.

Results: For commission error, a significant interaction between HRV and sex was found. With higher HRV, male participants made more commission errors, while female participants made less. We found significantly higher reaction times in the affective GNG. This difference in reaction time decreases with higher HRV. Furthermore, the association of HRV and reaction time is moderated by trait anxiety – with higher trait anxiety, low HRV is associated with longer reaction times, but high HRV with shorter reaction times.

Discussion: Taken together, our results support the conclusion that the association between HRV and measures of executive control is not universal, but depends on several factors. Specifically, gender seems to influence the association between HRV and behavioral inhibition and trait anxiety the association between HRV and orientation speed.

Keywords: heart rate variability, executive functions

Inter- and intraindividual differences in alpha synchronization during creative ideation

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Existing evidence on the relationship between EEG alpha power and creative ideation demonstrates that the process of creative ideation (measured with divergent thinking tasks) is associated with increases in alpha power (i.e. task-related alpha synchronization). Recent studies further indicate that this alpha synchronization changes depending on the time course of the creative process. However, the role of possible specificity of lower and upper alpha band power in the creative process seems to be unclear. While most studies concentrated on alpha power in the upper alpha band (10-12 Hz), others also focused on the lower alpha band (8 - 10 Hz) or on the broad alpha frequency range (8-12 Hz). The aim of this study was therefore to investigate the time course of EEG alpha power during the process of creative ideation separately for the lower and upper alpha bands. Furthermore, we were interested in whether this process of creative ideation differs with regard to inter-individual (originality and intelligence scores) and intra-individual (creative responses vs. non-creative responses) differences. For the study, sixty-one participants completed an Alternate Uses Task (AUT) while an EEG was recorded and changes in task-related performance (relative to rest) were determined in both alpha frequency sub-bands for three time intervals of the idea generation period. Data are currently being analyzed. This study allows a deeper understanding of the role of the different alpha frequency bands in the creative ideation process as a function of inter- and intraindividual differences.

Keywords: Creative Ideation, EEG, Alpha Power

Konsequenzen aversiver Kindheitserfahrungen – welche Effekte zeigen sich im Proteom von CD14+ Monozyten?

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Das Erleben von Vernachlässigung und Missbrauch in der Kindheit (*adverse childhood experiences*: ACE) stellt einen transdiagnostischen Risikofaktor für psychische und somatische Gesundheitsproblematiken dar. Mehrere biologische Mediatoren dieser Assoziationen werden diskutiert. Auf molekularer Ebenen erfahren dabei derzeit besonders epigenetische Modifikationen wie etwa die Methylierung von DNA gesteigerte Aufmerksamkeit. Darüber hinaus lässt sich eine Zunahme von Studien verzeichnen, die die Konsequenzen wiedriger Erfahrungen auf Ebene der Genexpression in den Blick nehmen. Über die Auswirkungen von ACE auf die Proteom-Komposition ist dagegen wenig bekannt. Obwohl Proteine nahezu alle zellulären Funktionen realisieren wurde diese Ebene molekularer Organisation bei der Untersuchung biologischer ACE-Konsequenzen bisher nicht berücksichtigt. Der vorliegende Beitrag stellt Ergebnisse einer Proteom-Studie vor. Methodisch wurden zunächst $CD14^+$ Monozyten aus dem Blut von 30 gesunden Erwachsenen mit ACE und einer passenden Kontrollgruppe vor und nach der Induktion von psychosozialem Stress (TSST) isoliert. Die Analyse des Proteoms erfolgte anschließend mittels Flüssigchromatographie-Tandem-Massenspektrometrie (LC-MS/MS). ACE assoziierte Proteine erwiesen sich als relevant für mitochondriale, proteinmetabolische und immunsystemische Prozesse. Diese Befunde waren sowohl vor als auch nach der Induktion von Stress zu beobachten und konnten mittels Protein-Interaktions- und Koexpressionsanalysen untermauert werden. Unsere Ergebnisse unterstützen die Idee mitochondrialer Dysfunktion als möglichen Mediator früher aversiver Erfahrungen.

Keywords: Aversive Kindheitserfahrungen, Monozyten, Proteomanalyse, Netzwerkanalyse

Narcissism and Error Processing: Variations of Admiration and Rivalry with the Error-Related Negativity and the Error Positivity

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The literature on narcissism suggests two contradictory ways how highly narcissistic individuals deal with failures: They might consciously avoid failures *or* vigilantly turn towards them as failures provide essential cues for the pursuit and protection of grandiosity. We tried to dissolve these (seemingly) contradictory positions by studying event-related potential components of error processing and their variations with narcissism. With a speeded Go/noGo task, we examined how the error-related negativity (Ne/ERN) and the error positivity (Pe) vary with Admiration and Rivalry, two narcissism dimensions (Back et al., 2013), under ego-threatening conditions. Using multilevel models, we showed that participants with high Rivalry displayed higher Ne/ERN amplitudes. We did not find variations of either narcissism dimension with the Pe. Thus, the results only supported the second position, a heightened vigilance to errors at early, rather automatic processing stages (reflected in a higher Ne/ERN). However, future studies might find reduced conscious error perception at later processing stages (reflected in Pe variations) by distinguishing between an early and a late Pe (Endrass et al., 2007) and by considering the error evidence accumulation account (Steinhauser & Yeung, 2012). After all, if one respects the temporal dynamics of error processing and different narcissism dimensions, highly narcissistic individuals might show heightened vigilance to *and* conscious avoidance of errors.

Keywords: Narcissism, Admiration, Rivalry, Error Processing, Event-Related Potentials

OXTR x CD38 interaction in differences in responsiveness to a Positive Psychological Intervention: replication and extension

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Oxytocin (OXT) has been associated with social interaction and positive emotionality. However, the role of OXT in responsiveness to interventions aimed at increasing positive emotions is largely unexplored. Yet, an oxytocin receptor (OXTR) gene SNP (rs53576) was identified to be relevant in predicting responsiveness to a Positive Psychological Intervention (PPI) (Luxem et al., 2019).

To replicate and extend this finding, we additionally tested whether the emotional benefit from a four-week group PPI (with one session per week) can be explained by a SNP (rs3796863) of the cluster of differentiation 38 (CD38) gene that is functionally relevant for the secretion of OXT.

First, with an enlarged Caucasian collective of N = 116, we found evidence for the PPI effectiveness as an increase in situational positive affect. Second, the effect of OXTR G allele carriers (n = 88) being more responsive to the PPI than A homozygotes was stable. Third, CD38 A allele carriers (n = 58) descriptively showed an overall higher and increasing emotional profit from the PPI over time compared to C homozygotes. Fourth, the OXTR x CD38 interaction was not significantly associated with responsiveness; though, OXTR G allele carriers with at least one CD38 A allele descriptively showed the greatest benefit.

Factors influencing the prediction of the interindividual responsiveness to PPI are discussed. To test these in the future, a further upsizing of the sample is necessary to increase the statistical power.

Keywords: Oxytocin, OXTR, CD38, Positive Psychological Intervention, Responsiveness

Oxytocin, Dopamine, and Attachment – Does the relationship person matter?

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Striatal dopamine (DA), especially in the ventral tegmental area (VTA), plays an important role in attachment. Catechol-O-Methyltransferase (COMT) is involved in degrading DA. Met-carriers of a polymorphism (rs4680) coding COMT activity show a reduced enzyme activity. Oxytocin (OT), central in processing social cues, has receptors in different brain areas, amongst others in the striatum. A-carriers of the oxytocin receptor polymorphism (OXTR) rs53576 show an increased need for social approval. OT inhibits exploratory behavior when modulating DA on the level of substantia nigra, whereas oxytocinergic effects on DA in the VTA stimulate social behavior. The interaction of DA and OT regarding adult attachment has been investigated. This result is expected to be replicated. Furthermore, it will be examined whether the DA-OT-interaction in attachment differs between relationship persons (mother/partner).

A total number of N=545 students (441 females, 3 non-binary) was genotyped for rs4680 and rs53576. Adult attachment was measured with the German version of the Attachment Style Questionnaire (ASQ). The attachment pattern according to different relationship persons was investigated in a subsample of N=214 (175 females, 2 non-binary) participants with the BBE (Beziehungsspezifische Bindungsskalen).

First, the results of our last study were replicated. The combination of Met- and A-homozygotes showed a significant higher score on the ASQ scale "Need for Approval". The same was shown for the scale "Relationships as Secondary". There were no significant results for the BBE, indicating that the interaction between DA and OX basically relates to attachment but not to different patterns according to different relationship persons.

Keywords: Oxytocin, Dopamine, Attachment, rs4680, rs53576

Performance monitoring in Impulsivity and Compulsivity

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Introduction. Adaptive behavior depends on monitoring response outcomes for the need to adapt behavior and the recruitment of cognitive control, a process called performance monitoring (PM). Neural correlates of PM, like the error-related negativity (ERN), are altered in various mental disorders, such as obsessive-compulsive disorder (OCD) and substance use disorder (SUD). These mental disorders are also marked by impulsivity and compulsivity. The current study investigated whether PM-related brain activity is altered in different configurations of impulsivity and compulsivity.

Methods. So far, we recruited a sample of 101 individuals from the general population, split into four groups: low impulsive and low compulsive (n=35), high impulsive and low compulsive (n=17), low impulsive and high compulsive (n=24) and high impulsive and high compulsive (n=25). Impulsivity was assessed using the Barratt Impulsiveness Scale and compulsivity with the Obsessive Compulsive Inventory – Revised. We used the error-related negativity (ERN) in a classical Flanker task to assess PM.

Results. Our preliminary analysis revealed significantly higher ERN amplitudes in the low impulsive/high compulsive group compared to the low impulsive/low compulsive group. The other groups did not differ from one another; however, as the sample size is small, confidence intervals are still large.

Discussion. This replicates the effect of increased ERN amplitude in compulsive individuals, in a classical Flanker task. There is no evidence, so far, of a modulation of ERN amplitude by impulsivity.

Keywords: Performance monitoring, ERN, impulsivity, compulsivity

Polygenic and Genome-Wide Associations with Small-World Propensity in Functional Brain Networks: A Genetic Imaging Study in N = 16,687 Individuals from the UK Biobank Cohort.

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Psychiatric disorders and psychological traits have a strong genetic foundation but the biological pathways remain largely elusive. A promising way to understand how genetic variation increases susceptibility for respective traits is the inclusion of intermediate phenotypes with established relevance for given traits. Recent evidence suggests that the overall efficiency of brain-wide functional connectivity networks is reduced in several psychiatric disorders. The present study operationalizes network efficiency through the small-world propensity (SWP) metric and investigates its putative role as an intermediate endophenotype in resting-state fMRI data from the UK Biobank (N = 16,687). We found a substantial genetic foundation of SWP, as well as genetic correlations and polygenic associations that are in line with the previously suggested dimensionality of the SWP measure across a wide range of behavioral and clinical traits. While our results are promising, it needs to be noted that the observed effect sizes are modest at best and preclude clinically relevant predictions at this stage. Considering the substantial SNP-based heritability of SWP, however, we believe that our results are a promising starting point towards establishing functional network efficiency as an endophenotype with substantial predictive accuracy for psychiatric disorders and psychological traits. We will discuss how the clinical neurosciences can leverage the currently emerging methodological advances and take advantage of growing sample sizes to unravel the neural pathways from genes to behavior.

Keywords: Small-World Propensity, Genetic Imaging, UK Biobank

Predicting Intelligence from Time-Resolved Brain Connectivity

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Introduction: Intelligence captures the general cognitive ability level of a person. Whereas its (neuro-)biological basis is not yet completely understood, intelligence can be predicted from time-averaged ('static') functional resting-state connectivity. When temporally decomposing this 'static' connectivity into time-varying connectivity patterns, individual participants can be identified based on the 5% of the resting-state (rs-)fMRI timeseries that show highest-amplitude whole-brain cofluctuations. Here, we test whether such connectivity states can predict individual differences in intelligence.

Methods: We identified three types of rs-fMRI connectivity states (N=281), each defined as a set of only 5% of the rs-fMRI timeseries, corresponding to i) highest-amplitude cofluctuations, ii) lowest-amplitude cofluctuations, and iii) local extrema within the cofluctuation timeseries. We then examined whether the Wechsler full-scale IQ can be predicted from these states, using a newly developed two-stage prediction framework involving the construction of interpretable features and cross-validated ElasticNet regression.

Results: Neither highest-amplitude nor lowest-amplitude cofluctuations significantly predicted intelligence (observed vs. predicted: both $r<.13$, $p>.05$). In contrast, local extrema connectivity states achieved above-chance prediction ($r=.3$, $p<.05$), thereby involving multiple functional brain networks. All results were replicated in an independent sample (N=831).

Discussion: Our results indicate that individual differences in intelligence depend on intermediate brain-wide connectivity states instead of moments of strongest cofluctuation. Together with the wide spatial distribution of the predictive features, this suggests that intelligence emerges as a whole-brain property from moments of dynamic changes in network interactions. Finally, the here proposed prediction method may allow for unbiased prediction analyses in various fields of neuroscience.

Keywords: cognitive ability, network neuroscience, dynamic functional connectivity, machine learning, prediction

Revisiting potential associations between brain morphology, fear acquisition and extinction through new data and a literature review

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Inter-individual differences in defensive responding are widely established but their morphological correlates in humans have not been investigated in depth. Previous studies reported associations with cortical thickness of the dorsal anterior cingulate cortex, insula and medial orbitofrontal cortex as well as amygdala volume in fear conditioning studies. However, these associations are partly inconsistent and often derived from small samples. The current study aimed to (conceptually) replicate previously reported associations between physiological and subjective measures of fear acquisition and extinction and brain morphology. Structural magnetic resonance imaging was performed on 107 healthy adults who completed a differential fear conditioning paradigm with 24h delayed extinction while skin conductance response (SCR) and fear ratings were recorded. Cortical thickness and subcortical volume were obtained using the software Freesurfer. Results obtained by traditional null hypothesis significance testing and Bayesians statistics do not support structural brain-behavior relationships: Neither differential SCR nor fear ratings during fear acquisition or extinction training could be predicted by cortical thickness or subcortical volume in regions previously reported.

In summary, the current pre-registered and peer-reviewed study does not corroborate associations between brain morphology and inter-individual differences in defensive responding. While differences in experimental design and analyses approaches are discussed, we would also like to emphasize the need for larger sample sizes to ensure sufficient power to detect smaller correlations. Looking into the future, we envision collaborative data pooling in order to meet the sample size requirements for individual difference research that are difficult to fulfill by individual research groups.

When Less Adaption is More: Multi-Task Brain Network Reconfiguration and its Inverse Relationship with General Intelligence

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Introduction: Intelligence predicts important life outcomes like educational success, health, and longevity. Functional brain network reconfiguration operationalized as adaptation of resting-state functional connectivity (FC) to cognitive demands was recently proposed as promising marker of intelligence. This study links general intelligence to brain network reconfiguration between resting- and seven specific task states.

Methods: We used data from 812 subjects of the Human Connectome Project. General intelligence was operationalized as latent g-factor derived from 12 cognitive tasks using bifactor analysis. Subject-specific FC matrices were constructed from fMRI data from resting state and seven tasks. Functional brain connections were filtered based on their correlation with intelligence and reconfiguration was operationalized as cosine distance between the filtered FCs of two states.

Results: Higher scores of general intelligence were associated with less brain network reconfiguration. This association was observed for all rest-task (rho = -.23, $p < .001$) and task-task (rho = -.23, $p < .001$) comparisons and for all functional brain networks except the motor systems. Results were replicated in two independent samples (N = 138, N = 184) indicating generalization to different intelligence measures and various cognitive demands.

Discussion: The robust relationship between higher intelligence and less brain network reconfiguration suggests that higher intelligent people may have an intrinsic network architecture that is closer to the network architecture as required for performing various cognitive tasks. Further, our results propose intelligence as an emergent property of a widely distributed multi-task brain network potentially reflecting the neural equivalent of the positive manifold of general intelligence.

Keywords: intelligence, functional connectivity, brain network reconfiguration, resting state fMRI, task state fMRI

One task to rule them all: Disentangling episodic and semantic memory formation

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Introduction. Systems memory consolidation postulates two brain systems for declarative memory coding different aspects of a memory, with the hippocampal system storing episodic and detailed information and the neocortex extracting regularities to generate concepts/schemata (Marr, 1970). Experimental paradigms are usually tailored to engage only one system, making it impossible to directly compare results. Therefore, we have designed a memory task that allows for identical visual stimulation while targeting either the episodic (EPI) or semantic system (SEM) via different instructions. Here we present preliminary data evaluating this novel paradigm.

Methods. During learning, 34 participants are presented with unknown stimuli ("aliens") in different contexts ("planets"). While every alien lives on one planet and has a unique appearance, some also share a similar shape/color scheme. Two experimental groups differ in the instructions on how to encode the stimuli with either having to categorize them into groups of aliens with shared features (SEM) or encode the stimuli based on individual features including the context (EPI). 24h later the participants perform two memory tests: A categorization task targeting the semantic system and an episodic recognition task.

Results. While there was no difference between conditions in performance levels and subjective task difficulty for the encoding task, SEM performed significantly better identifying new category members but worse at recognizing correct stimulus-context pairings.

Discussion. Preliminary results indicate that this paradigm induces differential engagement of episodic and sematic memory systems only by varying instructions, opening up new possibilities for neuroimaging to observe parallel memory formation and investigate systems interaction.

Keywords: Memory systems, episodic, semantic, encoding, consolidation

Decoding Human Memory Replay During Rest

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Animal research suggests replay of memory traces during rest and sleep improves performance, but this research relies on highly invasive methods and only has access to simple behavior. Similarly, quantifying replay in humans has proven difficult, and up to this point, no study exists that is able to detect endogenous human memory replay during sleep. In this proof-of-principle study, we applied a recently developed method in healthy humans to record item-level human replay events and thereby uncover the processes occurring during quiet rest. In subsequent studies we hope to further develop this method to be able apply it to human sleep.

In this study we attempted to detect sequential memory replay in humans during rest. In a first step, sixteen items were presented multiple times in a pseudorandom order while brain activity (MEG) was recorded in order to extract the representational brain state activity for these items. Machine learning classifiers were trained to decode the brain states belonging to each item. In a second step, the participants learned an ordering of the previously presented items. Subsequently, in a resting state condition, we were able to detect preliminary evidence for time-compressed replay of the learned items. Our analysis confirmed previous findings, that items are replayed with a time-lag of around 40-50 milliseconds between individual items.

Keywords: memory replay, decoding, MEG

Dynamics of nonlinguistic statistical learning: From neural entrainment to the emergence of explicit knowledge

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Statistical learning, which describes the ability to detect patterns in the environment, plays an important role in many aspects of cognition. Up to now, there is little knowledge about the dynamics of this implicit form of learning and its relation to explicit knowledge. In the present study, 24 healthy volunteers were exposed to an auditory nonlinguistic statistical learning paradigm while their brain activity was measured with magnetoencephalography. The stimulation paradigm was composed of 12 pure sinusoidal tones, arranged in one structured – containing repeating tone triplets – and one random sequence. Statistical learning was quantified by neural entrainment to the embedded tone triplets. When exposed to the structured sequence, participants showed strong neural entrainment to the embedded triplet pattern, which was present already after a few triplet repetitions. Source reconstruction revealed that in addition to brain areas included in the auditory processing hierarchy, the left pre-central gyrus plays a role in this form of statistical learning. Furthermore, neural entrainment to the triplet patterns increased over time and its overall strength predicted participants' subsequently tested explicit knowledge. This suggests that there is a systematic relationship between neural entrainment and explicit learning of triplet structures. While participants had some difficulty with explicitly expressing this kind of nonlinguistic learning, the measured neural entrainment and its temporal dynamics reflected a robust, implicit learning of underlying patterns.

Keywords: Statistical learning, MEG, auditory processing, implicit learning, explicit learning

Effects of contingency awareness on aversive and appetitive conditioning as revealed by pupillometry

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Evidence regarding unaware differential conditioning in humans is mixed. Moreover, while the very existence of implicit fear conditioning has recently been challenged, even less is known about effects of contingency awareness on appetitive conditioning. Phasic pupil dilation responses (PDR) might yield a promising readout that is potentially more sensitive to implicit learning than skin conductance responses (SCR) or other more established measures. Thus, the present study varied the type of contingency instructions (between) as well as valence of the unconditioned stimulus (UCS) (within participants).

After being randomized to either a fully instructed or non-instructed group, participants underwent a differential conditioning procedure involving perceptually matched grating stimuli varying in orientation (angle) only. One conditioned stimulus (CS+app) was followed by a noise signaling monetary reward (1€) in 13 of 20 trials, whereas another one (CS+avs) was associated with a mild electric shock. A third visual stimulus (CS-) was never paired with either aversive or appetitive UCS. PDR and SCR were recorded during both acquisition and extinction training.

SCR results demonstrated successful differential fear conditioning in the group of instructed participants. In the subgroup of non-instructed participants who remained unaware of the CS-UCS association, no effect on SCR, yet differential modulation of early pupil responsivity by appetitive cues emerged. However, this effect was diminished during later stages of acquisition, suggesting reduced stimulus discrimination.

Our findings add to the growing body of research utilizing PDR as an index of differential conditioning, indicating that pupillometry might be better suited to track implicit conditioning than SCR.

Keywords: pupil dilation responses, skin conductance, appetitive conditioning, aversive conditioning, contingency awareness

Electrophysiological correlates of sleep-associated memory consolidation in pre-school children

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Introduction: In adults, the precise temporal coordination of fast spindles (~12-16 Hz) and slow oscillations (< 1 Hz) is considered a key mediator of sleep-associated memory consolidation. However, across development, spindles and slow oscillations change considerably. Thus, it remains elusive whether the same mechanisms of sleep-associated memory consolidation as identified in adults are comparably functional in children.

Methods: Here, we characterise slow (~9-12 Hz) and fast spindles leveraging an individualised rhythm detection approach and their temporal modulation during slow oscillations using time-frequency analyses and peri-event time histograms in 24 5- to 6-year-olds. Further, we investigate whether spindles and their modulation during slow oscillations are associated with behavioural indicators of declarative memory consolidation.

Results: We reliably identify an endogenous, development-specific fast spindle type, though nested in the adult-like slow spindle frequency range, along with a dominant slow spindle type. Further, coupling analyses indicate the presence of fast spindle-slow oscillation coupling already in pre-school children -– though weaker and less precise than expected from adult research. While we do not find evidence for a critical contribution of the pattern of fast spindle modulation during slow oscillations for memory consolidation, crucially, robust regressions show that slow and fast spindles are differentially related to memory consolidation of items of varying encoding quality.

Discussion: Our results reveal two functionally relevant spindle types in pre-school children despite not fully matured spindle–slow oscillation coupling. However, it remains an open question what renders spindle-slow oscillation coupling more precise and pronounced and how this affects memory consolidation across development.

Keywords: children, memory consolidation, sleep spindles, slow oscillations

Encoding associative memories based on feedback – an fMRI study

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Introduction: The ability to update memory representations by (re)learning after recognizing missing or wrong memories is central for adaptive performance in everyday life. However, there has not been much neurophysiological research about how performance monitoring may improve the formation of long-term memories.

Methods: We conducted an fMRI study on 30 young participants (15 female) using a feedback-guided associative learning paradigm, in which unknown faces had to be matched with gabor patches of eight different orientations. On each trial, participants judged the confidence in their choice, received feedback on the correctness and were presented with the correct stimulus combination to encode correct associations for following trials. Successful feedback-based encoding was defined as a corrected error, i.e., correct reproduction of the face-orientation association on the next trial.

Results: After choosing wrong face-orientation associations, negative feedback was associated with increased BOLD responses in the anterior insula, posterior medial frontal cortex (pMFC) and frontoparietal network. Positive feedback was accompanied by effects among ventral striatum and ventromedial prefrontal cortex. Successful encoding based on negative feedback – later corrected compared to repeated errors – showed an overlap with negative feedback particularly in pMFC, supplementary motor area, dorsolateral and inferior frontal regions. In addition, signal increases in the anterior hippocampal formation were found.

Interpretation: The current results suggest that regions associated with negative feedback may guide successful encoding after previous mistakes by recruiting hippocampal activity. Further analyses will investigate feedback-dependent functional connectivity of these regions.

Keywords: reinforcement learning, associative learning, feedback processing, metacognition

Hippocampo-frontal multivoxel patterns are modulated by prefrontal stimulation and motor sequence learning

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Introduction: Motor sequence learning (MSL) is supported by dynamical interactions between striato- and hippocampo-cortical networks mediated by the prefrontal cortex. We examine whether multivoxel patterns in the dorsolateral prefrontal cortex (DLPFC) and hippocampus can be modulated via MSL and theta-burst-stimulation (TBS) of the DLPFC.

Methods: 19 participants received DLPFC-TBS before being scanned on a motor task in a 2x2-within-subject design [stimulation(iTBS/cTBS) by task(sequential/random)].

Resting-state (RS) scans were acquired before stimulation and after task performance.

For each ROI (DLPFC /hippocampus) and MRI session (RS pre- and post-stimulation/learning; early and late task), activity patterns were estimated by computing correlations among the n voxels extracted from each ROI. Pearson's correlations were computed between each of n BOLD-fMRI voxel time courses, yielding an n-by-n matrix (multivoxel-correlation-structure, MVCS, Tambini&Davachi(2013)). Similarity of the multivoxel patterns between two MRI sessions were computed as the correlation between the MVCS matrices and entered into 2 (task) by 2 (stimulation) repeated-measures ANOVAs.

Results: DLPFC patterns were more similar between the early and late task stages in the random as compared to the sequence task (task effect).

Hippocampal patterns at rest were more similar after the random than the sequence task (task effect) and in the iTBS as compared to the cTBS conditions (stimulation effect).

Conclusions: Our results show that MSL disturbed patterns of the DLPFC during task practice and of the hippocampus during post-learning rest. Importantly, prefrontal stimulation affected hippocampal patterns during post-learning/stimulation rest. Collectively, these data provide the first evidence that both MSL and stimulation modulate hippocampo-frontal multivoxel patterns.

Keywords: Theta-burst stimulation, motor sequence learning, DLPFC, hippocampus, multivoxel patterns

How sleep balances cortical circuit activity

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Introduction: Sleep shapes cortical network activity, contributing to a global homeostatic down-regulation of excitability, while in selected networks excitability is maintained or even up-regulated as a consequence of memory consolidation.

Methods: Here we used two-photon calcium imaging of cortical layer 2/3 neurons in sleeping mice to examine how these seemingly opposing dynamics are balanced in cortical networks.

Results: During slow-wave sleep (SWS) epochs, mean activity of excitatory pyramidal (Pyr) cells was decreasing. Simultaneously, however, variance in Pyr population activity was increasing, contradicting a homogenous down-regulation of network activity. Indeed, we identified a subpopulation of Pyr cells distinctly upregulating activity during SWS, which were highly active during sleep spindles known to support mnemonic processing. REM epochs succeeding SWS produced a general down-regulation of Pyr cells, including spindle-active Pyr cells, which persisted into following stages of sleep and wakefulness. Parvalbumin-positive inhibitory interneurons (PV-In) showed increasing activity during SWS epochs, but unchanged activity during REM sleep epochs.

Discussion: Our findings support the view that down-regulation of Pyr activity during SWS results from increased somatic inhibition via PV-In whereas down-regulation during REM sleep is achieved independently of such inhibitory activity. Overall, our findings show that SWS enables, through a spindle-related process, differential upregulation of cortical circuits likely involved in mnemonic processing, whereas REM sleep mediates general down-regulation, possibly through synaptic re-normalization.

Keywords: Schlaf, Plastizität, Gedächtnis, Spindel, REM

Humans Can Predict Changes in Brain Activation. An Amygdala Electrical-Fingerprint Neurofeedback Study

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Nowadays it is well-established that individuals can learn voluntary self-regulation of brain activity through neurofeedback (NF). However, the understanding of underlying mechanisms is still limited. The question remains: Can humans be aware of their own brain states? Although leading NF learning theory posits that individuals can self-estimate their brain state, discrimination learning has been largely neglected by research. Moreover, it remains unanswered whether individuals can make metacognitive judgments about brain states, that is, whether individuals are conscious about the accuracy of self-estimation. In two empirical NF studies we investigated whether healthy participants could accurately estimate their brain activation. Using a within-subject repeated measures design, we administered up to 20 NF runs. We used the amygdala Electrical Fingerprint (amyg-EFP), a functional Magnetic Resonance Imaging-inspired Electroencephalogram surrogate of deep brain activation. Employing stepwise multilevel modelling, we explored on which sources of information participants base their self-estimation. As we were interested in internal monitoring of brain activation, we adjusted statistically for experience-based rating. Additionally, we investigated whether self-estimation accuracy predicts participants' confidence about their rating. The analysis showed that amyg-EFP significantly covaried with ratings even after adjusting for experience-based strategies. This is in line with possible brain state discrimination. Unexpectedly, participants did not significantly improve in this skill. Higher rating accuracy predicted higher subjective confidence in the rating, which points to possible metacognition of brain states. This study provides initial evidence for awareness and metacognition in NF training with a marker from the affective brain circuit. The study was preregistered under https://osf.io/grxez.

Keywords: neurofeedback, amygdala-EFP, awareness, metacognition

Individual patterns of visual exploration predict the extent of fear generalization in humans

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Generalization of fear is considered an important mechanism contributing to the etiology and maintenance of anxiety disorders. Although previous studies have identified the importance of stimulus discrimination for fear generalization, it is still unclear to what degree overt attention to relevant stimulus features might mediate its magnitude. To test the prediction that visual preferences for distinguishing stimulus aspects are associated with reduced fear generalization, we developed a set of facial stimuli that was meticulously manipulated such that pairs of faces could either be distinguished by looking into the eyes or into the region around mouth and nose, respectively. These pairs were then employed as CS+ and CS− in a differential fear conditioning paradigm followed by a generalization test with gradual morphs. Shock expectancy ratings indicated a moderately curved fear generalization gradient that is typical for healthy samples but its shape was altered depending on individual attentional deployment: Subjects who dwelled on the distinguishing facial features faster and for longer periods of time exhibited less fear generalization. Although both pupil size changes and heart rate responses also showed the expected generalization gradients, these responses were not significantly related to visual exploration. In total, the current results indicate that the extent of fear generalization depends on individual patterns of attentional deployment. Future studies evaluating the efficacy of perceptual trainings that aim to augment stimulus discriminability in order to reduce (over-)generalization seem desirable. Data, materials, experimental & analysis scripts can be accessed via https://osf.io/4gz7f/.

Keywords: fear generalization, attention, social, faces, temporal dynamics

Information load at learning determines the formation of schema memories at the expense of episodic details

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The formation of semantic memories is assumed to result from the extraction of general, statistical knowledge across multiple experiences. At the same time, episodic details from the individual experiences might get lost during the abstraction of regularities among single events into schema-like memories. Thus, our investigation focused on the question under which circumstances schema-abstraction occurs at the expense of episodic details. For that, adult rats were subjected to a variation of the object place recognition task, in which animals were exposed multiple times to pairs of objects within an open field arena. Objects were positioned according to a spatial rule across learning trials. Learning either comprised a high information load, i.e. eight learning trials, or low information load, i.e. four learning trials. After learning, animals were left undisturbed for 24 hours, after which they were tested either for the expression of schema-memory, i.e. memory for the spatial rule, or episodic memory, i.e. memory for individual learning trials. We show that animals exhibit a more robust schema memory for the spatial rule in the high information load, compared with the low information load condition. In contrast, preliminary data suggests that animals only exhibit episodic memory for individual learning trials, when they were subjected to the low information load, but not the high information load condition. These findings suggest that whether individual memories are more likely to undergo abstraction into schema-memories or whether it is more likely that episodic details govern memory retrieval depends on the information load during initial learning.

Keywords: schema memory, episodic memory

Memory-based decisions depend on slower preference accumulation mechanisms than value-based decisions

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Introduction: Decision neuroscience endorses the concept of preference accumulation in value-based choice formation. Accordingly, a decision maker integrates subjective value of different choice options over time until one option outweighs the other one by some margin. Although this mechanism applies to value-based decisions, it is unknown how preference is accumulated when subjective value needs to be constructed from episodic memory.

Methods: Over two sessions participants performed a remember-and-decide task, where they made choices between money offers and snack items. Snacks were presented visually (value-based) or needed to be recalled from memory (memory-based). In session 1 we obtained choices and response times (RT) and estimated a Drift Diffusion Model (DDM) which specified preference accumulation dynamics. In session 2 we measured EEG data to study the neural markers of preference accumulation.

Results: While value- and memory-based choices were equally coherent with subjective value ratings, RT of memory-based decisions were significantly longer. Cognitive modeling indicated that longer RT in memory based-choices were due to lower drift-rate and higher boundary separation (in addition to increased non-decision time). Thus, the DDM predicted longer preference accumulation time in memory-based choices. This longer accumulation time was also reflected in EEG activity over central electrodes before motor responses, lending neural support for slower preference accumulation in memory-based choices.

Discussion: Preference accumulation unfolds more slowly in memory-based choices but leads to similar choice consistency as value-based decisions. These altered accumulation dynamics may be related to hippocampal-cortical activity which is known to play a distinguished role in memory-based decision making.

Keywords: Memory, Decision making, EEG, Cognitive Modeling, Value

Monetary incentives enhance intentional but not incidental subsequent recollection

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The positive effect of monetary reward on subsequent long-term memory performance is not consistent across studies. One possible explanation is that reward may have differential effects on incidental vs. intentional memory encoding. Here, we investigated this issue by using a monetary-incentive-delay (MID, incidental) and a monetary-incentive-encoding (MIE, intentional) task in 84 healthy human subjects (18-35 years old). In both tasks, participants had to respond as fast as possible to object images on day one and performed a modified remember-know recognition memory test approx. 24 h later. In the incidental MID task, participants received high vs. low rewards depending on reaction times on day one. In the intentional MIE task, participants also anticipated high vs. low rewards on day one, but received the rewards only for correct memory on day two. During encoding, participants responded faster to high vs. low reward images in the incidental MID task but not in the intentional MIE task. With regard to memory, high vs. low reward during encoding specifically promoted subsequent remember responses (i.e. recollection) in the intentional MIE task, but there was no effect of reward on memory in the MID task. Together, our findings suggest that reward promotes only intentional but not incidental subsequent hippocampus-dependent long-term recognition memory.

Keywords: Reward, Memory, Reaction Times

Noradrenergic stimulation reverses systems consolidation in humans

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Introduction: It is commonly assumed that episodic memories undergo a time-dependent systems consolidation process, during which initially hippocampus-dependent memories eventually become reliant on neocortical areas. More recent research indicates that this process of systems consolidation is much more dynamic than initially thought; yet, whether the dynamics of systems consolidation can be shaped by environmental conditions, such as emotional arousal, remains unknown.

Methods: We probed the impact of post-encoding noradrenergic arousal on systems consolidation by combining a single pharmacological elevation of noradrenergic activity with fMRI scanning both during encoding and recognition testing either 1d or 28d later.

Results: Compared to placebo, intake of the α2-adrenoceptor antagonist yohimbine reduced the decline of memory over time. At the neural level, the placebo group showed the reorganization predicted by the systems consolidation theory: Hippocampal activity and multivariate encoding-retrieval pattern similarity, an indicator of episodic memory reinstatement, decreased from the 1d- to the 28d-delayed memory test, whereas inferior frontal gyrus (IFG) activity increased with time. This increase in IFG activity was directly correlated with the time-dependent memory decline. In sharp contrast to placebo, yohimbine led to a time-dependent increase in hippocampal activity and encoding-retrieval similarity from the 1d to 28d test, accompanied by a time-dependent decrease in IFG activity.

Discussion: These findings demonstrate that increased noradrenergic activity after encoding may not only decelerate, but even reverse systems consolidation in humans, leading to increased hippocampal involvement in memory and potentially more vivid memories over time.

Keywords: norepinephrine, memory, systems consolidation, hippocampus, inferior frontal gyrus

Pharmacological increase of dopamine neurotransmission reduces decision thresholds during reinforcement learning.

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Introduction: Dopamine supports reinforcement learning by signaling expectancy violations. Pharmacological enhancement of dopamine transmission via l-dopa may improve reward learning relative to the D2 receptor antagonist haloperidol (Pessiglione et al., 2006). Here, we re-visited this finding in a larger within-subject study.

Methods: Healthy male participants (n=31) completed a reinforcement learing task (gain condition from Pessiglione et al., 2006) during fMRI directly after a previously reported four-armed restless bandit task (Chakroun et al., eLife, 2020). Participants received the dopamine precursor l-dopa (150mg), the D2 receptor antagonist haloperidol (2mg) or placebo (counterbalanced within-subjects). Data were modeled using reinforcement learning drift diffusion models (Pedersen et al., 2017) via hierarchical Bayesian estimation using JAGS.

Results: There was little evidence for drug effects on accuracy, total winnings or median response times (all $BF_{01} > 5$). Model comparison and posterior predictive checks revealed that in each drug condition, the data were best accounted for by a drift diffusion model with separate learning rates for positive and negative prediction errors. Boundary separation was reduced under both drugs (directional BF > 50, 95% HDI beyond ROPE).

Discussion: We did not confirm improved learning from positive reinforcement following l-dopa vs. haloperidol (Pessiglione et al., 2006). Instead, our data suggest similar effects of both drugs on boundary separation, compatible with a presynaptic autoreceptor-mediated enhancement of DA transmission via a low dosage of haloperidol (Wagner et al., 2020).

Keywords: reinforcement learning, dopamine, drift diffusion model, reward

Reliving emotional memories: Episodic recollection re-elicits affective psychophysiological responses

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Introduction: Episodic recollection allows us to vividly and holistically re-experience past events. Affective psychophysiological states that are associated with past events may provide crucial information for the adaptive value of episodic memories and should therefore be re-instated when remembering past events. We tested whether episodic recollection was holistic to the extent that affective psychophysiological states are re-expressed.

Methods: In two experiments, participants encoded positive, negative, and neutral movie clips (N1 = 48, N2 = 68). One day later, they remembered the movie clips in response to neutral screenshots from the movies. On both days, we measured facial electromyography of the zygomaticus major and the corrugator supercilii that quantify the psychophysiological expression of positive and negative affect, respectively. The second experiment comprised a preregistered replication and extension of the first experiment (tinyurl.com/PUG-Duken). Data and code will be made available upon publication.

Results: In both experiments, encoding and remembering positive events elicited zygomaticus responses, while encoding and remembering negative events elicited corrugator responses. However, the intensity of affective psychophysiological responses during encoding did not consistently predict the intensity of the responses during remembering.

Discussion: Episodic recollection led to a replicable psychophysiological expression of affect but there was no consistent association between responses during encoding and remembering. Affective psychophysiological responses to memories may result from constructive imagery processes rather than a mere replay of past emotions. Given the adaptive value of affective states and their pronounced effects on episodic memories, episodic memory research should incorporate affective psychophysiological responses in theories and experiments.

Keywords: memory, episodic recollection, affect, emotion, fEMG

Sleep-independent generalization of visual texture discrimination skills

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Introduction: Sleep-dependent consolidation of visual experience has been shown to improve texture discrimination. This improvement is thought to be specific for the trained location in the visual field. In the current study, we tested if previously acquired visual skills can be generalized to different locations and if such generalization benefits from sleep.

Methods: We trained healthy young participants on a visual texture discrimination task in only one visual quadrant before a night of sleep or daytime wakefulness. After the retention interval, participants were tested the following morning (Sleep group) or in the evening of the same day (Wake group) in both the trained as well as an untrained quadrant. Participants were explicitly informed about this testing procedure.

Results: Visual texture discrimination was better after retention compared to training, as suggested by reduced threshold stimulus onset asynchronies (SOA). Importantly, performance was not different between trained and untrained visual quadrants. There was also no difference between Sleep and Wake groups.

Discussion: Our results suggest that, unlike previously assumed, visual texture discrimination skills trained in a specific location can generalize to different locations in the visual field. Surprisingly, this effect appears to be independent of sleep, possibly related to prior explicit knowledge of both trained and untrained quadrants being tested after the retention interval. Future studies should determine the conditions in which visual skill knowledge does and does not generalize, with a particular focus on explicit vs. implicit instructions and the role of sleep in this context.

Keywords: sleep, memory, perceptual learning, visual texture discrimination

Transformation of visual memories in children and adolescents

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The abundant sensory inputs that we receive across the day contain much more information than we need to remember. In fact, it has been argued that episodic memory does not only rely on the precise reinstatement of information but also on representational transformations that reflect the extraction of relevant features and statistical regularities. How these memory-related representations change during development is largely unknown.

We investigated neural representations during a visual recognition memory task in 35 children and adolescents aged 6-21 years (16 female) who were implanted with intracranial EEG (iEEG) electrodes prior to epilepsy surgery. We applied representational similarity analysis on iEEG time-frequency features and compared item-specific encoding-recognition similarity of subsequently remembered vs. forgotten scenes. We further analyzed differences in the magnitude of reinstatement across age.

We found significantly higher reinstatement for remembered vs. forgotten scenes in visual association cortices, including late occipital cortex (V3-5), inferior temporal cortex, as well as in parahippocampal cortex. Interestingly, this pattern reversed in early visual area (V2), where remembered scenes were significantly less similar to the corresponding encoding patterns than forgotten scenes, indicating a functional benefit of memory transformation in this area. Crucially, the magnitude of this transformation increased with age.

Our findings demonstrate that exact reinstatement of memory traces is beneficial in higher order visual association cortices, but detrimental in early visual areas. The age dependency of this effect may explain developmental gains in memory, possibly reflecting more efficient encoding strategies or an increasing dependency on conceptual features of the stimuli during recognition.

Keywords: episodic memory, visual recognition, memory development, RSA, iEEG

Understanding the appetitive mechanisms underlying relief learning

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Startle response is an automatic defensive response, which is potentiated by threatening stimuli, but attenuated by safety stimuli. Strikingly, the termination of threatening events elicits appetitive responses (i.e., relief) and stimuli associated with relief also attenuate startle reflex. Hearth rate variability (HRV) seems to mediate the safety-related startle attenuation. Here, we wanted to extend previous findings and investigate the role of HRV on relief-dependent startle attenuation. Fifty-two participants learned that one stimulus ($_{fear}$CS) was shortly presented before an electric shock (unconditioned stimulus, US), one stimulus ($_{relief}$CS) was presented shortly after the US, and one stimulus ($_{safety}$CS) was never associated with the US. During the following summation test phase, both $_{fear}$CS and $_{relief}$CS as well as $_{fear}$CS and $_{safety}$CS were presented in compound. We found successful fear acquisition for both verbal and physiological responses meaning that $_{fear}$CS compared to both $_{safety}$CS and $_{relief}$CS was rated more aversive, elicited startle potentiation as well as larger skin conductance response (SCR). During summation test, both SCRs and startle responses were significantly attenuated by the compound safety/fear, while the compound relief/fear did not reduce startle potentiation. In summary, conditioned fear was inhibited by safety signal, but not by relief signal suggesting that relief-associated stimuli may entail distinct appetitive properties.

Keywords: classical conditioning, relief and safety, startle response

Where is the toaster? Interplay of episodic and semantic memory during remembering of past events

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Introduction: The scenario construction is a crucial part of remembering. Cheng, Werning & Suddendorf (2016) proposes in their new framework that during scenario construction, only the gist of an event is remembered episodically while missing details are substituted by semantic information. In our study we tested this prediction behaviorally.

Method: Therefore we used a desktop based virtual housing environment. We created a conflict between episodic and semantic memory by placing objects in other-than-expected rooms (e.g. a toaster in the bathroom) or congruently to their semantic category (a toaster in the kitchen). We further manipulated the salience of the objects by making an object taskrelevant or not. Object memory was measured with three tasks - free recall, recognition-based room-recall and a spatial recall. Participants conducted them one day and one week after encoding.

Results: Overall, both congruence and taskrelevance predicted successful memory retrieval. We could distinguish between correct, episodic recall (a toaster was recalled in the bathroom) and semantic substitution (a toaster was recalled in the kitchen). Specifically taskirrelevant objects were equally likely sorted to the correct room and to the semantically fitting room on both recall sessions during cued recall measures.

Discussion: Thus our results provide a behavioral basis for the scenario construction model. Participants actively reported to have encountered objects in the semantically fitting room rather than in the correct room while remembering an episode. In a next step, we want to further illustrate this finding by investigating the neural basis of semantic substitution using fMRI.

Keywords: episodic memory, scenario construction, memory, virtual reality

Working memory performances do not seem to correlate with attentional behavior for iconic gestures in speech comprehension: preliminary results

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Iconic gestures (IG) convey meaning semantically related (i.e., congruent) to the speech they accompany. Studies on visual attention (VA) showed that listeners fixated mainly the speaker's face and minimally IG. However, listeners appear to benefit from the presence of IG, particularly when presented with degraded speech. Recent studies have suggested an involvement of verbal and visuospatial working memory (WM) in the sensitivity to gesture-speech integration. The present study explores whether verbal and/or visuospatial WM performance could explain attentional allocation to IG in clear and degraded speech. One hundred and twenty-eight healthy French-speaking participants (35 men; M_{age} = 21.34; SD = 0.21) took part in the study. They first completed two WM tasks; the Digit Span Task (DST) and the Block Tapping Test (BTT). Then, fitted with an eye-tracking device, they performed a computerized task where they were simply asked to observe videos of an actor uttering short sentences and performing an IG. Regression analysis showed that in the presence of congruent IG and clear speech, performances at the BTT explained 3,9% of dwelling time on IG (R^2 = .039, $F_{(1,126)}$ = 5.11; p = .02). No other result was significant. While the presence of an association between visuospatial performances and VA to IG could be consistent with previous authors suggesting the creation, by IG, of a visuospatial context affecting language processing, globally, these results suggest an absence of relation between verbal/visuospatial performance and VA to IG. A subsequent study could investigate whether executive WM capacity could predict VA to IG.

Keywords: gesture-speech integration, iconic gesture, language comprehension, attentional processes, working memory

A dynamic system's theory of flow-experience

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Dolan et al. (2018) recently presented the idea of the improvisational state of mind. They reported that an improvisational approach of making music leads to increases in the entropy of an improviser's brain activity when it is compared to the brain activity accompanying strictly played music. In my Master's thesis (Settgast, 2020) I outlined, that the subjective experience which accompanies this improvisational approach shows a phenomenology resembling the so-called flow-experience (Csíkszentmihályi, 1975). Acknowledging the increased brain metastability (Carhart-Harris et al., 2014) seen in the increased entropy of Dolan et al.'s (2018) improvisational approach and with reference to the idea of (en)active inference (Allen & Friston, 2018; Clark, 2015), I therefore developed a theory of flow-experience which actually reflects – rather than solely correlates with – the flow's phenomenology. According to my theory, the increased entropy of the subject's brain activity during flow-experience corresponds to the brain's metastable attunement (Rietveld et al., 2018) to different affordances for action. This metastable property increases the possibility of attunement to the correct affordances (Bruineberg & Rietveld, 2014; Ryan & Gallagher, 2020) which for their part facilitate a skilful encounter with situational demands. Thus, the agent's metastable attunement to different affordances both seems to explain the behavioural fluency of actions linked to flow-experience (Montull et al., 2020) and the consciously experienceable contents within it (Scott & Carhart-Harris, 2019) due to its neurodynamical reflection in metastable brain activity which is measurable as entropy.

Keywords: Flow-Experience, Improvisation, Dynamic System's Theory, Complexity, Metastability

A single dose of Tyrosine reduces decision thresholds in temporal discounting and reinforcement learning.

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Introduction: We investigated the effect of tyrosine administration (2g) on two key aspects of catecholamine dependent decision-making: temporal discounting (TD) and sequential reinforcement learning (RL).

Methods: In a double-blind, placebo-controlled, within-subject design, n=30 healthy participants performed two tasks, TD and sequential RL. We utilized hierarchical Bayesian drift diffusion modeling to assess tyrosine related effects. Heart rate, pupil dilation, and spontaneous eye-blink rate were assessed before (T0) and 1 hour following (T1) tyrosine/placebo intake, for exploratory analyses.

Results

Tyrosine led to a consistent but non-significant reduction of participants' median response times in both tasks (mean±se TD=-.12±08, p=.12; RL(stage 1)=-.02 ± .02 , p=.28, RL(stage 2)=-.02±.02, p=.23), while leaving choices unaffected (TD: %LL-choices (tyrosine–placebo): .75±1.93; p=.7; RL: β(reward*transition*drug)=.03; z=1.3, p=.19). Modeling linked this to reduced decision thresholds during TD (median [90% HDI]=-.15 [-.31,.0], bayes factor=.06) and during RL (median [90% HDI]=-.05 [-.09,-.02], bayes factor=.02). Baseline spontaneous eye-blink rate predicted individual decision threshold heights during TD (r=-.55, p=.003), and tyrosine associated modulation thereof (r=.39, p=.04). Exploratory analyses revealed two potential novel physiological correlates of tyrosine, increased heart rate deceleration compared to baseline (%change T1-T0, tyrosine-placebo: -3.07±1.1, t(28)=-2.69, p=.01) and increased pupil dilation variance (13.89±7.72, t(28)=2.31, p=.02).

Discussion: Tyrosine reduced decision thresholds across both tasks, as revealed by hierarchical Bayesian DDMs. Exploratory analyses of psychophysiological parameters suggest attenuated sympathetic arousal following Tyrosine supplementation. Our data suggest that model-based approaches can reveal novel insights into potential cognitive effects of catecholamine precursor supplementation.

Keywords: drift diffusion modeling, tyrosine, reinforcement-learning, temporal-discounting

Acute effects of heart rate variability biofeedback on self-control

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Introduction: Practicing heart rate variability (HRV) biofeedback over several weeks is reliably associated with reduced anxiety and stress levels, but acute effects are still poorly researched. Since self-control is considered a mediating factor linking HRV to psychothalogy, we investigated the acute effect of HRV-biofeedback on self-control using the revised Attention Network Test (ANT-R).

Methods: Thirty-one participants were tested in a laboratory setting in two sessions. After measuring HRV at rest, in one session each subject received a HRV-biofeedback intervention and in the other a control intervention of paced breathing at normal ventilation rate. Subsequently, the ANT-R was completed. As a measure of self-control, the results of the orienting score of the ANT-R were tested for an association with baseline HRV and then compared between the two conditions.

Results: Higher resting baseline HRV was associated with better performance in the orienting score (r=-.39), but the ventilation condition had no significant main effect on self-control. However, post-hoc analyses revealed a trend for an interaction indicating better performance in the orienting score after biofeedback in individuals that responded to the biofeedback intervention with an increase of HRV (β=-.14).

Discussion: The results support previous research associating measures of self-control to HRV and point to differential acute effects of HRV biofeedback with possible benefits for cognitive performance in individuals that respond well to the intervention. However, this observation needs to be replicted in larger samples before definitive conclusions can be drawn.

Keywords: heart rate variability, vagal tone, biofeedback, self-control

Browser-based cumulative semantic interference with overt verbal vs. typewritten responses

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For experimental research on speech production, temporal precision and high quality of the recorded audio-files are mandatory. These requirements are a considerable challenge if speech production is to be investigated online. However, besides the current situation, online research has a huge potential regarding efficiency, ecological validity and diversity of study-populations in psycholinguistic and related research. Here, we supply confirmatory evidence that language production can be investigated online and demonstrate that the written naming responses (using the keyboard) are a reliable and efficient alternative to typical overt verbal responses. To assess semantic interference effects in both modalities we performed two pre-registered experiments (n=30 each) in online settings using the participants' web-browsers. A cumulative semantic interference (CSI) paradigm was employed that required naming several exemplars of semantic categories within a seemingly unrelated sequence of objects. Reaction time (RT) is expected to increase linearly for each additional exemplar of a category. In experiment 1, cumulative semantic interference effects in naming times described in lab-based studies were replicated. In experiment 2, the responses were typed on participants' computer keyboards and the first correct key press was used for RT analysis. This novel response assessment yielded a qualitatively identical, very robust CSI effect. Besides technical ease of application, collecting typewritten responses and automatic data preprocessing reduce work load for language production research. Results of both experiments open new perspectives for research on RT-effects in language experiments across a wide range of contexts. JavaScript- and R-based implementations for data collection and processing are available for download.

Keywords: Language production, online experiments, overt verbal naming, keystrokes, cumulative semantic interference, picture naming

Characterizing the relationship between temporal dynamics of reward processing and behavioral choices by using time-resolved multivariate pattern analysis of EEG data

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Optimal human decision-making relies on the ability to use feedback about decision outcomes to guide future choices. Unexpected outcomes produce reward prediction errors which modulate part of the neuronal reward signal as reflected by the so-called Reward Positivity (RewP) in the scalp-recorded EEG. So far, however, the link between the RewP and future choice behavior has only been observed inconsistently. In addition, previous studies identified the RewP as a heterogeneous signal that can reflect a mixture of timely extended signed prediction errors and surprise signals from different learning systems. We aim to further elucidate the relationship between timely distinct information during reward processing and subsequent behavioral choices by identifying periods of stable representations within the RewP time-window that correlate with choice behavior.

A combination of electroencephalography and time-resolved multivariate pattern analyses was used to decode periods of stable information processing in different reinforcement learning paradigms.

Preliminary results indicate that the overall reward signal is comprised of a chain of distinct components that only generalize over a short amount of time. Further analysis are ongoing.

While preliminary, our results provide novel insight into the representational structure in reward processing. This strengthens the possibility that spatiotemporally distinct processes are captured during RewP analysis, which may be uniquely related to behavioral choice.

Keywords: EEG, decoding, RewP, reward processing

Effect of 14 h fasting on task selection in voluntary task switching paradigm with food stimuli

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Introduction: Traditional work on multitasking has focused on cognitive control mechanisms that underlie execution and switching between tasks. However, little research has addressed volitional and motivational aspects of task selection mechanisms. In the present study, we investigated whether task selection and performance in task switching was influenced by 14 h fasting.

Method: Experimental group (N = 64) was deprived of food for 14 hours prior to testing, whereas the control group (N = 65) ate normally. We used a voluntary task switching paradigm with affective food and neutral stimuli. Subjects performed parity judgments on single digits and judgements on a type of food (salty vs sweat). The instructions were to perform the two tasks equally often and in a random order.

Results: The results indicate a lower switch cost for food stimuli in both groups, indicating faster engagement witch food task compared to neutral task. There was no significant effect of fasting on task switching performance and switch rate. Compared to non-fasting condition, however, fasted participants selected digit task more frequently.

Discussion: The results indicate that 14 h fasting does not affect task switching performance, but is associated with increased preference for one of the tasks.

Keywords: task switching, multitasking, fasting, food stimuli

Embodiment of sleep-related words: evidence from event-related potentials

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In this study, we tested the hypothesis whether cognitions related to sleep and wakefulness are embodied. We based our hypothesis on evidence, that semantic concepts can be capable of evoking associated sensorimotor representations and physiological responses and vice versa.

We experimentally manipulated the body position of 66 subjects (50 females, 16 males, 19-40 years) between standing and lying, which should systematically facilitate the activation of the sensorimotor representations (i.e., standing – wake vs. lying – sleep). In each position, subjects had to decide whether acoustically presented words belonged to the categories sleep or activity. We presented the stimuli around the individual speech recognition threshold to achieve a sufficient task difficulty.

We found a reduced N400 in congruent trials within the lowest volume level, suggesting that word processing was facilitated in the congruent body position (sleep words: lying down and activity words: standing upright) compared with incongruent body positions. Furthermore, early sensory components of the ERP were enhanced in the congruent condition, indicating that words were acoustically better understood when presented in a congruent body position. In contrast, subjects showed no differences in overt behaviour (reaction times, error rate).

In summary, we provide evidence for the embodied hypothesis by showing that body position influences word processing in our brain during wakefulness. Body position potentially induces a pre-activation of multimodal networks, thereby enhancing access to the semantic concepts of words related to current body position. Our findings provide an important basis for explaining interactions between cognitive processes and sleep.

Keywords: N400, embodied cognition, auditory word categorisation, language perception, multimodal representation

Event-Related Potentials of Urgency and SSRT in Response Inhibition

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Deficits in cognitive control can manifest in behavioral disinhibition and impulsive behavior or decision- making contributing to self-controls problems. Urgency, the tendency to act rashly and frequently on negative emotions, seems to be associated with deficits in response inhibition. However, it is still unclear how they are related and if they share neural correlates. To disentangle shared and distinct underlying neural processes of urgency and response inhibition, we conducted a study and analyzed data of n = 233 participants, who performed a stop-signal task while EEG was recorded continuously. Urgency and stop signal reaction time (SSRT) were not related on a behavioral level, but interestingly they shared some effects on event-related potentials. With single-trial regression analyses, we found smaller amplitudes of P3 with longer SSRT and higher urgency scores. In contrast, for early attention processes (P1) we found a positive association with the speed of the inhibition process. Furthermore, individuals with higher urgency scores showed larger P1 related activity in successful inhibition trials followed by an earlier peak of the P3. This neural configuration might explain why individuals high in impulsivity do not show deficits in response disinhibition per se. Although, we observed a reduction of the inhibitory activity in high urgency, increased early attention and a faster inhibition process seem to compensate and ensure unimpaired behavioral performance.

Keywords: response inhibition, urgency, SSRT, underlying process

Facts and Figures: Zwei Studien zur hemisphärischen Spezialisierung des Abrufs arithmetischer Fakten

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Für eine Vielzahl kognitiver Funktionen besteht eine (relative) funktionelle Asymmetrie (d.h. die Spezialisierung einer Hemisphäre) im menschlichen Gehirn. In der numerischen Kognition nimmt man eine solche Spezialisierung für den Abruf arithmetischer Fakten (wie dem kleinen Einmaleins) an. Demnach werden arithmetische Fakten verbal vermittelt und unilateral in einem linkshemisphärischen Netzwerk verarbeitet, das auch Sprachareale umfasst (Dehaene, et al., 2003). Diese Annahme ist jedoch kürzlich in Frage gestellt worden (Amalric & Dehaene, 2019).

Wir berichten hier zwei Studien, die mittels lateralisierter Stimuluspräsentation die hemisphärische Spezialisierung des arithmetischen Faktenabrufs untersuchen, d.h. ob gesunde Probanden arithmetische Fakten sowohl implizit (im Rahmen einer Zahlenbisektionsaufgabe, z.B. 12_16_20, Studie 1, N=23; open data: https://www.frontiersin.org/articles/10.3389/fnhum.2020.00088/full#supplementary-material) oder explizit (in einer Multiplikationsaufgabe, z.B. 12=3×4, Studie 2, N=35; präregistriert: https://aspredicted.org/blind.php?x=yc248x) signifikant besser abrufen, wenn die Stimuli nur im rechten visuellen Halbfeld dargeboten und damit zuerst links lateralisiert verarbeitet werden. Verglichen wurden beide Aufgaben mit einer numerischen Größenvergleichsaufgabe (siehe Rantinckx et al. 2006), für die bilaterale Verarbeitung angenommen wird, und mit einer klassischen Multiplikationsaufgabe (3×4=12).

In beiden Studien replizierten wir bilaterale Verarbeitungsvorteile (d.h. geringere Reaktionszeiten und Fehler; Rantinckx et al. 2006) für die numerische Größenverarbeitung. Jedoch führte die lateralisierte Stimuluspräsentation im rechten visuellen Halbfeld nicht zu Verarbeitungsvorteilen beim Abruf arithmetischer Fakten in der Zahlenbisektions- und der Multiplikationsaufgabe.

Die fehlende Evidenz für eine linkshemisphärische Spezialisierung in beiden Studien spricht gegen eine strikte Abgrenzung von unilateraler linkshemisphärischer linguistischer Verarbeitung arithmetischer Fakten und der bilateralen Verarbeitung numerischer Größe. Die Ergebnisse ergänzen damit die aktuelle Diskussion um die hemisphärische Spezialisierung bei der Zahlenverarbeitung im menschlichen Gehirn.

Keywords: Hemisphärische Spezialisierung, numerische Kognition, arithmetischer Faktenabruf, Multiplikation

How BOLD Are You? An fMRI Study Using the Balloon Analogue Risk Task

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Introduction: Risk-preference is an important factor in decision making. A prominent task to assess risk-taking behavior is the Balloon Analogue Risk Task (BART). The study aims were twofold: a) to introduce a modified BART that allows distinguishing anticipation from decision making related brain activity and b) to evaluate whether behavioral and self-reported individual differences in risk-taking have a neural equivalent in the BART.

Method: 34 participants completed the modified BART during functional magnetic resonance imaging. The within-participants design distinguished a decision, anticipation, and cash-out / loss phase. For each phase, mean activation was extracted from three regions of interest (ROI): nucleus accumbens, anterior cingulate cortex, and insula. Risk-related behavioral and self-report measures were combined to a latent risk-preference factor that was correlated to activity in these regions.

Results: Overall, whole-brain as well as ROI-results mirrored previous studies using the BART indicating increased activity in nucleus accumbens, anterior cingulate cortex, and insula relative to a control condition. In none of the phases a significant association of mean activation in the regions and the general risk factor was found.

Discussion: The results support the importance of the studied regions for risk-taking and suggest that anticipation can be separated from decision making in the BART. Future studies with a broader set of self-report and experimental measures are needed for unravelling the association between neural and behavioral markers of risk-preference.

Keywords: fMRI, BART, risk, anticipation, decision-making

How far would you go to survive? An Approach-avoidance foraging task in immersive virtual reality

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Avoidance is typically considered a maladaptive behavioral response to excessive fear and anxiety, potentially leading to the maintenance of anxiety disorders. Recent experimental work has focused on approach-avoidance (AA) conflicts by simulating foraging tasks under predation.

Here, we present pilot data from a novel avoidance paradigm in which an immersive AA conflict is induced in a virtual foraging task. The task is built on a matrix-designed environment, which enables us to track and visualize the AA-behavior as a function of spatial movement. Individuals are required to survive a 24-day period (divided into six blocks) by collecting the necessary amount of food (tokens) within three different contexts (forest, sea, desert). Each context is assigned to a different probability of encountering an aversive (electrical) stimulus in combination with an unpleasant lightning sound in the virtual environment while collecting a token. In order to encourage approach behaviour, the amount of potential reward is inversely linked to the probability of receiving the aversive stimulus. Thus, each individual is required to perform a certain approach-avoidance behaviour to achieve the task's goal, as to the time spent in each context and the spatial movement along the field.

In the present pilot sample, we evaluate the effectiveness of the developed AA task, by hypothesizing that each behaviour results in a unique "tipping point" between the time spent per context and the maximum achieved reward, revealing the extent to which each individual is willing to approach or to avoid a threat as a trade-off for better performance (reward).

Keywords: approach-avoidance, fear learning, VR, decision making

Individual freezing-like behavior and decision making in relation to threat proximity

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When facing threat, defensive circuits are activated to ensure survival. In the context of survival, blunted physiological responding is associated with action preparation, but less is known about the impact on the individual decision of staying or fleeing. Here I present the design of a novel paradigm which is intended to capture active approach-avoidance decisions in varying situations of threat imminence and safety. Within a multimethod approach, we use the human body sway, as assessed by a stabilometric force platform, heart rate variability, fear potentiated startle and skin conductance response as outcome measures and proxy for freezing-like behaviour in humans. The overarching aim is to identify data-driven latent subgroups based on the individual characteristics, freezing-like psychophysiological behaviour and the individual decision in relation to the perception of threat proximity with a sample of 500 participants. First results validated the paradigm by revealing a generally reduced freezing-like behaviour on the stabilometric-force platform in the experimental conditions of threat imminence. Here, showcase first results on freezing-like behaviour within a threat imminence context and on individual difference characteristics.

Keywords: threat imminence, approach-avoidance decision, freezing-like behaviour, individual differences

Linking Neurophysiological Processes of Action Monitoring to Post-Response Speed-Accuracy Adjustments in a Neuro-Cognitive Diffusion Model

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The cognitive system needs to continuously monitor actions and initiate adaptive measures aimed at increasing task performance and avoiding future errors. While action monitoring can be divided into early and late processes, post-response adaptation comprises processes such as the increase of response caution and the redirection of attention towards task-relevant features. To investigate the link between these cognitive processes, we introduce the neuro-cognitive diffusion model. This statistical approach allows a combination of computational modelling of behavioural and electrophysiological data on a single-trial level. Across three experiments, we found that early response monitoring indicated by the error/correct negativity (Ne/c) was related to slower and more accurate responses on the following trial. Our results suggest that increased early response monitoring is associated with an increased decision threshold (i.e. more evidence is accumulated before a response is initiated) and the redirection of attention towards the task-relevant features on the following trial, a phenomenon that improves future response accuracy. Furthermore, our novel methodological approach provides evidence that later response monitoring indicated by the error/correct positivity (Pe/c) might counteract early response monitoring regarding the decision threshold. This mechanism may serve to avoid an overly high decision threshold that would impede timely responses. Thus, for the first time, we provide evidence that early and late response monitoring keep each other in check regarding the conflicting demands of response speed and accuracy by adjusting the decision threshold of the following response.

Keywords: Error Negativity, Error Positivity, Post-Error Adaptation, Drift Diffusion Model, Single-Trial ERP-Analysis

Measuring affective task-switching ability – reliability and neuronal correlates.

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Introduction: Affective flexibility attracts increasing interest in individual differences research and may be understood as the ability to switch more or less efficiently between the processing of affective and non-affective information.

Method: Using a task-switching paradigm in which affective faces have to be judged according to either an affective (emotional valence) or an affectively neutral (gender) task rule, we investigated behavioral test-retest reliability (study 1; N=47) and neuronal correlates (study 2; fMRI; N=60) of affective task-switching costs.

Results: In both studies, affective task-switching resulted in strong response time switch costs for both switch directions (emotion to neutral and vice versa). Switch costs showed excellent internal consistency and good test-retest reliability (study 1). Affective task-switching was accompanied by increased activity in similar brain regions as described for cognitive task-switching (study 2). Behavioral switch costs were directly related to switching-related activity in bilateral supplemental motor cortices (positive association) and right anterior DLPFC (bordering frontopolar cortex; negative association), indicating that these regions play a particular role for individual differences in (affective) task-switching ability. A characteristic asymmetry in affective switch costs, with higher switch costs when switching to emotion than to the gender task, were accompanied by increased activity in the inferior frontal junction, supplementary motor cortex, and middle frontal gyrus.

Discussion: Affective switch costs are well-suited as individual differences measure and may be a valuable proxy for assessing affective flexibility. Asymmetric switch costs and corresponding neuronal activation patterns suggest that affective task-switching is more than a mere variant of cognitive task-switching.

Keywords: affective flexibility, task-switching, reliability, fMRI

Mental Rotation Task. What factors influence women's performance?

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Introduction: Spatial abilities (including mental rotation) are an important part of human intelligence. In this study, we focused on the mental rotation task (MRT), which is sensitive to the effect of sex and sex hormones. However, biological factors are not the only source of influence on MRT performance. Socio-cultural, cognitive, and individual differences can play a role as well. The aim of our study was to investigate the significance of these factors on MRT performance parameters, using multivariable linear regression.

Methods: We recruited 51 women (age 27.07 ± 4.36 years). The participants were divided into four groups according to hormonal contraceptive usage and menstrual cycle: users of oral contraceptives (OC, n = 8), intrauterine device users (IUD, n = 7), women in early follicular phase (NCF, n = 26) and mid-luteal phase (NCL, n = 10). Women performed computerized MRT, Visual Working Memory task (VWM) and paper-pencil Cross Section Task. The saliva samples were taken to assess concentration of sex hormones. All participants completed questionnaires assessing demographic information, personality traits, experience, and behaviour.

Results: Multivariable modeling revealed that analytic strategy, mathematical experience, and spatial abilities were positively associated with MRT accuracy. Age was inversely associated with MRT accuracy. MRT reaction time was positively related to reaction time of VWM task. No significant effect of women group and sex hormones was found.

Conclusions: These results suggest that cognitive factors, such as analytic strategy, individual differences, namely self- report mathematical experience, spatial abilities, age, and overall speed, are the strongest predicting factors for the MRT performance.

Keywords: Mental rotation, spatial abilities, women, hormones

Neurofeedback of parietal alpha for increasing sense of presence in immersive virtual reality

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Introduction: Fibromyalgia is a widespread medical condition that is characterized by chronic systemic pain and is hard to treat. Virtual reality (VR) was proven effective in reducing chronic pain and distracting attention away from noxious stimuli, which leads to reduced perceived pain. The parietal cortex processes multimodal sensory inputs into a space representation of self and the environment. It is directly involved in attentional orientation. A few studies demonstrated that increasing presence experience correlated with an activated parietal cortex, marked by a desynchronization of alpha rhythms. The study (VirtualNoPain BMBF FKZ: 13GW0343) will assess whether manipulating parietal alpha leads to an increased sense of presence.

Methods: We set up a neurofeedback (NF) training protocol targeting a reduction of parietal alpha in 10 sessions of 45min. Data will be acquired using 128 active EEG channels covering the scalp, feeding back normalized alpha power in real time as a vertical bar on a PC monitor. Before and after NF-training the participants experience a 15min immersive VR exploration scenario using a head mounted display to complete interactive tasks developed for this study.

The sense of presence questionnaire will be assessed during VR via ratings. Additionally, 10 control participants will not take part in NF-training sessions.

Results: Measurements are ongoing.

Discussion: This study will estimate whether alpha downregulation in the parietal cortex leads to an increased state of presence and how much training is required for neurophysiological changes. Further analysis of the dataset could potentially identify other cortical correlates of the sense of presence.

Keywords: neurofeedback, presence, virtual reality, pain

No effects of sleep on event-related potentials in a human fear conditioning paradigm

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Introduction: Animal studies suggest a critical role of REM sleep in fear memory traces consolidation. However, central mechanisms of sleep related consolidation of fear memory in humans are not well understood. Here, event-related brain potentials (ERP) and behavioral responses were recorded during in a fear conditioning experiment.

Methods: The procedure involved pairing of a neutral tone (CS+) with a highly unpleasant sound. As a control, another neutral tone (CS-) was paired with a neutral sound. Between two sessions of conditioning separated by approximately 2.5 hours, on one experimental day, subjects watched a silent movie; on another day they lied in bed and all of them fell asleep. Data of 18 participants were included in the final analysis.

Results: Differential conditioning manifested itself in the contingent negative variance (CNV)-like slow ERP component. Both period of sleep and wakefulness resulted in an increased amplitude of the CNV to CS+. Moreover, relearning of fear after the intervention and a block of extinction produced even stronger conditioned response than after initial learning before the intervention. We did not find an interaction effect of Time (Pre-Post) by Intervention (Sleep-Wake), suggesting that sleep did not affect the conditioned response differently as compared to a period of wakefulness.

Discussion: To summarize, the data indicate that fear memories are consolidated with the course of time with no beneficial effect of sleep or a period of wakefulness; relearning of fear causes stronger differential responses as indicated by slow wave amplitude.

Keywords: conditioninng, sleep, EEG, ERP, fear

Performance Evaluation Game: Opening a new chapter in the assessment of error awareness

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Influential theories on error processing assume that when we conduct errors, adaptive processes are triggered to improve our behaviour and prevent errors in the future. These processes appear to be more effective after errors were detected by participants. Therefore, the assessment of error awareness in the context of cognitive control and behavioural adjustments has gained more and more attention in the past years. A common methodological challenge posed on all studies investigating error processing is that usually, the number of unaware errors is rather low.

Here, we introduce a gamified experimental task that uses an efficient adaptive algorithm to generate a robust error rate which is stable across the experiment. The gamification led to high levels of motivation reported by our participants, while at the same time many unaware errors were conducted by all participants. Further, we were able to identify different error types, which interestingly differed in terms of their awareness. The results of a first experiment were replicated and extended by a second behavioural experiment. Interestingly, in Experiment 2, we specifically modulated the error awareness by changes in task design, while the error rate was kept constant. Potential applications of the open source code will be discussed. With this newly developed paradigm, we want to lay a foundation for future research to better understand (neural) processes associated with error awareness.

Keywords: Error Processing; Performance Monitoring; Experimental Design; Cognitive Control

Real world blink-related potentials reveal the positive impact of landmark-based navigation instructions

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Introduction: The use of navigation assistance systems reduces the attentional demand for navigation to assure safe locomotion. This, however, reduces the processing of the surroundings leading to reduced spatial memory of the travelled environment. Instead, introducing a landmark reference in auditory navigation instructions enhances spatial knowledge acquisition during assisted navigation. Whether this way underlying brain regions could be incidentally trained needs still to be investigated.

Methods: To test firstly the impact of landmark-based instructions on human brain activity during navigation in the real world, twenty-two participants navigated a predefined route through Berlin using either standard or landmark-based auditory navigation instructions. Afterward, participants solved spatial tasks testing their incidentally acquired landmark and route knowledge.

Electroencephalography (EEG) was recorded throughout the experiment. EEG was decomposed and independent components were used to identify blinks, saccades, and gait. The impact of auditory navigation instructions was then investigated in deconvolved blink-related brain potentials (bERPs).

Results: Replicating previous studies, performance in the spatial tasks indicated that participants using landmark-based instructions incidentally learned more environmental features compared to participants using standard instructions.

Deconvolved bERPs revealed significantly increased fronto-central activity during the presentation of landmark-based compared to standard navigation instructions.

Discussion: Mobile EEG during real-world navigation allowed for dissociating eye movement-, and gait- from brain-related EEG activity. bERPs showed stronger involvement of higher cognitive processes in alignment with more acquired spatial knowledge when using landmark-based navigation instructions rendering their use a promising approach to incidentally engage users again with the environment and their brain in processing spatial information.

Keywords: mobile EEG, navigation assistance, spatial knowledge acquisition, blink-related potentials

Response vigour and fixations reflect subjective preferences during intertemporal choice

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Introduction

Outcome measures of value-based decisions are often based on participants' choices and response times only. Since there is evidence that evaluation is reflected response vigour (Pessiglione et al., 2007; Reppert et al., 2015), we examined if response vigour, operationalised as gaze shifting and grip force, may serve as implicit measure of subjective utility.

Methods

We implemented an intertemporal choice task in which options were selected by pressing a grip force transducer and simultaneously tracked fixation shifts between the options. The amount of force produced was unrelated to the payout and not displayed. As outlined in our preregistration (https://osf.io/k6jct), we used hierarchical Bayesian parameter estimation to model the choices assuming hyperbolic discounting, compared variants of the softmax and drift diffusion model, and assessed the relationship between response vigour and the estimated model parameters.

Results

The behavioural data were best explained by a drift diffusion model specifying a non-linear scaling of the drift rate by the subjective value differences. Replicating previous findings (Green et al., 1997; Wagner et al., 2020), we found a magnitude effect for temporal discounting, such that higher rewards were discounted less. This effect was also reflected in response vigour: Stronger forces were exerted in the high vs. the low magnitude condition. Bayesian hierarchical linear regression further revealed higher grip forces, faster response times and a lower number of fixation shifts for trials with higher subjective value differences.

Discussion

Our data suggest that response vigour may serve as an implicit measure of subjective utility in value-based decision making.

Keywords: Response vigour, grip force, intertemporal choice, value-based decision making

Temporal dynamics of neuronal performance monitoring functions in a VR shooting task

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In daily life, for almost every action we take, we permanently monitor the result during and after the action in real-time. To make it even more complex, the information available for this assessment varies from action to action.

In order to match this level of dynamics, we implemented a performance monitoring task in which participants had to shoot targets (i.e., balloons) within a highly immersive virtual reality environment while wearing a 32-channel mobile EEG system. This allowed the magnitude of errors and the distance of the target to vary on a natural, continuous scale on trial level. To investigate the temporal dynamics of feedback processing, participants fired either a "laser gun" whose beam hit the target immediately or a gun using bullets, which could be observed, allowing for anticipation of the outcome during the flight phase of the projectile. To assess effects on trial level we analyzed regression-based ERSPs, considering the outcome, magnitude of error, distance of the target and corresponding interactions.

We found increased frontomedial theta (FMT) power after errors compared to hits. Interestingly, FMT power was independent of the target's distance in the laser gun condition. However, in the other condition where the flight of the projectile was observable, FMT power indicated the trial specific onset of error processing before the projectile reached the target or eventually missed it.

Overall, our results show that FMT power reflects the continuous anticipatory evaluation of upcoming action-outcomes based on steadily incoming information of goal-attainment vs. deviation.

Keywords: Mobile EEG, Virtual Reality, FMT, Performance Monitoring

Testing the automaticity of syntax in a subliminal priming paradigm: A behavioral assessment in German language

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Introduction:

Neurophysiological studies investigated the automaticity of syntactic processing under conscious conditions. However, it remains largely unknown whether syntactic analysis proceeds outside of conscious awareness. In this study, we employed a subliminal syntactic priming paradigm to address the automaticity of syntax in minimal phrases.

Methods:

We run four behavioral experiments to test whether recognition of a target's category (noun or verb) could be influenced by its syntactic relationship with a prime ("a" or "he"). Prime-target relationship was either congruent ("a" + noun, "he" + verb) or incongruent ("a" + verb, "he" + noun). In the pilot and Experiments 1 and 2, verbs included an overt morphological cue (the suffix "-t"), which was absent in Experiment 3. In Experiment 2 we included nonword primes as a baseline condition, to remove processing differences between nouns and verbs independent of syntactic context.

Results:

Experiments 1 and 2 revealed a subliminal syntactic priming effect: words preceded by syntactically congruent *masked* primes were processed faster than words preceded by incongruent primes. When no morphological cue was present (Experiment 3), we found no subliminal syntactic priming. Experiment 3 revealed an inhibitory nature of syntactic priming: incongruent primes slowed down the processing of nouns and verbs compared to nonword primes.

Discussion:

Our study shows that abstract syntactic representations might be accessed unconsciously in an automatic fashion. Furthermore, the results indicate a role of morphological cues in the early and automatic steps of syntactic analysis.

Keywords: syntax, syntactic priming, automaticity, two-word phrase, prediction

The "singing" brain – exploring structural brain connectivity changes in opera trainees

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Introduction: Many cross-sectional studies show neural differences between musicians and nonmusicians related to particular tasks musicians engage in – e.g., singers who often move in space to produce music have greater grey matter volume in auditory and somatosensory brain regions than nonsingers (Kleber et al., 2016). Less is known about actual changes that the brain undergoes through music training due to the scarcity of longitudinal data. Here, we explore diffusion tensor imaging data from 15 students before and after participation in an intense workshop, in which they rehearsed and performed an opera.

Methods: Data acquisition timepoints were three months apart. We explored changes in fractional anisotropy (FA), a measure of white matter coherence, using tract-based spatial statistics in FSL (Smith et al., 2006).

Results: Four clusters of at least 200 voxels in size showed greater FA at the second timepoint (ps < .05), specifically in the left superior and anterior thalamic radiation, the posterior limb of the left internal capsule, and bilateral external capsules.

Discussion: These areas are associated with emotion regulation, motor, and linguistic/music syntactical processes respectively (Deng et al., 2018; Makris & Pandya, 2009; Oechslin et al., 2018; Puig et al., 2011), which are highly engaged during opera performance. We propose that training associated with the opera workshop may have led to the observed changes. The clusters identified will serve as regions of interest in ongoing research, in which we compare opera trainees before and after one year of training to other trainees (instrumentalists, actors, language learners, athletes).

Keywords: opera training, music training, DTI, MRI, fractional anisotropy

The association of handedness with language lateralization measured by a sentence completion fMRI paradigm in healthy participants.

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Language lateralization and hand preference as part of functional asymmetry might be associated (Ockelenburg et.al., 2014). A recent study in a large cohort based on a dichotic listening task revealed a significant, but weak association between these trials (Packheiser et al., 2020). But, a dichotic listening task is influenced by noise compared to functional imaging, of which fMRI is the gold standard (Deffieux et al., 2018). Our study investigated the association of handedness with language lateralization measured by a robust sentence completion fMRI task (Wilson et.al., 2017; Barnett et.al., 2014).

Fifty neurologically healthy individuals participated in the study (32 females, mean age = 24.38, SD = 4.79, range 18 – 37 years). Handedness quotient (HQ) was estimated using the Edinburg inventory (Oldfield, 1971). fMRI was acquired using an EPI sequence with TR = 7000 ms; TE = 30 ms; FOV = 205*205 mm2 and spatial resolution = 3*3*3 mm3. A baseline condition was to read aloud strings of the four syllables and repeat the same syllable several times. The structure of the sentences consisted of an adverb of time, a subject, and a predicate with an omitted direct object. The activation maps obtained in the first-level statistical analysis were used to calculate the language lateralization index (LI).

Whole-brain LI was correlated with HQ, r(48) = .38, p = .006. Thus, this result indicates stronger association of language lateralization with handedness than in the previous study. Nevertheless, additional studies in larger cohorts based on a sentence completion fMRI task are needed.

Keywords: language lateralization, handedness, fMRI, sentence completion

The effect of induced optimism on contact heat evoked potentials (CHEPs) and the sympathetic skin response (SSR)

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Introduction: Experimentally induced optimism has been shown to influence self-report ratings of pain intensity and facial responses to pain. The aim of the present study was to enlarge these findings and examine the impact of an optimism induction on cortical and autonomous components of the pain response. Methods: Thirty-eight healthy participants underwent two blocks of phasic thermal stimulation. Self-report pain ratings, contact heat evoked potentials (CHEPs) and the sympathetic skin response (SSR) were recorded. Between the blocks of stimulation, the Best Possible Self (BPS) imagery and writing task was performed to induce situational optimism. Results: The optimism manipulation was successful in increasing state optimism. It did not affect any of the pain outcome variables (CHEPs, SSR, self-report ratings). Discussion: These results suggest that optimism might exert its influence on pain experience via slower cognitive processes which are not yet reflected in early cortical and autonomous responses to painful stimuli.

Keywords: pain, optimism, event-related potentials, sympathetic skin response

The sense of self in meditation and depersonalization

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Depersonalization (DPD) is characterized by experiences of unreality with respect to the self, including detachment from it (from one's body, thoughts, or actions) as well as by the sensation of being an observer of oneself. It is highly associated with depression and anxiety. On the other hand, a key concept in Buddhism is that the self is an illusion, and some meditators report similar experiences to DPD. However, usually with a positive valence, experiencing these as wisdom which brings a cessation of suffering or dissatisfaction. Despite the striking similarities (along with important differences) between these two populations, no empirical research has been done to date to try to disentangle the mechanisms of these experiences. The objective of this project is to fill this gap by performing, during the next few years, a) a qualitative study on the DPD-like experiences arising in different contexts (i.e., clinical, and spiritual), and b) behavioral experiments involving EEG using a Predictive Coding framework. We will analyze body ownership with the Rubber Hand Illusion paradigm and expect to find a stronger illusion in people with depersonalization and a weaker illusion in meditators compared to controls. In addition, we will run several experiments on the sense of agency. We hypothesize that both experimental groups give less weight to internal models (in this case, from the efference copy) and more to sensory input, with some crucial differences between the groups.

Keywords: depersonalization, meditation, qualitative, body ownership, agency

Towards a causal role of Broca's area in language: A TMS-EEG study on syntactic prediction

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Introduction: Structural predictions—e.g. expecting a noun or an adjective after processing a determiner like "a"—have been proposed as the mechanism supporting the fast route of syntactic analysis (Lau et al., 2006). Functional studies implicate Broca's area's involvement in categorical prediction (Bonhage et al., 2015), but causal evidence is still missing. In this study, we tested this claim by simultaneously combining online Transcranial Magnetic Stimulation (TMS) and Electroencephalography in a two-word auditory paradigm.

Methods: We employed grammatical (e.g., "a" and a noun) and ungrammatical structures (e.g., "a" and a verb) to elicit the Early Syntactic Negativity (ESN, Hasting & Kotz, 2008). We reasoned that, if Broca's area is causally involved in categorical prediction, impeding its functioning with TMS at the predictive stage (i.e., the first word) would have decreased the ESN effect (ungrammatical – grammatical) compared to two control conditions (sham and superior parietal lobe stimulation). Cluster-based permutation tests were conducted (N=29).

Results: A main effect of grammaticality was observed (ESN and a late positivity), replicating previous findings (Hasting & Kotz, 2008; Jakuszeit et al., 2013). Contrary to our hypothesis, TMS over Broca's area did not affect the ESN amplitude.

Discussion: Our findings suggest that Broca's area may not be causally involved in categorical prediction. They are compatible with a different role of this region in syntactic composition, namely the bottom-up integration of words into syntactic structures (Bhattasali et al., 2019), which is a testable computational hypothesis for future studies.

Keywords: EEG, TMS, language, prediction

Urgency influences evidence representation and performance accuracy in perceptual decision making

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Introduction: Adaptive decision-making requires accurate but also timely decisions. While evidence for the available options is accumulated over time, environmental constraints can require fast and sometimes premature responses at the cost of performance accuracy. Decision strategies underlying this speed-accuracy trade-off remain elusive. Here, we explore the effect of urgency on evidence accumulation and performance in a slow perceptual decision-making paradigm.

Methods: Thirty-five healthy humans performed the Token Task, during which an initial set of 15 tokens moved individually to one of two target locations. Participants were asked to select the target where the majority of tokens would end up. Thus, we sequentially provided bits of information about the required choice. We included trials with different sequences in which normative evidence accumulation was either informative, initially misleading, or random. In some conditions we induced urgency by rewarding fast decisions with monetary gains or saving time spent on the task.

Results: We found that participants' behaviour does not follow the predictions of normative evidence accumulation. Instead, a simpler estimation of evidence strength was adopted. Monetary and temporal incentives reduced decision time at the cost of accuracy in an additive fashion.

Discussion: With this slow-paced decision paradigm, we could identify variables influencing the utilization of evidence accumulation and the amount of information needed for committing to a decision. Specifically, decisions with urgency could be induced by money and time rewards. Further, we conclude, that simplified evidence estimation facilitates efficient human decision making.

Keywords: Urgency, decision-making, evidence accumulation, rewards, Token Task

Werden physikalische Dimensionen in einem mentalen Raum repräsentiert?

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Einleitung. Evidenz für räumliche Anteile in der mentalen Repräsentation von ordinalen Informationen wurde erstmal von Dehaene, Bossini and Giraux (1993) berichtet. Die Autoren zeigten in einem Reaktionszeitexperiment, dass Versuchspersonen auf kleine Zahlen schneller mit der linken Hand reagieren und auf große Zahlen schneller mit der rechten Hand. Dieser sogenannte SNARC-Effekt (Spatial-Numerical Association of Response Code) konnte auch für überlernte und neu gelernte nicht-numerische Reihen repliziert werden (Gevers, Reynvoet & Fias, 2003). In der aktuellen Studie wurde der Frage nachgegangen, ob auch physikalische Dimensionen mental räumlich repräsentiert werden.

Methoden. Hierfür wurden 24 Versuchspersonen gebeten auf mental visualisierte Objekte (Kleidungsstücke) schnell und fehlerfrei zu reagieren. Dabei sollten sie entweder mit linkem bzw. rechtem Tastendruck entscheiden, ob das Objekt leichter bzw. schwerer als eine Referenz ist oder ob es heller bzw. dunkler ist. Analysiert wurden Reaktionszeiten.

Ergebnisse und Diskussion. Eine für den SNARC-Effekt charakteristische Interaktion zwischen der Position des Objektes (vor oder nach der Referenz) und der Seite der Reaktion (links oder rechts) wurde für die Dimension des Gewichtes gefunden: Reaktionen mit der linken (rechten) Hand waren schneller bei leichteren (schwereren) Kleidungsstücken. Die Daten sprechen somit dafür, dass bei der mentalen Repräsentation von physikalischen Dimensionen ein mentaler Raum genutzt werden kann.

Keywords: Spatial Cognition, SNARC, Mental Represenation, Reaction Times

What your IAF can tell you about your cognitive performance: An EEG-study about the relationship between IAF and cognitive performance during an advanced matrices test

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According to the mental speed approach, individuals with higher intelligence scores can process information faster than individuals with lower intelligence scores. As a neurophysiological index for cognitive speed and, eventually, cognitive efficiency, the individual alpha peak frequency (IAF) was proposed, which refers to the highest peak within the alpha frequency band. Previous studies showed a positive correlational relationship between IAF and intelligence. Within these studies, the IAF was considered a stable trait and was primarily measured using resting states before and after the intelligence measurement. Proceeding from findings of less intraindividual variability of speed measures in individuals with higher compared to lower intelligence, we aim to examine the variability of the IAF during the completion of an intelligence test. For this purpose, we conducted an EEG-study with 60 healthy young adults (M_{age} = 23 ± 2.79; 17 males, 43 females). EEG was recorded while they performed 18 items of Raven's Advanced Progressive Matrices (RAPM). The data are currently analyzed focusing on individual alpha peak frequency (IAF) and its item-to-item variability during the RAPM to shed further light on the neurophysiological underpinnings of individual differences in psychometric intelligence.

Keywords: Intelligence, EEG

Who gets the biggest treasure? – Factors modulating foraging decisions in humans

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Introduction: Humans are confronted with dynamic environments which require to sequentially decide between exploitation and exploration. According to the marginal value theorem, current reward rates need to be continuously compared with potential future rewards to determine the opportunity cost of staying or leaving.

Methods: We developed the Gold-treasure-task (GTT) in which participants need to gain as much gold as possible within a certain time. Participants first decide between two harvesting options varying in value and probability of loss. While harvesting instantaneous reward rate (iRR) declines, participants need to decide when to leave the chosen option to achieve greater rewards elsewhere. The foraging environment varied between blocks and could be more or less advantageous. 33 healthy volunteers performed the GTT while electroencephalography (EEG) was recorded. We used single-trial regressions to investigate factors influencing value-based decisions and leaving time iRR.

Results: Behavioral results show that possible gain and risk of possible loss play a significant role in the value-based decision. The type of environment significantly influences the participants' decision when to leave the chosen option. In advantageous harvesting environments they leave at a higher iRR. Additionally, the factors influencing the foraging decision differ between environments.

Discussion: By creating two different environments, we are able to investigate adaptive foraging behavior of humans and its influencing factors. In the advantageous environment, mainly current reward-associated information seems to modulate the foraging decision, while in the disadvantageous environment, environmental history and current information seem to be crucial. EEG analysis addressing underlying neuronal mechanisms is in progress.

Keywords: decision making, foraging, value-based decision making, reward, EEG

Allocating spatial attention in multisensory environments: an ERP study

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Introduction: While the electrophysiological correlates underlying visual and auditory attentional orienting in unisensory settings have been subject to thorough investigations, studies investigating spatial attentional allocation in multisensory environments remain sparse. Here, using the electroencephalogram, we aim to unravel the interplay and temporal dynamics of unisensory attention mechanisms in an audiovisual search paradigm.

Methods: In a dynamic multi-talker speech localization task, participants were asked to determine the lateral position (left vs. right) of a predefined target word among two concurrently presented sound stimuli. Auditory speech stimuli were either presented together with (a) congruent visual speech, (b) unspecific visual speech or (c) without visual input (i.e., auditory-only). On the electrophysiological level, N2ac and N2pc serve as measures of auditory and visual attentional selection, respectively. The preregistered hypotheses and analysis plans can be found at https://osf.io/vh38g/.

Results: Data collection has not been completed yet. Preliminary results point toward a classical redundancy gain of multisensory stimulus presentation in blocks with audiovisual congruent compared to auditory only blocks, as evident in speeded response times. Further, the electrophysiological data suggest that N2ac amplitudes are increased in the audiovisual-congruent condition compared to the auditory-only condition.

Discussion: The present study sheds light on how the presence of visual information influences auditory spatial attentional processing. Preliminary behavioral as well as electrophysiological data show that complementary audiovisual stimulus presentation appears to facilitate (auditory) target individuation and selection.

Keywords: multisensory, spatial attention, N2ac, N2pc, cocktail-party

Alpha and theta oscillations following audiovisual speech in a multi-talker scenario: An EEG study on younger and older adults

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In difficult listening scenarios or so-called "cocktail-party" situations, the processing and understanding acoustic speech stimuli is supported by visual speech information. This additional input has also been shown to support older adults, who oftentimes experience difficulties in speech processing.

Using a multi-talker scenario with rare changes in target talker location, the current EEG study focused on the investigation of post-stimulus alpha- and theta-band power. We aimed at clarifying the relationship between post-stimulus alpha-band activity and attentional allocation and theta-band activity and the integration of multimodal speech input, considering possible age-related differences.

Videos from two concurrent talkers were displayed in three audiovisual speech conditions with (a) audio-visually congruent, (b) visually unspecific and (c) auditorily unspecific speech information, containing a target ("Yes" or "No") and a distractor word (digits "one" to "ten"). Older and younger participants were instructed to indicate the presented target word by button-press. In 80% of the trials, target presentation occurred from an expected location, with rare (20%) switches to the other location.

The study focusses on the role of theta oscillations in successfully integrated multimodal speech. It further highlights age-related changes in alpha- and theta-band modulations in speech perception. This adds to the understanding of underlying mechanisms in aging brains and the resulting difficulties in speech processing.

Keywords: multisensory perception, audiovisual speech, aging, spatial attention, oscillation

Autonomic and oculomotor indices of action preparation in response to threat and reward

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Introduction: Appropriate defensive mechanisms are crucial for survival. Upon the anticipation of anticipated or real threat, animals typically fall into a defensive state that consists of episodes of freezing accompanied by transient decreases in heart rate (bradycardia). A similar pattern has been reported in humans, which is paralleled by oculomotor inhibition. Specifically, a previous study showed more centralized visual exploration along with a co-activation of the parasympathetic (bradycardia) and sympathetic (increased skin conductance) nervous system when participants awaited an aversive stimulation they could avert by a quick behavioral reaction. The current two studies explored whether these action-preparatory responses are sensitive to demands in spatial attention and whether they depend on the valence of the context.

Methods: Subjects viewed naturalistic images while expecting a certain, no or a potential unpleasant electrotactile stimulation (Experiment 1) or monetary reward (Experiment 2) that could be avoided or gained by a fast joystick movement.

Results: In experiment 1, we found centralized gaze, bradycardia, increased skin conductance and pupil dilation when subjects could avoid aversive stimulation. In experiment 2, we failed to find globally narrowed visual exploration behavior, but autonomic dynamics resembled changes in the threat context.

Discussion: Global centralization of gaze seems to be a robust and threat-specific mechanism in anticipation of an avoidable threat. Bradycardia, in contrast, might reflect a more general action preparatory mechanism. These findings refine our view of action-preparatory states in humans by elucidating the complex dynamics of their autonomic and motor components.

Keywords: Defensive states, eye-tracking, freezing, action preparation, physiology

BRAC in the EEG: Early Occipital Processing of Stroop Response Conflict

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In contrast to most prominent conflict monitoring accounts (Botvinick et al., 2001, 2004) the Theory of Event Coding (TEC, Hommel, 2001, 2019) and the Binding and Retrieval in Action Control framework (BRAC, Frings et al., 2020) postulate an early integration of stimulus and response features in common event files. There is ample evidence from EEG research (Pastötter & Frings, 2018; Opitz et al., 2020) that response conflict arising in later processing stages can influence early sensory processing of flanking distractors. Here we present evoked and induced EEG time-frequency data (N = 50) from a lateralized colour-word Stroop task as a further piece in the search for neural event file formation. In general, behavioural and EEG results show more interference in response conflict compared to stimulus conflict, indexed by an increase in response-locked and stimulus-locked midfrontal theta power. In addition, the sensory processing of distractive colour words in occipital theta power is increased during response conflict, but not during perceptual stimulus conflict. In fact, the early detection of upcoming response conflict in occipital areas correlated negatively with theta power increase during the response selection stage. This data pattern supports the idea of a representational and functional link between stimulus perception and its related response activation, as BRAC and TEC suggest.

Keywords: Cognitive control, midfrontal theta, response conflict, TEC, BRAC

Can attentional bias towards threat be modified by reward contingencies?

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Anxiety disorders are thought to be caused by attentional biases (such as the preferential processing of threatening stimuli by visual and cognitive systems), according to a theory by MacLeod et al (1986). Consequently, MacLeod et al. (2002) suggested deliberately manipulating those biases in order to alleviate symptoms, commonly referred to as 'attentional bias modification' (ABM). This has typically been implemented by introducing a spatial contingency between stimuli in order to (implicitly) direct attention away from specific stimuli towards others.

The method has yielded mixed results, with success being modulated by factors such as type of anxiety, training paradigms and measured outcome variables. However, within the domain of social anxiety in particular, recent approaches have shown promising results for the improvement of both measurement and training procedures. Using socially relevant stimuli (i.e. faces) and participants preselected for increased social anxiety, Reutter et al. (2017) identified the N2pc component in the EEG as a reliable measurement for attentional bias. Concurrently, Sigurjónsdóttir et al. (2015) showed reward (instead of spatial contingencies) to be effective at influencing attentional biases in an ABM task.

Combining the two approaches, we attempted to replicate the influencing effect of reward on attentional bias in healthy subjects (N = 60), as measured by changes in the N2pc within a single training session. Simultaneously, we evaluated the effect of task instruction on the training's effectiveness by comparing implicit and explicit instruction conditions to a control condition.

Keywords: ABM, N2pc, reward, attentional bias

Categorical representations in early perceptual and late cognitive visual processing: Combined oddball and delayed memory paradigm

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Introduction: Encoding of perceptual categorical information has been observed in later cognitive processing like memory encoding and maintenance, starting around 300 ms after stimulus onset (P300). However, it remains open whether categorical information is also encoded in early perceptual processing steps (reflected in the mismatch negativity component; vMMN). The main goal of this study was to assess the influence of categorical information on both early perceptual (i.e., vMMN component) and later cognitive (i.e., P300 component) processing within one paradigm.

Methods: We used five-dot patterns belonging to distinct categories even though categorical information is not mirrored in their physical characteristics. In order to assess both early and later cognitive processing steps as indexed by the vMMN and the P300, respectively, we combined an oddball paradigm (i.e., rare patterns presented within a sequence of more frequent patterns) with a delayed memory comparison task (i.e., stimulus identity matching for two sequentially presented target patterns).

Results: Distinct vMMNs were observed for patterns belonging to the same as compared to different categories, suggesting that abstract categorical information was encoded during early perceptual processing. However, in contrast to prior studies, we observed no effect of categories on the P300, indicating no additional encoding of categorical information in later cognitive stages of processing.

Discussion: Categorical information was encoded without being relevant for the task. Our findings emphasize that the encoding of categorical information depends on specific task demands and hence is more flexible and dynamic than previously suggested.

Keywords: N-back, Categorization, Event-related potentials (ERP), Reflection and Rotation sets, visual Mismatch Negativity (vMMN), P300

Contextual Modulation of Heat Pain in Immersive Virtual Reality and the Role of Virtual Embodiment

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Introduction: Virtual reality (VR) and virtual embodiment can both have analgesic effects. In a recent study (Käthner et al., 2019), participants received painful heat stimuli on their forearm and could interact with a virtual environment with virtual hands by placing them under a virtual water tap under different conditions. We induced a temperature illusion by a red, blue or white light (displayed on the tap) suggesting warm, cold or no virtual water that affected pain perception. In the current study (ongoing), we investigate if and to what degree virtual embodiment is important (strengthens the effects of the contextual manipulation).

Methods: Participants (N = 39) wore a head-mounted display in a seated position. As in the previous study, participants received painful heat stimuli on their forearm and were instructed to place their hand (arm) under a virtual water tap with a temperature indicator displaying either a blue, red, or no light (contextual manipulation). In addition, we manipulated the virtual embodiment. Either no virtual hands were displayed or virtual hands co-located with the real hands of the participants that allowed interacting with the virtual water.

Results: As in our previous study, the blue light condition yielded significantly lower pain ratings compared with the red light condition. As expected, there was an interaction effect of the contextual manipulation and virtual embodiment on pain, but virtual embodiment strengthened the effects of the contextual manipulation less than expected.

Discussion: The interaction of virtual embodiment and contextual factors should be considered within VR based pain therapy.

Keywords: Pain, Virtual Reality, Virtual Embodiment

Cortical dynamics of context-dependent speech perception

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Introduction

An unresolved question in language processing is how cognitive control is installed in the human brain in order to internally monitor plausibility of verbal information and to choose an adequate interpretation of sometimes erroneous materials. The current functional magnetic resonance imaging study aimed to shed light into the cortical dynamics between three regions found to be involved in discourse comprehension: the left pre-supplementary motor area (pre-SMA), left inferior frontal gyrus (IFG), and right basal ganglia (BG).

Methods

We manipulated discourse coherence by using presupposition triggers in a test sentence that either corresponded or failed to correspond to items in a context sentence. Participants had to perform an acceptability rating during the scanning procedure. We applied dynamic causal modeling to investigate experimentally induced changes among pre-SMA, IFG, and BG that were activated by inadequate sentence pairs contrasted with adequate pairs.

Results

We found intrinsic connections from pre-SMA to IFG and from pre-SMA to BG while the inadequate conditions modulated the pre-SMA-IFG projection. Additionally, participants' ability to accommodate discourse violations seems to correlate negatively with the modulatory influence on the coupling from BG to pre-SMA.

Discussion

We discuss this connectivity pattern in the light of the aslant tract transmitting inhibitory control signals from pre-SMA to the left IFG in order to slow down procedural processing in case of detected errors. Further, the inhibitory control function of the pre-SMA itself seems to be regulated by a complex behavior of the BG depending on how good/bad participants accommodate a discourse violation.

Keywords: language, cognitive control, inhibition, discourse

Distractor effects on conscious auditory processing in a cross-modal task

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Introduction: Previous research showed that dual-task processes such as the attentional blink are not always transferable from unimodal to cross-modal settings. In the current study, we asked whether such a transfer can be observed for a distractor-induced impairment of target detection previously observed in the visual and auditory modality (distractor-induced blindness/deafness). Using event-related brain potentials (ERPs), wanted to identify the processes underlying successful target detection in a cross-modal setting.

Method: The task consisted of the detection of an auditory target embedded in a rapid serial auditory stream and indicated by a visual cue. Task-irrelevant auditory distractors appearing before the cue had to be ignored. ERP responses to detected (hits) and undetected (misses) targets were compared.

Results: Behavioral data confirmed a cross-modal distractor-induced deafness: target detection was significantly reduced if multiple distractors preceded the target, whereas a single distractor did not affect detection. ERPs revealed that hits were associated with a larger frontal negativity around 200 ms. In contrast to unimodal findings, the following P_3 amplitude showed no enhancement in case of an upcoming hit.

Discussion: The behavioral data demonstrate that distractor-induced deafness can also be observed in a cross-modal set-up and does not rely on sharing modality-specific resources in cue and target processing. However, the ERP results highlight that the early frontal process - related to the re-allocation of attentional processes - is closely linked to auditory target awareness, whereas P_3 enhancement – previously related to working memory processes - is not a valid signature.

Keywords: cross-modal perception, event-related potentials, auditory awareness, P_3, distractor-induced deafness

Do salient integrated objects summon attentional resources in the neglected visual field?

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The integration of fragmentary parts into coherent whole objects has been proposed either to rely on the availability of attentional resources or to arise automatically, that is, from preattentive processing (prior to the engagement of selective attention). In the present study, these two alternative accounts were tested in a group of neglect patients with right-hemisphere parietal brain damage and associated deficits of selective attention in the left (visual) hemispace. The reported experiment employed a search task that required detection of targets in the left and/or right hemifields, which were embedded in configurations that consisted of variants of Kanizsa figures. The results showed that a salient, grouped Kanizsa triangle presented within the unattended, left hemifield can substantially improve contralesional target detection, though the very same triangle configuration does not facilitate target detection in the impaired hemifield when presented together with an ipsilesional, but non-salient (i.e., structurally non-integrated, isolated) target. That is, attention is captured by the grouped object in the impaired hemispace only when it is not engaged in the processing of an (isolated) object in the attended hemispace. This demonstrates that both part-to-whole-object integration and search guidance by salient, integrated objects crucially require attentional resources.

Keywords: perceptual grouping, object integration, visual attention, hemispatial neglect, visual extinction

Does Self-Evaluation Impact Neural and Behavioral Correlates of Error Processing? Investigations from a Novel Complex Choice Task

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The way we process errors and adapt our actions can differ depending on whether or not we are aware of the error and on the significance we subscribe to it. Error awareness is often assessed in error detection tasks, where participants have to evaluate their response accuracy immediately after response execution. In our study we used cognitive neuroscience methods to investigate whether this immediate self-evaluation itself influences error processing by increasing error significance. In the first part of the experiment, participants performed our novel speeded choice task with a complex stimulus-response assignment. In the second part, they additionally evaluated their response accuracy after every trial by indicating whether it was correct or erroneous. We replicated common variations of early and later stages of error processing and action adaptation with error detection. The classical event-related potential approach did not reveal any specific influence of self-evaluation on error processing. Nevertheless, by implementing multivariate pattern analysis, we showed that self-evaluation did affect brain activity patterns preceding and following the response onset independent of response accuracy. The classifier was able to differ between responses from the self-evaluation and the no-self-evaluation condition as early as several hundred milliseconds before response onset. Further analyses point to a combination of self-evaluation and time on task that causes these effects. Our results demonstrate that self-evaluation might not impact error specific processes by increasing error significance. Instead, it might influence early, more general processing mechanisms such as stimulus encoding and the quality of attention.

Keywords: error detection, error significance, self-evaluation, event-related potential, multivariate pattern analysis

Drawing the line – the cognitive framing of line bisection changes anchor point perception

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Healthy participants typically show a slight bias to the left of the middle when bisecting a horizontal line (pseudoneglect). At the same time, anchor points, such as the midpoint of a number line (e.g., 5 in an 0-10 scale with endpoints), are supposed to enhance estimation accuracy. Here, we examined how framing a horizontal line in different cognitive contexts affects bisection behaviour.

Thirty-two elderly participants (age > 53 years) completed different estimations tasks: line bisection, number line estimation (NLE) on i) natural numbers on a 0-10 scale and ii) fractions on a 0-1 scale, and dividing lines into proportions (e.g., 4 equal parts). Only items corresponding to line bisections (e.g., the value 5 in 0-10; 1/2 and 2/4 in 0-1 NLE) were considered in the analysis.

Results indicated a significant effect of framing on participants' bisection performance. In particular, participants bisected lines more to the right in the proportion task, reflecting a reduction in pseudoneglect. Additionally, the unconventional presentation of a fraction (i.e., 2/4 in a 0-1 scale) amplified this effect compared to all other tasks.

This indicates that the framing of numerical tasks altered participant line bisection behaviour. Therefore, in diagnostic contexts, it should be considered that cognitive reframing of line bisection might influence the perception of (number) line anchor points, especially when unconventional notation is used (i.e., 2/4).

Keywords: Number Line Estimation, Line Bisection, Pseudoneglect, Proportional Reasoning

Dynamic interactions between action and attention during exposure to motivational biases

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Introduction: Motivation can bias behavior: Reward prospect drives people towards action invigoration, while punishment prospect suppresses action. Research on such motivational biases has primarily focused on their 'hardwired' automatic nature and their putative maladaptive consequences. We asked whether humans can adaptively recruit these biases in situations in which they could help select the right response.

Methods: In two eye-tracking studies (each N = 35; the second one a preregistered direct replication), participants learned whether to perform Go or NoGo actions to various cues. Action planning and execution were separated by a phase in which potential rewards and punishments for correct/incorrect responses were presented in a gaze-contingent manner.

Results: We observed that learned values of making a Go/NoGo action biased attention towards rewards/punishments, respectively. These findings indicate that action plans can prime attention towards valenced information. Vice versa, a reinforcement-learning drift-diffusion model (RL-DDM) revealed that both the size of rewards and punishments as well as how long participants looked at them predicted the final (Go/NoGo) response.

Discussion: These results suggest that humans might adaptively recruit motivational biases via selective attention to ensure the translation of intentions into actions.

Keywords: motivational bias, reinforcement learning, computational modeling, eye-tracking, attention

Emotional content only influences eye-movements under natural conditions

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In everyday life, people can freely decide if and where they would like to shift their attention and gaze, among other factors influenced by emotional content of stimuli. However, many laboratory paradigms explicitly instruct participants how to move their eyes, leading to unnatural eye-movements. The current preregistered (osf.io/bvcfz) study aimed to investigate to role of natural compared to instructed eye-movements in emotion-driven attention. Eighteen participants were presented with peripherally appearing faces with happy, angry and neutral expressions and either moved their eyes naturally, or were instructed to do so. Eye movements were measured using an arm-mounted EyeLink 1000plus eye-tracker. Results show that participants reliably moved their eyes towards peripheral faces, even when they were not instructed; however, eye movements were significantly slower under natural than under instructed conditions. The physically salient presence of a distractor decelerated both natural and unnatural eye movements. Interestingly, emotional salience only affected eye movements under natural conditions, with faster saccades towards emotional than towards neutral faces. No effects of emotional expression occurred when participants were instructed to move their eyes. The study shows that instructions play a considerable role when investigating effects of emotional salience. It can help explain previous mixed findings regarding whether or not emotional content affects early brain responses and saccades and advocates for the recent development to investigate eye movements under natural conditions.

Keywords: eye-tracking; attention; emotion; natural eye-movements

Eye- or mouth lookers? Saccade and pupillary responses to diagnostic features of emotional facial expressions

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Facial features convey important information on expressed emotions. However, the informative value of specific features differs between emotions with the eyes being more diagnostic for fear and the mouth region for happy facial expressions. Previous research has found sensitivity to the distribution of such diagnostic features in reflexive eye movements, but conflicting results have been reported for very brief viewing durations. Moreover, it is yet unknown whether autonomic activity also reflects the visual processing of these features.

We briefly presented (50 or 150 ms) emotional faces (fearful, happy, and neutral) either in an upright or inverted fashion to elicit reflexive saccades. Furthermore, participants were foveated on specific facial features (i.e., eyes or mouth) by vertically shifting faces relative to the previous central fixation cross. In addition to behavioural performance, we analyzed the proportion of saccades towards facial features in the visual periphery as well as pupil width.

While participants were generally very accurate and fast in classifying the emotional expressions, the initial fixation on diagnostic features did not significantly modulate their performance. However, we replicated the previously observed preferential visual orienting towards diagnostic features even for very brief presentation times. Pupil width was not modulated by the experimental manipulations.

The results show that facial expression categorization can be accomplished with very restricted visual input. However, even in such conditions, first saccades were preferentially targeting diagnostic features of emotional expressions. The behavioural relevance and stability of such explorations patterns need to be examined in future studies.

Keywords: Facial expressions, Saccades, Pupillometry, Diagnostic facial features

Facilitating Spatial Visual Search With Auditory Oddball Stimuli – an Experimental Investigation of the Mechanisms Underlying the Pip and Pop Effect

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Introduction. – In everyday life, we constantly find ourselves in complex, dynamic environments where multisensory stimulation competes for attentional resources in demand of a timely reaction. It has recently been found that visual stimuli in such environments are identified more readily when accompanied by synchronous sounds, a facilitation which is referred to as the pip and pop effect. The present study extends findings on the pip and pop paradigm and investigates underlying mechanisms.

Method. – Participants needed to identify a visual target within a multiple object visual search display which should be facilitated by an unspecific auditory stimulus (Experiment 1). We created a specific oddball condition susceptible to attentional capture but not to multisensory integration (Experiment 2). We intended to test the multisensory integration versus attention capture accounts.

Results. – Results confirmed that an auditory stimulus could aid target detection in complex visual environments (Experiment 1). Facilitation was not found when the auditory stimulus consisted of a tone break, thus a multisensory integration explanation could not be ruled out (Experiment 2).

Discussion. – We suggest that the pip and pop effect is likely accounted for by saliency enhancement due to multisensory integration and that attentional processes might contribute. Our study highlights the beneficial effects of audiovisual alignments and straightens out the perceptual processes involved. The results bring benefits for purposes of characterizing the facilitatory effects of synchronized tone-target events on the processing level and of optimally designing operator systems in order to shape human environment more efficiently, comfortably and safely.

Keywords: pip and pop effect, multisensory integration, attentional capture, oddball

Fixation-related potentials in EEG: Visual versus non-visual influences

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Fixation-related potentials (FRPs), brain-electric responses aligned to the end of saccades, are increasingly used as a tool in cognitive research. However, basic properties of the fixation-related EEG waveform are still poorly understood. In particular, it is unclear to what degree nonvisual processes (e.g., from a corollary discharge) also contribute to activity measurable at the scalp. Older EEG studies on this issue have yielded inconsistent results, with the majority of papers reporting that FRPs disappear entirely when a person's visual field is dark or featureless. The present work aimed to distinguish between nonvisual and visual contributions to the FRPs generated by spontaneous saccades. EEG and eye movements were recorded while participants searched for an occasionally appearing target stimulus in total darkness or while viewing scenes. Deconvolution modeling with nonlinear predictors (Dimigen & Ehinger, 2021) was used to estimate the responses. As a key finding, we observed significant post-saccadic activity over visual cortex in total darkness, which peaked as a negative potential at electrode Oz about 110 ms after saccade onset (or 70 ms after fixation onset). This nonvisual response was polarity-reversed compared to the much larger surface-positive postsaccadic lambda response (P1) seen with visual stimulation, but then followed by another positive potential peaking as late as 350 ms. Interestingly, nonvisual effects scaled nonlinearly with saccade size, suggesting that the established nonlinear relationship between saccade size and FRP amplitude may be partly explained by nonvisual mechanisms. In summary, we observed clear modulating effects of saccade execution on early visual areas in darkness.

Keywords: EEG, eye-tracking, scene perception, vision, extraretinal/corollary processes, deconvolution modeling of EEG

Increased N2PC for salient distractors indicates a bottom-up effect of temporal preparation in spatial selection

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INTRODUCTION. The N2pc is an event-related potential linked to spatial selection in visual search. Previous studies have shown that spatial selection of targets – as indexed by the N2pc – profits from temporal preparation. In this study, we investigated whether this beneficial effect is caused by an influence of temporal preparation on bottom-up or top-down processes in spatial selection

METHOD. Participants searched for a pop-out shape target while ignoring a color singleton distractor. Analogous to previous studies, we measured the N2pc evoked by the target. Furthermore, we measured the N2pc evoked by the singleton distractor and the distractor positivity (P_D) evoked by the singleton distractor to separate bottom-up from top-down processes, respectively.

RESULTS. We observed that temporal preparation increased the amplitude of the distractor N2pc and reduced the onset latency of the target N2pc. In contrast, it did not modulate the P_D.

DISCUSSION. The observation that temporal preparation did not modulate the P_D, but modulated the N2pc evoked by both the target and the salient distractor is not in line with the idea that temporal preparation facilitates top-down processes in spatial selection. Rather, it is in line with the idea that temporal preparation facilitates bottom-up processes in spatial selection.

Keywords: visual search, N2pc, EEG, spatial selection, temporal preparation

Influence of affective valence on bistable perception

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Introduction: Predictive coding models of human cognition conceive perceptual and affective processes to be closely interconnected. It is yet still an open question, whether the link of both processes is limited to the unidirectional influence of perceptual prediction errors on emotion or whether emotional status also can in turn alter low-level perceptual processing. We specifically wanted to test, whether positive emotion would facilitate a perceptual mode that is based stronger on endogenously produced content than on sensory evidence.

Methods: In this preregistered study 29 participants listened to either harmonic instrumental music or stressful acoustic noise, inducing positive and negative affect. They then were asked to indicate changes in perceived motion direction of a rotating bistable stimulus and in a perceptually similar but disambiguated control stimulus in which changes of motion direction were exogenously produced.

Results: Results indicate faster reaction times and therefore a higher number of perceived switches of motion direction in bistable stimulus when induced affect was positive compared to negative. The effect was limited to bistable perception and did not appear in disambiguated stimuli, ruling out possible confounding influences of arousal on response behaviour.

Discussions: Taken together with previous findings on the influence of affective valence on visual perception, these results suggest an influential role of emotional states in low-level perceptual processing. Specifically, positive affect seems to promote the influence of endogenous factors relative to external sensory evidence.

Keywords: predicitve processing, affect, bistable perception

Isolating neural correlates of consciousness in auditory perception

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How does our brain generate consciousness, i.e., the subjective experience of what it is like to see, hear, think or feel? In the search for the neural correlates of consciousness (NCC), several event-related potential (ERP) candidates have been proposed, including early negativities and late positivities. However, previous studies have primarily focused on visual perception, and awareness was often confounded with task-related processes (e.g., decision-making and report). To expand this research to the auditory modality, we presented spoken words in a sustained inattentional deafness paradigm. Electrophysiological responses were obtained from 68 participants in three physically identical experimental conditions with different instructions. Participants were 1) either left uninformed or informed about the presentation of spoken words and performed a demanding auditory distractor task (U/I condition), 2) all informed about the words while continuing the same task as before (I condition), or 3) requested to respond to the now task-relevant words (TR condition). After completion of the U/I condition, only informed participants reported awareness of the words, while uninformed participants experienced inattentional deafness. In ERPs, awareness of words was accompanied by an anterior auditory awareness negativity (AAN). Only when stimuli were task-relevant, late positivities emerged. Taken together, these results indicate that early negativities but not late positivities index awareness across sensory modalities. Thus, they support a role of early sensory processing in conscious perception and highlight the importance of considering task relevance in the search for NCC.

Keywords: consciousness, awareness, auditory perception, inattentional deafness, EEG

Keep slipping away – The impact of locomotion complexity on single-target visual search

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Nowadays, humans are surrounded by ubiquitous exposition to information. Even while walking additional information can be presented, may it be using a smartphone during a casual walk or via smart glasses during a warehouse commissioning shift. It has been shown that cognitive and motor demands compete for a limited pool of resources, but findings about the underpinnings of visual processing in motion are quite scarce while being very important to prevent injury.

In this study we investigated the influence of either standing, walking, or perturbed walking on a treadmill (GRAIL, Motek, NL) on a single-target visual search using a 64 electrode EEG setup (LiveAmp, BrainProducts GmbH, GER). In each trial, participants had to report the open side of a Landolt ring by pressing a button. The stimuli were presented at lateralized positions on a large projection screen, with an eccentricity ranging from -40° to +40° viewing angle.

We found an increase of response times with increasing locomotion complexity and target eccentricity. There were also neurophysiological indices in frontal and parieto-occipital regions (N1, N2, N2pc, theta power) that were negatively affected by increasing difficulty in the motor and visual domain. Still, event-related potentials indicated more rapid sensory processing of high-eccentricity stimuli during active locomotive states.

In general, these results demonstrate the intricate interplay of active locomotion and visual perception. Though there is clear evidence for cognitive-motor interference with increasing load in both domains, peripheral visual processing seems to be enhanced during locomotive states.

Keywords: mobile EEG, cognitive-motor interference, neuroergonomics, locomotion, visual processing

Late occipito-temporal processing reflects perception in the flash-lag illusion

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Introduction: Information following a stimulus within a temporal integration window (TIW) can influence perception. In the flash-lag illusion (FLI), the position of a flash presented ahead of a moving bar is mislocalized, so the flash appears to lag the bar. It appears perceptually linked to the moving bar's position only after the flash onset. Currently, it isn't clear whether this postdiction effect involves early and/or late processing stages.

Methods: We presented 17 participants with the FLI paradigm while recording EEG. A central flash occurred either 51ms ("early") or 16ms ("late") before the bar moving from left to right reached the screen center. Participants judged whether the flash appeared to the right ("no flash lag illusion") or to the left ("flash-lag illusion") of the bar. Using single-trial linear modelling, we examined the influence of Time ("early" vs. "late") and Perception ("illusion" vs. "no illusion") on flash-evoked brain responses, and estimated the cortical sources underlying the FLI.

Results: Replicating previous findings regarding the TIW, FLI perception was higher in "late" vs. "early" trials. A late positive ERP component (368-452ms after flash onset), localized to the inferior occipito-temporal cortex, reflected postdiction: "flash-lag illusion" evoked larger brain responses than "no flash-lag illusion".

Discussion: Postdiction in the reconstruction of ambiguous sensory stimulation involves late processes in the occipito-temporal cortex, previously associated with cognitive and attentional processing. This could indicate that the FLI involves an interplay between the ongoing processing of the moving bar and the conscious perception of the flash.

Keywords: EEG, ERP, Postdiction, Illusion, Perception

Lateralization of the Acoustic Startle Response is Sensitive to Subtle Variation in Spatially Indicative Sound Features

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Introduction: Several studies have shown lateralization of the acoustic startle response. The present study aimed at replicating and extending a previous report of stronger ipsilateral startle responses to different types of spatially indicative sounds. Auditory processing based on inter-aural level differences (ILD) likely involves the lateral superior olive as first site of analysis, whereas inter-aural time differences (ITD) are processed in the medial superior olive. Differences in these neurophysiological underpinnings could influence the magnitude of startle reactions, as indexed by bilateral EMG assessed at the orbicularis oculi muscle.

Methods: 58 healthy participants (49 women), audiometrically checked for normal hearing, were presented (via headphones) with noise bursts (105dB(A), 50ms) varying in spatial location and type: unilateral, ILD (5dB or 10dB), ITD (0.5ms or 0.7ms) and combined ILD/ITD. Participants were instructed to promptly indicate the perceived location of the sound source (left vs. right) by button press.

Results: Results showed adequate discrimination performance, with reaction times and accuracy reflecting effects of both ILD and ITD, as well as lateralization of EMG responses, characterized by stronger activation at the ipsilateral side for all three types of spatial sounds. However, ILD and unilateral sounds showed stronger lateralization effects than ITD.

Discussion: This is further evidence for lateralization of sensorimotor processes involved in the startle response, suggesting differential effects of spatial sound perception based on ILD vs. ITD.

Keywords: Startle, Lateralization

Methods of body odour sampling - assessment of different body sites in infants and adults

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Introduction:

Body odours and their importance for human chemical communication, e.g., in the mother-child relationship, is increasing focus of recent research. Precise examination of sampling methods in order to obtain robust and informative odour samples is therefore necessary.

Methods:

In this study, we sampled axilla, breast and head odours of 28 mother-infant dyads. The participating mothers had to evaluate their own and their infant´s body odour samples, as well as the samples of two unfamiliar mother-infant dyads. We tested whether pleasantness and intensity evaluation, as well as recognition ability of the odours differ with regard to the sampled body part.

Results:

For infantile odours, the body part affected pleasantness ratings, as the head odour was perceived as less pleasant, and all body parts were perceived equally intense. For maternal odours, the body part did not affect pleasantness ratings but intensity ratings, as the breast odour was rated as less intense compared to head and axilla. Familiarity of the odour did not affect pleasantness, but intensity ratings: Mothers rated the own and the own infant´s odour as less intense when compared to the unfamiliar samples. In addition, recognition performance of one's own and one´s own infant's was reliably above chance and the recognition performance did not differ between body sites.

Discussion:

In sum, our study reveals that it is possible to take valid body odour samples from the axilla, breast and head of both infants and adults without any significant difference being gained from any of the body sites.

Keywords: body odour, sampling methods, body parts, body sites, family odours

Mobile ear-EEG to study auditory attention in everyday life

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Introduction

How does our brain process auditory information in daily life? Most research investigating auditory perception uses controlled laboratory studies. This potentially limits the generalizability to everyday complex acoustic environments. In this study, we investigated auditory attention beyond the lab for more than six hours using a fully mobile, smartphone-based ear-centered electroencephalography (EEG) setup with minimal restrictions for participants. Two variants of the established auditory oddball paradigm were used.

Methods

Twelve participants were equipped with a mobile ear-EEG setup. In the morning, around noon, and in the afternoon, participants performed an auditory oddball task (tones every 2 s, 5 min total time) under controlled conditions. Between those sessions, participants left the lab and followed their regular office-day routine at their workplace (2 times 160 min); tones were presented once per minute. In the lab and at their workplace, participants had to react to target tones by pressing the display on the smartphone. Standard tones did not require a response. EEG data, behavioral data, and movement data (with a gyroscope) were recorded and analyzed.

Results & Discussion

The expected amplitude increase of the P_3 component in response to the target tone was observed for the lab and the workplace condition. In the lab, hit rates were higher, and reaction times were faster compared to the workplace. The movement data indicated that participants spent most of their office-day reasonably still. Overall, this study demonstrates that it is feasible to study auditory perception in everyday life using long-term mobile ear-EEG.

Keywords: Auditory attention, Beyond-the-lab, P_3 ERP, Long-term recording, Mobile cognition

Neuronal correlates of incorporating vs. ignoring changes in visuomotor delay under different attentional sets

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Introduction: To be able to distinguish between the „self" and the environment, the human brain uses information from different senses and integrates them to form an internal body model. In this study we are examining which mechanisms are responsible for the flexible weighting of sensory input depending on current behavioural demands. Methods: We used a dataglove to record participants' movements in a virtual reality setting. We combined a visuomotor incongruence task with a roving oddball paradigm (dynamic delay changes, 10 levels). Crucially, participants were instructed to track a virtual target with either the virtual hand (i.e. visuomotor adaptation) or their real, unseen hand. This effectivtely induced an attentional task set. We expected set to influence adaptation. Results: In a pilot experiment including data of three participants (full data collection from N=20 is in progress) we were able to show that participants did adapt to the different delays only when focussing on the virtual hand, while ignoring the changes for the real hand condition ($F(9, 1060)= 6.59$, $p< .001$). Furthermore, this effect was stronger, the clearer the delay changes could be perceived ($F(9, 1060)= 1.97$, $p= .04$). Discussion: We (preliminarily) show that processing of visuomotor surprise depends on its behavioural relevance. Thus, participants incorporated changes in visuomotor delay only when those were task relevant, and clearly perceived as such.

Keywords: Bodymodel, Virtual Reality

Neuronal correlates of visuomotor performance depending on attentional set

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Introduction: Our brain represents our body by combining sensory feedback of multiple modalities based on their specific relevance to the current situation.

Here, we examined the neuronal correlates of performance during a task with incongruent visuo-proprioceptive body position feedback, depending on instructed attentional set (i.e., task focus on visual versus proprioceptive feedback).

Methods: Controlling a hand model in virtual reality via a data glove in an MR scanner, participants (N = 16) matched either the virtual (VH) or (unseen) real hand (RH) to the phase of a periodically moving target. Visuo-proprioceptive congruence was altered by delaying the VH movements in half of the trials, and performance measured as the root-mean-square error between target and hand position.

Results: fMRI showed a significant correlation ($p<0.05$,FWE-corrected on cluster level) of performance with activation in the contralateral supplementary motor area (SMA; x:-6 y:-12 z:54) and primary visual cortex (V1, x:14 y:-96 z:8). Crucially, when contrasting the RH condition, where focus lay on proprioceptive feedback, with the VH condition (visual focus), we found a significant effect in the contralateral primary somatosensory cortex (S1, x:-40 y:-40 z:48, $p<0.05$, FWE-corrected on cluster level). Finally, we found a stronger correlation ($p<0.05$, FWE-corrected on cluster level) of activation in the posterior parietal cortex (PPC, x:22 y:-74 z:54) with performance error for the VH than the RH condition under delay compared with synchronous movement.

Discussion: These results differentiate the processing of general task performance in higher motor areas from attentional set dependent processing of (somatosensory vs visual) feedback in the S1 and the PPC.

Keywords: fMRI, attentional set, visuomotor performance, S1, PPC

Olfactory Perception in Relation to the Physicochemical Odor Space

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A growing body of research aims at solving what is often referred to as the stimulus-percept problem in olfactory perception. Although computational efforts have made it possible to predict perceptual impressions from the physicochemical space of odors, studies with large psychophysical data sets from non-experts remain scarce. Following previous approaches, we developed a physicochemical odor space using 4,094 molecular descriptors of 1,389 odor molecules. For 20 of these odors, we examined associations with perceived pleasantness, intensity, odor quality and detection threshold, obtained from a dataset of 2,000 naïve participants. Our results show significant differences in perceptual ratings, and we were able to replicate previous findings on the association between perceptual ratings and the first dimensions of the physicochemical odor space. However, the present analyses also revealed striking interindividual variations in perceived pleasantness and intensity. Additionally, interactions between pleasantness, intensity, and olfactory and trigeminal qualitative dimensions were found. Our results support previous findings on the relation between structure and perception on the group level in our sample of non-expert raters. Nevertheless, human olfactory perception is no analytic process of molecule detection alone. Therefore, to gain an understanding of stimulus-percept relationship in the individual, future studies should shift towards a more holistic view that takes into account the influences of context, experience and other interpersonal characteristics.

Keywords: olfaction, perception, physicochemical odor space

Posterior alpha power increases reflect involuntary spatial attention due to task-distracting, novel sounds

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Introduction: Shifting attention towards a spatial location can be voluntary (goal-driven) or involuntary (stimulus-driven). The posterior cortical alpha rhythm (8-14 Hz) is causally involved in controlling spatial attention, with alpha power decreases linked to the processing of task-relevant information in the attended space and increases linked to the inhibition of processes associated with information in the unattended space. Crucially, posterior alpha power decreases have been observed for both voluntary and involuntary attention, while alpha power increases have been reported only for voluntary attention, suggesting fundamentally different mechanisms of involuntary and voluntary attention. We aimed to challenge that claim.

Methods: We recorded magnetoencephalographic and behavioral data in a paradigm that combines a distraction task with a stimulus-driven cueing task. Participants responded to the location of a target (left or right). Each target was preceded by a task-irrelevant sound: a frequent standard sound or a rare task-distracting, novel sound. Half of the deviants occurred on the same side as the target, and half occurred on the opposite side.

Results: Responses were slower to targets that followed a novel compared to a standard. Also, responses were faster when targets followed novels on the same versus different side. Crucially, we found an alpha power increase in the hemisphere ipsilateral to the novel.

Discussion: Overall, our findings show an involuntary shift of spatial attention due to a task-distracting novel sound. Crucially, posterior alpha power increased in the hemisphere ipsilateral to the novel sound, implying the same biasing mechanisms in involuntary attention as in voluntary attention.

Keywords: alpha oscillations, involuntary attention, magnetoencephalography, spatial attention

Predicting Occluded Trajectories using Temporal Information

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Recent studies reported low-level visual cortex to be instrumental in the anticipation of upcoming apparent motion, when only the beginning of an event sequence is presented. However, it remains unclear, if continuous motion is governed by the same mechanisms. We investigate how prediction of trajectories of occluded moving stimuli affects fMRI-responses, focusing on low-level visual areas. Volunteers (n=16) participated in a two-day experiment, in which they performed training and test phases. During training, they passively observed a white dot continuously moving horizontally, then vertically up or down. The direction of vertical trajectories were determined by stimulus velocity (fast/slow). During the test phase, the vertical trajectories were occluded and participants judged where and when the stimulus would end, based on the speed of the horizontal trajectory. Results revealed that the visible stimulation elicited higher BOLD responses in the V1, V2 and V3, as expected ($F(1,15) = 9.327$, $p < .001$, as well as an interaction between direction and velocity ($F(1,15) = 5.582$, $p = .032$). Likewise, during the test phase, the same regions also showed enhanced responses ($F(1,15) = 16.534$, $p < .001$), along with the direction-velocity interaction ($F(1,15) = 32.75$, $p < .001$). Moreover, multivariate pattern analysis revealed that these and additional regions, as hMT/V5, may encode direction-related information when a classifier was trained in the visible stimulation and tested in the occluded one, for some cases. This suggest that, during prediction of occluded movement, there might be mental representations already in the early stages of visual cortex supporting this process.

Keywords: prediction, dynamic occlusion, early visual cortex

Prepulse inhibition of the startle response: Comparison between blink reflex and perceptual rating of the stimulus.

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The human startle reflex and prepulse inhibition (PPI) are well established tools in psychophysiological and neurocognitive research. Effects of PPI on the motor response and on perceived stimulus properties might be based on overlapping but not identical circuits. The present study (N = 12) investigated the influence of the intensity of the startle stimulus on the magnitude of the startle response as well as on subjective ratings, with and without PPI. Assuming a linear relationship between startle stimulus intensity in the 85 – 105 dB range and magnitude of the startle response, the influence of a prepulse was investigated. Acoustic startle stimuli with intensities of 85, 95, or 105 dB, were presented, with a 60 dB prepulse 120 ms before a 105 dB startle stimulus on some trials. The presence of a prepulse resulted in PPI, with the resulting startle magnitude extrapolated to be equivalent to that of a startle response to an 83 dB startle stimulus without prepulse presentation. The prepulse also reduced subjective ratings of the loudness and aversion of the startle stimulus. A comparison of the inhibition patterns supported the hypothesis that prepulse inhibition of the blink reflex and perceived startle stimulus intensity are based on overlapping but not identical circuits. These data also offer the possibility of conceptualizing PPI as either percent change relative to control, or as equivalent to a reduction in eliciting stimulus intensity in decibels.

Keywords: Startle, Prepulse Inhibition, Perception

Reality in a sphere: A direct comparison of social attention in the laboratory and the real world

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Introduction

Humans often show reduced social attention in real situations, a finding rarely reported in controlled laboratory studies. Virtual reality is supposed to allow ecologically valid and at the same time highly controlled experiments. This study aimed to provide further insights into the usage of virtual reality and the role of interactions for social attention.

Methods

We chose five public places in the city of Würzburg and measured eye movements of 44 participants for 30 seconds at each location twice: Once in a real environment with mobile eye tracking glasses and once in a virtual environment playing a spherical video of the location in an HMD with an integrated eye tracker.

Results

As hypothesized, participants demonstrated reduced social attention with less fixations on passengers in real environments (M = 7%, CI = [5%, 9%]) as compared to virtual environments (M = 30%, CI = [28%, 32%]). This is in line with earlier studies showing social avoidance in interactive situations. Furthermore, we observed more consistent fixation patterns in virtual environments.

Conclusion

These findings highlight that the potential for social interactions and an adherence to social norms are essential modulators of viewing behavior in social situations and cannot be easily simulated in laboratory contexts. However, spherical videos might be helpful for supplementing the range of methods in social cognition research and other fields. Preregistration, data and analysis scripts are available at https://osf.io/hktdu/.

Keywords: social attention, spherical videos, eye tracking, ecological validity, virtual reality

Statistical signatures of Bayesian confidence can be misleading about the neural correlates of perceptual confidence

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Introduction: Many recent studies traced the neural correlates of perceptual confidence using statistical signatures of confidence. The most widely used statistical signature is the folded X-pattern, which was derived from a Bayesian model of perceptual decision making. According to the folded X-pattern, confidence increases with discriminability of the stimulus in correct trials and decreases with discriminability in incorrect trials. We investigated if the folded X-pattern is a valid signature of the neural correlates of perceptual confidence.

Methods: Analytical computations were used to examine the statical properties of perceptual confidence implied by more general Bayesian model of perception. In addition, EEG and confidence judgments were recorded during a post-masked orientation discrimination task.

Results: Our computations show that Bayesian confidence in incorrect choices increases, not decreases with discriminability if observers obtain reliable trial-by-trial evidence about discriminability itself. In the masked orientation discrimination task, EEG recordings revealed that the Pe component at centroparietal electrodes 200 – 500 ms after participants' orientation judgments closely resembled the folded X-pattern. However, behavioural confidence matched neither the folded X-pattern nor the Pe component. Instead, confidence judgments were closely related to the P3 component recorded over centroparietal electrodes 300 – 500 ms after onset of the target stimulus.

Discussion: These findings demonstrate that the folded X-pattern does not necessarily follow from Bayesian models of decision making. Assuming the folded X-pattern without empirical cross-validation may detect spurious neural correlates of confidence.

Keywords: Perceptual confidence, P300, EEG, Event-related potentials, Neural correlates of confidence

Studying face-to-face conversations with a validated eye tracking paradigm

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Face-to-face conversations make up an important component of social relationships, and their study provides important insights into the dynamics of such relationships. This requires paradigms that map these dynamics and make them measureable. We developed such a paradigm for the field of eye tracking research and validated it in three independent studies with respect to data quality, feasibility and robustness to movement.

Study 1 and 2 measured robustness, precision and accuracy for static stimuli compared to a classical display-based setup and as a function of stimulus dimensionality. Study 3 evaluated data quality over the course of a real face-to-face conversation, examining gaze behavior on the facial features of the conversation partner. Attention was paid to how movements due to speech and facial expressions affected data quality.

Study 1 provides evidence that the quality indices for the scene-based setup were comparable to those of a classical display-based setup. Study 2 demonstrates that quality of eye tracking is sufficient for 3D stimuli. Study 3 confirms the long-term stability of tracking accuracy during a face-to-face interaction despite naturally occurring movements and demonstrates typical gaze patterns for facial features.

The results suggests that the eye tracking paradigm presented is feasible for studying gaze behavior in dyadic face-to-face interactions. Eye tracking data obtained with this paradigm achieve an accuracy that is sufficient for investigating gaze behavior and even eye contact in social interactions. Application is conceivable in various contexts, e.g., to study clinical disorders such as social phobia or autism spectrum.

Keywords: eye tracking, gaze behavior, social interaction, face perception, accuracy

The CNV reflects automatic temporal expectancy: Further evidence from the temporal oddball task

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Introduction: The nature of the contingent negative variation (CNV), a slow cortical potential being typically observed in S1-S2 paradigms, has been the subject of a long-standing debate. In a temporal oddball task, it was previously shown that a CNV occurs relative to the expected onset of a stimulus even if the actual onset is later – indicating that it reflects automatic temporal expectancy. In the present study, we further examined the automatic nature of this expectancy-related CNV.

Method: In each trial, we presented two audio-visual stimuli, S1 and S2, separated by a short (1,500 ms) or long (2,500 ms) ISI. The two ISIs were drawn from an oddball probability distribution: In separate blocks, either the short ISI was the standard and the long one was the deviant (standard-short block), or the long ISI was the standard and the short one was the deviant (standard-long block; standard-to-deviant ratio in both blocks: 3:1). Participants were instructed to attend to the S1-S2 sequence without any further task.

Results: Our analysis of deviant trials in the standard-short block revealed a fully-pronounced CNV not only before the actual S2 onset, but already before its expected (standard) onset. Importantly, an expectancy-related CNV in deviant trials was also present in the standard-long block, that is, when the expected (standard) onset was after the actual S2 onset.

Discussion: The observation that a CNV emerges relative to the expected (standard) stimulus onset although the actual stimulus has been presented before supports the view that it reflects automatic temporal expectancy.

Keywords: temporal expectancy, event-related potential, CNV, temporal oddball task

The impact of emotional prosody on task irrelevant auditory distractors in a serial recall task in visually impaired individuals: an online experiment

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Previous research suggest that varying task-irrelevant sound (i.e., changing-state sound such different spoken syllables) is more disruptive of performance in a serial recall task than sound that remains constant in its acoustic parameters (steady-state sound). However, blind individuals' short-term memory has been reported to be less susceptible to irrelevant speech distractors compared to sighted individuals. In this online experiment, we asked whether the emotional prosody of task-irrelevant auditory syllables modulates the changing-state effect on memory performance and whether visually impaired individuals are less distracted by the task-irrelevant stimuli spoken in different emotional prosodies. Eighty-three sighted participants and thirty-seven visually impaired individuals were asked to memorize a random sequence of eight spoken digits, which was followed either by a period of silence or the presentation of task-irrelevant non-sense syllables spoken with different prosodic intonation (happy, neutral, fearful, or threatening). Results suggests that visually impaired individuals were better able to recall the digits compared to sighted individuals. Further, emotional prosody modulated the changing state effect in the visually impaired, conversely, the prosodic intonation did not affect the changing state effect in the sighted controls. We discuss specific psychoacoustic properties of emotional speech as well as the setting of an online experiment to study auditory distraction in visually impaired individuals.

Keywords: Auditory memory, visual impairment, emotional prosody, changing state effect

The Role of EEG Alpha Oscillations in TVA Parameter Values

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Computational modelling algorithms based on the theory of visual attention (TVA) represent a powerful tool to disentangle cognitive functions in visual information processing. One can model an *effective exposure duration* (to) to process visual information consciously, *speed of visual information processing* (C), and a maximum *capacity of visual short-term memory* (K) by means of accuracy data at different exposure durations. Also, one can model *top-down control* (alpha) by comparing accuracies in conditions where distractors need to be suppressed with such where not; and one can model *spatial attentional weighting* (w) in the visual field. To this point, predominantly alterations in ERPs such as the N1, the CDA, the PCN and ERL have been related to differential TVA C, K, alpha and w values, respectively. But the role of neural oscillatory activity in TVA is rather unexplored. We propose that alpha waves, i.e. neural oscillatory activity from 8 to 14 Hz, represent a promising neural correlate of TVA functions because they are an established neural substrate of attentional control in perception, memory, and executive functions. We recruited 35 healthy participants to perform a visual short-term memory paradigm where they memorized white shapes depicted on an invisible circle either with or without distracting black shapes at one of three different exposure durations while their EEGs were recorded. We found robust model fits between EEG alpha activity and TVA K, alpha and w values; and weaker ones with to and C values. Thus, alpha waves may be a crucial neural mechanism in TVA.

Keywords: oscillatory activity, computational modelling, attention, short-term memory, perception

Uncertain reward cues dominate perception at binocular-rivalry onset

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Binocular rivalry occurs when the eyes are presented with two dissimilar images and visual awareness fluctuates between them. Previous findings suggest that perceptual dominance of a rewarded stimulus may increase relative to an unrewarded stimulus, implying a direct effect of reward on visual representations. Here, we asked how uncertainty about reward occurrence and average reward expectancy affect dominance in binocular rivalry. In three experiments, participants learnt to associate drifting gratings of distinct colors with different levels of uncertainty and expectancy. Uncertainty was manipulated by rewarding each correct trial either with 100% probability (no uncertainty) or with 50% probability (high uncertainty). The amount of reward was either identical per rewarded trial, yielding a lower expectancy in uncertain trials (experiments 1 and 2), or reward expectancy was matched across uncertainty levels by doubling the award per rewarded trial for uncertain trials (experiment 3). In experiment 2, an additional low-reward condition with no uncertainty was included. Using a no-report paradigm, we measured the perceptual dominance of these gratings relative to a grating that was unassociated with reward, before and after associations had been acquired. When the rewarded stimulus feature (color) was task relevant, dominance durations increased for all rewarded gratings after acquisition. In an early phase after rivalry-onset we found increased perceptual dominance for cues associated with uncertain reward compared to cues associated with certain reward. This confirms an effect of reward on perceptual dominance, and suggests that reward uncertainty associated with a stimulus has a direct bearing on its visual representation.

Keywords: learning, vision, perception, visual perception, visual awareness

Understanding object function instantly shapes perception within less than 200 ms

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Introduction: Does our perception of an object change as soon as we discover what function it serves? This question is relevant for our everyday lives, where we encounter novel tools and gadgets as parts of our dynamic working and private environments. It also pertains to the long-standing debate around the (im)penetrability of perception by higher cognitive capacities.

Method: In this experiment, we showed participants (n = 24) pictures of 120 unfamiliar objects either together with matching information about their function—leading to semantically informed perception—or together with non-matching information—resulting in naive perception. We measured event-related potentials (ERPs) to investigate at which stages in the visual processing hierarchy these two types of object perception differed from one another.

Results: We found that semantically informed as compared to naive perception was associated with larger amplitudes in the N170 component and reduced amplitudes in the N400 component. When the same objects were presented once more (without any information), the N400 effect persisted and we now also observed enlarged amplitudes in the P1 component in response to objects for which semantically informed perception had taken place. We replicated these novel findings in an independent sample (n = 24).

Discussion: Consistent with previous work, our results suggest that obtaining semantic information about previously unfamiliar objects alters aspects of their lower-level visual perception (P1 component), higher-level visual perception (e.g., holistic perception; N170 component), and semantic processing (N400 component). These effects can already be observed within the same trial and/or one trial after the information has been acquired.

Keywords: visual perception, semantic knowledge, objects, event-related potentials

750mg Metyrapone – sufficient to modify salivary cortisol in CP stress protocol

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The passive physical «Cold Pressor Test» (CPT) enriched with the active mental «Paced Auditory Serial Addition Task» (PASAT) reliably provokes profound activation of the autonomous nervous system (ANS) and the hypothalamus-pituitary-adrenal (HPA) axis, the latter resulting in the release of cortisol. Metyrapone is a well-known adrenocorticostatic agent which inhibits cortisol synthesis by blocking adrenal 11-beta-hydroxylase. This study aimed to investigate whether Metyrapone can specifically diminish the cortisol response after a stress protocol including CPT and PASAT. Our sample consisted of 19 healthy, young men. One hour after receiving either oral 750mg Metyrapone or placebo, both of their feet were exposed to ice water for 3 minutes while simultaneously performing the PASAT test. Salivary cortisol was collected every 20 min prior and every 10 min after the stress test. Subjective stress ratings were assessed before and after the stress test. Results showed that Metyrapone significantly lowered salivary cortisol at most time points. Peak cortisol levels differed significantly from baseline values after placebo, but not after Metyrapone intake. Subjective stress ratings remained unaffected by Metyrapone. This data indicates that 750mg of oral Metyrapone is sufficient to reduce overall cortisol levels. However, it remains unclear whether 750mg of oral Metyrapone is sufficient to specifically inhibit stress reactivity of the HPA axis.

Keywords: Cold Pressor Test, PASAT, Metyrapone, salivary cortisol, stress research

A Pooled Preliminary Analysis on the Effects of Transcutaneous Auricular Vagus Nerve Stimulation on Salivary Alpha-Amylase as Noradrenergic Biomarker

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Introduction: There is multiple evidence pointing to a modulatory role of transcutaneous auricular vagus nerve stimulation (taVNS) on cognitive and affective functions, which is likely mediated by activation of the locus coeruleus-noradrenaline (LC-NA) system. However, reliable effects of taVNS on noradrenergic biomarkers have not been demonstrated yet. Possible reasons for this lack of replicability are relatively small sample sizes and the heterogeneity of stimulation procedures used across studies. The aim of the present study is to overcome these limitations by pooling existing data across labs that examined the effects of taVNS on salivary-alpha amylase (sAA), a putative indirect marker for noradrenergic activity.

Methods: sAA data from four of our taVNS studies with healthy subjects (N = 147) were analyzed using linear mixed models with log-transformed sAA data as predicted variable, and stimulation type (taVNS or sham stimulation) and time (before or after stimulation) as predictors.

Results: The pooled analysis across these four studies revealed that taVNS, compared to sham stimulation, significantly increased sAA levels over time.

Discussion: Our preliminary data supports the assumption that taVNS affects the LC-mediated noradrenergic system. This is an ongoing project and more data from different labs will be included with an increased number of variables (e.g., stimulation duration, stimulation intensity) to identify further factors that may modulate the tVNS-induced sAA changes.

Keywords: transcutaneous auricular vagus nerve stimulation, salivary alpha-amylase, noradrenergic biomarkers, pooled data

Acute stress alters probabilistic reversal learning in healthy participants

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Introduction Stressful situations can improve or impair learning from rewards. Reversal learning requires flexible adaptation to sudden changes in reward contingencies. Acute stress effects on reversal learning are rarely investigated but highly relevant for psychiatric disorders. Here, we employed model-based functional MRI in a within-subject design with healthy participants to investigate the effect of acute social on flexible behavioral adaptation

Methods Healthy participants (n=28) underwent MRI during a reversal learning task, once after the Trier Social Stress Test and after a control condition in separate sessions. During the task participants chose between two stimuli with anti-correlated reward contingencies, in order to obtain rewards in three phases with different levels of volatility. Effects of stress on choice behavior were investigated using generalized linear mixed-effects models and a set of computational models describing different learning processes that might have generated the data (hybrid Pearce-Hall/Rescorla-Wagner). Models were fitted using a hierarchical Bayesian approach with reward prediction errors (RPE) as parametric first-level regressor for fMRI.

Results Cortisol responses demonstrated that stress induction was successful. Stress significantly albeit subtly increased correct responses. Model comparison revealed that a Rescorla-Wagner model with individual scaling of the inverse decision temperature best explained the observed behavior under stress. On the neural level, RPE signals were coded in striatum and vmPFC, but we did not observe whole-brain correctable effects of stress on RPE representation.

Discussion Our study shows that acute social stress has an impact on reversal learning and the need for future studies to explore high interindividual variability further.

Keywords: stress, reversal learning, fMRI, computational modeling

Acute stress effects on emotion regulation strategy preference and success as a function of stimulus intensity

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Introduction: Stress has been shown to initialize a shift from flexible, demanding to rigid, undemanding cognitive processes. Reappraisal and distraction are two frequently studied emotion regulation strategies that vary in their effectiveness as a function of stimulus intensity and their cognitive demands. As such, one might assume that stress may favor preference for distraction over reappraisal serving an adaptive purpose. To test this hypothesis, we investigated acute stress effects on preference for reappraisal or distraction in dependence of stimulus intensity and additionally explored its impact on emotion regulation success.

Methods: Eighty healthy male participants underwent the Trier Social Stress Test or a control condition 25min prior to an emotion regulation choice paradigm asking them to choose between reappraisal and distraction downregulating upcoming emotions towards low and high intensive negative pictures. Affective ratings and pupil dilation served as emotion regulation outcome measures. Relative preference for reappraisal or distraction for each participant with respect to both stimulus intensities was determined.

Results: Stress led to higher odds preferring distraction relative to reappraisal to downregulate high intensive emotions. No such prediction of strategy preference by stress occurred for low intensive emotions. In addition, stressed participants reported to be more successful downregulating high intensive emotions compared to controls, which was positively correlated to their cortisol increases.

Discussion: Taken together, our findings might imply that stress favors preference for less cognitively demanding strategies particularly when downregulating high intensive emotions suggesting adaptive strategy choices in response to acute stressors.

Keywords: stress, cortisol, cognitive emotion regulation, pupil dilation, stimulus intensity

Affektive Sprachverarbeitung und chronischer psychischer Stress: eine Online-Studie.

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Unser Wissen über Sprache ist in den letzten Jahrzehnten explosionsartig gewachsen. Umso erstaunlicher ist , dass wenig darüber bekannt ist, wie psychosoziale Faktoren wie Depression oder Stress die Sprachwahrnehmung beeinflussen können. Dieser Mangel an Forschung ist überraschend angesichts der Prävalenz von diesen Faktoren und der Tatsache, dass gesprochene Sprache unser primäres Kommunikationsmittel ist und eine Beeinträchtigung dieses Systems unter Stress vielfältige negative Auswirkungen haben kann. Besonders relevant ist dies auch im medizinischen Bereich, da Patienten bei einem Arztbesuch in der Regel akut, aber zu einem großen Teil auch chronisch gestresst sind.

In der aktuellen prospektiven Beobachtungsstudie, welche wir online an 200 Versuchspersonen durchführen, untersuchen wir die Schwierigkeit der Emotionserkennung in der Sprache in Abhängigkeit von dem subjektiven Stressempfinden. Dazu werden die Versuchspersonen gebeten, die Emotion von einem gehörten Pseudosatz einzuschätzen. Die Sätze wurden sowohl emotional neutral als auch in 4 Emotionen (angenehme Überraschung, Trauer, Angst, Freude) eingesprochen. Als abhängige Variable messen wir die Hit rate und die Reaktionzeiten. Außerdem fragen wir das subjektive Stressempfinden der letzten vier Wochen sowie die Stressbewältigungsstrategien der Versuchspersonen ab.

Wir erwarten, dass grundsätzlich Emotionen schlechter erkannt werden, je gestresster die Person in dem vergangenen Monat war. Für die Emotion Angst erwarten wir jedoch auf Grund der Aktivität der Spiegelneurone bei gestressteren Personen eine bessere Emotionsdetektion als bei weniger gestressten Personen.

Da in der Literatur vielfach soziale Unterstützung als wirksamer Stresspuffer berichtet wird, erwarten wir einen weniger starken Einbruch in der Emotionserkennung, wenn die Versuchsperson auf soziale Unterstützung als primäre Bewältigungsstrategie zurückgreift.

Keywords: Affektive Prosodie, Stress, Stressbewältigung, Sprachperzeption

Association of daily life stress with the cortisol awakening response over a 14-months stress phase

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The objective of the prospective-longitudinal and quasi-experimental JurSTRESS project is to contribute to the understanding of the biopsychological mechanisms mediating the well-known association between chronic stress and the risk for several disorders.

In this project, 471 law students from Bavarian universities are studied over a 14-months period. The experimental group (EG) consists of students experiencing a long-lasting and significant stress phase, namely the preparation for the "Erste Juristische Staatsprüfung", while law students assigned to the control group (CG) are studied over an equally long period without particular stress exposure.

In the present analysis, we focus on the association of daily life stress with the cortisol awakening response (CAR) over this long-lasting stress phase. The CAR is a well-established marker of cortisol regulation in psychoneuroendocrinology. To investigate stress-related alterations in the CAR, we included 204 students, 97 subjects from the EG and 107 from the CG. Stress perception in daily life is measured with repeated ambulatory assessments on six sampling points (T1 – T6), with the first assessment taking place twelve months prior to the exam. T1, T2, T5 and T6 consist of two consecutive sampling days, whereas T3 and T4 - both close to the exam - measure stress perception on one day. Subjects complete ten electronic queries on each sampling day. The CAR is assessed via saliva samplings after awakening, +30 and +45 minutes on the first day of each sampling point. Since data collection is not fully completed, results will be presented at the conference.

Keywords: Cortisol awakening response, longitudinal, stress perception, psychoneuroendocrinology, chronic stress

Cortisol administration prior to extinction generalization results in return of fear after reinstatement

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While extinction learning appears to be stimulus-specific, generalization of fear seems to be naturally acquired as it is frequently observed in fear-related disorders. Thus, treatments aiming to generalize extinction learning might comprise the chance to overcome stimulus-specificity and consequently reduce relapses, especially after the encounter of stressful events.

In this pre-registered, three-day fear conditioning study, we aimed to create a generalized extinction memory trace in 60 healthy men and women using multiple sizes of one conditioned stimulus (CS+G; generalized) during extinction training, whereas the other CS was solely presented in its original size (CS+N; non-generalized). Extinction training took place either after pharmacological administration of the human stress hormone cortisol or placebo.

Following successful fear acquisition on the first day, prolonged activation of the bilateral insula and dACC for CS+G minus CS+N indicated prolonged fear during extinction training for the CS+G on the second day. During retrieval on the third day, an activation of the left hippocampus was observed for the contrast CS+G vs CS+N. In line with our hypotheses, amygdala and dACC responding during reinstatement test was reduced for the CS+G as compared to CS+N. However, cortisol abolished this dACC activation relative to placebo.

Extinction generalization processes appear to rely on prolonged fear expression that in turn leads to attenuated return of fear after reinstatement. Cortisol administration prior to extinction training, however, appears to increase consolidation of this prolonged fear signaling leading to its reemergence after unsignaled reinstatement shocks.

Keywords: extinction, generalization, cortisol, stress, fear conditioning

Do neural responses to acute stress predict chronic stress perception in daily life over 14 months?

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The objective of the prospective-longitudinal and quasi-experimental JurSTRESS project is to contribute to the understanding of the biopsychological mechanisms mediating the well-known association between chronic stress and the risk for several disorders.

In this project, 471 law students from Bavarian universities are studied over a 14-months period. The experimental group (EG) consists of students experiencing a long-lasting and significant stress phase, namely the preparation for the "Erste Juristische Staatsprüfung", while law students assigned to the control group are studied over an equally long period without particular stress exposure.

In the present analysis, we focus on the predictive value of neural responses to acute stress for stress perception in daily life over 14 months. Thus, the fMRI paradigm Scan*STRESS* was applied to 123 students from the JurSTRESS sample at study entry, including 60 subjects from the EG and 63 subjects from the CG. Scan*STRESS* consists of two runs with stress and control conditions and it prompts the subject to solve arithmetic and rotation tasks while being evaluated by an observation panel. Stress perception in daily life is measured with repeated ambulatory assessments on six sampling points (T1 – T6), with the first assessment twelve months prior to the exam. T1, T2, T5 and T6 consist of two consecutive sampling days, whereas T3 and T4 - both close to the exam - measure stress perception on one day. Subjects complete ten electronic queries on each sampling day. Since data collection is not fully completed, results will be presented at the conference.

Keywords: stress, MRI, ambulatory assessment, longitudinal study

Does stress influence cortisol synchrony in groups during the Trier Social Stress Test for Groups or a non-stressful control task?

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Physiological synchrony (PS) is defined as the co-occurrence and interdependence of physiological activity between interaction partners. Previous research has uncovered numerous influences on the extent of PS, such as relationship type or individual characteristics. Here, we investigate the influence of acute stress on PS. We do so in a setting in which PS was not promoted but contact between group members was explicitly minimized. We reanalyzed cortisol and subjective stress data from 138 participants (mean age = 23.48 ± 3.99, 47.1% female) who previously underwent the Trier Social Stress Test for groups (TSST-G) or a non-stressful control task together, collected as part of a larger project (Popovic et al., 2020). Using a stability and influence model, an established method to test for synchrony, we tested whether individuals' cortisol concentrations could be predicted by group members' cortisol levels. We found PS in participants who were in the same group, the extent of which was stronger in the non-stressful control condition. This suggests that while PS can occur in group settings even with spurious interaction, stressor exposure might attenuate its extent. We argue that if PS occurs in a sample where interaction was minimal, the phenomenon might be more widespread than previously thought. Further, stressor exposure might influence whether a situation allows for PS. We conclude that PS should be investigated within group settings with various degrees of social interaction to further expose mechanisms of and influence on PS.

Keywords: Trier Social Stress Test for groups, physiological synchrony, stress contagion, cortisol

Düsseldorf Social Anxiety Test (DSAT): Anxiety instead of Stress

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Introduction: The Trier Social Stress Test for groups (TSST-G) is a reliable stress induction method provoking both, anxiety and anger. In this study, the TSST-G was modified to a Düsseldorf Social Anxiety Test (DSAT) in order to induce anxiety rather than anger.

Methods: A total of 26 men participated in a mock assessment center (anxiety session), with three participants per group performing in front of a female evaluator. The two TSST-G tasks (job interview, mental arithmetics) were adjusted to three DSAT tasks (job interview, discussion of a politically controversial topic, defense speech). The control session consisted of heart rate-adjusted ergometer training in the presence of an experimenter. Physiological (saliva cortisol) and psychological (State Trait Anxiety Inventory, range 20-80, State Trait Anger Expression Inventory, range 15-60) stress indicators were assessed at the beginning and at the end of the DSAT.

Results: Participants had a higher saliva cortisol level during the anxiety session compared to the control session ($p < .001$), and felt more anxious during the anxiety session ($M = 36.37$, $SD = 8.07$) compared to the control session ($M = 30.45$, $SD = 3.59$, $p = .001$). They reported a near to bottom anger level in the anxiety session ($M = 16.04$, $SD = 1.56$) and in the control session ($M = 15.23$, $SD = 0.60$, $p = .008$).

Discussion: The results demonstrate that the DSAT induces anxiety, but no psychologically significant anger. Thus, it appears as the method of choice when induction of anxiety without anger is desirable.

Keywords: TSST, Anxiety, Anger, Stress

Effekte einer Lichtintervention bei Student*Innen mit starken Stresssymptomen - eine Pilotstudie

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Anhaltender Stress ist einer der wichtigsten Risikofaktoren für die psychische und physische Gesundheit von Student*Innen. Bisher ist die klinische Evidenz unzureichend, um klare Empfehlungen für eine effektive Behandlung von stressbedingten Störungen zu geben. In Situationen mit intensivem Stress scheitern konventionelle Methoden, wie Entspannung und achtsamkeitsbasierte Programme oft an mangelnder vorheriger Übung. Kognitiv-behaviorale Interventionen werden nur von wenigen genützt. Obwohl Medikamente die Stresssymptome innerhalb weniger Tage verringern können, sind deren Nebenwirkungen nicht zu vernachlässigen. Daher besteht ein hoher Bedarf an einer effektiven und effizienten Behandlungsmethode von stressbedingten Störungen bei Student*Innen. Lichttherapie ist eine wirkungsvolle Behandlungsmethode für viele psychische Störungen, z. B. affektive Störungen, Schlafstörungen und Essstörungen.

Da helles Licht seine positive Wirkung am besten durch eine morgendliche Exposition entfaltet, nutzen die Studienteilnehmer*Innen, hoch gestresste Student*Innen, die Lichtintervention direkt nach dem Aufwachen für eine Stunde über einen Zeitraum von drei Wochen. Die vorliegende randomisiert-kontrollierte Feldstudie besteht aus zwei unterschiedlichen Lichtinterventionen: helles weißes Licht (Verum) und stark gedimmtes, rötliches Licht (Placebo). Wir stellen die Hypothese auf, dass eine helle Lichtintervention im Vergleich zur Placebo-Intervention die subjektiven und physiologischen Stressparameter der Student*Innen reduziert, ihre Stimmung, kognitiven Funktionen und Schlafparameter verbessert und den zirkadianen Aktivitätsrhythmus stabilisiert. Die Daten werden mithilfe kontinuierlicher ökologischer Momentaufnahmen (EMA), kontinuierlicher Aktigraphie am Handgelenk, einer Haarprobenmethode (ELISA), zur Ableitung der Cortisolwerte und einer Methode zur Messung der kognitiven Funktionen erhoben.

Aufgrund der geringen Stichprobengröße (n=22) konnten keine signifikanten Interaktionseffekte beobachtet werden. Die Analysen zeigen jedoch Tendenzen in Richtung einer Stressreduktion durch eine helle Lichtintervention. Die Stichprobengröße der Hauptstudie umfasst 100 Studienteilnehmer*Innen.

Keywords: Lichtintervention, Stress, Student*Innen

Eignen sich die zirkulierenden Monozyten als Zellkulturmodell für die Stressforschung: Ergebnisse aus einer tierexperimentellen Studie und einer Humanstudie

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Fragestellung: Die Untersuchung zirkulierender Monozyten als Zellkulturmodell erfreut sich in der Stressforschung großer Beliebtheit, weil diese Zellpopulation als antigen-präsentierende Zelle (APZ) eine zentrale Rolle bei der Auslösung einer spezifischen Immunreaktion spielt. Neben den Monozyten üben auch die plasmazytoiden-dendritischen Zellen (PDZs) die Funktion einer APZ aus. Es wurde bisher noch nicht untersucht, ob dieses Zellkulturmodell ohne vorherige Prüfung eingesetzt werden kann. Dieser Fragestellung gingen die vorliegende tierexperimentelle Studie und die Humanstudie nach.

Methoden: In der tierexperimentellen Studie wurde bei vier Schweinen das Bandscheibenkerngewebe aus der Bandscheibe entnommen, in Titankammern (NP Kammern) gelegt und danach die gefüllten NP Kammern unter der Haut implantiert. In der Kontrollbedingung wurden dem narkotisierten Schwein auf der gegenüberliegenden Körperseite leere Titankammern implantiert. Nach einer Woche wurden die Gewebeflüssigkeiten entnommen und durchflusszytometrisch analysiert.

In der Humanstudie wurden aus dem operativ entfernten Bandscheibengewebe von 15 Patienten mit einem freien Sequester und drei Patienten mit einem subligamentären Sequester enzymatisch eine Zellsuspension isoliert und die angefärbten Zellen durchflusszytometrisch analysiert.

Ergebnisse: Im Vergleich zu den leeren Kammern konnte in den NP Kammern der signifikant größte Anteil der Zellen als $CD14^+$Zellen, die auf der Oberfläche auch CD8o exprimierten, gezählt werden. In der Humanstudie konnte bei den 13 Patienten, deren C-Reaktives Protein (CRP)-Werte normal waren, ein geringerer Anteil der Zellen als $CD14^+CD11c^+$Monozyten und ein größerer Anteil als $CD123^+CD4^+$PDZs identifiziert werden.

Schlussfolgerungen: Die Untersuchungsbefunde bestätigen nicht die Hypothese, dass die zrkulierenden Monozyten als Zellkulturmodell für die unspezifische Immunreaktion ohne Prüfung verwendet werden kann. Stattdessen sollte zuerst untersucht werden, ob der prozentuale Anteil dieser Zellpopulation am größten ist.

Keywords: Psychoneuroimmunologie, Antigen-Präsentierende Zelle, Plasmazytoide-dendritische Zellen, Zellkulturmodell. Monozyten

Estradiol and oxytocin modulate sex differences in hippocampus reactivity and episodic memory

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Introduction

Considerable evidence supports sex differences in episodic memory favoring women. The hormones estradiol and oxytocin both affect episodic memory, but possible sex-specific effects and hormonal interactions have not been systemically tested in humans.

Methods

We conducted a randomized, placebo-controlled, parallel-group functional magnetic resonance imaging (fMRI) study involving healthy women (n = 120) and men (n = 120). Participants were scanned under four experimental conditions: 1. estradiol gel (2 mg) and intranasal oxytocin (24 IU), 2. placebo gel and intranasal oxytocin, 3. estradiol gel and placebo spray, 4. placebo gel and placebo spray. During the fMRI, participants viewed positive, neutral and negative scenes. A surprise recognition task 72 h later was used to classify encoding trials as remembered or not-remembered. The study protocol and analysis have been pre-registered and the data will be made publicly available (https://osf.io/hvknp/).

Results

Under placebo, women showed a significantly better recognition memory and increased hippocampus responses to subsequently remembered items compared to men independent of the emotional valence. The separate treatments with either estradiol or oxytocin significantly diminished this mnemonic and hippocampal sex difference, whereas the combined treatments cancelled each other out.

Discussion

Collectively, our results suggest that estradiol and oxytocin play a crucial role in modulating sex differences in episodic memory. Furthermore, possible antagonistic interactions between estradiol and oxytocin could explain previously observed opposing hormonal effects in women and men.

Keywords: Memory, Estradiol, Oxytocin, fMRI, Sex differences

Feelings from the Heart: Developing HRV decrease-trigger algorithms via multilevel hyperplane simulation to detect psychosocially meaningful episodes in everyday life

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Heart rate variability (HRV) has been associated with diverse psychosocial concepts, like stress, anxiety, depression, rumination, social support, positive affect, and self-worth, among others. Although recent research devoted the analysis of cardiac-psychosocial interactions in daily life using ecological momentary assessment, traditional time sampling designs are compromised by more or less random pairing of cardiac and psychosocial variables across several time points. Grounding on the concept of additional heart rate (Mrytek & Brügner, 1996) and additional HRV (Brown et al., 2016), which aims to control for metabolic-related changes in cardiac activity, we aim to present an approach to derive algorithm settings, which can later be used to automatically trigger the assessment of psychosocial states by online-analysis of transient HRV changes. As a first step, we used an already published data set (Schwerdtfeger, Rominger, & Obser, 2020) in order to identify potential triggers offline indexing meaningful HRV decrements as related to low quality social interactions. Two patterns of non-metabolic HRV decreases (i.e., magnitude of the decreases, frequency and duration of decreases) were systematically manipulated and quantified by binary triggers (HRV decrease detected vs. not). Triggers were subjected to multilevel models predicting (lower levels of) social support. Effect estimates, significance levels and bootstrap power simulations were then visualized on a hyperplane to inform about the most robust trigger settings. A trigger setting associated with 14 HRV decreases out of 29 minutes seems to be particularly sensitive to low quality of social interactions. Further algorithm refinements and validation studies are encouraged.

Keywords: Heart rate variability; Interactive ambulatory psychophysiological assessment; Simulation

Geschlechterunterschiede in der maximalen Griffkraft modulieren nicht die Reaktivität im Handgrip-Test

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Einleitung: Im klinischen Kontext ist der Handgrip-Test als Instrument zur Erfassung der körperlichen Gesundheit seit Langem etabliert, während er in der Psychophysiologie erst seit Kurzem als Stressor genutzt wird. Bei Dauerbelastung (3 min) wird eine stärkere kardiovaskuläre Reaktivität bei Männern sowie höhere Schmerzwahrnehmung bei Frauen beobachtet. Zugleich zeigen Männer jedoch eine deutlich höhere maximale Griffkraft als Frauen. Untersucht werden soll daher anhand einer Reanalyse bestehender Daten, inwieweit das Geschlecht einen Einfluss auf die Griffkraft und weitere physiologische Faktoren hat und ob Geschlechterunterschiede in der Stressreaktion (kardiovaskuläre Reaktivität sowie Schmerzwahrnehmung) durch Unterschiede in maximaler Griffkraft erklärt werden können.

Methoden: In verschiedenen Experimenten absolvierten 96 Studenten und Studentinnen (50 weibl.) einen Test ihrer maximalen Griffkraft sowie anschließend ihrer Kraftausdauerleistung, in welchem ein Griffball mit der dominanten Hand mit 45% (42-48%) ihrer Maximalkraft für 3 Minuten gehalten werden sollte. Zusätzlich wurden verschiedene physiologische und psychologische Variablen (Größe, Gewicht, Fitness, Schlaf, Ratings von Angst, Erregung und Stress, Selbstwert) durch Anamnese- bzw. Selbstauskunftsverfahren erfasst.

Ergebnisse: Die Mittelwerte der maximalen Griffkraft von Männern und Frauen unterschieden sich, wie erwartet, signifikant voneinander ($p<.001$). Wenn der Einfluss der maximalen Griffkraft (sowie anderer Variablen) auf die Indikatoren der Stressreaktion statistisch kontrolliert wurde, blieb ein Geschlechtereffekt signifikant.

Diskussion: Das Profil der Reaktivität während des Handgrip-Tests scheint sich geringfügig, aber signifikant zwischen Männern und Frauen zu unterscheiden. In zukünftigen Untersuchungen könnte der Einfluss von weiteren physiologischen und psychologischen Faktoren wie Stimmung und Motivation oder die Anatomie der Hände auf die maximale Griffkraft miteinbezogen werden.

Keywords: Stress, Handgrip, Geschlechterunterschiede

MRI as a stressor: Analysis of the psychological and physiological stress response of clinical patients to MRI and its predictors

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Background: MRI-examinations provoke stress and anxiety in many patients and elicit a physiological stress response of cortisol and salivary α-amylase (sAA). However, the latter findings are mostly based on non-clinical samples challenging their validity for clinical patients. Further, little is known about factors that predict the stress response. This study characterizes the psychological and physiological stress response of clinical patients to MRI and its determinants.

Methods: Ninety-nine MRI-patients of the radiology department of the University-Hospital-Erlangen participated in the study (M_{Age}=48.93, SD_{Age}=14.92; 60.6% female). Patients filled in questionnaires on their psychological state and provided saliva samples before and after the examination. Eighty-eight patients sent back an additional questionnaire on personality factors (response rate: 88.89%).

Results: While psychological stress and anxiety declined from pre- to post-MRI, cortisol- and sAA-levels remained constant. Women reported higher anxiety levels and lacked the sAA-decrease observed in men. Physiological stress was unrelated to most psychological measures of stress, anxiety, or depression except for claustrophobia. More severe diseases were associated with higher post-MRI-anxiety but not physiological stress. The examined body part was unrelated to physiological stress, but mammary patients were most anxious. Contrarily, pathologies only differed in the physiological reaction. It was least pronounced for musculoskeletal/connective-tissue-diseases and neoplasms and most for diseases of the circulation-system (cortisol) or external violations (sAA).

Conclusions: The physiological and psychological responses of clinical patients to MRI seem to depend on different factors and are largely independent. Given the lack of other studies on this topic more research is needed to consolidate our findings.

Keywords: Patient Experience, MRI, Anxiety, Stress, Clinical Patients

Need for Cognition, Impulsivität und Diabetes. Mögliche Pfade zum besseren Verständnis des Langzeitzuckers.

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Abstract

Fragestellung: Impulsivität zeichnet sich durch mangelnde Reflektion und vorausschauende Planung aus, wohingegen Need for Cognition (NFC) als intrinsische kognitive Motivation zur elaborierten Informationsverarbeitung charakterisiert ist. Studien legen für beide Persönlichkeitsfaktoren Zusammenhänge mit Gesundheits- und Adhärenzverhalten nahe. Ziel dieser Studie war es daher, die potentielle Rolle dieser Persönlichkeitseigenschaften als Protektiv- bzw. Risikofaktoren bezüglich Diabetesselbstmanagement und glykämischer Kontrolle als Biomarker des Langzeitzuckers zu untersuchen. Des Weiteren wurde untersucht, ob diabetesspezifische Selbstwirksamkeit als Mediator für diese Zusammenhänge fungiert.

Studiendesign: Anhand einer Stichprobe von 77 Patienten mit Typ 2 Diabetes wurden selbstberichtetes NFC, Impulsivität, diabetesspezifische Selbstwirksamkeitserwartung und Diabetesselbstmanagement erfasst. Glykämische Kontrolle wurde anhand des Biomarkers HbA_{1c} beurteilt. Dieser spiegelt den durchschnittlichen Blutzuckerwert der letzten 3 Monate wider und wird aus dem Vollblut gewonnen.

Ergebnisse: NFC wies starke positive Assoziationen mit Diabetesselbstmanagement und glykämischer Kontrolle (HbA_{1c}) auf, während bei Impulsivität eine inverse Beziehung beobachtet wurde. Ergebnisse einfacher und serieller Mediationsmodelle zeigten zudem, dass sowohl die Effekte von NFC als auch von Impulsivität durch Selbstwirksamkeitserwartung mediiert wurden.

Diskussion: Die Befunde unserer Studie legen nahe, dass NFC einen möglichen protektiven und Impulsivität einen möglichen Risikofaktor für effektives Diabetesselbstmanagement und die glykämische Kontrolle (HbA_{1c}) als Biomarker für den Langzeitzucker darstellt. Diese Persönlichkeitseigenschaften könnten mithin eingesetzt werden, um einfach anwendbare Screeningverfahren zu entwickeln, welche patientenzentriertere Programme oder Behandlungen ermöglichen könnten.

Keywords: Diabetes, glykämische Kontrolle, Need for Cognition, Langzeitzucker, Impulsivität

Neuroendocrine trait-vulnerability markers of premenstrual syndrome: An ERP-study across the menstrual cycle

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Background: According to the biopsychosocial model of premenstrual syndrome (PMS), trait-like alterations in structure and function of neuroendocrine systems predispose affected individuals to experience adverse physiological and psychological symptoms during their premenstrual days. In order to study alterations of emotional processing in PMS, gonadal steroids were assessed, and the event-related P300 component was recorded as an indicator of information processing and (selective) attention.

Method: A non-clinical sample of N = 35 naturally cycling women with (n = 19) and without (n = 16) PMS completed an Emotional Picture Stroop Paradigm during follicular phase, ovulation and luteal phase. P300 amplitudes towards erotic, positive and neutral pictures were assessed. Furthermore, subjects provided saliva samples for analysis of gonadal steroids. PMS was measured using the trait version of the PMS inventory.

Results: Subjects affected by PMS showed reduced P300 amplitudes in reaction to all picture categories across cycle phases. However, groups (PMS vs. non-PMS) did not differ in their reaction towards emotional vs. neutral pictures. While no group differences were observed in progesterone and testosterone levels, overall estradiol levels were higher in individuals affected by PMS. Assessed hormones were not associated with differences in emotional picture processing.

Conclusion: Results indicate reduced allocation of attentional resources to different classes of social stimuli as a trait- rather than state-vulnerability marker in women suffering from PMS. However, further studies - especially in clinical samples - are needed to clarify these results.

Keywords: Premenstrual syndrome, Menstrual cycle, Even-related-potentials, P300, Emotional processing

No general effects of stress on working memory performance using the ScanStress paradigm

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At the group level, stress has adverse effects on cognitive performance. However, as huge interindividual differences in stress reactivity exist, there is also a large variability in studies reporting on the relationship between acute stress and cognitive performance on the behavioral as well as the neural level. For the latter, some studies report increases of lateral prefrontal activity after stress, whereas others report decreases and yet again others report differences in hippocampal or amygdala activity.

Here we studied 0- and 3-back working memory performance in 172 young participants (94 male, age 18-33) pre and post the ScanStress stress induction paradigm. Effects of the stress induction were measured using salivary cortisol, heart rate, and subjective stress levels.

We consistently induced subjective and cardiovascular stress reactions but no overall salivary cortisol response. Working memory performance did not change from pre to post and there were no reliable differences between male and female participants or cortisol responders and non-responders. At the neural level, we found load dependent activity in the fronto-parietal executive control network, which was not further modulated by stress induction (pre / post stress), sex, cortisol response, or any interaction between these factors.

Our results suggest that subjective and cardiovascular stress responses can be effectively elicited using the ScanStress paradigm whereas the cortisol response was rather weak. Despite our rather large sample size, our data does not correspond well with previous findings of adverse effects of stress on working memory and lowered stress-related lateral prefrontal, hippocampal or amygdala activity.

Keywords: Stress, Working Memory, Executive Functions, HPA, Cortisol

Non-invasive vagus nerve stimulation increases stomach-brain coupling in a vagal afferent network

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Maintaining energy homeostasis is vital and mainly supported by vagal signaling between peripheral organs and the brain. Whereas previous research has established the existence of a gastric network in the brain, we currently lack methods to modulate stomach-brain interactions to better characterize their functional role.

To close this gap, we investigated the effect of right-sided acute transcutaneous auricular vagus nerve stimulation (taVNS) versus sham stimulation (randomized crossover-design) on the coupling between brain activity (as indexed by resting-state fMRI) and gastric frequency (as indexed by electrogastrography, EGG) in 31 (20 female) healthy participants. To identify brain regions coupled to the intrinsic gastric rhythm, we computed phase coupling of fMRI and EGG time series at rest before and after onset of the stimulation (taVNS vs. sham; ~10 min each, collected on different days).

Independent of stimulation, we confirmed key nodes of the gastric network, such as the primary somatosensory cortex and the cingulate sulcus. In line with vagal afferent modulation, taVNS increased stomach-brain coupling in the nucleus of the solitary tract (p_{SVC} = 0.015) of the brain stem. We observed additional increases in coupling in the dopaminergic midbrain.

In line with preclinical research, our results suggest that acute taVNS modulates stomach-brain coupling, possibly through midbrain dopaminergic pathways. We conclude that taVNS could be a promising tool to investigate neuro-gastric coupling, including potential links to somatic symptoms in neurological and mental disorders (e.g., Parkinson's disease or depression).

Keywords: EGG, fMRI, tVNS, interoception, electrophysiology

Perceived stress, depressive symptoms, and the cortisol awakening response in times of crisis – a longitudinal study in young German adults during the COVID-19 pandemic

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Introduction. The pandemic caused by Sars-CoV-2 is a worldwide health crisis with a strong impact on individuals and the society, and unknown long-term effects on psychlogical health. In the past, chronic stress and depressive symptoms have been linked to changes in the regulation of the endocrine stress system. In this study we monitored perceived stress (PS) and depressive symptoms (DS) during the ongoing Covid-19 pandemic and investigate how they relate to the cortisol awakening response (CAR), an integral marker of the endocrine stress system.

Methods. We assessed PS (Perceived Stress Scale) and DS (Brief Symptoms Inventory subscale) in German adults just prior to the pandemic (to=autumn 2019), and at three subsequent timepoints (t1=spring 2020, t2=autumn 2020, t3=spring 2021) using an online survey. The CAR was assessed by measuring salivary cortisol levels at awakening and +30, +45, +60min thereafter on two consecutive workdays in March/April 2021. We hypothesized that PS increased significantly after to, and that this increase is linked to an increase in DS. Further, we will test whether PS- and/or DS-dynamics predict the CAR at t3.

Results. N=33 (n=26 female, $mean_{age}$=26.24, SD_{age}=9.46) participants completed all components of the study. PS increased by 14.75% (difference to-t1: t(32)=-1.37, p=.090, d=-0.24) and remained heightened throughout t2 and t3. DS increased by 20.18% (difference to-t1: t(32)=-2.34, p=.013, d=-0.41) and remained heightened thereafter. PS increase from to to t1 was significantly related to DS increase in the same interval, r(31)=.37, p=.032.

Discussion. Further results will be presented and discussed at the conference.

OSF: https://osf.io/ck9qf/.

Keywords: perceived stress, depression, cortisol awakening response, Covid-19, longitudinal data

Physiological stress in response to dual- and multitasking demands – A systematic review and meta-analysis

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Introduction: Doing several things at the same time can be perceived as demanding with the individual perception of being stressed. But this does not necessarily indicate that physiological stress systems become activated during dual- or multitasking (DT/MT). Multitasking describes the activity of performing multiple (at least two) tasks at the same time. Dual tasking refers to the sequential switching between two tasks.

Methods: The aim of our systematic review and meta-analysis was to investigate whether physiological stress systems become activated in response to DT/MT and whether these physiological response patterns are higher compared to single tasking. We focused on the Sympathetic Nervous System (SNS), the Parasympathetic Nervous System (PNS), the hypothalamic-pituitary adrenal (HPA) axis, and the immune system.

Results: In total, sixteen studies were identified as eligible. Our main findings were that SNS activity is significantly higher and PNS activity is significantly lower during DT/MT than during single tasking. No HPA axis responses were found. No studies were identified in which immune system re-activity to DT/MT was investigated that met our inclusion criteria.

Discussion: We present the first systematic review on physiological stress system activity in response to DT/MT demands. Our analysis confirms that DT/MT is not only associated with the subjective feeling of being stressed but must be considered as an objectively measurable physiological stressor, which is related to an up-regulation of the SNS and a down-regulation of the PNS. Our findings have important implications, because multitasking requirements are becoming increasingly common in modern living and working environments.

Keywords: Stress, Multitasking, Dual-tasking, Sympathetic Nervous System, Parasympathetic Nervous System

Probing the association between psychological resilience and brain network dynamics

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Introduction: Clinical neuroimaging has established a link between changes in intrinsic functional brain connectivity and psychological disorders. Consequently, it has also become a focus of interest to understand the neurobiological preconditions for preserving mental health even in the face of stress and adversity (resilience; e.g., Southwick & Charney, 2012). Two recent studies suggest an association between psychological resilience and brain network dynamics, based on resting state EEG (Paban et al., 2019) and fMRI data (Long et al., 2019). However, whereas EEG suffers from inherently spatial resolution, the latter study explored network dynamics at an unacceptably low temporal resolution of only 12 layers. Here, we aimed at replicating and extending this study by applying multilayer modularity analyses (Muldoon & Bassett, 2016) to temporally highly resolved resting-state (rs-) fMRI.

Method: Fast multiband rs-fMRI was acquired from 52 healthy young adults who completed three different resilience questionnaires. Associations between resilience and dynamic network properties (node flexibility, promiscuity, degree) were tested using FDR-corrected spearman correlations. To investigate the influence of different sampling schemes, we also downsampled the rs-fMRI data to better resemble the original study.

Results: We observed no significant correlations for any of the combinations between the three brain measures and resilience questionnaires (all $p > .06$), neither for the original nor for down-sampled data.

Discussion: Our results do not support the association between resilience and resting-state network dynamics postulated by Long et al. (2019) and highlight the need for testing the robustness of such effects by imposing methodological rigor and replication approaches.

Keywords: network neuroscience, mulitlayer modularity, brain dynamics, psychological resilience, replication

Rapid and delayed stress effects on recognition of female and male faces

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Introduction: Stress and the stress hormone cortisol typically impair memory retrieval, especially for emotional words, scenes or objects. However, prior research almost exclusively focused on the rapid non-genomic cortisol effects. Additionally, findings for face stimuli are contradictory and rare, although very relevant for everyday life.

Methods: In this pre-registered study, we investigated the rapid and delayed stress effects on memory retrieval for faces. In a two-day design, 52 healthy men learned pictures of male and female faces with distinct emotional expressions on day 1. On day 2, participants underwent either a stress or a control condition. Memory for the faces was retrieved at two time points, once 25 minutes later (recall 1), at the peak of the cortisol increase for stressed participants (non-genomic effects), and 90 minutes later (recall 2), when cortisol concentrations were back to baseline (genomic effects).

Results: During recall 1, stress enhanced memory retrieval for female faces selectively, whereas stress generally enhanced memory retrieval during recall 2. Altogether, we observed a beneficial rather than detrimental impact of stress on face recognition, in particular, non-genomic cortisol effects were restricted to female faces.

Discussion: It remains to be determined if this beneficial stress effect relies on the interaction of the sex of the participant and the sex of the stimuli. Future research should also more closely look at the underlying mechanisms of how stress exactly influences face recognition, which is for example critically relevant for testimonies.

Reducing acute stress responses via post-hypnotic suggestions of safety

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Stress leads to physiological and psychological changes that can have a negative impact on health. While there are numerous methods to reduce chronic stress, there are only few to reduce acute stress. Therefore, we look for methods to build resilience against acute stress. An established protocol to evoke social stress is the Trier Social Stress Test (TSST). We hypothesize that an acute stress response can be reduced by a post-hypnotic safety trigger.

In our planned study, we compare two groups, each consisting of 15 female and 15 male participants. All participants receive the same live induction of hypnosis with the implementation of a post-hypnotic safety trigger. The participants in the safety group use the safety trigger during the TSST while the control group uses a neutral trigger. To determine psychological changes we measure state anxiety, safety and rumination ratings. For post-stress physiological changes, besides pulse and heart rate variability, we also measure alpha-amylase and cortisol by repeated saliva samples, immune parameters (IL-1ß, IL-6 & CRP), and adrenaline in repeated blood plasma samples. For long-term effects, participants rate the effectiveness of the safety trigger one week later.

We expect that the post-hypnotic safety trigger reduces stress responses during the acute stress induction and one week later. In the safety group we expect higher subjective safety ratings, less rumination, lower state-anxiety ratings, cortisol, alpha-amylase, and heart rate increases. Additionally, we expect differences in immune parameters. If the hypotheses are confirmed, it would demonstrate that acute stress can be reduced with posthypnotic suggestions.

Keywords: Stress, Anxiety, Resilience, Hypnosis, TSST

Stress effects on memory retrieval of aversive and appetitive counterconditioning

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Introduction: Extinction training creates a second inhibitory memory trace and effectively reduces conditioned responding. However, acute stress inhibits the retrieval of extinction memories. Therefore, approaches counteracting detrimental stress effects are needed. Counterconditioning (CC), for instance, pairs a previously learned conditioned stimulus with an unconditioned stimulus of the opposite valence. The current pre-registered study investigates whether stress also decreases the retrieval of CC memories with aversive and appetitive consequences.

Methods: 52 healthy men were randomly assigned to either a control or stress group and took part in a two-day instrumental learning paradigm. During a first phase, participants learned that pressing specific buttons on a keyboard in response to the presentation of four neutral stimuli either leads to gaining or losing money. During a second phase, two stimuli reversed their contingencies (CC). One day later, participants were exposed to acute stress (i.e., socially evaluated cold-pressor test) or a control condition prior to the same task, which no longer included feedback about gains or losses.

Results: Preliminary results regarding day two suggest that acute stress improves the retrieval of CC memories on the first trial. Over the course of retrieval, reaction patterns became more alike between groups and stimuli. However, stressed participants tend to display more approach of gains, whereas control participants tend to show more avoidance of losses.

Discussion: Our findings indicate that stress effects on memory retrieval differ depending on the specific learning paradigm. These differences might be related to stress effects on decision-making and different motivational systems involved.

Stressreaktion und Leistung im Homeoffice mit und ohne angeschalteter Kamera.

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In Zeiten der Pandemie müssen die meisten zuvor in Präsenz abgehaltenen Leistungserhebungen online im Homeoffice stattfinden. Diese Studie untersucht, ob ein Wortflüssigkeitstest, auf der Plattform Zoom durchgeführt, Effekte auf das subjektive Stressniveau und auf physiologische Stressmarker wie Cortisol und salivare Alpha Amylase (sAA) hat und ob sich bei eingeschalteter Kamera stärkere Stressantworten und/oder schwächere Leistung zeigen.

107 Studierende der Psychologie wurden zufällig den Bedingungen *Kamera an* und *Kamera aus* zugeordnet. Subjektiver Stress, Cortisol und sAA wurden jeweils eine Minute vor (T1) und eine (T2), 10 (T3) und 20 Minuten (T4) nach dem Wortflüssigkeitstest erfasst.

Es zeigte sich nach dem Leistungstest ein Anstieg des Cortisolspiegels im Speichel (logarithmiert; $McortT_1 = .90$, $SD_{cortT1} = .60$, $M_{cortT2} = 1.10$, $SD_{cortT2} = .79$; $t_{(106)} = 3.06$, $p = .003$), des subjektiv empfundenen Stress ($M_{subjT1} = 3.21$, $SD_{subjT1} = 1.78$, $M_{subjT2} = 5.20$, $SD_{subjT2} = 2.13$, $z = 7.2$, $p < .000$) und der sAA (logarithmiert; $Ms_{AAT1} = 4{,}58$, $SDs_{AAT1} = .70$, $Ms_{AAT2} = 4.66$, $SD_{sAAT2} = .55$; $t(107) = 1{,}96$, $p = .027$ einseitig). Bei eingeschalteter Kamera fanden sich keine stärken Stressantworten, hingegen fiel die Leistung bei eingeschalteter Kamera deutlich schwächer aus ($M_{Kamerao} = 51.29$, $SD_{Kamerao} = 10.89$, $M_{Kamera1} = 46.33$, $SD_{Kamera1} = 11.98$; $t_{(106)} = 2.24$, $p = .027$).

Ein online durchgeführter Leistungstests löste Stressreaktionen aus. Die Kamera wirkte sich ungünstig auf die Leistung aus. Möglicherweise fordert die Wahrnehmung des Kamerabildes notwendige Aufmerksamkeitsressourcen.

Keywords: Homeoffice, Onlinetest, Stressreaktionen, Leistung

The effect of dorsal pulvinar inactivation on heart rate, heart rate variability and breathing

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Cardiac dysfunctions are a complication of stroke in humans and rely on structural and functional alterations in brain regions belonging to the 'central autonomous network (CAN)'. Since disentangling the contribution of a specific brain region to cardiac activity is difficult in human patients, we here combined local inactivation with ECG in awake monkeys. We tested the causal contribution of the medial pulvinar (mPul) to cardiac activity. Medial pulvinar has reciprocal interconnections with major CAN regions (amygdala, insula, cingulate and PFC).

We reversibly inactivated neural activity of mPul in three rhesus monkeys using GABA-A agonist THIP (7 sessions) comparing them with control sessions (7 sessions). Each session consisted of interleaved blocks of rest and visual decision task. ECG and capnography were recorded to calculate the respiration rate, heart rate and its variability per block.

In one of three monkeys, mPul inactivation significantly slowed down the average heart rate for rest (~31 bpm) and task (~28 bpm), increased heart rate variability during task (~3 ms) and decreased the breathing rate during rest (~2 bpm). The other two monkeys did not show consistent heart or breathing rate changes, although the inactivation was effective as evidenced by task-related performance changes. The three monkeys differed in their baseline heart rate (CO: ~170 bpm, CU: ~110 bpm, MA: ~125 bpm). Monkey CO had the highest baseline heart rate showing the inactivation effect.

To summarize, while mPul has a causal effect on heart rate and its variability, there seem to be factors that determine such an effect.

Keywords: Thalamus, body signal

The effects of oxytocin in females and males on trusting potential romantic partners

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A seminal study on the effects of oxytocin has demonstrated that it increases trust in males in interactions with anonymous, unknown interaction partners. We had not known whether oxytocin has similar effects in women and in interactions involving additional personal information about interaction partners (e.g., sex, faces). We therefore administered 24 IU intranasal oxytocin or placebo to 144 heterosexual, single participants of both sexes (male: N = 71; OT: N = 33, PL: N = 38; female: N = 73; OT: N = 36, PL: N = 37). 40 minutes later, participants played multiple rounds of a trust game and were confronted by the faces of different interaction partners of the opposite sex whose facial features had been manipulated on attractiveness and threat. Participants had to decide whether they wanted to transfer financial resources to their interaction partner (= trust behavior) or not (= distrust behavior); transfers would trigger an increase in the participant's resources if the interaction partner sent half of the multiplied resources back. We observed that oxytocin, compared to placebo, increased trust behavior to a larger extent in men than in women. Furthermore, this sex difference was more pronounced when participants were interacting with unattractive and unthreatening interaction partners than with attractive and threatening interaction partners. Oxytocin thus seems to have sex-specific effects on trusting opposite-sex interaction partners in a trust game with real faces, leading to enhanced approach behavior towards potential romantic partners in males but not females.

The influence of language and perceived discrimination on the acute stress response in a Latin American sample

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Objective: Previous studies reported higher stress responses in association with experienced discrimination. This study focused on differences in cortisol and alpha-amylase (sAA) responses to the Trier Social Stress Test (TSST) in Latin Americans in Germany depending on conducting the test in their native language Spanish or German.

Method: Thirty participants (60 % female) between the age of 19 and 53 (mean = 30.10) from Latin America were tested (14 in Spanish, 16 in German). Participants gave six saliva samples and were randomized to a German or Spanish version of the TSST. Experienced discrimination was assessed using the Everyday Discrimination Scale.

Results: A significant difference between conditions was found for salivary cortisol concentrations ($F(2.64,73.97) = 3.66$, $p < .05$, $\eta_p^2 = .12$), but not for sAA ($F(5,140) = 0.56$, $p > .05$, $\eta_p^2 = .02$). A moderation analysis was run to determine whether the interaction between language and discrimination significantly predicts cortisol response. Results show that language significantly moderated the association between perceived discrimination and cortisol increase ($\Delta R^2 = 10.19\%$, $F(1,26) = 4.34$, $p < .05$, 95% CI[0.006, 0.861]).

Conclusion: Taken together, a stronger stress response to the TSST in the German condition compared to native language was found for cortisol but not for sAA. Cortisol increase was significantly affected by an interaction between language and perceived discrimination. Higher discrimination led to higher cortisol increase in the foreign language condition only. This could be a sign for protective mechanisms of native language against stress inducing risk factors such as discrimination.

Keywords: Acute stress, perceived discrimination, cortisol, foreign language

The role of paternal overprotection in autonomic nervous system regulation: First evidence from a sample of healthy young students

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Different forms of early life adversity (ELA), for example parental maltreatment or neglect, are associated with dysregulations of the autonomic nervous system (ANS) and an increased risk for mental disorders later in life. In contrast to ELA, dispositional mindfulness (DM) might positively influence ANS regulation by fostering regenerative relaxation responses. Thus, aim of this study was to investigate DM as a potential buffer against effects of ELA on ANS regulation.

To investigate ANS reactivity in response to relaxation, we implemented a relaxation intervention with three quasi-randomized groups: a meditation video, a relaxation video and a control video (total N = 150 students; 51% female; age mean = 23.14 years, age range 18 – 49 years). High frequency heart rate variability (HF-HRV), a vagally-mediated ANS component, was derived from heart rate recordings during baseline and video watching, in conjunction with self-report measures of DM and ELA (maternal and paternal care and overprotection). Effects of ELA and DM on changes in HF-HRV were examined using multilevel mixed models.

Paternal – but not maternal – overprotection predicted a lower HF-HRV across all experimental conditions, while a significant negative association with DM was only observed for maternal overprotection. We could not observe any interaction effects of ELA with DM to predict HF-HRV over time.

To date, the majority of psychological research on adverse parenting effects has emphasized the role of maternal behavior. Findings of this study now suggest that paternal overprotection reduces HF-HRV and hence might also play an important role in ANS regulation.

Keywords: parental bonding, fathering overprotection, heart rate variability, mindfulness

The role of slow wave and theta activity in stress adaptation after experimental trauma

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Introduction: Intrusive memories developed after major stressors such as trauma are thought to rely on an insufficient memory integration of the event hampering its adaptive consolidation. Sleep plays an essential role in the processing and integration of memories. Here, we investigated (i) how an experimental trauma influences sleep architecture and EEG oscillatory activity and (ii) how intra-individual trauma-related changes of oscillatory activity may influence intrusion development.

Method: In a within-subject comparison, twenty-four female, healthy participants either watched a film-clip including traumatic contents or a neutral film-clip before bedtime. Brain activity during sleep was recorded using 64 channel high-density EEG and intrusive symptoms were evaluated for one week after trauma film exposure.

Results: Our findings show a prolonged sleep latency after the trauma film compared to the neutral film. No difference in any other general sleep parameters was found. Interestingly, participants showed a slower increase in slow wave activity (SWA; 0.5-4 Hz) after the trauma film compared to the neutral film. Further, increased theta activity (4-9 Hz) during REM sleep after the trauma film condition was associated with less intrusive reexperiencing during the following week.

Discussion: The results point out an important role of SWA and theta activity in stress adaption that is consistent with previous studies underlining the role of SWA in the integration of novel experiences and suggesting theta activity as driver for affective depotentiation.

Keywords: trauma, sleep, memory consolidation, intrusive memories

A billion windows to the social world? Individual differences in social attention are stable, meaningful, but not generalizable to real-life contexts

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Introduction: The eyes are the window to the world: Our gaze determines which aspects of our environment we process. Research on social attention indicates that we preferentially look at other people. Although individual differences in this social preference exist, it is unclear a) whether they represent a stable, individual trait, b) if they relate to behavioural preferences, and c) whether they generalize to naturalistic contexts.

Methods: The three-part-study was preregistered (https://osf.io/zmt8n/). Thirty-seven participants initially viewed 48 images of complex social scenes for 10 seconds each. Subsequently, they viewed one of 20 new social and non-social images, freely pressing a key to continue to the next image. Presentation durations represented behavioural preferences. Finally, in a real-life context, participants interacted with the experimenter for two minutes. Fixations on peoples' faces were recorded using eye tracking in both laboratory and real-life contexts.

Results: A permutation analysis of odd-even-reliabilities confirmed a high individual consistency (r_{mean} = .82) of social fixations in the first part. These social fixations correlated with the behavioural preference for social pictures in the second part (r = .30). Finally, fixation patterns between laboratory and real contexts did not correlate significantly (r = -.20).

Discussion: Our results support a stable, trait-like social attention in laboratory contexts: How much we attend to social information relies on individual predispositions. This gaze-trait is related to behavioural social preferences. The lacking generalizability to naturalistic contexts, however, highlights the importance of ecological validity. Further research differentiating bottom-up and top-down aspects of social attention is needed.

Keywords: social attention, eye tracking, ecological validity, individual differences

A laboratory medical anamnesis interview elicits psychological and physiological arousal

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Introduction: Since medical communication can be perceived as stressful, the assessment of patients' physiological arousal and behavior during anamnesis interviews may lead to a better understanding of doctor-patient interactions. Therefore, the aim of this study was to test physiological arousal and word use in a laboratory anamnesis interview.

Methods: Sixty-five participants with a mean age of 25.0 years were randomly assigned either to an experimental group, in which they underwent an anamnesis interview or to a control group. Physiological arousal was assessed by salivary cortisol, salivary alpha-amylase (sAA), heart rate (HR) and heart rate variability (HRV). Anamnesis interviews were analyzed using the Linguistic Inquiry and Word Count text analysis tool (LIWC).

Results: Participants of the experimental group showed an increase of cortisol, sAA, HR and negative affect (p's≤.0.05). Moreover, higher cortisol area under the curve with respect to ground (AUCg) was associated with lesser use of positive emotion words during the interview and subsequent higher negative affect (p's<.05).

Conclusions: Results indicate that talking about one's own and family's medical history in anamnesis interviews induces physiological arousal. Anamnesis interviews could not only induce higher negative affect, but also induce physiological arousal, underscoring the importance of good doctor-patient communication.

Keywords: cortisol, heart rate, anamnesis, doctor-patient-interaction

Activation in right inferior parietal lobe differentiates personal distress from cognitive and affective empathy

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Empathy constitutes a crucial element in human social interaction. Although it is widely perceived as a multifaceted construct – with mainly two separate components being involved: affective empathy (AE) and cognitive empathy (CE) – there are few studies on the neural differences between these two components. In addition, the neural substrates of a possible third component: personal distress (PD) have not yet been addressed fully in the literature. Hence, the current fMRI study sought to identify brain regions that show common, as well as distinct activity patterns for AE, CE, and PD.

Thirty healthy female psychology students completed a novel empathy fMRI-paradigm. Participants were presented with pictures depicting suffering individuals and were asked to rate their level of compassion towards the depicted person (AE), the depicted person's level of distress (CE), and their own level of distress (PD). During the control condition, participants had to determine the size of a presented circle. The neuroimaging data was acquired with a Siemens 3.0 Tesla MRI scanner.

Applying region of interest analyses, the empathy conditions compared to the control condition resulted in stronger activation in the amygdala, insula, anterior cingulate cortex, and inferior parietal lobe (IPL). Activation in the right IPL was found to be specific to the experimental conditions, with the highest activation for PD.

The results support the hypothesis that AE, CE and PD are associated with common, as well as distinct neural patterns. These findings add to the understanding of empathy, and suggest PD as a separable empathy component.

Keywords: empathy, personal distress, fMRI

An online experience sampling study on wellbeing during the first and second lockdown period in Germany

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Introduction: In an attempt to "flatten the curve" during the COVID-19 pandemic, lockdowns restricted public and private life. This experience sampling study was conducted to contribute to the understanding of psychological effects - caused by social isolation, uncertainty and psycho-emotional stress - and their mutual relationships, during the first and second lockdown in Germany.

Methods: Participants (n_{first_wave} = 248, n_{second_wave} = 116, n_{both_waves} = 77) filled out daily surveys for 28 days, measuring mood, productivity, (social-)media usage and social contacts. Additional weekly questionnaires assessed coping, loneliness, depression and anxiety. Data was analysed using network analysis.

Results: The networks were highly similar between the two lockdowns. Across participants, those who indicated more positive valence scored lower on depression and loneliness, but higher on productivity. Additionally, whenever participants felt stressed, they also tended to feel anxious and depressed. Adaptive coping was negatively correlated with experienced stress during the first lockdown only. Alcohol consumption correlated positively with social contacts during the first phase, but negatively with workload during the second wave. Within participants, positive mood lead to reduced loneliness.

Discussion: Despite differences in incidence numbers and restrictions, certain clusters among psychological indicators of well-being were relatively stable during both periods of measurement: Depression, stress, and anxiety form a central cluster, which is associated with negative mood. Crucially, high amounts of social contact and positive mood were correlated with less loneliness. Interestingly, the rarely highlighted aspects of productivity and workload are associated with better mood and less maladaptive coping during the pandemic.

Keywords: COVID-19, wellbeing, network analysis, productivity, workload

Automatic Facial Coding und machine-learning-basierte Klassifikation emotionaler Gesichtsausdrücke

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Einleitung: Das Facial Action Coding System (FACS) ist eine etablierte Beobachtungsmethode, durch die Experten einzelne Bewegungseinheiten im Gesicht (i.e., *Action Units*; AU) kodieren können. Automatic Facial Coding (AFC) ermöglicht eine software-gestützte, automatische Messung dieser AU Aktivität. Während AFC emotionale Gesichtsausdrücke standardisierter und prototypischer Bilderinventare trainierte Schauspieler akkurat klassifiziert, scheinen Gesichtsausdrücke untrainierter Studienteilnehmer häufigeren Fehlmessungen zu unterliegen.

Methode: In der vorliegenden Studie wurden 70 untrainierte Studienteilnehmer instruiert, aktiv die Gesichtsausdrücke von Freude, Ärger, Traurigkeit, Ekel, Angst und Überraschung darzustellen. Videoaufnahmen der intensivsten Gesichtsausdrücke wurden mit einer etablierten AFC Software analysiert (FaceReader, Noldus Information Technology) um AU-Parameter zu generieren und mit Daten von 70 trainierten Schauspielern aus standardisierten Bilderinventaren verglichen. Auf Grundlage der AU Messungen wurden zudem künstliche neuronale Netze zur Klassifikation der Emotionskategorien trainiert um mit Hilfe einer innovativen Technik (*permutation-based variable importance*) relevante AUs für die Klassifikation zu identifizieren.

Ergebnisse: Die intendierten Emotionen konnten sowohl bei trainierten als auch bei untrainierten Stichproben mit hoher Genauigkeit (> 90%) klassifiziert werden (insb. Freude). Allerdings konnten auch signifikante Unterschiede in den AU Profilen und relevanten AUs zwischen den beiden Stichproben beobachtet werden.

Diskussion: AFC scheint eine reliable Alternative zu menschlichen FACS Beobachtern zu sein. Allerdings demonstriert die vorliegende Studie, dass teilweise große Unterschiede in den Gesichtsausdrücken für spezifische emotionale Gesichtsausdrücke zwischen trainierten und untrainierten Stichproben existieren. Zukünftige Forschung sollte diese Unterschiede in naturalistischeren Versuchsdesigns untersuchen, um die Validität von AFC für spontane Reaktionen auf emotionale Stimuli zu überprüfen.

Keywords: Emotion, Gesichtsausdruck, Automatic Facial Coding, künstliche Intelligenz

Behavioral and neuronal correlates of reward and aversion discounting as a potential pathomechanism in substance use disorder

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Preregistration: https://osf.io/cj35t

Aim: Delay discounting (DD) is an aspect of decision making whereby individuals attribute decreasing value to rewards in the distant future. Substance use disorders (SUDs) have been related to greater extents of DD in individuals. However, so far we do know much less about DD in the context of negative consequences. Since many SUD patients ignore negative consequences of their consume behavior in the future, DD of negative consequences might be an important SUD pathomechanism.

Method: We conducted a pilot study, combining a binary choice task for reward and loss discounting with a monetary incentive/loss delay task. Thirty healthy participants (age 18-35, 14 female) completed the study. In each trial, participants had to choose between a smaller immediate loss/win (aversion condition/reward condition) and a larger loss/win at a delay of two weeks. Task-related brain activation was measured with fMRI.

Results: An exponential model using different discounting parameters for reward and aversion described the behavioral data best. During decision-making, BOLD activation was observed in the parietal and prefrontal cortex. During reward and loss anticipation, activation was observed in the ventral striatum, anterior cingulate cortex and anterior insula. There were no significant differences in neural activity between the win and loss condition.

Conclusion: We observed DD in both the reward and loss condition, with evidence for different behavioral patterns in the two conditions. Neural activation during the loss and reward condition were comparable. Overall, we conclude that aversion discounting might be a promising future target for SUD research.

Keywords: delay discounting, addiction, substance use disorder, impulsivity, reward, aversion, fmri

Characterization of underlying dimensions of life adversity in emotional processing in adulthood

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The ability to understand and predict psychopathology based on individual characteristics (e.g. exposure to life adversity) is a longstanding goal of psychiatry. Current views posit that specific dimensions of childhood maltreatment might be associated with the recruitment of specific defensive neural systems. Besides considerations, our on-going systematic review indicates that there is a lack of studies linking emotion processing with specific response patterns in adulthood. In this preregistered study (https://osf.io/8kmgw) we aspire to fill this gap by examining emotional processing in the so-called 'Affective Startle Modulation' Paradigm (ASM). The ASM, is a well-established tool for eliciting positive and negative emotions by passively viewing pleasant or unpleasant pictures, specifically selected to elicit differing responses of arousal of valence. Using fear potentiated startle and skin conductance response we aimed to investigate the impact of exposure to childhood maltreatment (assessed by the Childhood Trauma Questionnaire) or recent life adversity (assessed by the List of Threatening Experiences) on emotional processing in adulthood in 500 healthy participants. First results confirm a generally blunted physiological responding irrespective of picture valence in adults exposed to childhood maltreatment or recent life adversity. In an ongoing (explorative) data-driven subgroup analysis, we explore specific reaction patterns. Ultimately, a data driven model of specific emotional processing profiles holds promise to not only improve our mechanistic understanding but can also be expected to contribute to the development of specifically tailored ('individualized') intervention and targeted prevention programs in the future.

Keywords: emotional processing, life adverstiy, psychophysiology, affective startle modulation

Children's body odors as chemosignals in the mother-child relationship - Integration of genetic, developmental and neurobiological factors

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Introduction: To form a secure bond towards their child, parents invest resources in a targeted manner. Chemosignals are assumed to facilitate this investment by mediating kin recognition and affection. We investigated the impact of children´s chemosignals in mother-child dyads over the complete development. We tested, whether mothers a) can identify their own child by body odor (BO), b) prefer this BO, c) can classify their child´s developmental stage; explored genetic and hormonal mediators, and neural correlates of BO perception.

Methods: 164 mothers evaluated BOs of own (226 children, aged 0-18 years) and unfamiliar children, which differed in development stage and genetic similarity. Genetic similarity was mapped via human leukocyte antigen (HLA) profile, developmental status was determined by steroid hormone concentration and pubertal status. In 38 mothers, neural responses to BOs of their own and unfamiliar babies were measured using fMRI.

Results: Mothers identified their own child's BO above chance and preferred this odor with the exception of early pubertal children (9-13 years). For pubertal sons, reduced BO liking linked to increased testosterone levels. Genetic similarity was transported via BO, as ratings did not differ between the own and a same-aged HLA-similar child. Mothers classified the child´s developmental status above chance, predicted by perceptual BO ratings and the child´s pubertal status. Baby BOs elicited neural correlates of reward and pleasure in the maternal brain.

Discussion: This work reveals that children´s chemosignals mediate both, maternal identification and affective perception. In future, chemosensory profiling may clarify which molecular components alter BO during development.

Keywords: perception, olfaction, bonding, chemosignals, body odours, mother-child relationship

Cortico-limbic functional connectivity and dispositional use of emotion regulation strategies: A preregistered replication and extension study

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Introduction Tasked-based emotion regulation (ER) is linked to enhanced connectivity between amygdala and cortical regions during resting-state. However, it is unclear whether task-based ER and its neural correlates are related to dispositional ER strategy use. The present study aimed to (1) replicate previous findings on differential cortico-limbic coupling during resting-state depending on dispositional ER strategy use; and (2) to examine whether differences in cortico-limbic coupling predict experiential and neuronal ER success in a standard ER task. All hypotheses and the analysis plan were preregistered at https://osf.io/8wsgu.

Methods N = 117 adults completed the Emotion Regulation Questionnaire (ERQ), underwent an 8-min resting-state fMRI acquisition, and completed an ER task during fMRI. The sample size was more than twice as large as in the original study. Functional connectivity maps of the amygdala were associated with activity in predefined cortical regions, and correlated with ERQ scores, experiential, and neuronal ER success.

Results Opposed to prior findings, we could not replicate a correlation of dispositional ER strategy use with cortico-limbic functional connectivity ($p > 0.05$, FWE-corrected). Furthermore, there was no association of experiential and neuronal ER success with cortico-limbic functional connectivity ($p > 0.05$, FWE-corrected). All data, materials, and code for reproducible analyses can be found at https://osf.io/p7hb5/.

Discussion The present preregistered replication study calls into question the reported association between individual differences in resting-state cortico-limbic connectivity and dispositional ER strategy use. Ongoing advances in brain imaging and distributed network approaches may leverage the identification of reliable functional connectivity patterns that underlie successful ER.

Keywords: emotion regulation, resting-state, amygdala, reappraisal, functional connectivity

Do we feel us? A cross-cultural fMRI study on empathy between Germans and Chinese

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Introduction: Empathy allows us to understand (cognitive empathy) and to feel with (affective empathy) another person. How well one understands the emotion of the other person, and how strongly one feels for them can be influenced by the valence of the other person's emotion and by their in- or outgroup status. Culture is a factor that could influence perceived group membership as well as empathy processes.

Methods: In our study, 34 Germans and 35 Chinese completed an fMRI task, in which they rated affective and cognitive empathy towards happy and fearful facial expressions of persons from their own and the foreign culture.

Results: Germans in comparison to Chinese showed enhanced activation in inferior parietal lobe, frontal lobe and fusiform gyrus when empathizing with Germans as opposed to Chinese. Additional analyses revealed higher activation in middle frontal gyrus and superior parietal gyrus in Germans (> Chinese) for cognitive empathy (> affective empathy) and in orbital gyrus in Chinese (> Germans) for fearful faces (> happy faces).

Discussion: Our results suggest a cultural influence on the neural correlates of empathy, depending on the empathy process (cognitive or affective) and the valence of the emotion. In addition, Germans seem to show an intracultural advantage in empathy that might lead to higher empathy for people from the own culture.

Keywords: cross-cultural, empathy, fmri, emotion, in-out-group

Early hypervigilance and later avoidance: ERPs track the processing of threatening stimuli in anxiety and their modulation by distraction

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Avoidance behavior, a key symptom of anxiety disorders, can be treated with exposure therapy, albeit not always. Previous research suggests to decompose anxiety into two dimensions: anxious apprehension (i.e. worry) and anxious arousal (i.e. physiological hyperarousal). However, how these two dimensions might differentially affect avoidance behavior, exposure, and their interaction, and how they affect the accompanying neural processes is barely understood. Therefore, we collected EEG data from 124 healthy individuals, participating in a two-phase passive picture-viewing task including neutral and threatening pictures. We used a 2 (anxious apprehension: low/high) × 2 (anxious arousal: low/high) design and analyzed emotion processing by means of ERPs (i.e. SPN, N1 and LPP). Results showed that during habituation, when instruction was to either distract from or maintain the upcoming emotions during picture presentation, threatening compared to neutral pictures were associated with increased in-depth processing (increased LPP), modulated by instruction (lower during distraction) and worry (lower for high worry participants). During re-exposure, when participants saw the same pictures again, now instructed to always maintain the emotions, previous maintained compared to distracted pictures revealed a decreased in-depth processing (decreased LPP), indicative of successful habituation. Again, this was modulated by worry (increased LPP for high worry participants). Moreover, high worry participants showed an increased anticipatory attention (increased SPN) to threatening vs. neutral pictures and a heightened automatic processing (increased N1), independent of stimulus type. Together, these results suggest, that anxious apprehension vs. anxious arousal affects the neural processing during distraction, thereby maybe affecting the progress of exposure therapy.

Keywords: Anxiety, avoidance, habituation, EEG study

EEG Theta Oszillationen im dorsalen anterioren Cingulum während Akquisition und Extinktion von Furcht

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Konditionierungsparadigmen dienen als Modell für die Entstehung und die Behandlung pathologischer Furcht. Trotz hoher translationaler Relevanz wurden bislang nur selten bedrohungsrelevante EEG-Oszillationen untersucht, die mit der Synchronisation neuraler Aktivität zwischen Hirnregionen assoziiert werden. Bisherige EEG-Studien konnten erhöhte oszillatorische Theta-Aktivität (4-8 Hz) in präfrontalen Regionen, insbesondere dem dorsalen anterioren Cingulum (dACC), während der Darbietung zuvor konditionierter Stimuli (CS) 24h nach der Furchtakquisition zeigen. Theta-Oszillationen wird demnach eine besondere Rolle bei der Furchtexpression zugesprochen. Ziel der vorliegenden Studie war es, Theta-Oszillationen sowohl im Verlauf des Furchtlernens, als auch des Extinktionslernens zu untersuchen.

In der vorliegenden Studie haben wir ein kürzlich entwickeltes, für EEG-Untersuchungen optimiertes 2-Tages Furchtkonditionierungsparadigma (Tag 1: Furchtakquisition; Tag 2: Extinktionstraining) eingesetzt. Dabei wurden EEG, Hautleitwert (SCR) und Verhaltensdaten bei n=21 gesunden Versuchspersonen neu ausgewertet.

SCR- und Verhaltensdaten zeigten eine erfolgreiches Furchtlernen, wobei die differentielle konditionierte Reaktion (CS+>CS-) im Laufe des Extinktionstrainings wieder abnahm. Auf Skalp-Ebene zeigte sich signifikant höhere Theta Power in der Furchtakquisition an fronto-zentralen Elektroden (FCz), die im Laufe des Extinktionstrainings wieder abnahm. Zudem konnte Theta in Furchtakquisition und Extinktionstraining im dACC quelllokalisiert werden, wobei das dACC Cluster im Extinktionstraining weiter anterior lokalisiert wurde.

Unsere EEG-Daten zeigen, dass oszillatorische Theta-Aktivität nicht nur beim Abruf konditionierter Furcht, sondern bereits während des Furchtlernens eine zentrale Rolle spielt. Zum ersten Mal konnten hier Theta-Oszillationen während der Furchtakquisition im dACC lokalisiert werden. Mit dem Extinktionslernen nahm die konditionierte Furchtreaktion wieder ab. Die Verschiebung der dACC Lokalisation im Extinktionstraining könnte für eine „Frontalisierung" sprechen, die jedoch in zukünftigen Studien näher untersucht werden müsste.

Keywords: Furchtkonditionierung, EEG, Theta, Oszillationen

Effects of emotion regulation on EEG microstates – Valence and arousal are not processed sequentially

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Introduction: In electroencephalography (EEG), microstates are distributions of activity across the scalp that persist for several tens of milliseconds before changing into a different topographical pattern. Microstate analysis is a promising way of utilizing EEG as both temporal and spatial imaging tool, but has mostly been applied to resting state data.

Methods: This study aimed to conceptually replicate microstate findings of valence and arousal processing and to investigate the effects of emotion regulation on microstates, using existing data of 107 healthy adults who actively viewed emotional pictures, cognitively detached from them, or suppressed facial reactions. EEG data were clustered into microstates based on topographical similarity and compared on global and electrode level between conditions of interest.

Results: Within the first 600 ms after stimulus onset only the comparison of viewing positive and negative pictures yielded significant global results, caused by different electrodes depending on the microstate. The microstates associated with more and less arousing pictures did not differ from each other. When extending the analysis to 2,000 ms after stimulus onset, global microstate differences were exclusive to the comparison of viewing and detaching from negative pictures. Intriguingly, we observed the novel phenomenon of a significant global difference that could not be attributed to single electrodes on the local level.

Discussion: Sequential processing of valence and arousal information could not be replicated. The phenomenon of exclusively global significance suggests that microstate analysis can detect differences beyond those detected by event-related potential analysis, simply by not confining the analysis to single electrodes.

Keywords: Emotion Regulation, EEG, Microstates, Neuroscience Methods

Effort beats effectiveness in emotion regulation choice

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Introduction. Emotion regulation (ER) can be implemented by different strategies which differ in their capacity to alter emotional responding. What all strategies have in common is that cognitive control must be exercised in order to implement them. The aim of the present preregistered studies was to investigate whether the two ER strategies suppression and distancing require different amounts of subjective and physiological effort.

Methods. Subjective effort was assessed via ratings and physiological effort via pupillometry. In two studies, N = 110 and N = 52 healthy adults conducted an ER paradigm. Participants used suppression and distancing during inspection of positive and negative pictures. They also had the choice to reapply either of the strategies at the end of the paradigm. All data, codebooks, and analyses routines are openly available on OSF (https://osf.io/dk4s9/)

Results. Although distancing was more effective in downregulation of subjective arousal (Study 1: $p < .001$, $\eta_p^2 = .20$; Study 2: $p < .001$, $\eta_p^2 = .21$), about two thirds reapplied suppression, because it was perceived as less effortful. Effort was rated significantly lower for suppression compared to distancing (Study 1: $p = .042$, $\eta_p^2 = .04$; Study 2: $p = .002$, $\eta_p^2 = .13$). However, differences in effort were not reflected in pupillary data (ps > .678 and $\eta_p^2 \leq .01$).

Discussion. Results suggest that people tend to use the ER strategy that is perceived as less effortful, even though it might not be the most effective strategy. Findings are consistent as they were replicated in study 2.

Keywords: emotion regulation, effort, pupillometry, expressive suppression, distancing

Ende gut, alles gut oder alles eine Frage der Perspektive? – Elektrokortikale Effekte der kognitiven Neubewertungstaktiken Reinterpretation und Distanzieren

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Reinterpretation und Distanzieren stellen zwei wichtige Taktiken der kognitiven Neubewertung dar. Zahlreiche Studien konnten zeigen, dass kognitive Neubewertung in Bezug auf aversive Bilder mit einem verringerten Late Positive Potential (LPP) assoziiert ist, das als Maß des Erregungsniveaus sensitiv auf kognitive Emotionsregulation reagiert. Trotz erster Hinweise auf eine unterschiedliche Wirksamkeit, werden die beiden Taktiken kaum differenziell betrachtet, worin das Ziel unserer Studie bestand. Dabei wurden die Taktiken bezüglich ihrer kurzfristigen und überdauernden Wirksamkeit untersucht. Probanden (n = 39) wurden in der Regulationsphase instruiert, neutrale sowie aversive Bilder zu betrachten oder mittels kognitiver Neubewertung (Distanzieren und Reinterpretation) negative Gefühle zu verringern. In der Abrufphase (30 Min. später) wurde das Bildmaterial erneut präsentiert. In beiden Phasen erfolgte nach der Bildpräsentation eine Einschätzung des Erlebens negativer Gefühle durch die Probanden. Erste Ergebnisse zeigten einen kurzfristigen Effekt für beide Taktiken (im Vergleich zum bloßen Betrachten), wobei sich eine verringerte Amplitude des LPP im Zeitfenster von 500 – 3000 ms für Reinterpretation des Bildinhaltes und von 500 – 1400 ms für Distanzieren zeigte. Überdauernd zeigte sich ein signifikanter Effekt für Distanzieren im Zeitfenster von 800 – 1400 ms, ein tendenzieller für Reinterpretation. Auf subjektiver Ebene führten Reinterpretation als auch Distanzieren kurzfristig sowie überdauernd zu einem geringeren Erleben negativer Gefühle im Vergleich zum Betrachten aversiver Bilder, wobei Reinterpretation kurzfristig zu einer stärkeren Reduktion führte. Diese Ergebnisse unterstreichen die Wirksamkeit der beiden Taktiken auf subjektiver sowie elektrokortikaler Ebene und geben Hinweise auf eine differentielle Wirksamkeit.

Keywords: EEG, LPP, Emotionsregulation, überdauernde Effekte

fMRI adaptation in the mirror neuron system in response to emotional facial expressions

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The mirror neuron system is assumed to respond when observing and when executing motor actions. By using an adaptation design that reveals responding of neuronal populations to sensory information, the present fMRI study was aimed to investigate such a mirror neuron mechanism for emotional facial expressions.

74 healthy participants completed an experimental paradigm that included happy and fearful facial expressions while undergoing fMRI scanning. Participants were instructed to either imitate, or observe the facial expression, or to press a button when an inverted face was presented. To assess adaption, each picture was presented twice with either twice the instruction to observe, or to imitate, or first to imitate then to observe, or vice versa.

Adaptation during imitation was mainly found in inferior parietal lobe, and during observation in inferior frontal gyrus. Activation in both regions was higher when observation and imitation changed than for repeated imitation, or repeated observation. A change from observation to imitation resulted in higher activation in inferior frontal gyrus than a change from imitation to observation.

The study shows that brain regions supposed to host mirror neurons; i.e. inferior frontal gyrus and inferior parietal lobe are involved in the observation and imitation of facial expressions. Since the adaptation pattern for imitation and observation differed, the results are not in clear favour of the mirror neuron hypothesis.

Keywords: Mirror neuron system, fMRI, social cognition, imitation, adaptation

How does placebo analgesia affect decisions to exert effort to reduce another's pain?

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Previous studies on placebo analgesia showed that down-regulation of first-hand pain influences the way we empathize with another person in pain. Thus, we might understand the pain of a conspecific by engaging the same mental processes responsible for experiencing that pain ourselves. Although empathy and prosocial behavior are closely linked, effects of placebo analgesia on prosocial behavior have not been tested as of yet. We conducted a preregistered behavioral study (https://osf.io/g3acp, https://osf.io/qw3kg) that investigated whether and how this manipulation modulates prosocial behavior. We induced placebo analgesia in 45 participants (placebo analgesia group), while a control group (n = 45) did not undergo this experimental manipulation. Participants completed a pain task and a prosocial decision-making task, making choices whether to exert physical effort via a hand dynamometer to decrease another participant's pain. Preregistered analyses showed a significant first-hand placebo analgesia effect. The placebo analgesia group displayed reduced prosocial behavior, suggesting that placebo analgesia can influence our willingness to reduce another's pain: While both groups helped similarly when reducing the amount of shocks by a large number (e.g. five shocks), the control group was more motivated to help in situations of smaller pain reduction (reducing the number by only one or two shocks). Interestingly, these effects did not seem to be mediated by reductions in empathy. Moreover, physical strength, unpleasantness and physical demand when exerting effort, or motivation to win money for oneself were not affected by the placebo. This study highlights the far-reaching effects of altered first-hand pain perception on prosociality.

Keywords: empathy, prosocial behavior, placebo analgesia, open science

Impact of Perceived Social Support in Virtual Reality on Pain Perception

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Introduction: Pain is a multidimensional phenomenon influenced by biological and psychosocial factors. Several studies demonstrated that social support can lead to pain-reduction. The present study investigated social support in a standardized way with virtual humans.

Methods: Healthy participants were immersed into a virtual natural environment and received heat pain stimuli at different stops in the virtual environment in a within-subjects design. Depending on the condition, a virtual human accompanied them. Conditions differed in perceived agency and social support. In one condition, participants were led to believe that the virtual character was controlled by an employee next door (avatar condition). In another condition, participants were told that they interacted with a computer (agent condition). In both cases, the virtual human was controlled by predefined computer scripts. Social support was provided verbally by the virtual humans immediately before pain stimulation. A third control condition was presented without social support. In each condition, three pain stimuli were applied. Pain ratings and psychophysiological measurements (electrodermal activity, heart rate) were recorded.

Results: Comparisons between the agent and the control condition demonstrated lower sensory pain ratings than in the control condition without social support ($d = 0.4$). Comparisons between the avatar and control condition and between the agent and avatar condition revealed no significance in sensory pain ratings (all $d < .2$).

Discussion: The current study contributes to understand virtual social support and its modulation of pain. Given the increase in social interactions online, this research contributes also to understanding how humans respond to virtual characters.

Keywords: virtual reality, social support, pain modulation

Kann ich dir vertrauen? Eine fMRT-Studie zur Einschätzung von Vertrauenswürdigkeit und sexuell übertragbaren Erkrankungen

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Einleitung: Funktionelle Bildgebungsstudien weisen darauf hin, dass sowohl die Einschätzung einer Person als unvertrauenswürdig, als auch die Vermutung, dass eine Person eine sexuell übertragbare Erkrankung (SE) hat, mit Aktivierung im Salienznetzwerk einhergeht. Bislang fehlen Studien zur Bewertung der Vertrauenswürdigkeit von Personen, bei denen zuvor die Wahrscheinlichkeit eine SE zu haben als hoch oder niedrig eingeschätzt wurde.

Methoden: 34 Proband:innen sahen während einer fMRT-Messung Fotos von 50 Stimuluspersonen und bewerteten deren Vertrauenswürdigkeit. Die Wahrscheinlichkeit, mit einer SE infiziert zu sein, war in einer vorherigen Studie für jeweils die Hälfte der Personen als hoch bzw. niedrig klassifiziert worden.

Ergebnisse: Die Proband:innen bewerteten die Fotos nicht entsprechend der früheren Studie. Entsprechend liesen sich auch auf neuronaler Ebene keine signifikanten Aktivierungsunterschiede nachweisen, wenn die Vorab-Klassifikation von hoch und niedrig SE zugrunde gelegt wurde. Basierend auf den individuellen Einschätzungen der Proband:innen zeigte sich jedoch eine signifikant höhere Aktivierung in der Insula in Reaktion auf unvertrauenswürdige als auf vertrauenswürdige Personen. Im medialen Orbitofrontalen Kortex (mOFC) war dieser Effekt umgekehrt.

Diskussion: Die Studienergebnisse legen nahe, dass sich die Einschätzung, ob eine Person eine SE hat, nicht verallgemeinern lässt. Erwartungskonform kam es zu Aktivierung der Insula als Teil des Salienznetzwerk, wenn eine Stimulusperson als nicht vertrauenswürdig bewertet wurde. Die Aktivierung im mOFC könnte darauf hinweisen, dass vertrauenswürdig eingeschätzte Personen als belohnend wahrgenommen werden. Aufgrund der Bandbreite an subjektiver Definitionen des Konzepts „Vertrauenswürdigkeit", sollten künftige Studien einen klaren Kontext für die Einschätzung der Vertrauenswürdigkeit vorgeben.

Keywords: fMRT, Vertrauenswürdigkeit

Loneliness and trauma memory: sex-specific dysregulation of amygdala reactivity to social fear signal

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Loneliness exacerbates psychological distress and increases the risk of psychopathology after trauma exposure. Accumulating evidence indicates sex-specific effects of loneliness, but it is still unclear whether a lack of social connectedness may affect trauma-induced intrusions and the processing of fear signals via altered habituation or extinction learning in women and men.

We used a pre-stratification approach and recruited n = 47 (20 women) healthy individuals with high loneliness scores and n = 35 (18 women) controls (out of a screened sample of n = 4514). Participants were exposed to an experimental trauma and evoked intrusive thoughts in daily life were monitored for three consecutive days. Functional magnetic resonance imaging was used to assess fear learning (conditioning and extinction) and neural habituation to emotional faces. The study protocol and analysis were preregistered and the data will be publicly available at OSF (https://osf.io/np9wr).

Our results revealed a significant interaction between loneliness and sex such that loneliness was associated with more intrusive memories in men, but less intrusions in women. A similar pattern emerged on the neural level, with both reduced amygdala habituation to repeated fearful faces and amygdala hyperreactivity during the extinction of fear signals in high-lonely men, but not women.

Our findings indicate that loneliness may confer vulnerability to intrusive memories after trauma exposure in healthy men and this phenotype relates to altered limbic processing of social fear signals. Collectively, interventions targeting social connectedness may address similar neural mechanisms as exposure therapy and thus mitigate the sequelae of traumatic experiences.

Keywords: Loneliness, Trauma, Habituation, Extinction Learning, Amygdala

Male or Female? – Influence of Gender Role and Sexual Orientation on Sex Categorization of Faces

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Introduction: The categorization of dominant facial features, such as sex, is a highly relevant function for social interaction. It has been found that attributes of the perceiver, such as their biological sex, influence the perception of sexually dimorphic facial features, with women showing higher recognition performance for female faces than men. However, evidence on how aspects closely related to biological sex influence face sex categorization are scarce.

Methods: Using a previously validated set of sex-morphed facial images (morphed from male to female and vice versa), we aimed to investigate the influence of the participant's gender role identification and sexual orientation on face sex categorization, besides their biological sex. Image ratings, questionnaire data on gender role identification and sexual orientation were collected from 67 adults (34 females).

Results: Contrary to previous literature, biological sex per se was not significantly associated with image ratings. However, an influence of participant sex was reflected in connection with data on sexual orientation and certain attributes of gender role identity: Participants strongly identifying with male gender attributes and showing strong attraction towards feminine individuals perceived masculinized female faces and femininized male faces as more male when compared to participants to whom these characteristics applied less.

Discussion: Considering that our sample predominantly consisted of cisgender and heterosexual individuals and given the crucial role of sex categorization for social behavior and interaction, investigation of face sex perception in individuals identifying with a gender different from their assigned sex (i.e. transgender people) represents an important objective for further research.

Keywords: face perception, sex categorization, gender role, sexual orientation

Modulation of Experimentally Induced Pain in Virtual Reality by Emotional Valence and Arousal

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Introduction: Chronic pain is a severe condition, which affects millions of people worldwide. As standard treatments are less powerful as expected, virtual reality (VR) might be a promising new approach in developing additional treatments. Previous research has shown the effectiveness of VR in reducing acute and chronic pain. Recently, the psychological factors mediating the effects received heightened interest. Basic non-VR based research has shown that particularly high arousing positive emotional states reduce self-reported pain. However, thus far studies in VR do not allow deducing if valence or arousal is driving the effect. Accordingly, the present study aims to investigate the differential impact of positive valence and arousal on experimentally induced pain.

Methods: Sixty-four healthy participants will be immersed into a newly created virtual environment. Participants in the experimental group will receive painful stimuli during the study. Positive vs. neutral mood will be systematically varied by reading (self-affirmative) statements in high vs. low arousing environmental conditions (manipulated by height). Self-report (pain intensity and unpleasantness) and physiological data (heart rate and skin conductance) will be recorded.

Results: Data collection currently started.

Discussion: We expect the highest reduction of pain in the high arousing positive mood condition. The results of the study may stimulate further research on the mechanisms of VR induced pain reduction and new approaches in the treatment of acute and chronic pain.

The study is part of the research consortium VirtualNoPain, funded by the BMBF in the medical technology funding initiative (FKZ: 13GW0343).

Keywords: Acute and chronic pain, Virtual Reality, Mood Induction, Valence, Arousal, Presence

Negative artificial facial expressions evoke the strongest brain reactions in both men and women

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Introduction. In recent years, studies on artificial emotional faces and their perception have attracted much attention from researchers investigating emotions and their nature. The structural features of computer-generated faces have less variance; therefore, the intensity of the expression may be manipulated, and differences specifically related to emotional processing may be evaluated more accurately. However, it remains unclear whether sex influences the emotion recognition of the artificial faces and emotion-evoked ERP's.

Our study aims to investigate the sex effect on behavioural and electrophysiological measures during emotion recognition in artificial faces.

Methods. 71 volunteers performed an emotion recognition task, designed using artificial faces that portrayed six basic emotions, while EEG was recorded. Accuracy and response time of emotion recognition were measured. Global field power calculation and topographic analysis were performed to assess electrophysiological differences.

Results. We demonstrated that: 1) sadness was the poorest identified emotion but females demonstrated a higher accuracy in its recognition compared to males; 2) fear, disgust, and anger evoked higher LPP amplitudes compared to neutral facial expression; 3) females demonstrated higher GFP amplitude around 380 – 525 ms after stimuli onset.

Discussion. Women demonstrated a significant advantage in recognition of subtle emotions, however, our findings suggest that they are not superior at identification of artificial emotions in general. This is consistent with a higher women's GFP amplitude which could be associated with greater focus or efforts during emotion recognition.

Keywords: Emotion recognition, Event-related potentials (ERPs), Artificial faces, Late Positive Potential (LPP)

New insights on the correspondence between subjective affective experience and physiological responses from representational similarity analyses

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Introduction: Affect is the general sense of feeling experienced throughout each day, characterized by two features: valence and arousal. Some evidence suggests that affect is related to a specific physiological response (*fingerprint hypothesis*). However, recently it was postulated that similar affective experiences may rather evoke different physiological responses (*populations hypothesis*). To advance this debate, we examined the similarities between the physiological reactivity and subjective affective experience evoked by emotional and neutral stimuli across various emotion induction contexts using representational similarity analysis (RSA).

Methods: 64 students from the University of Potsdam underwent a passive picture viewing task, a passive sound listening task and an imagery task, in which pleasant, unpleasant and neutral materials were presented. SCR, HR, startle and corrugator activity and subjective valence and arousal ratings were measured during all tasks. RSA were performed to compare the representation similarity matrices (RSM) of the physiological reactivity and the subjective experience of affect for each task and physiological variable, separately. RSMs of SCR and HR were compared to the RSM of arousal ratings, whereas RSMs of the startle and corrugator were compared to the RSM of valence rating.

Results: Significant similarities were exclusively observed between SCR and arousal in the passive picture viewing task. However, none of the other physiological measures showed a significant relation with valence and arousal ratings in any of the tasks.

Discussion: These findings support the populations hypothesis, suggesting that there is no clear match between the evoked physiological responses and the experienced subjective affect.

Keywords: Affect, Physiology, Startle, SCR, Corrugator, Heart rate

Nucleus accumbens Aktivierung bei mehrdeutigen emotionalen Gesichtsausdrücken

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Bei Schizophrenie treten sowohl bei der Emotionserkennung, als auch bei der Entscheidungsfindung Defizite auf. Um die neuronale Grundlage des Entscheidungsverhaltens im Kontext der Emotionserkennung zu erforschen, haben wir ein Jumping-To-Conclusion (JTC) Paradigma entwickelt, bei dem Fotos von gemorphten Gesichtern gezeigt werden, die gleichzeitig zu verschiedenen Anteilen Freude und Angst ausdrücken.

In einer ersten fMRT-Studie haben wir mithilfe dieses Paradigmas die Gehirnaktivierung beim probabilistischen Entscheiden und bei finalen Entscheidungen in einer Stichprobe von 47 gesunden studentischen Proband:innen erhoben (Schmidt et al., 2019). Übereinstimmend mit früheren Ergebnissen von nicht-sozialen JTC Aufgaben, fanden wir Aktivierung im fronto-parietalen Netzwerk während probabilistischer Entscheidungen, und im Nucleus accumbens bei finalen Entscheidungen.

Wir präsentieren diese Ergebnisse sowie die vorläufigen Befunde einer unabhängigen, laufenden Erhebung von aktuell 12 gesunden Proband:innen aus der Allgemeinbevölkerung. Bei dieser noch kleinen Stichprobe bilden sich bereits vergleichbare Ergebnisse ab, hauptsächlich eine Tendenz für eine Aktivierung des Nucleus Accumbens bei finalen Entscheidungen.

Unsere Ergebnisse weisen auf eine zentrale Rolle des Nucleus accumbens bei der Entscheidungsfindung im Rahmen der Emotionserkennung hin. Die Zwischenergebnisse der laufenden fMRT-Studie liefern erste Hinweise auf eine Replizierbarkeit der Befunde und bieten somit die Grundlage für die Untersuchung von Personen mit Schizophrenie.

Keywords: fMRT, decision making, nucleus accumbens, Emotionserkennung, soziale Kognition

Pain inhibits negative affect to aversive sound: Does threat play a role?

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Background: Emotions are not additive. For example, we are not twice as fearful when confronted with two rather than one threatening stimulus. Pain research showed even decreased pain perception by the application of a competing pain stimulus ("counterirritation"). Inhibition mechanism might also regulate negative affect, which could be an important mechanism to prevent an "emotional overload". Since affect regulation seems to vary within subjects, the influence of the situational context (threat context) on inhibition is investigated.

Objectives: We investigated the inhibition of the processing of aversive sound using the method of "counterirritation". We assumed that pain decreases the perception (loudness) and the negative emotional response (measured by the startle reflex) to aversive sound. Moreover, we assumed that threat reduces inhibition efficacy.

Methods: Sixty-three healthy subjects completed two experimental blocks, one with presentation of aversive pictures showing burn wounds (high threat block) and one with presentation of neutral pictures (low threat block). Aversive sound was presented in the two blocks- first alone, then during counterirritation (immersion of the right hand in a hot water-bath). Loudness ratings and startle reflex were recorded and compared between baseline and counterirritation in the low and high threat condition.

Results: Results showed decreased startle reflex amplitudes and reduced loudness ratings during counterirritation. Threat did not effect inhibition.

Conclusion: Our results revealed that pain suppresses negative affect. This might mean that if we are already in pain, we are protected from negative emotions. Threat cannot explain inter-individual differences in the efficacy of emotion inhibition.

Keywords: emotion regulation, startle reflex, counterirritation, pain, threat

Self-Reported Gaze Anxiety Does Not Predict Gaze Behavior: A Dual Eye Tracking Setup to Examine Naturalistic Gaze Behavior in a Face-to-Face Interaction

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The latest scientific findings on gaze behavior largely rely on screen-based studies employing static stimuli or brief social sequences. However, in everyday interactions, eye information is much more complex, dynamic, and dependent on how both interaction partners interact. To overcome these limitations here, we applied a recently developed, innovative dual eye-tracking setup that enables to record naturalistic gaze behavior of both interacting opponents simultaneously in face-to-face interactions while delivering high data quality. To investigate whether the self-reported fear of eye contact also influences one's own gaze behavior, 102 healthy females and males engaged in a standardized conversation. Using self-reported gaze anxiety ratings, high and low gaze-anxious participants interacted with average gaze-anxious participants.. Our results show that (a) data quality of this dual-eye-tracking setup was satisfactory, and similar to the validation study's, (b) we are able to study dyadic one-way and two-way gaze behavior, (c) high and low gaze-anxious participants did not differ in their gaze behavior. These findings demonstrate that subjectively reported gaze anxiety does not predict gaze behavior in this friendly naturalistic interaction. These results can be due to a cognitive distortion; gaze anxiety might be a subjectively reported rather than an objectively measurable fear, and these results could serve an important argument supporting cognitive therapy for social anxiety. In further studies, this face-to-face dual-eye-tracking setup can be used to investigate gaze behavior in very diverse social interactions (e.g. stressful, threatening) and in a range of populations including clinical conditions (e.g. autism spectrum, social phobia).

Keywords: dual eye tracking, gaze behavior, mutual gaze, social interaction, gaze anxiety

Soziale Unterstützung verbessert die Fähigkeit zur Geschlechtsidentifikation von geschlechts-ambigen Augenpaaren

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Einleitung: Untersucht wurde, ob soziale Unterstützung und soziale Persönlichkeitseigenschaften die Leistung bei einer Geschlechtsidentifikationsaufgabe mit Augenpaaren ambivalenten Geschlechts beeinflussen.

Methoden: 61 Teilnehmende sollten das Geschlecht (männlich vs. weiblich) von geschlechts-gemorphten Augenpaaren (60% männlich, 40% weiblich und vice versa) identifizieren. Für ein Augenpaar wurde jeweils ein männliches und ein weibliches Gesicht aus der Radbound Faces Datenbank (*RAFD*) übereinander gelegt, im angegebenen Verhältnis gemorpht (*Abrosoft FantaMorph*) und ausgeschnitten. Insgesamt 30 Augenpaare wurden 30 Teilnehmenden (davon 14 Männer) für 100 ms und 31 Teilnehmenden (davon 15 Männer) für 300ms präsentiert. Jedes Augenpaar wurde dreimal innerhalb von 90 Trials präsentiert (randomisierte Reihenfolge). Für die Auswertung wurde ein Mittelwert für jede Augenpartie über alle drei Wiederholungen errechnet und dann ein Summenscore über die 30 Augenpartien erstellt. Soziale Unterstützung (*Social Support Questionnaire-6*), soziale Kompetenz (*Interpersonal Competence-Questionnaire-15*), Soziale Erwünschtheit (*Soziale Erwünschtheits-Skala*) und soziale Ängstlichkeit (*Social Interaction and Anxiety Scale*) wurden über Fragebögen erfasst.

Ergebnisse: Teilnehmende konnten bei 300ms Präsentation das Geschlecht besser identifizieren, im Mittel bei 19.84 Augenpaaren (SD = 1.74), als die Teilnehmenden, denen die Augenpaare nur 100ms präsentiert wurden (M = 17.53, SD = 2.26, $p < .001$, t-Test). Je mehr sozial unterstützende Personen die Teilnehmenden in der 100ms Bedingungen angaben, desto besser war ihre Leistung bei der Geschlechtsidentifikation (Pearsons r = + .50, p = .005).

Diskussion: Die Ergebnisse zeigen, dass soziale Unterstützung einen großen Einfluss auf die soziale Wahrnehmung hat. Soziale Unterstützung scheint daher unabdingbar für eine erfolgreiche soziale Kommunikation.

Keywords: Soziale Unterstützung, Geschlechtserkennung, Augenpaare, Soziale Wahrnehmung

The effect of oral contraceptives on emotional recognition and emotional contagion

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Emotion recognition abilities (ER) may be affected in women taking oral contraceptives (OC), although results are inconsistent (Shirazi et al., 2020). The use of different tools to measure ER, and the aggregation of OC-users independent of varying hormonal formulations, may contribute to the mixed findings. In the current study, we wanted to compare the effects of oral contraceptives on emotion recognition across two measures –the Reading the Mind in the Eyes Task (RMET), and the Emotional Recognition Task (ERT). Furthermore, we wanted to determine whether OCs also affected emotional contagion, which we measured with a video-based emotional contagion task (ECT). Methods: Forty women (20 OC users; mean age = 21.50 years, SD = 2.10 years) were recruited. Non-OC users were in the late luteal or early follicular phase. OC users all used OCs with the same ratio of 1:5 ethinylestradiol to levongesterol. Results: All participants performed equally well on the RMET. In contrast, in the ERT, OC-users were significantly worse at identifying emotions correctly. However, when correct, OC-users were significantly better at identifying more ambiguous emotions. In the ECT, when OC-users watched videos of speakers experiencing varying degrees of stress, their parasympathetic nervous system activity changed concordantly to the speakers'. No such association was found in non-OC users. Conclusion: First, OC-users were less accurate yet faster at detecting emotions in faces. Second, OC-users show more evidence for emotional contagion, which may be related to a more sensitive perception of subtle emotions in others.

Keywords: oral contraceptives, emotional contagion, emotion recognition, estrogen, progesterone

The role of mirror neurons in social cognition – a multivariate pattern approach for fMRI

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The discovery of mirror neurons (MN) has inspired the embodied simulation theory of human social cognition (e.g., Gallese, 2007). In this theory, a common neuronal representation for action and perception is suggested that allows an automatic understanding of another person's mental state. Multivariate pattern analysis of fMRI data is sensitive to spatially distributed responses and therefore an ideal candidate to assess neural representation patterns in social-cognitive processes.

75 participants performed a social-cognitive task with emotional facial stimuli during fMRI scanning with the conditions imitation, execution, observation and control. Conditions will be distinguished using support vector machines with cross validation. Furthermore, classification accuracy of fear and anger will be investigated within modality (i.e. separately for imitation and observation) and across modalities. Region of interest analyses will be performed within the MN system and the face processing network. Within-subject and inter-subject classification performance will be considered to assess stability of representations across individuals.

Activation analyses confirmed increased MN system activation during imitation, but not during observation in contrast to a control condition (Schmidt et al., 2021). Classification analyses are currently ongoing.

The lack of MN system activation during observation contradicts simulation theory. Classification analyses might prove more sensitive to fine-grained responses and might thus allow to detect MN involvement across conditions. These findings will help to understand the neural basis of social cognition and will add to our understanding of the human MN system.

Keywords: mirror neuron system, machine learning, fMRI, MVPA, social cognition

Tryptophan availability is linked to the processing of social information

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Understanding of emotions and intentions are key processes in social cognition at which serotonin is an important neuromodulator. Its precursor is the essential amino acid tryptophan (TRP). Reduced TRP availability leads to weaker impulse control ability and higher aggression, while TRP supplementation promotes confidence.

In a double-blind placebo-controlled fMRI study with 77 healthy adults, we investigated the influence of a 4 week TRP enriched diet and an acute 5-hydroxytryptophan (5-HTP) intake on two social-cognitive tasks, a moral evaluation and an emotion recognition task.

With 5-HTP, immoral behavior without negative consequences was rated as more reprehensible. Additionally, during story reading, activation in insula and supramarginal gyrus was increased after TRP intake. No significant effects of TRP on emotion recognition were identified for the whole sample. Importantly, emotion recognition ability decreased with age which was for positive emotions compensated by TRP.

Since the supramarginal gyrus is associated with empathy, pain and related information integration results could be interpreted as reflecting stricter evaluation of negative behavior due to better integration of information. Improved recognition of positive emotions with TRP in older participants supports the use of a TRP-rich diet to compensate for age related decline in social-cognitive processes.

Keywords: tryptophan, social, MRI

Wie fühlst du dich, Avatar? I & II

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Einleitung: Das Erkennen von Schmerzausdrücken (Dekodierung von Schmerzmimik) spielt eine wichtige Rolle in der sozialen Interaktion und im klinischen Setting. Um zu verstehen, welche Mechanismen dem Dekodieren zugrunde liegen (Dekodierungsstudien), ist es notwendig, Gesichtsausdrücke kontrollierbar und flexibel darzustellen, was durch computer-generierte Gesichtsausdrücke von Avataren möglich ist. Ziel dieser Studie war es, zu untersuchen, wie derartige computer-generierte mimische Schmerzausdrücke im Vergleich zu computer-generierten Gesichtsausdrücken der sechs Basisemotionen wahrgenommen werden.

Methode: Hierfür wurden zwei Online-Studien durchgeführt. In der ersten Studie bewerteten 106 Probanden die Valenz, das Arousal und die Natürlichkeit des gezeigten Gesichtsausdrucks. In Studie 2 sollten 200 Probanden bewerten, welche Affektzustände sie mit welcher Intensität in den gezeigten Gesichtsausdrücken erkennen.

Ergebnisse: In Studie 1 zeigte sich, dass die Gesichtsausdrücke der Avatare als natürlich wahrgenommen wurden. Der Schmerzausdruck wurde – erwartungskonform - hoch im Arousal und niedrig in der Valenz bewertet; und ähnelte in den Arousal- und Valenzratings den Gesichtsausdrücken von Ärger und Ekel. In Studie 2 wurde in den Schmerzausdrücken zuverlässig Schmerz gesehen. Es zeigte sich zudem, dass die Schmerzmimik recht mehrdeutig („ambiguous") wahrgenommen wird, da ebenfalls Ärger und Ekel mit hoher Intensität wahrgenommen wurde.

Diskussion: Durch computer-generierte Avatare lassen sich die intendierten mimische Affektausdrücke gut erkennen. Es zeigte sich eine Ambiguität des Gesichtsausdrucks des Schmerzes, da in diesem neben Schmerz auch Ärger und Ekel wahrgenommen werden. Dies könnte darauf zurückzuführen sein, dass alle drei Affektzustände mit ähnlichen mimischen Muskelkontraktionen (Corrugator supercilii, Depressor supercilii) einhergehen, so dass hierdurch zwar eine negative Valenz zuverlässig kommuniziert wird, jedoch nicht eindeutig der spezifische Affektzustand.

Keywords: Schmerz, Schmerzausdruck, Avatar, Dekodierungsstudie, Mimik, Gesichtsausdrücke

Age differences in neural selectivity during encoding and recognition

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One important factor contributing to age-related memory decline is the loss of distinctiveness with which information is represented in brain activity. This loss in neural selectivity may be driven by neural attenuation (i.e. reduced activation to target stimuli) or neural broadening (i.e. increased activation to non-target stimuli). Few studies have studied the specific patterns underlying neural selectivity, and those focused entirely on encoding, leaving it unknown whether attenuation or broadening drives neural selectivity at recognition.

In a fMRI study, a group of younger and older adults performed an incidental encoding task with face and house images and subsequently completed a surprise old/new recognition memory task. We assessed age differences in neural selectivity at encoding and recognition, the relation of neural selectivity to memory performance, and the underlying pattern (broadening versus attenuation).

We found lower neural selectivity in older compared to younger adults at both encoding and recognition. Neural selectivity at both time points was positively related to memory performance, demonstrating the importance of distinct representations for memory performance. Crucially, while reduced selectivity in older adults was due to neural broadening at encoding, it was driven by neural attenuation at recognition. Furthermore, neural selectivity at encoding and recognition was highly correlated, indicating that one common mechanism may explain interindividual differences in memory performance.

Thus, we demonstrated that age differences in neural selectivity are present, but manifest differently at encoding and recognition, revealing how the utility of the task (i.e. passive viewing versus active recognition) interacts with age-related decline in neural distinctiveness.

Keywords: episodic memory, aging, neural selectivity, fMRI

Can you remember what you can do? - The impact of action relationships as bottom-up unitization approach on the associative memory deficit

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According to dual-process theories, successful recognition memory is supported by familiarity and recollection. While familiarity is preserved in healthy aging, recollection usually declines during aging, leading to an age-related associative memory deficit (AMD). Increasing the contribution of familiarity to associative memory could alleviate the age-related AMD. This can be achieved, for example, by creating encoding conditions that support unitization (i.e., integrating separate stimuli to an entity). The current study uses behavioural and event-related potential (ERP) measures to investigate whether bottom-up unitization induced by action relationships (ARs) between semantically unrelated object pairs can reduce the age-related AMD. Younger (YA) and older adults (OA) studied object pairs that were arranged in a way that an action between the objects was possible (unitized) or not (non-unitized). At test, participants had to distinguish intact from recombined and new object pairs. In both age groups, memory performance benefited from the presence of ARs. We also found the expected age-related AMD with larger age-related differences for associative memory than for item memory. For OA, the ERP correlate of familiarity was only present for intact action-related pairs. For YA, a similar effect appeared for both, intact and recombined action-related pairs, which we interpreted as familiarity effect for abstracted actions. Both age groups showed the ERP correlate of associative recollection for action-related pairs. In conclusion, both age groups' associative memory benefits from unitization by ARs, but by different mechanisms: YA seem to rely more on associative recollection, while OA rely more on associative familiarity for action-related pairs.

Keywords: aging, associative memory, unitization, action relationship

Childhood maltreatment is associated with changes in mitochondrial bioenergetics in maternal, but not in neonatal immune cells

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Background: Childhood maltreatment (CM) causes psychological as well as biological alterations in affected individuals. Mitochondria, intracellular organelles that produce most of the biochemical energy, have recently been implicated in psychobiological health and disease. We previously found that higher mitochondrial respiration in immune cells was associated with increasing CM severity in postpartum women. However, in humans, it is hardly explored whether these CM-related biological alterations can be found intergenerationally. As mitochondria are maternally inherited, this study investigated the associations between maternal CM and mitochondrial bioenergetics (mitochondrial respiration and density) in immune cells of postpartum mothers and in their newborns.

Method: In n = 102 mother-newborn dyads, maternal peripheral blood mononuclear cells and neonatal umbilical cord blood mononuclear cells were collected and cryopreserved shortly after parturition to measure mitochondrial respiration and intracellular mitochondrial density with high-resolution respirometry and spectrophotometric analyses of *Citrate synthase* activity, respectively. A maternal history of CM was retrospectively assessed with the *Childhood Trauma Questionnaire*.

Results: Maternal and neonatal mitochondrial bioenergetics were quantitatively comparable and positively correlated. Female newborns showed higher mitochondrial respiration compared to male newborns. Higher maternal maltreatment load was associated with higher mitochondrial respiration and density in mothers, but not in their newborns.

Discussion: This is the first study to report data on mitochondrial bioenergetics of mother-newborn dyads with varying degrees of CM. We found no evidence for an intergenerational effect of maternal CM on mitochondrial bioenergetics in immune cells of their newborns.

Keywords: childhood maltreatment, mitochondria, bioenergetics, immune cells

Classification and prediction of cognitive performance differences in older age

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Age-related cognitive decline varies greatly in healthy older adults, which may partly be explained by differences in the functional architecture of the brain. Resting State Functional Connectivity (RSFC) derived graph metrics have been successfully used as diagnostic marker for neurodegenerative diseases. The current study aimed at examining whether RSFC graph metrics may also be useful in classifying and predicting cognitive performance differences in a large sample of healthy older adults using machine learning (ML).

We evaluated ML classification and prediction performance across different pipeline configurations in 1000BRAINS participants (N=813, 372 females, 55-85 years) on graph metrics from resting state fMRI. Composite and domain-specific cognitive scores were derived from Principal Component Analysis (PCA) including 14 cognitive tests (attention, language, executive functions, episodic and working memory) and used as targets for prediction. For classification, a median split was performed to obtain high and low performance groups matched for age, education, and sex (N=518, 232 females). Nodal and network level RSFC graph metrics were used as features. Ten algorithms were assessed in a robust cross-validation scheme.

Classification performance did not exceed 60% balanced accuracy (BAC) for global and domain-specific cognition ($Mean_{BAC}$: 46.94-58.44%). Prediction performance was equally poor with high mean absolute errors (MAEs ≥ 0.63) and low explained variance ($R^2 \leq 0.07$) across targets and pipeline configurations ($Mean_{MAE}$: 0.63-0.84; $Mean_{R\text{-}squared}$: -0.21-0.07).

Current results emphasize limited potential of RSFC graph metrics as sole biomarker for cognitive aging. Findings add to past research showing that establishing brain-behaviour relations may be challenging.

Keywords: cognition, aging, resting-state functional connectivity, machine learning

Dopaminergic and noradrenergic integrity are differentially associated with late-life memory performance

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Introduction: Cognitive aging is linked to changes in catecholaminergic neuromodulation. However, research disentangling the contribution of different neuromodulatory systems to cognitive decline is scarce.

Methods: To investigate the associations of dopaminergic and noradrenergic integrity with late-life cognition, younger and older participants of the Berlin Aging Study-II (n~320) underwent 3T-MRI. The imaging protocol included three scans sensitive for the substantia nigra and locus coeruleus—a Fast-Spin-Echo [FSE] sequence, and a Magnetization-Transfer sequence, acquired once with a dedicated magnetic saturation pulse [MT] and once without, resulting in a proton-density like image [noMT]. Participants moreover completed a comprehensive cognitive battery, including tests of fluid intelligence, episodic and working memory.

Substantia nigra and locus coeruleus MR-intensity ratios, non-invasive proxies for neuronal density, were semi-automatically extracted from FSE, MT, and noMT scans. We integrated substantia nigra and locus coeruleus ratios across imaging modalities to derive latent, multimodal factors expressing dopaminergic and noradrenergic integrity. Similarly, we used a previously established cognitive factor structure to integrate performance across multiple cognitive tasks to retrieve measures of fluid intelligence, episodic and working memory.

Results: Merging neural and cognitive models, we found differential associations of dopaminergic and noradrenergic nuclei to late-life cognition. While locus coeruleus ratios were related to better episodic memory, substantia nigra ratios were linked to working memory performance. Consistent with a largely shared biosynthesis, dopaminergic and noradrenergic integrity were positively associated.

Discussion: Our findings support the utility of MRI as proxy for catecholaminergic integrity and highlight differential roles of dopaminergic and noradrenergic neuromodulation in late-life cognitive decline.

Keywords: Dopamine, Noradrenaline, Cognitive Aging, Memory, Locus Coeruleus

Effekte von emotionaler Misshandlung und Vernachlässigung in der Kindheit auf Mustertrennungsfähigkeit und Furchtkonditionierung im Erwachsenenalter

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Die weitreichenden Folgen von in der Kindheit erfahrener körperlicher, aber auch emotionaler Misshandlung (EMK) und Vernachlässigung (EVK) auf die psychische Gesundheit konnten in zahlreichen Studien dokumentiert werden und spiegeln sich auch in strukturellen sowie funktionalen neuronalen Veränderungen wieder. Als besonders vulnerabel für solche aversiven Kindheitserfahrungen hat sich der Hippocampus erwiesen. Dies legt auch eine Beeinträchtigung der Mustertrennungsfähigkeit nahe, ein ebendort lokalisierter Prozess der Differenzierung zwischen ähnlichen alten und neuen sensorischen Informationen. Die Mustertrennungsfähigkeit, wiederum, spielt eine zentrale Rolle in mit Furcht verknüpften Lernprozessen, die einen Kernmechanismus in der Ätiologie von Angststörungen darstellen.

Um Effekte von EMK und EVK auf Mustertrennungsfähigkeit und Furchtlernen zu überprüfen, wurden einundsiebzig gesunde Studentinnen basierend auf den Subskalen „emotionale Misshandlung" und „emotionale Vernachlässigung" des *Childhood Trauma Questionnaire* (mittels Mediansplit) in Gruppen mit hoher und niedriger EMK bzw. EVK eingeteilt. Sie alle absolvierten an einem ersten Untersuchungstag eine behaviorale *Mnemonic Similarity Task*. An zwei weiteren aufeinanderfolgenden Untersuchungstagen wurde zudem ein kontextuelles Furchtkonditionierungsparadigma mit Furchtakquisition und Extinktionslernen (Tag 2) sowie Extinktionsabruf und Furchtrenewal (Tag 3) durchgeführt.

Die Gruppen mit hoher EMK und EVK zeigten keine Defizite bei der behavioral erfassten Mustertrennungsfähigkeit. Nichtsdestotrotz unterschieden sich die hoch-EMK und -EVK Gruppen in ihrer neuronalen Aktivierung während der Furchtkonditionierung von den nicht misshandelten Kontrollen.

Dass bereits bei einer im Durchschnitt nur geringen Ausprägung von EMK und EVK nachhaltige Effekte auf die neuronale Basis zentraler Mechanismen bei Angststörungen beobachtet werden können, unterstreicht die Auswirkung solcher Erfahrungen für die neuronale Entwicklung und psychische Gesundheit.

Generalizing longitudinal age effects on brain structure – a two-study comparison approach

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Cross-sectional studies indicate age-related decreases in regional volumes of brain structure and cognitive performance. Longitudinal studies, however, are relatively rare and inconsistent regarding their outcomes. Particularly the heterogeneity of methods, sample characteristics and the high inter-individual variability in older adults prevent the deduction of general trends. Therefore, we aimed to compare longitudinal changes in brain structure and its relation to changes in cognitive performance in two large independent samples of healthy older adults. Individual annual percentage changes (APC) of cortical thickness (CT; hemispheres and regions of the Desikan-Killiany Atlas) and cognitive performance (processing speed, concept shifting, verbal fluency and reasoning) were calculated for two independent samples: Longitudinal Healthy Aging Brain (LHAB; University of Zurich, Switzerland; 69.9±4.1 years; 85 females) and 1000BRAINS (Research Center Juelich, Germany; 69.2 ± 4.6 years, 76 females). We estimated 1) cortical thinning separately for the two groups 2) between-sample differences in CT with baseline age, sex, education and Euler number (as surface reconstruction quality measure) as covariates and 3) the relation between APC of CT and cognitive performance. APCs in the two samples were stable or slightly decreased. After correction for major covariates, sample differences were only marginally present. APC in CT did not correlate to APC in cognitive performance in neither of the two samples. Thus, our findings indicate highly similar patterns of age-related changes in CT in two independent samples of older adults. General trends over time might be generalizable across independent samples, assuming same methodology is used and similar sample characteristics are present.

Keywords: brain structure, aging, cognition, longitudinal change, old age, cortical thickess

How the refocusing of attention following interruptions is affected by aging: evidence from posterior alpha and mid-frontal theta oscillations

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Working environments are prone to interruptions. Older adults are more negatively affected by interruptions than younger adults. This is especially challenging in the context of increasing work-life times. Thus, it is important to understand the electrophysiological mechanisms underlying the difference in interruption processing between both younger and older adults.

In a working memory task, participants maintained lateralized information for later recall. This primary task was interrupted by either a low- or high-demanding secondary task in half of the trials. At the end of each trial, a retro-cue indicated one of the initially encoded items to be retrieved from working memory.

Interruptions impaired working memory performance strongly in older compared to younger adults. While, in younger adults, primary task performance differed depending on the cognitive requirements of the interruption task, both tasks affected the elderly similarly.

Mid-frontal theta power was analyzed as correlate of cognitive control processes. Directly after an interruption, theta power was increased in older compared to younger adults. Thus, older adults need more cognitive resources for refocusing on the primary task. Modulations of posterior alpha power following retro-cue onset served as proxy for attentional processing. While older adults showed weaker alpha power suppression following interruptions (compared to no-interruption trials), this difference was less pronounced in younger adults.

In conclusion, aging reduces the ability to re-allocate attention to the interrupted primary task. This as well as a deficit in attentional selection of primary task information contributes to age-related deficits in handling of task interruptions.

Keywords: interruptions, osciallations, working memory, attention

Infantile experience shapes adult spatial performance and associated functional brain circuitry

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Introduction: Adult behavior is commonly thought to be shaped by early-life experience, but paradoxically, episodes experienced during infancy are forgotten. The hippocampus has an important role in episodic memory and during infancy undergoes a developmental critical period. Whether the memories acquired during this critical period might affect adult behavior is not known.

Methods: We trained different groups of rats during their infancy on hippocampal and non-hippocampal tasks and, at the adulthood, we tested their spatial performance. The early hippocampal experiences consisted of four object-place recognition (OPR) tasks that were performed on every other day following the initial test on postnatal day (PD) 18. To provide non-hippocampal experience, the novel object recognition (NOR) task was conducted. At the adulthood testing (PD 80) all rats were subjected to the OPR task, with a 3-hour retention interval, and 90 min after the retrieval test brains were removed for immunocytochemistry analyses of c-Fos.

Results: Rats in adulthood were significantly better at forming persistent spatial memory when subjected to infantile spatial experiences than were control rats with only non-spatial infantile experience. Infantile spatial experience increased c-Fos activity at memory testing during adulthood in prelimbic medial prefrontal cortex, whereas hippocampal activity remained unchanged.

Discussion: We find that a seemingly insignificant event strongly impacts learning behavior and related brain organisation during adulthood: This means at adulthood, the rats displayed enhanced capabilities to form persisting spatial memories, and this was specifically related to the use of spatial representational systems residing in cortical rather than hippocampal networks.

Keywords: early-life experience, spatial memory, hippocampus, medial prefrontal cortex.

Kennen wir uns? Individuierung unvertrauter Gesichter bei 5 Monate alten Säuglingen: Eine FVPS-Oddball-Studie

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Einleitung: Von Geburt an unterscheiden Säuglingen das Gesicht der Mutter von anderen Gesichtern (Coulon et al., 2011). Kategorisierung ermöglicht dabei die Diskrimination des Gesichtes von anderen Gesichtern sowie die Generalisierung der Identität über verschiedene Situationen. Wie unbekannte Gesichter gelernt und kategorisiert werden, ist allerdings noch nicht gut erforscht.

Methoden: Aus diesem Grund untersucht die vorliegende Studie mittels Fast Periodic Visual Stimulation (FPVS) in einem EEG-Oddball-Paradigma, wie 5 Monate alte Säuglinge eine Interaktionsperson (Experiment 1, N = 22) oder fremde Person (Experiment 2, N = 9, Datenerhebung wird fortgesetzt) individuieren. Standard Stimuli wurden mit einer Frequenz von 6 Hz präsentiert. An jeder fünften Position erschien der Oddball (Kategorienwechsel bei 1.2 Hz). Im ersten Experiment wurde das Gesicht einer Zielperson (nach 10-minütiger Interaktion), im zweiten Experiment das einer fremden Person als Oddball oder Standard präsentiert. Analysiert wurden Baseline-korrigierte Amplituden und Z-Werte an okzipital-posterioren Elektroden.

Ergebnisse: Das Gesicht der Interaktionsperson löste eine starke Kategorisierungsantwort aus, SNR = 1.18, Z = 3.32, unabhängig von der Position (Oddball vs. Standard, $p > .05$). Eine weniger starke Kategorisierungsreaktion wurde in der Fremdengruppe (Experiment 2) gefunden, SNR = 1.10, Z = 0.74, keine Unterschiede zwischen Oddball- und Standard-Bedingung ($p > .05$). Die Individuierungsreaktionen der Interaktions- und Fremdengruppe unterschieden sich nicht signifikant ($p > .05$).

Diskussion: Die Experimente zeigen, dass 5 Monate alte Säuglinge schnell dargebotene Gesichter individuieren können. Es konnte allerdings kein statistisch bedeutsamer Unterschied in der Individuierung abhängig von der Vertrautheit mit dem Gesicht gefunden werden. Zukünftige FPVS-Oddball-Studien könnten diesen Einfluss mit größeren Stichproben erforschen.

Keywords: Elektroenzephalographie, EEG; Fast Periodic Visual Stimulation, FPVS; Individuierung; Kategorisierung; Frühe Kindheit

Lifetime environmental enrichment is associated with fornix microstructure in older adults

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Background: Episodic memory processes are affected in aging and early Alzheimer's disease (AD). Maintenance of connectivity in the hippocampal network is therefore essential in older age. This study investigated associations between environmental enrichment (EE), measured through lifetime engagement in multicomponent leisure activities (MLA), and microstructural integrity in memory-related white matter (WM) tracts.

Methods: Cognitively normal participants (age: ≥ 60 years) from the DZNE-DELCODE cohort (DRKS00007966) were included in this study. Microstructural integrity in selected WM tracts was determined using diffusion tensor imaging (DTI). Self-reported frequency of engagement in socio-cultural, physical, and intellectual activities was assessed using the Lifetime of Experiences Questionnaire (LEQ, Valenzuela and Sachdev, 2007). Based on combined responses for youth- and middle-life stages, two groups of participants with higher (n=107) or lower (n=99) lifetime EE were identified. Multiple linear regression models were calculated, comparing EE groups on fractional anisotropy (FA) and mean diffusivity (MD) of the fornix, uncinate fasciculus, and parahippocampal cingulum, with the optic radiation as control region.

Results: Higher lifetime EE was associated with higher FA (β= .134, p= .019) and lower MD (β = -.129, p= .03) in the fornix, adjusting for age, gender, education, intelligence, socioeconomic status, diagnostic group, and scanner site. No significant group effects were observed for the other WM tracts (p's> .05).

Discussion: Microstructure of the fornix seemed to be most sensitive to experience-dependent plasticity, albeit with a small effect size. Lifetime MLA could represent an enrichment strategy contributing to preservation of hippocampal pathways in older age.

Keywords: enrichment, leisure activities, fornix, microstructure, DTI

Multimodal investigation of the association between shift work and the brain in a population-based sample of older adults

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The extent of cognitive decline in older adults is highly variable and influenced by a multitude of factors, possibly comprising working conditions. Shift work e.g. is a challenge for the human circadian system and has been associated to reduced cognitive performance.

We tested whether shift work is associated with differences in brain structure (cortical thickness) and function (resting-state functional connectivity of seven resting-state networks) as well as cognitive performance (processing speed, attention, working memory and executive functions) in older adults aged between 55 and 85 years of the 1000BRAINS study. These parameters were compared between three groups, who had worked in night shift at time of assessment (PRESENT shift workers, n = 15), prior to assessment, (FORMER shift workers, n = 99) or never (NEVER shift workers, n = 478).

Only the visual network was associated to shift work: In PRESENT shift workers more years of shift were associated with higher segregation of this network, possibly reflecting less communication to other networks. Regarding cognitive performance, PRESENT showed lower processing speed than NEVER shift workers and in FORMER shift workers more years of shift were associated with lower executive functions. We found no consistent associations between shift work, working memory, attention or cortical thickness.

The observed associations showed high uncertainty reflected in broad confidence intervals and pertained to specific cognitive parameters and one functional brain network rather than to the brain as a system. Thus, shift work appears to affect the brain of older adults only to a limited extent.

Keywords: Shift work, cognition, resting-state functional connectivity, cortical thickness

Speech perception slopes across the first year of life: Maturation of consonant perception, but not vowel perception, predicts lexical skills at 12 months

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Introduction: Consonants and vowels differentially contribute to lexical acquisition across the first year of life, with a preferential role of consonants from 8 months. Infants' differential reliance on consonants versus vowels in word recognition predicts later lexical outcome. This predictive value, however, has not been evaluated for infants' longitudinal trajectories of consonant and vowel perception. We here aimed to study brain markers that capture perceptual changes before infants show vowel or consonant preferences in word recognition behaviorally.

Method: We examined longitudinally whether infants' (n= 59) maturational trajectories of vowel and consonant discrimination differentially predict their later lexicon. At 2, 6 and 10 months, we measured infants' discrimination abilities in a multi-feature paradigm by electrophysiological mismatch responses (MMR) to consonant and vowel deviants. At 12 months, we assessed infants' lexicon through parental report. Using second-order latent growth models, we tested the maturation slopes of vowel and consonant MMRs as predictors of word production and perception at 12 months, controlling for individual MMR amplitudes.

Results: The consonant MMR slope significantly correlated with word perception and production, whereas the vowel MMR slope was no significant predictor. Note that the consonant MMR slope had additive predictive value beyond the single-time point MMRs.

Discussion: These results confirm a prominent role of consonant discrimination for word learning from early on. Our study points to an earlier predictive value of consonant perception for language development than previously found in behavioral studies and to a particular role of the longitudinal maturation of this skill in lexical acquisition.

Keywords: Mismatch Response, event-related potentials, developmental trajectory, lexical acquisition

The trajectory of speech perception development: Investigating event-related potential Mismatch Responses to different speech and non-speech features in infants of 2, 6 and 10 months

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Introduction: Infants rapidly advance in their speech perception, reflected in transitions from immature, positive-going to adult-like, negative-going electrophysiological mismatch responses (MMR) in auditory deviancy detection. Since the infant MMR's characteristics have been linked to inter-individual differences in language development, it is discussed as a potential predictor of language difficulties. Indeed, studies reported associations with later language difficulties for MMRs to different stimuli across development. However, reliably utilizing the infant MMR as a predictive measure for later language development first requires systematic investigations of the MMR's maturation depending on stimulus-type.

Method: We here longitudinally explored the maturation of the infant MMR to changes in consonant, vowel, vowel-length, and pitch. MMRs were obtained when infants (n = 59) were 2, 6 and 10 months old. To specifically tackle the different MMR's maturational trajectories, we applied second-order latent growth curve models.

Results: Results showed positive-going MMRs to all deviant types across all assessment points. However, MMR amplitudes decreased over time towards a negativity in differently shaped curves for each deviant. Pitch and vowel-length MMRs decreased linearly across age; the consonant MMR initially became more negative, then stabilized between 6 and 10 months; while the vowel MMR first increased until 6 months and then declined in a u-shaped trajectory.

Discussion: These results demonstrate that infant speech discrimination matures in different rates and amplitude trajectories across the first year, dependent on the studied feature. We thus argue that the MMR's stimulus-dependent maturational trajectory needs to be considered when aiming for reliably predicting later language development.

Keywords: Mismatch Response, event-related potentials, speech discrimination, developmental trajectory

Videospielkonsum im Jugendalter: Folgen für die kognitive Entwicklung?

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Einleitung: Videospiele gehören heute zu den beliebtesten Freizeitaktivitäten von Kindern, Jugendlichen und Erwachsenen. In aktuellen Studien konnte ein Zusammenhang von Videospielkonsum und verbesserten kognitiven Fähigkeiten beobachtet werden. Diese Daten beziehen sich allerdings vornehmlich auf Studien mit Erwachsenen, Jugendliche sind bisher selten untersucht. Dies überrascht, ist doch gerade diese Lebensspanne mit vielfältigen psychosozialen, kognitiven und neurobiologische Veränderungen sowie einem Anstieg im Medienkonsum assoziiert. Ziel der aktuellen Untersuchung war es daher herauszufinden, wie sich Videospielen im jugendlichen Alter auf die kognitiven Fähigkeiten auswirkt.

Methodik: Im Rahmen einer großen multizentrischen und europaweiten Längsschnittstudie (IMAGEN) wurden 2076 Jugendliche im Alter von 14 Jahren und 18 Jahren unter anderem neuropsychologisch (CANTAB) getestet. Hieraus wurde der „Rapid Visual Information Processing" (RVP) Test zur Erfassung der Aufmerksamkeit und Informationsverarbeitung analysiert. Der Videospielkonsum wurde in dieser Zeitspanne mittels eines Fragebogens Videospielkonsum bei n=1100 erfasst.

Ergebnisse: Videospielen mit 18 Jahren korrelierte positiv mit der visuellen Aufnahmefähigkeit und Fähigkeit zur anhaltenden Aufmerksamkeit in diesem Alter ($r=0{,}13$, $p<0{,}001$). Die Häufigkeit des Videospielkonsum im Alter von 14 und 15 Jahren korrelierte zudem ebenfalls positiv mit der visuellen Informationsverarbeitung im Alter von 18 Jahren ($r=0{,}13$, $p<0{,}03$). Einen negativen Effekt zeigte hingegen eine vermehrte Spieldauer pro Tag ($r=-0{,}13$—$0{,}16$, $p<0{,}01$-$0{,}03$).

Diskussion: Videospiele im jugendlichen Alter scheinen die Entwicklung von visueller Aufnahme- und Konzentrationsfähigkeit begünstigen zu können. Dies scheint jedoch entscheidend von der jeweiligen Spieldauer abhängig zu sein und legt somit bestimmte Grenzeffekte und einen kurvilinearen Zusammenhang zwischen Videospielen und kognitiven Fähigkeiten nahe. Mögliche abzuleitende Folgen und sich daraus ergebende Fragestellungen werden diskutiert.

Keywords: kognitive Entwicklung, Videospiele, Jugendliche, visuelle Informationsverarbeitung, CANTAB

Vulnerability of inter-hemispheric functional connectivity in the aging sensorimotor network

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Brain aging is accompanied by a functional reorganization, such as age-related hemispheric asymmetry reductions. Focusing on older adults, the sensorimotor network (SMN) was shown to be particularly important: Decreases in intra-network functional connectivity (FC) seem to mediate age-related cognitive decline. Whether the SMN would also show age-related asymmetric FC reductions across hemispheres, was investigated in 636 older adults (55-87 years, 324 men, 92% right-handed) from 1000BRAINS.

We calculated edgewise intra-network FC for the right, left and bilateral SMN and inter-network FC with the visual (VN), dorsal-attention (DAN), ventral-attention (VAN), frontoparietal (FPN) or DMN. For each set of connections, we statistically compared the proportions of age-related changing edges between hemispheres.

Age-related intra-network FC decreases within the SMN were more pronounced in the right as compared to the left hemisphere, but most pronounced between hemispheres. Regarding inter-network FC, the SMN showed age-related FC increases with the FPN and DMN and decreases with regions spanning the dorsal stream (i.e. VN, SMN and DAN), the latter again more pronounced within the right hemisphere.

Our results support two major aging theories: First, the right hemi-aging model suggesting right-hemispheric brain parts to decline earlier than left-hemispheric parts. Second, given our predominantly right-handed sample, stronger right-hemispheric FC decreases of the dorsal stream might point at the use-it-or-lose-it principle as the respective left-hemispheric regions may be more constantly involved in eye-hand coordination of right-handed people. Hence, the current results emphasize an inter-hemispherically different vulnerability of the SMN in older adults.

Keywords: resting-state functional connectivity, aging, inter-hemispheric differences, sensorimotor network

Abnahme der phasischen Herzratenvariabilität mit zunehmender Nähe zur interozeptiven Bedrohung bei Patienten mit Panikstörung und Agoraphobie

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Theoretisch kann die Pathologie der Panikstörung mit Agoraphobie als eine Kaskade sich dynamisch ändernder Defensivreaktionen auf Bedrohungshinweise aus dem Körperinneren heraus konzipiert werden. Abgelehnt an dieses transdiagnostische Modell testeten wir die Wechselwirkung zwischen defensiver Aktivierung und vagaler Kontrolle als Marker für die präfrontale Hemmung subkortikaler Reagulationskreisläufe. Wir untersuchten ultrakurze Veränderungen der vagal kontrollierten hochfrequenten Herzratenvariabilität (HRV) während einer standardisierten Exposition mit einem bedrohlichen Kontext bei 232 Patienten mit Panikstörung und Agoraphobie sowie deren Wechselwirkung mit verschiedenen Indizes der defensiven Aktivierung. Wir fanden eine starke inverse Beziehung zwischen HRV und Herzrate während der Konfrontation, die zu Beginn der Exposition stärker war. Patienten mit einem starken Anstieg der Herzrate zeigten eine Deaktivierung der präfrontalen Vaguskontrolle, während Patienten mit einer geringeren Herzratenbeschleunigung einen Anstieg der Vaguskontrolle zeigten. Darüber hinaus brach die vagale Kontrolle im Falle einer unmittelbar bevorstehenden Bedrohung zusammen, d.h. wenn die Körpersymptome zunehmen und außer Kontrolle zu geraten scheinen. In diesen Fällen von Abwehrmaßnahmen flohen die Patienten entweder aus der Situation oder erlebten eine Panikattacke. Aktive Vermeidung, Panikattacken und erhöhte sympathische Erregung sind mit der Unfähigkeit verbunden, die vagale Kontrolle über das Herz aufrechtzuerhalten, was darauf hindeutet, dass das Vermitteln solcher Regulationsstrategien während der Expositionsbehandlung hilfreich sein könnte, um die präfrontale Kontrolle aufrechtzuerhalten, insbesondere während der Übergangszone von Verhaltensmodi bei distaler vs. imminenter Bedrohungslage.

Keywords: Herzratenvariabilität, Panikstörung, Expositionstherapie, präfrontale Kontrolle

Affective neural signatures do not distinguish women with emotion dysregulation from healthy controls: A mega-analysis across three task-based fMRI studies

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Pathophysiological models are urgently needed for personalized treatments of mental disorders. However, most potential neural markers for psychopathology are limited by low interpretability, prohibiting reverse inference from brain measures to clinical symptoms and traits. Neural signatures—i.e. multivariate brain-patterns trained to be both sensitive and specific to a construct of interest—might alleviate this problem, but are rarely applied to mental disorders. We tested whether previously developed neural signatures for negative affect and discrete emotions distinguish between healthy individuals and those with mental disorders characterized by emotion dysregulation, i.e. Borderline Personality Disorder (BPD) and complex Post-traumatic Stress Disorder (cPTSD). In three different fMRI studies, a total sample of 192 women (49 BPD, 62 cPTSD, 81 healthy controls) were shown pictures of scenes with negative or neutral content. Based on pathophysiological models, we hypothesized higher negative and lower positive reactivity of neural emotion signatures in participants with emotion dysregulation. The expression of neural signatures differed strongly between neutral and negative pictures (average Cohen's d = 1.17). Nevertheless, a mega-analysis on individual participant data showed no differences in the reactivity of neural signatures between participants with and without emotion dysregulation. Confidence intervals ruled out even small effect sizes in the hypothesized direction and were further supported by Bayes factors. Overall, these results support the validity of neural signatures for emotional states during fMRI tasks, but raise important questions concerning their link to individual differences in emotion dysregulation. Data and annotated scripts to reproduce the analyses can be found on: https://github.com/MaurizioSicorello/MVPAemoDys_Analyses

Keywords: emotion, neuroimaging, mental disorders, individual differences

Affective Processing During Error Monitoring in Patients With Obsessive-Compulsive Disorder

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Altered performance monitoring, specifically enhanced error monitoring, has been frequently found in obsessive-compulsive disorder (OCD), often apparent in heightened amplitudes of the error-related negativity (ERN). Yet, little is known about how the ERN relates to affective action appraisal. This study aimed to extend previous findings of a relation between ERN and affective action evaluation (i.e., affective labeling of own actions) by investigating affective priming on trial-level in OCD. Electroencephalography was recorded while 28 patients with OCD and 28 healthy control (HC) participants performed an affective priming paradigm in which responses in a go/no-go task served as primes for the subsequent affective categorization (positive or negative) of words. Mixed-effects models revealed an action-based affective priming effect in both groups, indicating faster categorization of words when preceded by an action of the same assigned valence (e.g., negative words after errors). Patients with OCD showed a diminished priming effect after errors compared to HC participants. Contrary to our expectations, the priming effect was not related to the amplitude of the ERN and there was also no group difference in this association. We found no evidence that the ERN is linked to automatic, affective evaluation of self-generated actions, with trial-by-trial ERN variation reflecting emotional significance of errors. In OCD, affective appraisal of errors seems to be hampered, possibly resulting from processes interfering with internal action appraisal (e.g., worry). Altogether, our findings imply that alterations in the affective appraisal of actions may be implicated in altered error monitoring in OCD.

Keywords: affective processing, error monitoring, error-related negativity, mixed-effects modeling, obsessive-compulsive disorder

Altered Event Processing in Persons with Parkinson's Disease

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Persons with Parkinson's disease (PD) often show particular problems in seemingly simple routines despite relatively preserved cognitive function. Therefore, the processing of everyday events was investigated on behavioral and neurophysiological levels in persons with versus without PD. Both groups had to indicate per button press whether three sequentially presented sub-events described a previously defined event (e.g., going grocery shopping). Sub-event sequences were either correct, or one of them did not belong to the event (content violation), or was chronologically wrong (temporal violation). During task execution event-related potentials (ERP) were recorded. Generally, task performance was slower and more inaccurate in persons with compared to persons without PD, independently from task conditions. In response to temporal violations, healthy persons expressed a late positive component (LPC), which in persons with PD had an earlier, novelty-P3a-like onset and was diffusely broadened. Upon content violations, healthy persons showed a right lateralized N400 effect, followed by a LPC response. For persons with PD, the N400 was missing and, again, the LPC was of broader distribution. Together, these findings show impaired performance and task condition-related ERP alterations in persons with PD. Decreased error detection and missing N400 indicate poor event prediction in PD which might originate from weak event representation or retrieval, partially compensated for by extended signal re-analysis reflected by LPC enhancement and possibly related to prevalent behavioral dysfunctions in PD.

Keywords: Event knowledge, temporal and content violation, Parkinson's disease, event-related potentials, LPC, N400

Assoziationen zwischen einer serotonergen Modulation und dem Belohnungslernen in Anorexia nervosa - eine fMRT-Studie

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Die Serotonin-(5-HT)-Hypothese der Anorexia nervosa (AN) beschreibt, dass ein zentralnervöser hyperserotonerger Zustand bei der Entwicklung sowie beim Rückfall der AN eine Rolle spielt. Die Reduktion der Essenszufuhr könnte dementsprechend als Mittel betrachtet werden, die 5-HT-Verfügbarkeit zu reduzieren (über eine verminderte Versorgung mit Tryptophan-Vorläufern) und damit assoziierte negative Stimmungszustände zu verbessern. Wichtig ist, dass das 5-HT-System auch allgemein mit der Belohnungsverarbeitung in Verbindung gebracht wird, die bei AN ebenfalls nachweislich verändert ist.

In dieser doppelblinden Crossover-Studie unterzogen sich 22 ehemalige AN-Patientinnen (recAN) und 25 gesunde Kontrollteilnehmerinnen (HC) einer funktionellen MRT-Messung, während sie ein etabliertes instrumentelles Belohnungslernparadigma in Kombination mit einer akuten Tryptophan-Depletion (ATD; eine diätetische Intervention, die die zentralnervöse 5-HT-Verfügbarkeit senkt) sowie einer Sham-Depletion durchführten.

Auf der Verhaltensebene zeigten sich Haupteffekte von Belohnung und ATD, jedoch keine Gruppenunterschiede. fMRT-Analysen zeigten eine Interaktion von Gruppe × ATD × Belohnungsniveau in der ventralen anterioren Insula während der Belohnungsantizipation sowie im medialen orbitofrontalen Kortex während des Erhalts der Belohnung.

Vor dem Hintergrund der Ergebnisse diskutieren wir Interpretationen der neuralen Antwortmuster und mögliche Implikationen für Modelle zur Ätiologie der AN im Hinblick auf die 5-HT-Hypothese. Außerdem diskutieren wir, wie die Ergebnisse die Entwicklung von Behandlungsansätzen bei AN beeinflussen können.

Keywords: Psychiatrie, Neuroimaging, Anorexia nervosa, Belohnung

Autonomic dysregulation in child social anxiety disorder: An experimental design using CBT treatment

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Introduction: Etiological models of social anxiety disorder (SAD) stress the relevance of physiological arousal in a disorder-typical situation. Up to date, only limited research has been conducted in children with SAD in experimental designs. Thus, to shed light on the relevance of autonomic physiological arousal children with and without SAD were confronted with a standardized social stressor (Trier Social Stress Test for Children-C; TSST-C). Pre-existing differences to the healthy control (HC) group were expected to decrease in the group receiving CBT.

Method: Children with SAD (n = 64) and HC children (n = 55) completed a TSST-C. Children with SAD participated in a second TSST-C after either cognitive-behavioral treatment or a waitlist-control period (WLC).

Results: In line with previous studies, children with SAD showed blunted reactivity in heart rate compared to HC children. Further, children with SAD had elevated levels of tonic sympathetic arousal as indexed by skin conductance level compared to HC. Finally, children with SAD showed lower parasympathetic arousal during the baseline compared to HC children. Children with SAD receiving treatment did not differ from children in the WLC condition in a repeated social stress test.

Discussion: Psychophysiological differences between children with SAD and HC children could be confirmed as indicated by previous research. The lack of physiological effects of the intervention as an experimental manipulation might be related to slower changes in physiology compared to e.g. cognition. Further implications and limitations of these findings are discussed.

Keywords: TSST, sympathetic, parasympathetic, social stress, CBT, RCT

Broaden the perspective using combined M/EEG and MRI: heritable imaging phenotypes in patients with epilepsy and their siblings

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Genetic generalized epilepsy (GGE) is a common epilepsy syndrome and conceptualized as brain network disorder with genetic etiology. Using magnetoencephalography (MEG), we have previously shown that increased brain network levels are heritable and a hallmark of GGE patients (Stier et al., manuscript accepted). In this study, we complement these findings using high density-EEG (hd-EEG) and structural measures for an extended understanding of brain pathology.

We analyzed 5 minutes of cleaned MEG and hd-EEG resting-state data sequentially acquired in 23 GGE patients, 18 unaffected siblings and 35 controls, comparable for age and sex. We computed source-reconstructed connectivity in six frequency bands (1-40 Hz). Cortical thickness measures were derived from individual 3T MRI scans. Group differences were assessed using permutation analysis of linear models using non-parametric combination of modalities.

When combining M/EEG maps, GGE patients had higher connectivity in fronto-temporal and central regions than controls, particularly in theta and low beta frequencies ($P < 0.05$, familywise error (FWE)-corrected). Medication load was further associated with the network patterns ($P_{FWE} < 0.05$). GGE patients showed cortical thickness reductions in fronto-central regions and cuneus (Cohen's $d < -0.5$, $P_{uncorrected} < 0.05$). Siblings statistically fell between structural and functional levels of patients and controls.

Combined M/EEG analyses led to a more focused, spatially and spectrally defined GGE imaging phenotype compared to univariate contrasting, encouraging multimodal assessment for predictive modeling and classification. Structural alterations in patients showed spatial correspondence to connectivity increases in fronto-central regions. Similar observations in healthy siblings point to genetic influence on imaging patterns.

Keywords: functional connectivity, cortical thickness, endophenotypes, multimodal, imaging genetics

Can worry interventions alter error-related brain activity? Results from a randomized controlled trial

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Background: Most previous studies utilized cross sectional designs to investigate the association of anxiety and overactive performance monitoring, as measured by the error-related negativity (ERN) and correct-response negativity (CRN). A better understanding of these associations requires intervention studies that allow causal inferences. This preregistered study aimed at replicating and expanding previous findings of an ERN modulation by worry interventions.

Method: A priori, we determined the sample size using a power analysis. Ninety undergraduate students performed a flanker task to assess their baseline ERN (T0). We randomly assigned them to one of three groups: (1) worry induction, (2) worry reduction, and (3) passive control group. Subsequently, participants performed another flanker task to determine potential alterations of their ERN (T1). As a manipulation check, we measured state worry before T0 and T1 and before the interventions.

Results: Groups did not differ regarding demographic or clinical variables. Both experimental groups, but not the control group, reported higher state worry after the interventions. Thus, only the worry induction was successful. However, we found no differences in ERN amplitudes between T0 and T1 in any group. Regarding the CRN, all groups showed smaller amplitudes at T1.

Discussion: The present study investigated the impact of experimental manipulations of state worry on performance monitoring. Worry interventions did not alter ERN or CRN amplitudes. This corresponds with previous results indicating that ERN amplitudes are independent of symptom severity and treatment outcome. Thus, our results support conceptualizing the ERN as a trait-like neural risk marker insensitive to symptom fluctuations.

Keywords: Anxiety, error-related negativity, ERN, performance monitoring, worry

Differential effects of gambling-related environments on temporal discounting and model-based reinforcement learning in regular slot-machine gamblers.

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Introduction: Gambling disorder is a behavioral addiction that negatively impacts personal finances, work, relationships and mental health. In this pre-registered study https://osf.io/5ptz9/) we investigated the impact of real-life gambling environments on two putatively trans-diagnostic markers, temporal discounting (Dixon et al., 2006) and model-based reinforcement learning (Daw et al., 2011).

Methods: Regular gamblers (n = 30; DSM-5 score mean[range] = 5.93[3-9]) performed both tasks in a neutral (café) and a gambling-related environment (slot-machine venue) in counterbalanced order. Data were modeled using drift diffusion models for inter-temporal choice (Peters & D'Esposito, 2020) and reinforcement learning (Pedersen et al., 2017) via hierarchical Bayesian estimation.

Results: Discounting was steeper in the gambling vs. neutral context, replicating previous results (Dixon et al., 2006). This effect was positively correlated with gambling related cognitive distortions (pre-registered analysis) and shorter non-decision times (exploratory analysis). In contrast to our pre-registered prediction, model-based reinforcement learning was increased in the gambling context.

Discussion: We replicate previous findings of increased temporal discounting in gamblers in the context of gambling venues (Dixon et al., 2006) and link this effect to maladaptive control beliefs. Although gambling disorder is associated with increased temporal discounting (Wiehler & Peters, 2015) and reduced model-based learning (Wyckmans et al., 2019), we show that these effects are modulated in opposite ways by real-life gambling cue exposure. Addiction-related environments potentiate dopamine release (Robinson & Berridge, 1993), suggesting a potential mechanism underlying the observed effects.

Effects of Attention Focus Modulation in a Virtual Public Speaking Exercise to Reduce Social Anxiety

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Background. Self-attention is regarded a relevant factor in the maintenance of social anxiety. Therefore, changing the attention focus from internal to external cues is a core component in cognitive behavior therapy. Because different kinds of external cues have not yet been examined, we compared the effects of focusing either on the audience or on neutral objects during a Virtual Reality (VR) public speaking task.

Methods. Highly socially anxious participants were asked to give three short talks (pre-test, intervention, post-test) in front of a virtual audience. They were randomly assigned to either focus on the virtual agents or on neutral objects during the interventional talk. Subjective measures, heart rate, and eye tracking data were measured, and fear of negative evaluation and the subjective anxiety level were analyzed as primary outcomes. Repeated measures ANOVAs were calculated to detect significant time and time*group-interaction effects.

Results. Forty-one participants were included in the analysis sample (audience-focus group: n=21; neutral objects-focus group: n=20). Both groups significantly reduced their level of anxiety and fear of negative evaluation from pre-test to post-test, with no significant differences between them.

Conclusion. We conclude that attention modulation is an important factor for the treatment of social anxiety and can be successfully implemented as VR intervention. VR tasks could be used fruitfully to further investigate the role of the content of external focus in contrast to the mere process of directing attention outward in treating social anxiety, and to guide patients to regulate attention processes during exposure interventions.

Keywords: Social Anxiety, Attention, Eye tracking, Virtual Reality

Effects of different craving regulation strategies and re-exposure on cue-induced craving and the late positive potential in smokers.

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Introduction: Craving predicts drug use and relapse. Cognitive strategies to regulate craving are a promising treatment approach. Reappraisal and distraction differ in how deeply craving-inducing cues are processed. Thus, we compared these strategies regarding their longer-term effects on subjective craving and the Late Positive Potential (LPP), which was previously shown to map emotion regulation.

Method: Fifty-seven smokers viewed smoking related pictures and focused on long-term negative (LATER) or short-term positive (NOW) consequences of smoking, or engaged in an arithmetic task to distract themselves from processing the picture (DISTRACT). After a break, all pictures were presented again without regulation instruction (re-exposure). EEG was continuously recorded and subjective craving was rated after each picture.

Results: For the regulation phase, the analysis revealed lower subjective craving in the LATER and DISTRACT than the NOW condition. The LPP was only reduced in the DISTRACT compared to the NOW condition. In the re-exposure phase, lower subjective craving followed pictures connected with LATER compared to DISTRACT and NOW conditions. There were no differences in the LPP.

Discussion: The results show that both distraction and reappraisal reduce subjective craving well in the short term. However, the more complex reappraisal strategy seems to have an advantage over the simpler distraction strategy by inducing a longer-lasting effect. In contrast to emotion regulation, the LPP does not seem to directly reflect craving regulation.

Keywords: Craving, Regulation, Late Positive Potential, Smokers, EEG

Going on a space adventure with Manchu the monkey: Reducing preoperative anxiety and postoperative pain in children via a hypnosis audio-intervention

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When children must undergo a surgery, they often perceive it as an uncontrollable situation where they feel helpless. This in turn leads to preoperative anxiety which is associated with negative consequences such as pain, vomiting, or delirium upon awakening from anesthesia. Since hypnosis is an effective way to prevent preoperative anxiety in children and has a generally large effect on negative affect and pain during surgery, we developed an auditory hypnosis intervention to reduce preoperative anxiety and postoperative pain in 3–6-year-old children undergoing tonsillotomy or adenotomy. This hypnosis intervention describes the surgery like a space adventure with Manchu the monkey. It suggests feelings of courage, pride, and strength considering the upcoming surgery. The audio intervention was designed according to an already existing comic book explaining the procedures in the hospital with pictures of Manchu the monkey and thus reducing preoperative anxiety. We hypothesize that the auditory hypnosis intervention leads to a reduction of preoperative anxiety, postoperative pain and nausea as well as reported experienced distress. We also expect that it decreases parental preoperative state anxiety which has shown to be a predictor for difficulties occurring after surgical interventions. We compare 40 children in the control group receiving only the comic book with 40 children in the experimental group listening to the auditory hypnosis intervention in addition to the comic book at home before surgery. We anticipate that our auditory hypnosis intervention can serve as a non-pharmacological intervention reducing preoperative anxiety and postoperative pain in children.

Grey matter changes in patients with Alcohol Use Disorder: Results of an ALE-Meta-Analysis, Behavioral Domain Analysis and Meta-Analytic Connectivity Modeling.

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Numerous studies indicate widely distributed grey matter (GM) volume reductions in Alcohol Use Disorder patients (AUD) compared to healthy controls. The identified brain regions vary considerably across different studies. To detect above chance convergence of the reported coordinates in voxel-based morphometry imaging studies we applied Anatomical Likelihood Estimation (ALE) and extended our analyses by characterizing the behavioral profile of the resulting clusters using meta-data from the BrainMap database. Finally, we performed a Meta-Analytic Connectivity Modeling analysis (MACM), to determine in which neural networks the resulting clusters could represent potential nodes. Twenty-seven eligible studies, entailing a total of 1,045 AUD patients and 1,054 healthy controls, with 376 reported peak voxel coordinates were included into the ALE-Meta-Analysis. GM alterations were identified in eight clusters covering different parts of the cingulate and medial frontal gyri, paracentral lobes, left post- and precentral gyri, left anterior and right posterior insulae and left superior frontal gyrus. The behavioral characterization associated these regions with specific cognitive, emotional, somatosensory and motor functions. MACM shows that these regions represent nodes in the salience, cortico-cerebellar, control, insular, default, fronto-striatal and motor control networks. Our findings suggest that chronic high alcohol consumption is associated with reduction in GM volume in specific brain regions that were associated with processes that may underlie known impairments in AUD (e.g. inhibitory control). Earlier studies have investigated specific neural networks in AUD, but very few studies have considered their interaction. Therefore, our work provides a reliable basis for future functional analyses.

Keywords: Alcohol Use Disorder, Grey Matter, Voxel-Based Morphometry, Meta-Analysis

Heart Rate and Heart Rate Variability During Spontaneous Posttraumatic Dissociation

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Introduction: Recurring posttraumatic dissociation is a known phenomenon in patients suffering from chronic posttraumatic stress disorder (PTSD). Especially, symptoms of depersonalization and derealization were reported, which describe out-of-body experiences, or the feeling, that the surrounding seems to be unreal. These reactions can be interpretated as attenuation in the sensory and emotional self-experience, to mentally escape dangerous (or later) stressful situations, when fight or flight reactions are impossible. A growing body of research indicates that stress response is generally impaired in PTSD. This impairment is associated with autonomic nervous system dysregulation, reflected by higher heart rate (HR) and lower heart rate variability (HRV). Although dissociation seems to diminish sensory, emotional, and motor activity, little is known about psychophysiological reactivity during posttraumatic dissociation. Therefore, we examined, if there is an association between posttraumatic dissociation and psychophysiological reactions under non-laboratory conditions.

Method: To assess spontaneous dissociation, we used an event sampling method via smartphone application in female in-patients with PTSD and dissociative experiences. Patients tracked quality, intensity, and duration of every experience, they indicated as dissociation. Meanwhile, they wore a mobile ECG device within 12h during waketime, over 5 to 10 days. Regarding HR and HRV (RMSSD, HF-HRV), dissociative events and baseline were compared.

Results: Preliminary data of 36 patients, who tracked in total 117 dissociative events, are presented.

Discussion: To our knowledge this is the first study that examines spontaneous posttraumatic dissociation and associated physiological reactions. Due to the field study design, methodological limitations must be discussed.

Keywords: PTSD, psychophysiology, ecological momentary assessment

Impaired dominance judgement in Huntington's disease despite over-activation of the social cognition network

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Background: Huntington's disease (HD) is a hereditary, progressive neurodegenerative disorder, characterized by involuntary movements, cognitive deterioration, and impaired emotional processing. In this context, patients are less able to judge trustworthiness and dominance in the faces of others at the time when they need to rely increasingly on others as they lose their autonomy. In the current study, we investigated the neural correlates of this inability.

Methods: We included 13 patients with early manifest HD (2 females; age mean + SD, 47.07 + 8.94) and 14 healthy volunteers (3 females; age mean + SD, 43.26 + 7.49). Similar to our previous study, we applied a social cognition task, in which the participants needed to rate trustworthiness, dominance, and gender of computer-generated faces. The task was applied both outside and inside a 3T MRI scanner while participants underwent structural and functional imaging.

Results: Patients with HD consistently rated faces as more dominant than healthy volunteers. Additionally, during dominance ratings, functional activity in the insula and the fusiform gyrus increased in patients with HD. We found no significant differences between groups for trustworthiness or the control task.

Conclusion: HD patients over-activate the insula and fusiform gyrus, two regions known to be involved in social cognition, and exaggerate in their judgement of dominance in faces. Over-activity at important hubs for the social cognition network is either inefficient to maintain normal network function or directly related to misreading dominance.

Keywords: Huntington's disease, trustworthiness, dominance, face perception, social cognition

Interozeption und der Einfluss traumatischer Kindheitserlebnisse bei Patienten mit PTBS, Major Depression und Somatic Symptom Disorder

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Hintergrund: Traumatische Kindheitserlebnisse (ACE) können zu emotionaler Dysregulation und assoziierten Störungen wie posttraumatischer Belastungsstörung (PTBS), Major Depression (MD) und Somatischer Belastungsstörung (SSD) führen. Ein möglicher vermittelnder Faktor könnten Defizite in der Interozeption sein. Der Einfluss von ACE auf Interozeption ist bislang wenig erforscht. Ziel der vorliegenden Studie war die Untersuchung interozeptiver Dimensionen und der Zusammenhang zu ACE und emotionaler Dysregulation.

Methode: ACE, emotionale Dysregulation und Interozeption wurden mittels Fragebögen, einer etablierten Herzschlagperzeptionsaufgabe und Elektrokardiogramm bei Patienten mit MD (n = 35), SSD (n = 34) und PTSD (n = 33) und gesunden Kontrollen (HC; n = 34) erhoben. Einschlusskriterium für die vorliegende Studie war das Vorliegen mindestens eines ACEs.

Ergebnisse: Die Gruppen unterschieden sich nicht hinsichtlich der objektiven Herzschlagwahrnehmung und der metakognitiven Bewusstheit der eigenen Wahrnehmung. Die Analyse der Selbstberichte zeigte, dass Patienten mit SSD dazu neigten die eigenen interozeptiven Fähigkeiten zu überschätzen und alle Patientengruppen höhere Körperdissoziationswerte berichteten als HC. Patienten mit MD wiesen niedrigere Herzratenvariabilitäten im Vergleich zu HC und Patienten mit SSD auf. Es zeigten sich keine signifikanten Korrelationen zwischen ACE und der Herzschlagwahrnehmung, jedoch für interozeptive Selbstberichte, darunter Körperbewusstsein und Körperdissoziation. Eine Mediationsanalyse ergab, dass der Zusammenhang zwischen ACE und emotionaler Dysregulation durch Körperdissoziation mediiert wurde.

Diskussion: Die Ergebnisse legen Unterschiede in subjektiven Körperüberzeugungen anstelle objektiver interozeptiver Defizite nahe. Da die Patienten in der PTSD Gruppe höhere ACE Werte aufwiesen und nur gesunde Kontrollen mit ACE erhoben wurden, sind weitere Studien notwendig. Integrative therapeutische Interventionen könnten Betroffen helfen Schwierigkeiten in der Emotionswahrnehmung und -regulation zu überwinden.

Keywords: Interozeption, Dissoziation, Emotionale Dysregulation, Trauma

Multidimensional assessment of interoceptive abilities, emotional processing and the role of early life stress in inflammatory bowel diseases

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Introduction: Perception of bodily sensations includes three dissociable constructs: interoceptive accuracy, interoceptive sensibility, and interoceptive awareness. Interoception plays a crucial role in emotional processing and impairments of these processes have been observed in several psychiatric disorders. The aim of the study was to investigate the associations between the different dimensions of interoception and emotional processing in Inflammatory Bowel Disease (IBD), while taking childhood traumatization into account.

Methods: We recruited 35 remitted IBD patients and 35 healthy control participants (HC) matched for age, sex and education. Interoception was assessed as a multidimensional construct using the heartbeat tracking task and the Multidimensional Assessment of Interoceptive Awareness questionnaire. Emotional processing was measured using an experimental task, where participants were asked to rate the valence and arousal when presented with affective stimuli. Childhood traumatization was assessed using the Childhood Trauma Questionnaire.

Results: IBD patients reported greater awareness of the connection between bodily sensations and emotional states and showed a stronger tendency to use distraction from unpleasant sensations compared to HC. Our findings suggest that emotional processing in IBD is linked to interoceptive sensibility and not to interoceptive accuracy. The association between interoception and emotional processing was modulated by the severity of childhood traumatization.

Discussion: This is the first study showing that IBD patients did not differ in their ability to detect visceral signals but in their subjective perception of these. Psychotherapeutic interventions might profit from taking the interplay between emotion processing, interoception and childhood trauma into account.

Keywords: interoception, somatic disorder, childhood traumatization, emotional processing, body awareness

Neural fingerprints of emotion processing in bipolar disorder – a meta-analytic approach

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Bipolar disorder (BD) manifests in alternating episodes of euphoric-irritated and depressed moods. To test putative mechanisms behind these extreme affective fluctuations, neuroscientists have studied how BD-patients process emotions. Functional magnetic resonance imaging studies found that BD-patients show increased activity in limbic-striatal brain areas and decreased activity in inferior frontal areas when viewing emotional stimuli compared to healthy participants. However, due to the very small and heterogeneous samples, it remains unclear whether BD-patients process positive and negative stimuli differently and to what extent their mood state influences emotion processing.

To integrate previous results, we conducted a systematic literature search for journal articles in the Web of Science Core Collection including MEDLINE databases and employed a coordinate-based-meta-analysis of functional-MRI studies comparing emotion-processing in BD-patients with controls using seed-based d mapping with the linear model function to test for between-subjects-effects. We included 32 studies published before 05/2020 containing N=724 BD-patients and N=871 controls.

The meta-analysis revealed mood-state- and valence-specific neural activations of BD-patients: The processing of positive compared to negative stimuli was associated with higher neural activity in the insula and lower neural activity in the cuneus and the medial frontal gyrus. Depressed in comparison to manic BD-patients showed higher activity in middle temporal gyrus, parahippocampal gyrus and medial cingulate cortex, while they showed lower activity in the anterior insula, striatum and right thalamus.

In sum, the meta-analysis indicates differential neural fingerprints of emotion processing in BD-patients during manic and depressive episodes as well as for positive and negative stimuli.

Keywords: functional neuroimaging, meta-analysis, seed-based d mapping, bipolar disorder, emotion processing

Oxygenierung des Präfrontalkortex im Ruhezustand bei Jugendlichen mit nichtsuizidalem selbstverletzendem Verhalten

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Einleitung: Dem Präfrontalkortex (PFK) wird ein Großteil der Inhibitionskontrolle zugeschrieben und er ist häufig Gegenstand der Erforschung psychischer Störungen. Insbesondere bei nichtsuidzidalem selbstverletzendem Verhalten (NSSV) wird der Einfluss von Inhibitionskontrolle diskutiert. Bei jugendlichen PatientInnen mit NSSV gibt es bislang kaum bildgebende Untersuchungen zur Funktion des PFK. In dieser Studie wurde die Oxygenierung des PFK im Ruhezustand und deren Zusammenhang mit der klinischen Symptomschwere bei Jugendlichen mit NSSV und gematchten gesunden Kontrollen untersucht.

Methoden: Jugendliche (12-17 Jahre) mit regelmäßigem NSSV (n = 170) und Kontrollen (n = 43) haben eine Baseline Aufgabe bearbeitet, während die PFK Oxygenierung und die funktionelle Konnektivität im PFK mithilfe eines 8-Kanal funktionellen Nahinfrarot Spektroskopie (fNIRS) Geräts gemessen wurde. Klinische Variablen aus Selbstauskunftsfragebögen und diagnostischen Interviews wurden berücksichtigt, um potenzielle Zusammenhänge mit der PFK Oxygenierung und der Konnektivität zu untersuchen.

Ergebnisse: Jugendliche mit NSSV zeigten eine signifikant verringerte PFK Oxygenierung im Vergleich zu den Kontrollprobanden im oxygenierten Hämoglobin ($t = -2.33$; $p = .021$). Niedrigere PFK Oxygenierung korrelierte mit mehr negativen Kindheitserlebnissen ($r = -.155$; $p = .034$), während stärkere PFK Oxygenierung mit einer besseren selbstberichteten gesundheitsbezogenen Lebensqualität korrelierte ($r = .154$; $p = .049$). Bei der Untersuchung der Konnektivität wurden keine Gruppenunterschiede gefunden.

Diskussion: Die Befunde tragen zum Wissensstand zur PFK Oxygenierung bei Jugendlichen mit NSSV bei. Mögliche Einflüsse von Psychotherapie und Alter auf die Oxygenierung im PFK werden diskutiert. Weitere Untersuchungen sind notwendig, um einzuordnen, inwiefern die gefundenen Unterschiede in der Oxygenierung mit Psychopathologie allgemein oder mit spezifischen Kriterien von NSSV im Besonderen zusammenhängen.

Keywords: Nichtsuizidales Selbstverletzendes Verhalten, Jugendliche, Präfrontalkortex, Nahinfrarot Spektroskopie

Phonetic perception but not perception of speaker gender is impaired in chronic tinnitus

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Introduction. While tinnitus is known to compromise the perception of speech, it is unclear if the same holds for extralinguistic speaker information. Furthermore, research with simple tone stimuli showed that unilateral tinnitus binds spatial attention, thereby impeding the detection of auditory changes in the non-affected ear.

Methods. Using dichotic listening tasks, we tested left-ear tinnitus patients and control patients for their ability to ignore speech and speaker information in the task-irrelevant ear. To this end they heard vowel-consonant-vowel (VCV) syllables simultaneously spoken by gender-ambiguous voices in one ear and male or female voices in the contralateral ear. They selectively attended to speech (Exp. 1) or speaker (Exp. 2) information in a designated target ear, by classifying either the consonant (/b/ or /g/) in VCV syllables or voice gender (male or female) while ignoring distractor voices in the other ear.

Results. While performance was comparable across groups in the gender task, tinnitus patients responded slower than controls in the consonant task, with no effect of target ear.

Discussion. This suggests that tinnitus hampers phonetic perception in speech, while preserving the processing of extralinguistic speaker information. These findings support the growing evidence for speech perception impairments in tinnitus.

Keywords: Tinnitus, Speech, Speaker gender, Voice perception, Dichotic listening, Executive attention

Predicting Response to Cognitive-Behavioral Therapy in Patients with Obsessive-compulsive Disorder: Association with Emotional Processing Measured with the Late Positive Potential

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The efficacy of cognitive-behavioral therapy (CBT) for treatment of obsessive-compulsive disorder (OCD) is well established. However, a number of patients do not respond to the treatment. In order to improve this situation, it is important to identify psychological and biological markers associated with individual differences in CBT response. Previous findings have shown an association between altered emotional processing and therapy response in several disorders, such as depression and anxiety. With the current study, we investigated whether emotional processing could be used to predict therapy response in a relatively large sample of patients with OCD (n = 133). To assess emotional processing, the late positive potential (LPP) was recorded while the patients were presented with emotional stimuli (i.e., IAPS pictures). The LPP is an event-related brain potential (ERP) that reflects sustained attention to emotional stimuli. Severity of OCD symptoms was measured with the Yale-Brown Obsessive-compulsive Scale before and after CBT, and therapy response was estimated using the Reliable Change Index.

Initial results from multiple moderation models show a gender-moderated prediction of therapy response by LPP to negative, but not positive, emotional stimuli. Specifically, female patients with higher sustained attention to negative stimuli seem to be more likely to benefit from CBT. Further associations with clinical and psychometric variables will be presented. The current findings have the potential to improve our understanding of individual predictors for therapy response in OCD, highlighting the relevance of biological indicators of emotional processing in this context.

Keywords: therapy response, cognitive-behavioral therapy, obsessive-compulsive disorder, event-related brain potential, late positive potential

Preset to threat: Anxious apprehension influences startle and P300 in threat anticipation

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Background: A widely shared framework suggests that anxiety symptomatology maps onto two dimensions: Anxious apprehension and anxious arousal. Previous research associated individual differences on these dimensions with differential neural response patterns in neuropsychological, imaging, and physiological studies. Differential effects of the anxiety dimensions might contribute to inconsistencies in clinical and non-clinical studies that examine neural processes underlying anxiety. The present study therefore tested associations between the anxiety dimensions and the neural processing of threat anticipation.

Method: From a larger online sample (N = 1,603), we oversampled 101 non-clinical subjects with converging and diverging anxious apprehension and anxious arousal profiles. The subjects underwent the NPU-threat test with alternating phases of unpredictable threat, predictable threat, and safety, while physiological responses (i.e., startle reflex, N100, and P300) to auditory startle probes were recorded.

Results: Multilevel regression models revealed that anxious apprehension enhanced startle responses to unpredictable threat relative to safety. Further, anxious apprehension decreased attentional allocation (P300) to predictable threat relative to safety. However, anxious apprehension did not significantly affect automatic sensory processing of startle probes (N100). Further, no evidence emerged for anxious arousal affecting threat anticipation.

Conclusion: These results suggest that trait variations in anxious apprehension shape the dynamics of neural processing of threat stimuli. Specifically, anxious apprehension seems to simultaneously increase the defensive preparation during uncertain threat anticipation and attenuate attentional responding to predictable threat. However, we could not validate a role of anxious arousal in threat processing. Altogether, our data further highlight the role of uncertainty in anxiety.

Keywords: anxiety, startle reflex, event-related potentials, NPU-threat test, worry

Psychobiologische Stressreaktivität bei Grundschulkindern: Effekte zweier Kurzinterventionen

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Einleitung: Das Stressniveau und die damit assoziierten körperlichen und psychischen Symptome bei Kindern und Jugendlichen nehmen zu. Während soziale Unterstützung als wichtige stressprotektive Ressource identifiziert werden konnte und die Notwendigkeit und Wirksamkeit verschiedener Stressbewältigungstrainings empirisch belegt wurde, untersucht die aktuelle Studie, ob eine Kurzintervention bereits positive Effekte erzielen kann und ob darüber hinaus die Intervention mit dem Schwerpunkt „soziale Unterstützung" als Bewältigungsstrategie der aktiven Kontrollgruppe überlegen ist.

Methoden: In einer randomisierten Studie wurden 47 Kinder der 3. & 4. Klassen zufällig einer von zwei Stressmanagementtrainings (4 mal 90 Minuten) zugeteilt. Während die eine Gruppe Psychoedukation zu Stress sowie Übungen der Progressiven Muskelentspannung (PMR) und imaginative Entspannungsübungen enthielt, wurde in der zweiten Gruppe zusätzlich die Suche nach sozialer Unterstützung angeregt. Zur Analyse der Wirksamkeit wurde vor und nach dem Trainingszyklus eine adaptierte Kurzvariante des Trierer sozialen Stresstests für Kinder (engl.: Trier Social Stress Test for Children, TSST-C; Buske-Kirschbaum et al., 1997) durchgeführt, um die Stressreaktivität auf physiologischer (Speichelkortisol) und psychologischer Ebene (Fragebogen) sowie stressassoziierte Symptome und Verhalten zu untersuchen.

Ergebnisse: Die Analysen zeigen unterschiedliche Veränderungen der Stressreaktivität der beiden Gruppen, wobei die Gruppe mit Fokus „soziale Unterstützung" auf physiologischer Ebene profitiert, während die Vergleichsgruppe auf Ebene der subjektiven Stresswahrnehmung profitiert. Alle Kinder zeigen einen Rückgang stressassoziierter und sozialängstlicher Symptome nach dem Training.

Diskussion: Die Wirksamkeit von Kurzinterventionen auf die kindliche Stressreaktivität und stressassoziierte Symptome konnte in dieser Studie bestätigt werden. Die Interventionen sind auf Umsetzbarkeit im Schulalltag der Kinder konzipiert. Zukünftige Studien sollten prüfen, ob sie zur Stressprävention bei Grundschulkindern eingesetzt werden können.

Keywords: Kurzintervention, soziale Unterstützung, Stressreaktivität, Grundschulkinder

Psychophysiologische Reaktionen auf emotionale Erinnerungen bei sozialer Angststörung

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Viele PatientInnen mit Sozialer Angststörung (SAD) berichten von sozial bedrohlichen Erfahrungen aus der Vergangenheit, die mit dem Beginn der Störung assoziiert sind. Trotz der Bedeutung dieser Erinnerungen für die SAD, gibt es bisher nur wenige Hinweise auf Unterschiede zwischen gesunden Personen (die ebenfalls sozial bedrohliche Erfahrungen erlebt haben) und PatientInnen mit SAD hinsichtlich der Repräsentation dieser Erinnerungen im Gedächtnis. Das Ziel dieser Studie war zu untersuchen, inwiefern SAD PatientInnen eine Trauma-ähnliche Abspeicherung dieser Erinnerungen in Form von erhöhter emotionaler Reaktivität, sowie Intrusivität und Disorganisation der Erinnerung aufweisen. Zudem wurde untersucht, ob diese Gedächtnischarakteristika mit posttraumatischen Belastungssymptomen (PTBS Symptomen) zusammenhängen.

Die emotionale Reaktivität (subjektiv, psychophysiologisch) von 84 SAD PatientInnen und 84 gesunden Kontrollpersonen wurde mithilfe einer Vorstellungsaufgabe erfasst, während der die ProbandInnen die Aufgabe hatten, sich drei verschiedene Erlebnisse (sozial aversiv, nicht-sozial aversiv, neutral) möglichst lebhaft vorzustellen. Während der Vorstellungsaufgabe wurden psychophysiologische Maße wie die Herzrate (HR), die Hautleitfähigkeit (SCR), sowie die Muskelaktivität im Gesicht (Corrugator supercilii, Zygomaticus major) erfasst.

Die Ergebnisse dieser Studie zeigen, dass SAD PatientInnen während der Imagination der sozial bedrohlichen Situation eine erhöhte autonome Reaktivität (HR, SCR) und mehr negative Gefühle erleben, sowie eine größere Intrusivität der Erinnerung berichten. Zudem mediieren PTBS Symptome teilweise den Zusammenhang zwischen diesen Gedächtnischarakteristika und SAD Diagnose.

Diese Ergebnisse weisen darauf hin, dass SAD PatientInnen im Gegensatz zu gesunden Personen eine Trauma-ähnliche Repräsentation der sozial bedrohlichen Erfahrungen aufweisen, die möglicherweise eine Rolle bei der Entstehung von PTBS Symptomen, sowie schließlich der Entstehung bzw. Aufrechterhaltung der sozialen Ängste spielt.

Reducing math test anxiety with hypnosis in a school setting

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Research shows that math test anxiety has a significant negative impact on students' performance in math exams because it impedes successful knowledge retrieval. Since hypnotherapeutic techniques are highly successful in reducing stress and anxiety, we developed a hypnosis audio-intervention for the school context to reduce math test anxiety and hence improve test results. The intervention starts with the induction of a mild trance in which students are suggested positive feelings like pride and positive expectations like an optimal test performance in upcoming math tests. We plan to test 24 students aged 17-18 from the Grete Unrein School in Jena. The hypnosis audio-intervention is implemented between two math exams. Before taking the first exam, we assess students' trait math anxiety with a single item math anxiety scale (SIMA). Before each math test, we measure state anxiety with the State-Trait-Anxiety-Inventory (STAI-S) and record heart rate and breathing frequency as physiological markers of anxiety. Math test performances are also included in the analysis. We expect that our hypnosis audio-intervention decreases anxiety measures before math tests (STAI-S, heart rate, breathing frequency) and therefore improves math test performance. The aim of the study is to provide a successful math anxiety prevention and treatment method that is easy to deliver to students, also during the current corona pandemic. Reducing test anxiety at school will positively affect students' well-being and might establish successful coping mechanisms leading to general resilience.

Responsibility for others' outcomes differentially affects reinforcement learning in Social Anxiety Disorder

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Learning to reconcile our own interests with those of others is crucial for successful social interactions. Moreover, worsening the outcome of others by making a wrong decision is stressful. Individuals with Social Anxiety Disorder (SAD) fear evaluation by others. This fear can be triggered if they are responsible for a bad outcome that affects the whole group.

75 adult participants (35 diagnosed with SAD and 40 age-, gender-, and education-matched healthy controls (HC)) underwent event-related functional magnetic resonance imaging while having to weigh the outcomes for a group of people they had just met against their own outcomes during a learning task known to elicit robust Reward Prediction Errors (RPE). We fit different reinforcement learning models to choice data and compared them using Hierarchical Bayesian Inference. BOLD data were analysed in SPM, restricted to predefined ROIs and corrected for multiple comparisons using permutation tests.

Contrasting RPE-related activation between SAD and HC, we found excess activation of a region of the left Inferior Parietal Lobule (caudal A40) for RPEs regarding participants own outcomes. RPEs related to the outcomes of others' differentially activated medial Area 9 in SAD.

Overall, these findings elucidate differences in the employment of learning mechanisms in cortical areas in SAD when taking responsibility for others' outcomes, a mechanism that closely corresponds with neurobiological endophenotypes recently proposed for SAD.

Keywords: Social Anxiety Disorder, fMRI, reinforcement learning, responsibility aversion

Slow-wave sleep predicts treatment outcomes in trauma patients

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Introduction. Successful psychotherapy essentially relies on a person's ability to integrate and store new adaptive information. Basic research indicates that these processes of memory formation are supported by sleep. However, most psychiatric patients suffer from sleep disturbances questioning that they can optimally benefit from psychological interventions. In this study, we aim to investigate whether objective and subjective sleep parameters prior to psychotherapy can predict treatment outcomes in traumatized patients.

Method. Forty-five patients suffering from post-traumatic stress symptoms spent two nights in our sleep laboratory before receiving disorder-specific psychotherapeutic treatment. Subjective sleep was assessed with the PSQI (Pittsburgh Sleep Quality Index) questionnaire and objective sleep was measured using standard polysomnography. Pre-to-post-treatment change scores were calculated for relevant symptoms such as anxiety, depression, emotion-regulation, and post-traumatic symptoms using standard questionnaires (i.e., Beck Depression and Anxiety Inventory (BDI, BAI), Emotion Regulation Questionnaire (ERQ), Post-traumatic Diagnostic Scale (PDS)).

Preliminary results. Psychological symptoms (BDI, BAI, and PDS) and subjective sleep quality substantially improved after psychological treatment (all $p < 0.001$) while Subjective sleep parameters did not change pre- to post-treatment. The amount of slow-wave sleep prior to psychotherapy was correlated with reductions in anxiety-related symptoms ($p=.004$) as well as in dysfunctional emotion regulation strategies ($p = 0.006$) pre-to-post-treatment.

Discussion. Our findings underline the essential role of slow-wave sleep in psychotherapeutic success. Future studies are needed to investigate whether improving sleep quality using sleep-related interventions prior to psychotherapy can improve treatment outcomes.

Keywords: slow-wave sleep, psychotherapy, trauma patients

Subjective, behavioral and physiological cue-reactivity in virtual reality environments in gambling disorder

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Introduction: In recent years, the emergence of high-performance virtual reality (VR) technology has opened up new possibilities for the examination of contextual effects in psychology. In this preregistered study (https://osf.io/4mrta), we investigated subjective, physiological and behavioral effects of exposure to gambling-related and neutral VR environments in regular gamblers agreeing to at least one of the DSM-5 criteria for gambling disorder (mean = 5.4, range: 1 to 8) and non-gambling controls.

Methods: Gamblers (n=31) and matched controls (n=29) completed testing sessions on three different days. On two days, participants explored two rich and navigable VR-environments (neutral [café] vs. gambling-related [casino/sports-betting facility]), while electrodermal activity (EDA) and heart rate were measured using remote sensors. Within the VR-environments, participants performed a temporal discounting task and a sequential decision-making task (Daw et al., 2011).

Results: In line with prior results (Wiehler & Peters, 2015), we found strong evidence for increased temporal discounting in the group of regular gamblers. Subjective craving increased significantly in gamblers when exposed to the gambling-related VR environment, but there was little evidence for increased temporal discounting (Dixon et al., 2006). Similarly, the EDA increased in response to immersion in VR in general, but there was no evidence for physiological cue-reactivity towards the gambling-related VR-environment.

Discussion: The results suggest that gambling-related virtual environments can induce subjective craving in participants reporting frequent or pathological gambling. Why a similar effect wasn't observed for behavioral measures of cue-reactivity (e.g., temporal discounting, see Dixon et al., 2006) or the physiological measures remains open for debate.

Keywords: gambing addiction, cue-reactivity, cognitive modeling, virtual reality, psychophysiology

Targeted Extinction of Drug Cues During Sleep

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Introduction: It is well established that memories undergo consolidation during sleep via repeated reactivation of newly encoded information, which offers a unique opportunity to manipulate memories. In patients suffering from disorders linked to maladaptive reward memory (e.g. substance use disorders), memory consolidation during sleep may be used to attenuate addiction memories. Using targeted memory reactivation (TMR), sensory stimuli paired with memories during wake can be used to reactivate corresponding memory traces during sleep. Recently, TMR has successfully been applied to extinguish conditioned fear responses. Thus, we aimed to transfer this method to alcohol use disorder patients and to extinguish addiction related maladaptive memories by presenting addiction related odour cues during sleep.

Methods: Patients (N = 172) will receive either alcohol or neutral (unlinked) odours during Non-REM sleep, whilst polysomnography is recorded. Before and after sleep, cued reactivity of each patient towards alcohol and neutral will be recorded using fMRI.

Results: We hypothesize that cue reactivity towards alcohol stimuli may be reduced by TMR. Moreover, we will record activations focusing on the following RoIs: in hippocampus and dorsolateral prefrontal cortex as memory related RoIs, in striatum and insula as reward related RoIs and in anterior cingulate cortex and ventrolateral prefrontal cortex as cognitive control related RoIs. After the intervention we expect a higher activation in memory and cognitive control regions and lower activity in reward regions.

Discussion: If effective, TMR can be used to accompany conventional treatment options and might be especially useful for patients who find alternative treatments ineffective.

Keywords: targeted memory reactivation, cue reactivity, alcohol use disorder, sleep

Vagus nerve stimulation normalizes food ratings and improves food liking in people with anhedonia

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Introduction: The vagus nerve plays a prominent role in the regulation of food intake and metabolic processes. Previous studies on vagus nerve stimulation yielded conflicting results as to whether it affects reactivity to food cues in healthy participants and participants with major depressive disorder (MDD), for which vagal nerve stimulation has proven as an effective treatment. Here, we investigated the acute effects of right transcutaneous auricular vagus nerve stimulation (taVNS) on subjective ratings of wanting and liking of various food and non-food items in a sample of 65 participants, including 31 patients with MDD.

Methods: To test for tVNS-induced changes and compare effects between healthy participants and patients with MDD, we performed linear mixed-effects analysis including either group (MDD) or questionnaire scores on anhedonia. In addition, we assessed whether tVNS-induced changes ("slopes") were dependent on average ratings ("intercepts").

Results: We found that taVNS increased liking of food cues in MDD, but not in healthy participants. Across participants, taVNS reduced the variance of food liking compared to sham, suggesting that taVNS normalizes extreme ratings towards moderate levels of liking. In line with this convergence effect, taVNS induced larger improvements in liking ratings with increasing scores of anhedonia.

Discussion: Our results show that taVNS acutely ameliorates hedonic responses suggesting that it could provide an effective treatment of anhedonia, one of the cardinal symptoms of MDD. As symptoms of anhedonia are difficult to treat with conventional therapies, taVNS may provide a powerful adjuvant to rapidly improve motivational deficiencies.

Keywords: taVNS, motivation, anhedonia, MDD

Verbessern Entspannungsverfahren die Interozeptionsfähigkeit? – Eine 1-wöchige Intervention

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Interozeption, die Wahrnehmung und Verarbeitung körpereigener Signale, ist ein zentraler Aspekt von Gesundheit und Krankheit. Eine gestörte Interozeptionsfähigkeit zeigt sich bei verschieden psychischen Erkrankungen, wie Depression oder auch Essstörungen.

In der vorliegenden Studie wurde an 76 gesunden Studenten untersucht, ob sich die interozeptive Genauigkeit und das interozeptive Bewusstsein durch eine 5-tägige körperbezogene Imaginationsübung (Bodyscan) per Audiodatei verbessern lassen. Als Kontrollbedingung diente eine nicht-körperbezogene Traumreise und nicht-entspannungsbezogene Podcasts der Serie ZeitWissen. Die Erhebung erfolgte online. Vor und nach der 5-tägigen Intervention wurden interozeptive Genauigkeit (Interoceptive Accuracy Scale (IAs)) und interozeptives Bewusstsein (Multidimensional Assessment of Interoceptive Awareness (MAIA)) erfasst.

Erste Ergebnisse zeigen eine interventionsunabhängige Zunahme der interozeptiven Genauigkeit und des interozeptiven Bewusstsein nach allen Interventionen. Unabhängig von Intervention und Messzeitpunkt scheinen allerdings depressive, Angst- und Stresssymptome, gemessen mit Depressions-Angst-Stress-Skalen (DASS), sowie psychische Belastungen durch die aktuelle Covid-19 Pandemie insbesondere interozeptives Bewusstsein und in geringerem Ausmaß interozeptive Genauigkeit negativ zu beeinflussen. Die wöchentliche Häufigkeit, mit der generell eigene Achtsamkeits- oder Entspannungsübungen durchgeführt werden, wirkt sich positiv auf das interozeptive Bewusstsein aus.

Insgesamt scheint Interozeptionsfähigkeit auch durch eine körperbezogene kurze, intensive imaginative Entspannungsübung in gesunden jungen Erwachsenen nicht verbessert zu werden, im Gegensatz zu regelmäßigem Yoga-, Mediations- oder Achtsamkeitstraining, welches interozeptives Bewusstsein positiv beeinflusst.

Keywords: interozeptive Genauigkeit, interozeptives Bewusstsein, MAIA, Entspannungsübungen

Wirksamkeit eines computergestützten Flexibilitätstrainings bei Zwangsstörung

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Die Zwangsstörung (OCD) führt zu deutlichen Beeinträchtigungen und Leid bei den Betroffenen und ist mit erheblichen gesellschaftlichen Kosten verbunden. Obwohl sich die Kognitive Verhaltenstherapie mit Exposition und Reaktionsverhinderung als eine effektive Intervention etabliert hat, brechen zahlreiche Patienten die Behandlung ab oder profitieren nicht ausreichend davon. Aus diesem Grund sind zusätzliche Augmentationen der Psychotherapie erforderlich.

Bei Patienten mit OCD wurde wiederholt eine Überaktivität der Handlungsüberwachung festgestellt. Diese manifestiert sich in einer gegenüber Gesunden erhöhten Amplitude des ereigniskorrelierten Potentials „error-related negativity" (ERN) im EEG. Darüber hinaus scheint auch die Flexibilität der Handlungsüberwachung reduziert. So zeigen sich bei Patienten mit Zwangsstörung Hinweise auf eine verringerte adaptive Anpassung der neuronalen Aktivierungsmuster und des Verhaltens an den Aufgabenkontext. Die Überaktivität der Handlungsüberwachung findet sich auch bei nichterkrankten erstgradigen Angehörigen von OCD Patienten und reflektiert daher möglicherweise einen Risikofaktor für diese Störung und somit einen fruchtbaren Ansatzpunkt für augmentative Interventionen.

Im Vortrag werden erste Daten aus einer Interventionsstudie zur Untersuchung der Wirksamkeit eines computergestützten Trainings bei OCD Patienten vorgestellt. In einem Prä-Post-Design wird überprüft ob ein dreiwöchiges internetbasiertes Training bei OCD Patienten zu einer verbesserten behavioralen Leistung (Reaktionszeiten, Fehlerraten), einer Flexibilisierung der neuro-kognitiven Handlungsüberwachung (ereigniskorrelierte Potentiale von Fehlerverarbeitung und Konfliktüberwachung) und zu einer Veränderung der Zwangssymptomatik führt. Zudem wird geprüft, inwieweit diese Outcome-Variablen im Zusammenhang stehen.

Keywords: Zwangsstörung, kognitives Training, Handlungsüberwachung, ERN, N2

Zusammenhang von neuronalen Korrelaten kontextabhängiger Furchtkonditionierung und Intrusionen in Reaktion auf aversive Lebensereignisse

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Intrusionen rufen Gefühle und Reaktionen hervor, als ob sich eine traumatische Situation im Hier und Jetzt wiederholen würde, obwohl sich die Person in einer sicheren Umgebung befindet. Obwohl Intrusionen ein Kernsymptom der Posttraumatischen Belastungsstörung (PTBS) sind, treten sie auch bei anderen furchtbezogenen Störungen nach störungsspezifischen aversiven Ereignissen auf und sind daher von hoher transdiagnostischer Relevanz. Ätiologische Modelle nehmen Schwierigkeiten in der kontextabhängigen Modulation von konditionierten Furchtreaktionen als Erklärung für intrusive Symptome an. Diese Studie untersucht daher, ob Unterschiede in den neuronalen Korrelaten kontextabhängiger Furchtkonditionierungsprozesse zwischen Personen mit und ohne Intrusionen in Reaktion auf aversive Lebensereignisse bestehen.

In dieser funktionellen Magnetresonanztomographie-Studie durchliefen 74 gesunde Frauen ein 2-tägiges kontextabhängiges differentielles Furchtkonditionierungsparadigma mit Furchtakquisition in Kontext A und Extinktionslernen in Kontext B (Tag 1) sowie Extinktionsabruf im sicheren Kontext B und Furchtabruf in einem neuen Kontext (Kontext C) einen Tag später. Als abhängige Variablen wurden die elektrodermale Reaktion (EDA) sowie die neuronale Aktivität in furcht- und extinktionsassoziierten Arealen gemessen. Intrusives Wiederleben wurden mittels der „Posttraumatic Diagnostic Scale" in Reaktion auf das aversivste Lebensereignis der Teilnehmerinnen erfasst.

Erste Ergebnisse sprechen dafür, dass Frauen mit im Vergleich zu Frauen ohne Intrusionssymptome in Reaktion auf das aversivste Lebensereignis einen reduzierten Extinktionsabruf aufweisen. Ein reduzierter Extinktionsabruf zeigte sich in Form einer stärkeren konditionierten EDA und einer reduzierten vmPFC- und Amygdala-Aktivierung. Diese Befunde stehen im Einklang mit früheren Studien zu neuronalen Korrelaten des Extinktionsabrufs bei PTBS. Ein reduzierter Extinktionsabruf könnte auf Schwierigkeiten in der Nutzung von Kontextinformationen zur Modulation von Furchtreaktionen hindeuten.

Keywords: Intrusionen, PTBS, Extinktion, vmPFC

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