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BRIEF ARTICLE

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Effects of dysphoria and induced negative mood on the processes underlying hindsight bias

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ABSTRACT
Hindsight bias is the tendency to overestimate one's prior knowledge of facts or events once the actual facts or events are known. Several theoretical frameworks suggest that affective states might influence hindsight bias. Nondysphoric participants ($n = 123$, BDI ≤ 13) in negative or neutral mood, and dysphoric participants ($n = 19$, BDI > 13) generated and recalled answers to difficult knowledge questions. All groups showed hindsight bias, that is, their recalled estimates were closer to the correct answer when this answer was shown at recall. Multinomial modelling revealed, however, that under dysphoria and induced negative mood different processes contributed to hindsight bias. Dysphoria, but not induced negative mood, was associated with a stronger reconstruction bias, compared with neutral mood. A recollection bias appeared in neutral, but neither in induced negative nor dysphoric mood. These findings highlight differences between the cognitive consequences of dysphoria and induced negative mood.

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Once we have acquired new knowledge about facts, it is remarkably difficult to accurately recall our *prior* knowledge of these facts. Specifically, we tend to overestimate what we knew beforehand. This *hindsight bias* is a well-researched and omnipresent cognitive distortion (see Roese & Vohs, 2012, for a review). Consider the following example of a participant in a typical hindsight-bias laboratory task. First, she answers a series of difficult knowledge questions that require numerical estimates (original judgements, OJs). For example, to the question "How many detective stories did Agatha Christie write?" she answers with an OJ of 54. After a retention interval, she is instructed to recall her OJs (recall of original judgement, ROJ). Critically, for part of the items (experimental items) the solution (correct judgement, CJ) is shown before recall ("Agatha Christie wrote 66 detective stories."). For the other items, the CJ is not shown. Hindsight bias occurs when due to the knowledge of the CJ, the ROJ shifts toward the OJ.

Knowing the CJ can bias hindsight judgements at two subsequent stages: recollection and reconstruction (Erdfelder & Buchner, 1998; Hawkins & Hastie, 1990). When asked for an ROJ, a participant will first attempt to directly recollect the OJ (54 in our example). CJ knowledge (66 in our example) may impair recollection of the OJ, resulting in poorer memory for experimental compared to control items. Thus, the participant may fail to recollect her OJ of 54, because she has been informed of the true number. This bias is called *recollection bias*. Second, when the OJ cannot be recollected, the participant must reconstruct the OJ. This reconstruction is often biased towards the CJ, because the participant uses the CJ in the reconstruction (e.g. by using it as an anchor). In this case, *reconstruction bias* occurs. In the example, the participant may reconstruct an OJ of 58 (i.e. her ROJ has shifted toward the CJ). Empirical findings suggest that recollection bias contributes only little to hindsight bias, whereas

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reconstruction bias plays a more prominent role (for a review, see Erdfelder, Brandt, & Bröder, 2007).

Many judgements are rendered in hindsight, and hindsight bias may have significant consequences in everyday life. In legal settings, for example, outcome knowledge may tempt jurors to overestimate a defendant's prior knowledge. Hindsight bias may thus cause premature assignment of guilt (e.g. Harley, 2007). Importantly, hindsight (and other) judgements are often rendered in a certain mood or emotional state. Numerous studies have shown that affective states and affective disorders (such as depression) impact performance in various cognitive tasks (see Gotlib & Joormann, 2010; Huntsinger, Isbell, & Clore, 2014, for recent reviews). Surprisingly, however, there is no published study to date that addresses whether mood and depressive symptoms influence the processes that underlie hindsight bias. As both the OJ and ROJ tasks are complex, open, and constructive, judgements and thus hindsight bias may be particularly prone to be influenced by affective information (*affect infusion*, Forgas, 1995).

The aim of the present study was to investigate how negative (vs. neutral) mood affects judgements in a standard hindsight-bias task. We compared two types of negative mood: induced (i.e. transient) negative mood, and dysphoria (i.e. persistent negative mood that accompanies depressive symptoms). How might transient negative mood affect hindsight bias? Research on affect and cognition has accumulated evidence for a dedicated link between the nature of an affective state and the style of information processing. Negative mood is a signal of an aversive situation. Such situations encourage the avoidance of mistakes and, therefore, promote accommodation-type processing. That is, existing knowledge is transformed to fit external information (Fiedler, 2001; cf. Piaget, 1954). Negative mood is thus associated with a verbatim, detail-oriented, and bottom-up style of information processing and can thereby lead to an adaptive tuning of the cognitive system. In accordance with these ideas, participants in induced negative mood are less prone to judgement biases (Ruder & Bless, 2003), memory errors (Deese-Roediger-McDermott paradigm; Storbeck & Clore, 2005), and memory distortions (misinformation effect; Forgas, Laham, & Vargas, 2005).

If negative mood facilitates accommodative processing (i.e. attention to detail, avoidance of mistakes), an induced negative mood should result in the generation of more accurate OJs, and in better OJ encoding and hence better OJ recall. Better OJ recall should make the CJ relatively less accessible (*relative trace strength hypothesis*; Hell, Gigerenzer, Gauggel, Mall, & Müller, 1988), which should reduce the probability of recollection bias in induced negative mood compared with neutral mood. Better OJ recall should also reduce the necessity of compensatory reconstructive processes, which in turn should lead to lower probability of a reconstruction bias (Groß & Bayen, 2015) in induced negative mood compared with neutral mood. Thus, negative mood in the absence of depressive symptoms should result in less hindsight bias.

In addition to induced negative mood, we considered dysphoria, a persistent negative mood that accompanies depressive symptoms. Interestingly, negative mood in the context of depression may influence the processes underlying hindsight bias differently than transient negative mood in the absence of depressive symptoms. The general memory impairments associated with depressive symptoms, specifically in free recall and in unstructured tasks (Hertel & Rude, 1991; Mathews & MacLeod, 2005), may lead to worse OJ recall than that of control participants without depressive symptoms. Worse OJ recall may lead to a higher probability of recollection bias. Impairments in attentional processing associated with depressive symptoms, that is, in maintaining task focus and inhibiting irrelevant material (cf. Gotlib & Joormann, 2010), may lead to a higher probability of the CJ biasing OJ reconstruction. The potential benefits of a transient negative mood (in terms of weaker bias) may thus be superimposed by impairments related to dysphoria. The two types of negative mood, dysphoria and transient negative mood, may therefore have different effects on the processes that underlie hindsight bias.

To investigate these issues, we had our participants without depressive symptoms (nondysphoric) perform a hindsight task in either induced negative mood (induced-negative-mood condition) or in neutral mood (neutral-mood condition). All participants with depressive symptoms (dysphoric) performed the hindsight task without negative mood induction (dysphoric-mood condition). We expected participants in induced negative mood, compared with neutral-mood and dysphoric participants, to show higher OJ accuracy and better OJ recollection, as well as weaker recollection bias and reconstruction bias. We expected dysphoric participants, compared to induced-negative-mood and neutral-mood participants, to show poorer OJ recollection as well as stronger recollection bias, and stronger reconstruction bias.

The multinomial processing tree (MPT) model of hindsight bias

Empirical measures are rarely process-pure. Whereas traditional measures of hindsight bias (e.g. [OJ – ROJ]/[OJ – CJ] × 100, as proposed by Hell et al., 1988) measure the overall impact of the CJ on hindsight judgements, these measures do not allow us to estimate the separate contributions of recollection and reconstruction processes to hindsight bias. To test specific predictions regarding the effects of mood on these processes, we used a multinomial processing tree (MPT) model.

MPT models are stochastic models for categorical data and have become increasingly popular since Riefer and Batchelder's (1988) seminal publication (see Erdfelder et al., 2009, for a review of MPT models and their applications in cognitive psychology). With MPT models, we can estimate the separate contributions of different latent cognitive processes from category frequencies for a defined set of responses in an experimental task. Model parameters – probabilities of the underlying processes – are estimated via a maximum-likelihood (ML) method. A major advantage over standard statistical models such as ANOVA is that MPT models are tailored to the specific theoretical issue and experimental task under investigation.

The MPT model of hindsight bias (Erdfelder & Buchner, 1998) provides estimates of the probabilities of OJ recollection, recollection bias, and reconstruction bias (the latent processes) from the observed response frequencies in the rank order categories of OJ, CJ, and ROJ, such as OJ < CJ < ROJ. There are 10 possible response categories each for experimental and control items.

Figure 1 shows the model's core assumptions and includes the most relevant parameters. For a detailed model description including all 13 parameters and 20 response categories, see Erdfelder and Buchner (1998). The model assumes that participants facing the ROJ task recollect their OJ with probability r_C for control items (as implied, e.g. by the response category ROJ = OJ < CJ). If recollection fails in the absence of the CJ (with probability $1 - r_C$), reconstruction of the OJ will be unbiased.

For experimental items, participants recollect their OJ with probability r_E. If OJ recollection is impaired by the presence of the CJ, then $r_C > r_E$ (recollection bias). If recollection fails in the presence of the CJ ($1 - r_E$), reconstruction of the OJ is biased by the CJ with probability b (reconstruction bias, as implied, e.g. by the response category CJ < ROJ < OJ). OJ reconstruction is unbiased with probability $1 - b$.

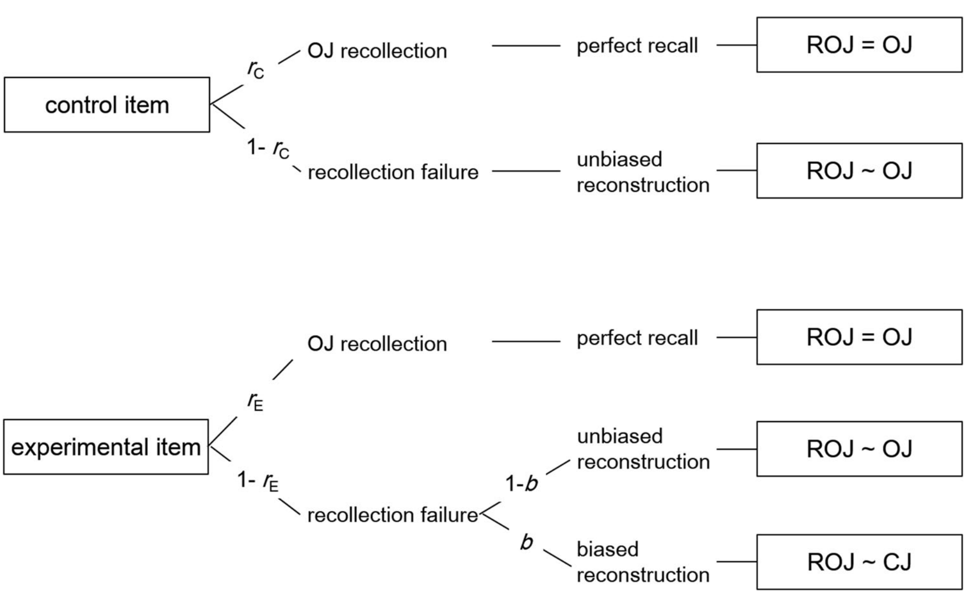

Figure 1. Core assumptions of the multinomial model of hindsight bias by Erdfelder and Buchner (1998). Rectangles represent observable events. r_C and r_E = OJ recollection probabilities for control and experimental items, respectively; b = probability of a biased reconstruction given a failure to recollect the OJ; OJ = original judgement; ROJ = recall of original judgement; CJ = correct judgement. Adapted from "Recollection biases in hindsight judgments", by Erdfelder et al., 2007, Social Cognition, 25, p. 117. Adapted with permission of Guilford Press.

Method

Participants

A total of 147 students of Heinrich-Heine-University Düsseldorf participated, with the following inclusion criteria. They were either native speakers of German or had been living in Germany since the age of six. They were female, because mood-induction procedures were more effective for females in some studies (e.g. Albersnagel, 1988). We used a non-clinical sample, that is, participants declared, prior to testing, to have no current mental disorder. However, in the demographics and health questionnaire that was administered later during testing, one participant reported a current depression, and four reported current treatment for a neurological and/or psychiatric disorder. We excluded the data of these participants. The final sample thus comprised 142 participants with a mean age of 22.4 years ($SD =$ 3.9, range 17–46 years).

Participants were administered the German version of the revised Beck Depression Inventory (BDI). The BDI-II is a well-validated self-report measure to detect depressive symptoms (Hautzinger, Keller, & Kühner, 2006). Participants with a BDI-score ≤ 13 (no or minimal depressive symptoms according to the cut-offs proposed by Beck, Steer, & Brown, 1996, $M = 4.9$, $SD = 3.3$, range 0–13) were classified as nondysphoric and randomly assigned to either the induced-negative-mood ($n = 63$) or the neutral-mood condition ($n = 60$). Participants with an elevated BDI-score of >13 (mild, moderate, or severe depressive symptoms, $n =$ 19, $M = 20.3$, $SD = 6.8$, range 14–38) were classified as dysphoric and were tested in the neutral-mood condition. None of the participants reported a current depressive episode; however, as we did not include a diagnostic assessment of depression, it is possible that participants qualified for a diagnosis of depression, specifically those with BDI-scores >20.

Material and measures

Mood induction. We used a combined music and life-event mood-induction procedure, because these tend to be most effective (for a meta-analysis, see Westermann, Spies, Stahl, & Hesse, 1996). Participants in the neutral-mood condition listened to G. Fauré's "Ballad for Piano and Orchestra, Op. 19" (6 min), whereas participants in the induced-negative-mood condition listened to S. Prokofiev's "Russia under the Mongolian Yoke" at half speed (5 min).

Mood measure. To measure mood, we presented three questions, each accompanied by two adjectives as anchors. Participants adjusted an arrow on a slide bar, resulting in a (non-visible) numerical value between 0 and 100. The questions and anchors were: "At the moment, my mood is [very bad – very good]", "At the moment, my mood is [depressed – cheerful]", and "At the moment, I feel [sad – happy]."

Items. We used 60 difficult knowledge questions that required exact numerical judgements. Questions were selected such that participants would be familiar with their topic but rarely knew the correct answer (e.g. "When was Leonardo da Vinci born?", "How many African nations are there?", "How many strings has a harp?"). These questions had been successfully used in prior studies (e.g. Groß & Bayen, 2015).

Procedure and design

Unless noted otherwise, tasks were computer-based. Participants were tested individually or in groups of up to five. They were seated in individual computer booths, provided informed consent (including information that their mood might change during the experiment), and completed a paper-pencil version of the BDI-II. According to the result, participants were either in the dysphoric condition or were randomly assigned to the neutral-mood condition or the induced-negative-mood condition (nondysphoric participants). Participant group (induced negative mood, neutral mood, dysphoric) was thus a between-subjects variable.

After an *Initial mood rating*, participants received the first mood induction. Participants in the neutral-mood and in the dysphoric conditions wrote down on a piece of paper the events on a routine day of the last week. Participants in the induced-negative-mood condition wrote down an event in their life that had made them feel sad or worthless (e.g. Schwarz & Clore, 1983). These tasks were to be completed within 10 min. Afterwards, all participants read their written paragraph while listening to the respective piece of music suggestive of either neutral or negative mood.

The mood induction was followed by a second mood rating (*Pre-OJ mood rating*) to assess the effectiveness of the induction. Afterwards, participants provided 60 OJs in an order randomized by participant. The questions appeared one at a time, and participants typed in their answers at their own pace. After the first 30 items, there was a third mood rating (*OJ mood rating*) to assess mood maintenance, followed by the remaining 30 OJs. Afterwards, there was a 20-min retention interval that included a demographics and health questionnaire as well as a second mood induction. Here, participants wrote down the events of another day from the past week (neutral mood and dysphoric) or another negative life event (induced negative mood) and afterwards listened to the same piece of music as before while reading the second written events. This was followed by a fourth mood rating (*Pre-ROJ mood rating*).

During the ensuing ROJs, participants recalled their 60 OJs in the same randomized order, with another mood rating after the first 30 items (*ROJ mood rating*). The questions again appeared one at a time, and participants typed in their self-paced answers. Half the items appeared as experimental items (i.e. along with the CJ). For example,

> When was Leonardo da Vinci born?
> Correct: 1452.
> What was your OWN answer?
> ______________.

The other half appeared as control items (i.e. without the CJ). For example,

> When was Leonardo da Vinci born?
> What was your OWN answer?
> ______________.

Item type (experimental vs. control) was thus a within-subjects variable. To counterbalance the appearance of the items as experimental or control item, as well as the appearance in the first half (position 1–30) or the second half (position 31–60) of the OJs and the ROJs, we randomly assigned the 60 items to four sets of 15 items each, with each set appearing equally often in each counterbalancing condition.

Finally, participants watched a short funny film and were given an unexpected gift (choice of smoothie or chocolate) to reestablish positive mood. They were then debriefed and compensated.

Results

Sixty items and 142 participants resulted in 8,520 OJ–ROJ pairs. In 29 cases (0.34%), the OJ equaled the CJ (0.36% for induced negative mood, 0.29% for neutral mood, and 0.44% for dysphoric). We excluded these rare cases from the analyses, because hindsight bias is not defined for these cases. In three cases (0.04%), the ROJ was missing, leaving 8,488 OJ–ROJ pairs for analyses.

Mood

We averaged the three mood items to a combined score, as Cronbach's α was $\geq$.95 at all measurement points. Higher scores indicate more positive mood.

To compare the initial mood ratings across the three participant groups, we conducted an ANOVA with participant group (neutral vs. induced negative vs. dysphoric) as between-subjects factor. Despite the differences in sample size, the variance in mood ratings did not differ between groups, $F(2, 139) = 0.13$, $p = .877$. The main effect of group on mean mood rating was significant, $F(2, 139) = 13.63$, $p < .001$, $\eta_p^2 = .16$. As expected, Scheffé *post hoc* comparisons revealed that dysphoric participants' mood ($M = 47.8$, $SD = 18.3$) was significantly lower than that of each of the two nondysphoric groups (neutral: $M = 69.3$, $SD = 16.1$, induced negative: $M = 67.1$, $SD = 15.7$; both $p < .001$), and that the nondysphoric groups did not differ from each other ($p = .757$).

To test whether the mood induction was successful, we conducted a repeated-measures ANOVA with time of measurement (Initial, Pre-OJ, OJ, Pre-ROJ, ROJ) as within-subjects factor and experimental group (neutral mood vs. induced negative mood) as between-subjects factor. The significant main effects of time of measurement, $F(4, 121) = 69.24$, $p < .001$, $\eta_p^2 = .36$, and experimental group, $F(1, 121) = 30.77$, $p < .001$, $\eta_p^2 = .20$, were qualified by a time of measurement × experimental group interaction, $F(4, 121) = 30.29$, $p < .001$, $\eta_p^2 = .20$. Bonferroni-adjusted pairwise comparisons indicated that mood scores were significantly lower in the induced-negative-mood compared to the neutral-mood condition at all times of measurement (all ps < .001), except for the initial time of measurement ($p = .453$). The manipulation was thus successful. To check whether dysphoric and induced-negative-mood participants differed in their mood ratings after the mood induction, we compared ratings at the pre-OJ time of measurement (dysphoric: $M = 46.4$, $SD = 13.6$, induced negative: $M = 39.7$, $SD = 18.3$) and found no significant difference, $t(77) = 1.48$, $p = .143$.

Accuracy of the original judgements

If negative mood facilitates accommodative processing, induced negative mood should result in more accurate OJs. We measured OJ accuracy as the absolute distance between OJ and CJ. Smaller values indicate more accurate numerical judgements. We log-transformed the distances due to skewness of the distribution (skewness = 74.8, $SE = 0.03$). Subsequently, we performed itemwise *z*-transformations because of differences in scaling, and calculated median scores across items for each participant. Descriptively, participants in induced negative mood showed more accurate judgements ($M = 0.07$, $SD = 0.19$) than participants in neutral mood ($M = 0.13$, $SD = 0.16$) and dysphoric participants ($M = 0.14$, $SD = 0.22$). However, this difference was not significant in a univariate ANOVA, $F(2, 139) = 2.07$, $p = .130$, $\eta^2_p = .03$.

Hindsight bias

To investigate whether mood affected overall hindsight bias, we analysed the effect of participant group on Hell et al.'s (1988) hindsight-bias index score, [(OJ – ROJ)/(OJ – CJ)] × 100. It is an overall measure of the impact of the CJ on hindsight judgements; a difference between experimental and control items on this score indicates the presence of hindsight bias.

To control for outliers, we calculated the median of the hindsight-bias index scores for each participant, separately for experimental and control items, as is frequently done (e.g. Bayen, Erdfelder, Bearden, & Lozito, 2006; Erdfelder & Buchner, 1998; Hell et al., 1988). Mean scores for control items in the neutral-mood, induced-negative-mood, and dysphoric groups were 0.13 ($SD = 0.91$), 0.25 ($SD = 1.02$), and 0.72 ($SD = 2.41$), respectively. Mean scores for experimental items in these groups were 4.54 ($SD = 11.07$), 3.76 ($SD = 8.73$), and 7.11 ($SD = 15.40$), respectively. A repeated-measures ANOVA with item type as within-subjects variable and group as between-subjects variable revealed a main effect of item type only, $F(1, 139) = 21.15$, $p < .001$, $\eta^2_p = .13$. This demonstrated the presence of hindsight bias; however, overall hindsight-bias magnitude did not differ between the three conditions, that is, there was no interaction, $F(2, 139) = 0.53$, $p = .587$, $\eta^2_p = .01$.

Yet, because this index confounds effects of recollection and reconstruction, we cannot use it to test specific predictions regarding the effects of mood on the processes that underlie hindsight bias. In order to do so, we applied the MPT model of hindsight bias.

MPT analyses. For MPT analyses, we tallied the frequencies of all possible response categories separately for each participant group (the frequencies are provided as Online Supplemental Material). For goodness-of-fit tests, we used the G^2 statistic, which is asymptotically chi-square distributed. The model fit the data for each group (all $G^2 < 11.07$, with $df = 5$).

Parameter estimates are shown in Figure 2.[1] Hypotheses concerning the parameters are tested by comparing the difference (Δ) in G^2 between a baseline model and a hierarchically nested model that includes (additional) parameter constraints (e.g. representing the null hypothesis of no recollection bias, $r_C = r_E$). If this constraint leads to a significant decrease in model fit, the null hypothesis is rejected.

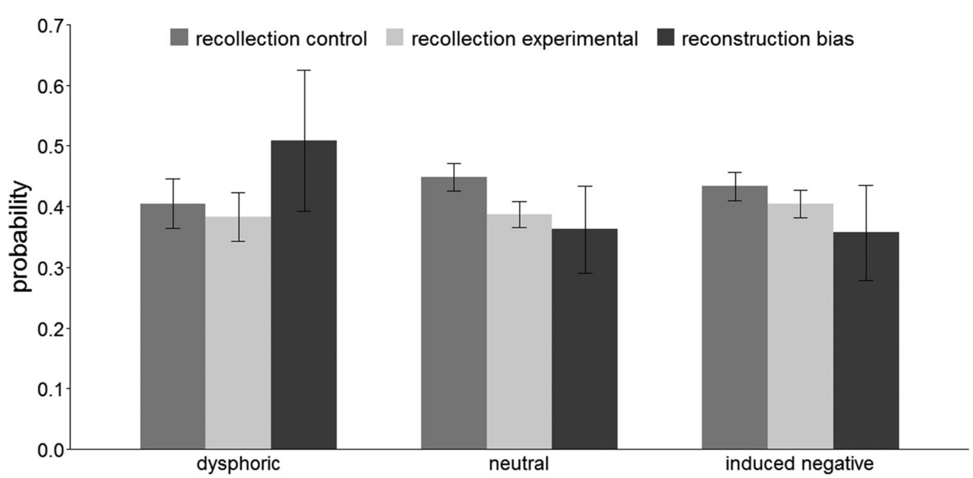

Figure 2. MPT parameter estimates for the recollection of the OJ and for reconstruction bias as a function of mood group. Error bars represent 95% confidence intervals.

To recapitulate, if negative mood facilitates accommodative processing, induced negative mood should result in better overall recollection, a lower probability of recollection bias, and a lower probability of reconstruction bias. If depressive symptoms are associated with memory and attentional impairments, dysphoric mood should result in worse overall recollection, a higher probability of recollection bias, and a higher probability of reconstruction bias.

Overall recollection. We observed a trend towards higher OJ recollection in neutral mood ($r_C = .45$) compared with dysphoric mood ($r_C = .40$), $\Delta G^2(1) = 3.37$, $p = .066$. The negative-mood group fell in between ($r_C = .43$) and did not differ from the other two groups, both $\Delta G^2(1) < 1.45$, both $p > .229$.

Recollection bias. Only the neutral-mood group showed significant recollection bias, that is $r_C > r_E$, $\Delta G^2(1) = 14.62$, $p < .001$. There was no significant recollection bias in the induced-negative-mood group, $\Delta G^2(1) = 3.00$, $p = .083$, nor the dysphoric group, $\Delta G^2(1) = 0.55$, $p = .459$.

Recollection bias (i.e. the difference $r_C - r_E$) did not differ between the induced-negative group and the neutral group. That is, the interaction of item type and group on recollection was not significant, $\Delta G^2(1) = 2.03$, $p = .096$.[2] Recollection bias also did not differ between the dysphoric and the neutral group, $\Delta G^2(1) = 1.24$, $p = .265$.

Reconstruction bias. Each participant group showed significant reconstruction bias, that is, parameter $b > 0$, all $\Delta G^2(4) > 40.59$, all ps $< .001$. Reconstruction bias was larger in dysphoric participants ($b = .51$) than in neutral-mood participants ($b = .36$), $\Delta G^2(1) = 3.92$, $p = .048$, and induced-negative-mood participants ($b = .36$), $\Delta G^2(1) = 4.05$, $p = .044$. The two nondysphoric groups did not differ, $\Delta G^2(1) = 0.01$, $p = .919$.

Discussion

This study investigated effects of dysphoria and induced negative mood on the processes that underlie hindsight bias. Participants were assigned to a neutral or a negative mood induction if they had no or minimal depressive symptoms (nondysphoric), and they received a neutral mood induction if they had at least mild depressive symptoms (dysphoric). Based on the assumption of a dedicated link between affective state and processing style, with accommodation-type processing under negative mood, as well as based on previous findings (e.g. Forgas et al., 2005), we expected induced negative mood to be associated with more detail-oriented processing and hence less susceptibility to bias. Based on findings regarding information processing in depression (Gotlib & Joormann, 2010), we expected dysphoric participants to show impaired recollection and increased susceptibility to bias. We used both an overall hindsight index (Hell et al., 1988) and Erdfelder and Buchner's (1998) MPT model to address these research questions.

Mood induction was successful. The intensity of negative mood did not differ between the two types of negative mood, suggesting a qualitative, not a quantitative difference between dysphoria and transient negative mood. We observed no effect of induced negative mood nor dysphoria on the overall measure of hindsight bias (a measure that confounds effects of recollection and reconstruction), whereas we did observe different effects of induced negative mood and dysphoria on the processes that underlie hindsight bias as measured with the MPT model. We thus demonstrated the superiority of the MPT approach over an overall index (see also, e.g. Bayen et al., 2006). The results were as follows:

Mood did not affect OJ generation. We expected induced negative mood to promote more effortful deliberation and hence more accurate estimates. We found the descriptive pattern of estimation accuracy to be in line with this expectation, however, the effect was not statistically significant.

Mood did not affect the probability of correct OJ recollection. We found a trend towards worse OJ recollection in dysphoric participants compared with neutral-mood participants. This trend may reflect the general memory impairments typically found in depression (Mathews & MacLeod, 2005). Contrary to our expectations, there was no recall benefit under induced negative compared to neutral mood in nondysphoric participants.

Mood affected recollection bias. In line with our expectations, we found significant recollection bias in neutral, but not in induced negative mood. Negative mood may thus protect individuals from the biasing influence of the CJ on OJ recollection. This result, however, needs to be taken with caution, because recollection bias in neutral mood was small, and the difference in recollection bias between neutral and induced negative mood (i.e. the interaction) fell short of significance. Yet, this result is in line with earlier work showing that recollection bias is generally small (Erdfelder et al., 2007), only in some studies reliably present (e.g. Erdfelder & Buchner, 1998, Exp. 4), and sometimes absent even under promotive conditions (e.g. with a long retention interval, Groß & Bayen, 2015; but see Coolin, Erdfelder, Bernstein, Thornton, & Thornton, 2016). Dysphoric participants were, contrary to our expectations, not more prone to recollection bias than nondysphoric participants. In fact, they did not show recollection bias, just like participants in induced negative mood. Thus, dysphoric participants were similar to nondysphoric participants in neutral mood when it came to the accuracy of OJs and the recollection of these OJs, and similar to induced-negative-mood participants regarding the impact of new information (the CJ) on this recollection.

Finally, mood affected reconstruction bias. We found significantly larger reconstruction bias in dysphoric compared to nondysphoric participants. This may result from differences in cognitive or motivational processes known to affect hindsight bias. We predicted that limited attentional capacities in dysphoric individuals (Joormann, 2010) would lead to increased reconstruction bias, because these individuals may have difficulties in inhibiting the CJ while reconstructing the OJ. There are possible alternative explanations, however. The increased reconstruction bias in this group may also reflect an increased need for predictability, or increased self-presentational concerns. These motives have been found to be positively correlated with hindsight bias magnitude (Campbell & Tesser, 1983) and may be particularly present in dysphoric individuals. Future research should discern different possible explanations for the high reconstruction bias in dysphoric participants.

Contrary to our expectations, mood induction did not affect reconstruction bias in nondysphoric participants. On the one hand, this may indicate that the effect of induced mood on reconstruction bias is not very strong. On the other hand, we cannot rule out that induced negative mood had two opposite effects on OJ reconstruction that evened out. In addition to more detail-oriented, careful processing of the CJ during OJ reconstruction – which should reduce reconstruction bias – induced negative mood may also have led to more extensive search for information that is consistent with the CJ – which would increase reconstruction bias. The latter mechanism has been suggested to underlie larger anchoring effects in induced negative mood (Bodenhausen, Gabriel, & Lineberger, 2000; Englich & Soder, 2009). Future research should thus attempt to better disentangle these processes in the reconstruction of OJs.

An additional reason for the lack of a difference in reconstruction bias between the two nondysphoric groups could be demand characteristics. Participants were aware that part of the procedures could lead to a change in mood. Moreover, they provided multiple mood ratings during the experiment, which may have further increased awareness of the topic. Hence, the mood ratings may have overestimated how much mood truly changed as a consequence of the mood-induction procedure. Therefore, we may have underestimated the true effect of mood on the processes that underlie hindsight bias. However, exposing the purpose of the mood-induction procedure can help participants apply additional strategies to get in the desired mood (for a discussion of the pros and cons of using cover stories in mood-induction studies, see Västfjäll, 2002).

Recollection and reconstruction of the OJ depend on the quality of OJ encoding on the one hand and the relative influence of the CJ presented during the attempt to retrieve the OJ on the other hand (Hell et al., 1988). Further research could attempt to disentangle effects of mood on encoding and retrieval by comparing conditions in the current experiment – that is, mood induction before both OJ and ROJ – to an experiment where mood is not induced until shortly before ROJ. This would allow us to estimate effects of mood on OJ retrieval (as compared to a combination of generation/encoding and retrieval).

To summarize, we found that induced negative mood and dysphoria affected the processes that underlie hindsight in different ways. We found partial support for theories that assume a link between mood state and style of information processing (Fiedler, 2001; see the *affect-as-cognitive-feedback account*, Huntsinger et al., 2014; and the *affect-as-information account*, Schwarz & Clore, 1983, for related ideas). We also found partial support for theories regarding cognitive consequences of dysphoria (Gotlib & Joormann, 2010). Future research should investigate further the exact mechanisms that give rise to effects of mood and dysphoria on hindsight processes and extend the present design to include a positive mood induction. In addition, the current findings await replication with clinically depressed participants.

Notes

1. As per suggestion of a reviewer, we additionally analysed the data with a hierarchical MPT approach that takes parameter variability into account and simultaneously estimates model parameters as well as correlations between parameters (latent-trait approach, Klauer, 2010). Parameter estimates obtained with both approaches largely concur.

2. The MPT model can be reparameterised such that r'_E in the reparameterised model represents the difference $r_C - r_E$ in the original model. The interaction can be tested by setting the r'_E parameter equal across groups.

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