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BRIEF REPORT

Selecting decision strategies: The differential role of affect

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Many theories on cognition assume that people adapt their decision strategies depending on the situation they face. To test if and how affect guides the selection of decision strategies, we conducted an online study (N = 166), where different mood states were induced through video clips. Results indicate that mood influenced the use of decision strategies. Negative mood, in particular anger, facilitated the use of non-compensatory strategies, whereas positive mood promoted compensatory decision rules. These results are in line with the idea that positive mood broadens the focus of attention and thus increases the use of compensatory decision strategies that take many pieces of information into account, whereas negative mood narrows the focus of attention and thus fosters non-compensatory strategies that rely on a selective use of information. The results further indicate that gaining a deeper theoretical understanding of the cognitive mechanisms that govern decision processes requires taking emotions into account.

Keywords: Affect; Decision-making; Strategy selection; Online study; Bayesian statistics.

Many theories on cognition assume that people have a repertoire of alternative strategies available to them to solve a given task. This idea of a strategy repertoire or cognitive toolbox provides a fruitful theoretical framework to account for systematic variability in behaviour both within and between individuals. Accordingly, toolbox models can be traced across many areas of research, including judgement and decision-making, cognitive development, and categorisation, to name but a few (Scheibehenne, Rieskamp, & Wagenmakers, 2013).

In decision-making, the idea of an "adaptive toolbox" has received considerable attention (Gigerenzer & Selten, 2001). It assumes that people select qualitatively different strategies depending on the demands of the decision task. A related theoretical framework, sometimes referred to as an adjustable spanner (Newell,

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2005), assumes a continuum in the amount of information search ranging from little to exhaustive search rather than a discrete choice of strategies. A central aspect of both the toolbox approach and the adjustable spanner is that people adapt the way they decide depending on the situation they face.

Here we investigate the influence of different mood states on this adaptation process. Mood states have been shown to systematically affect various higher order cognitive processes including the search and processing of information (Blanchette & Richards, 2010). Thus, specific moods could influence which decision strategies people use to search and combine information and thus help to uncover how individuals adapt their behaviour depending on the environment they face.

THE INFLUENCE OF MOOD STATES ON INFORMATION PROCESSING

Affective states such as moods or emotions have been shown to impact on how people search and process information (Schwarz & Clore, 2007). In the following we will review some of the literature in this domain of research, focusing on aspects that relate to decision-making and strategy selection.

For one, numerous studies show that mood influences the focus of attention when considering information (for a review see Friedman & Förster, 2010). It has been argued that this mood-related change in attention focus has evolved as an adaptive response to the environment. Accordingly, positive mood presumably leads to a broadening of attention because a broad focus of attention enhances the detection of novel incentives or ideas. In contrast, negative affect is expected to induce a narrowing of attention, because when threatened, a narrow attention focus enables concentrating on the problem at hand (Fredrickson & Branigan, 2005; Friedman & Förster, 2010).

Besides the focus of attention, another pathway through which affect might influence decision strategies is by influencing how deeply or thoroughly information is processed. Schwarz (1990) and Schwarz and Clore (2007) suggested that emotions and moods evolved to provide information about the nature of the situation. In particular, positive mood states signal that the current environment is benign and therefore no careful information processing is required. Negative mood states on the other hand provide a stop signal that informs people that they may be in a problematic environment that demands a careful examination. Accordingly, it has been argued that positive mood leads to a shallow and superficial processing of information, whereas negative mood motivates more thorough and effortful information processing. In line with this prediction, Bless, Mackie, and Schwarz (1992) report empirical evidence showing that the strength of an argument only had an influence on attitude change when participants in an experiment were in a negative mood but not when they were in a positive mood, suggesting that participants in a negative mood processed the provided information more deeply. Likewise, depressed individuals have been found to search for more information than non-depressed individuals in a sequential decision-making task (von Helversen, Wilke, Johnson, Schmid, & Klapp, 2011).

Although many studies report effects in line with the idea that affect influences the depth of processing, doubts have been raised that the observed effects are necessarily due to changes in the motivation or ability to process information. As an alternative hypothesis, researchers have argued that people in a positive mood are more likely to rely on the information that is currently dominant or accessible whereas negative mood inhibits the reliance on dominant situational responses, a prediction that is also referred to as the malleable mood effect (Clore & Huntsinger, 2009; Hunsinger, Isbell, & Clore, 2012). The malleable mood effect hypothesis provides an alternative explanation of why people rely on "superficial" information such as stereotypes in a positive mood. Furthermore, it suggests that if positive and negative moods broaden or narrow, the attentional focus will depend on the

attentional scope that is activated by the task (Huntsinger, 2013a).

To further differentiate the effect of emotions on how people make decisions, it is important to distinguish relevant decision strategies in more detail, which we turn to next.

DECISION STRATEGIES

Within the decision-making literature, researchers often distinguish between compensatory and non-compensatory strategies. Compensatory strategies assume that decisions are made by forming overall, holistic impressions of the options under consideration. Importantly, relevant information is combined such that positive values on one attribute can compensate for negative values on other attributes and vice versa. Common examples of such compensatory strategies are the weighted-additive rule (WADD) or the equal-weight rule (EQW). When options are described on several attributes or cues, WADD multiplies the attribute values with their respective importance weights, sums across the products to form an overall evaluation and chooses the option with the highest score. EQW also considers all relevant information but assigns each attribute the same weight. In cases where the options are described along dichotomous attributes, EQW simply requires keeping a tally of the number of positive attributes for each option and then chooses the option with the higher tally.

In contrast to compensatory strategies, non-compensatory strategies assume that no trade-offs between conflicting attributes or cue values take place. For example, the lexicographic (LEX) decision strategy predicts that options are compared based on their attributes and that the attributes are considered in the order of their importance or validity. The most valid (i.e., "best") cue that discriminates between the options determines the choice (Payne, Bettman, & Johnson, 1993). Both compensatory and non-compensatory strategies are frequently used and it is often assumed that people select strategies more or less adaptively depending on the situation they face (e.g., Payne et al., 1993). If all relevant information is readily available, past research has indicated that compensatory strategies often serve as a default that is only abandoned if an alternative strategy leads to more accurate choices (Rieskamp & Otto, 2006).

While there is a debate on which strategy is easier to implement or cognitively more demanding (Bröder & Newell, 2008; Marewski & Mehlhorn, 2011), compensatory and non-compensatory strategies can be distinguished based on the amount of information that needs to be combined and the complexity of the information integration process. Whereas compensatory strategies consider all relevant information, non-compensatory strategies such as LEX require a detailed and selective search for information that focuses on specific details rather than forming a holistic impression. Accordingly, compensatory strategies require a broad focus of attention that encompasses many cues, whereas for LEX, decision-makers need to narrow their focus of attention and to disregard available information, particularly if it is readily available or can be easily retrieved.

It has been argued that the information integration process for non-compensatory strategies is computationally simpler than the information integration process of compensatory strategies because they only consider a limited amount of information and no differential weighting of information to form an overall impression is required (e.g., Payne et al., 1993; Rieskamp & Hoffrage, 2008). In support of the idea that LEX is computational simpler, Mata, Schooler, and Rieskamp (2007) found that a decrease in cognitive abilities in older age was related to less information search and a higher reliance on LEX (but see Bröder & Newell, 2008). Similarly, time pressure has been shown to increase reliance on non-compensatory decision strategies (Rieskamp & Hoffrage, 2008).

THEORETICAL PREDICTIONS

Based on the assumption that strategies are more likely to be selected if they match the information

processes triggered by specific mood states, one can derive diverging hypotheses about how positive and negative mood states influence strategy selection.

With respect to the focus of attention, it can be hypothesised that decision-makers in a positive mood are more likely to rely on compensatory decision strategies as compared to people in a negative mood. That is because if the attention focus of happy people is rather broad, they should be more likely to consider all (relevant) information and hence apply a compensatory strategy. On the other hand, a more narrow focus of attention is expected to foster non-compensatory strategies that rely on only a few relevant details. We refer to these predictions as the *attention hypothesis*.

Alternatively, it could be argued that positive emotions should foster non-compensatory decision strategies such as LEX and that negative emotions promote compensatory strategies such as WADD or EQW. Indeed, to the degree that negative mood increases a thorough and effortful style of information processing, negative mood should foster reliance on compensatory strategies that require a more exhaustive search for information and possibly higher processing costs. Similarly, to the degree that positive mood leads to superficial information processing, it may enhance reliance on non-compensatory strategies that do not require the integration of information and need only little search. We refer to this prediction as the *processing hypothesis*.

Finally, the *malleable mood effect hypothesis* predicts that positive mood will enhance and that negative mood, in particular sadness, will dampen the reliance on the dominant or default response. Thus, to the degree that a broad attentional focus and compensatory rules depict the default strategy when solving a given task, the malleable mood effect hypothesis predicts that positive mood will increase reliance on compensatory strategies, whereas negative mood will decrease reliance on compensatory strategies.

THE PRESENT RESEARCH

To test these hypotheses, we conducted an online experiment where participants repeatedly chose between pairs of options after they had seen movie clips that induced either positive or negative mood. Based on the observed choices following the mood induction, we tested whether participants differed in their use of compensatory or non-compensatory decision strategies, focusing on LEX, a prototypical non-compensatory strategy, and on EQW and WADD as compensatory strategies.

METHODS

Participants

Participants were recruited through mailing lists of volunteers maintained at the Psychology Departments of the University of Basel, Switzerland and Mannheim, Germany (http://www.forschung-erleben.de). Participants within each subject pool had an equal chance to win one of two book vouchers worth 50 EUR each (approx. US$60). The final sample size of 166 participants (50 men and 116 women, mean age 25, *SD* = 8.5) resulted from the number of people who volunteered to participate in the study. Most participants were university students from Switzerland and Germany. Participants were only included in the analysis if they were older than 18 years and finished the study in less than 45 and in more than 10 minutes, the minimum time required for completing the study.

Mood manipulation

The experiment was conducted online using the "Unipark" software (http://www.unipark.com). Mood was manipulated by means of two short video clips. Participants in the positive mood condition (N = 47) saw a clip from the Hollywood movie "Ice Age" (opening scene, 1:59) and a compilation of funny cat videos from the Internet (3:53). In the negative mood condition, participants either saw two clips that aimed at eliciting anger (N = 61) or two clips with a sad content (N = 61). To elicit anger, we used a German television documentary about the mass slaughter of dolphins (3:59) and an interview of a victim raped during war (3:04). For inducing sadness

($N = 58$), we used a video clip from the Hollywood movies "The Champ" (death scene, 2:51) and "Green Mile" (execution scene, 3:57). The video clips were selected based on a literature review (Schaefer, Nils, Sanchez, & Philippot, 2010) and pre-tested on an independent sample of university students. Participants were randomly assigned to one of the three moods and the order of the two video clips within each condition was randomised. There was no "neutral" mood condition because the hypotheses referred to a relative difference between positive and negative mood states.

As a manipulation check after each video, participants rated how much attention they paid to the clip and how much they thought an average viewer would like the clip, both on a scale from one to seven. They further rated the happiness, sadness and angriness of each movie on a scale from one to five. As a manipulation check, at the very end of the study participants rated their current mood on 12 items (four items for each emotion, happiness, anger and sadness) taken from the German version of the PANAS-X (Grühn, Kotter-Grühn, & Röcke, 2010), also on a scale from one to five.

Choice task

Following the mood manipulation, all participants repeatedly decided which of two hypothetical movie options, labelled *A* and *B*, would yield higher sales at the box office.[1] There were 30 choice pairs in total, 15 after each video, presented in random order. Each movie was described by the recommendations of five critics who either had recommended the movie (indicated with a star) or had given no recommendation (indicated with a hyphen). The critics differed in the validity of their recommendations. The validity was expressed as a percentage value indicating how often the movie recommended by this critic yielded higher sales as compared to a non-recommended movie. This percentage was presented on the screen next to each critic and remained constant throughout the experiment. Participants received detailed explanations of the choice task at the beginning of the experiment, including a description of the information board, the recommendation scheme and how to interpret the critics' validity ratings.

The weights used for the implementation of the compensatory WADD model were obtained by rescaling the validities presented on the screen into Goodman–Kruskal validities (i.e., weight = 2 × validity − 1) to control for chance (Reimer & Hoffrage, 2006). The movie pairs were selected such that a simple non-compensatory LEX strategy made opposite predictions to a WADD or EQW strategy (the latter two made similar predictions). Thus, the proportion of non-compensatory choices could be estimated by counting how often the movie predicted by LEX would be chosen; the complementary proportion indicated the proportion of compensatory choices. Finally, participants were asked some demographic questions. Those interested in participating in the voluntary book-voucher lottery were also asked for contact information.

RESULTS

Manipulation check

The ratings of the video clips indicate that the movies mostly matched the intended mood manipulation. The videos in the positive mood condition scored high on happiness and low on sadness and anger while the videos in the negative mood condition all scored low on happiness. In the negative mood condition, sad movies yielded high sadness ratings and somewhat elevated anger ratings whereas movies that aimed at eliciting anger scored high on both, anger and sadness[2]. Together, these results indicate that anger and sadness often co-occurred in the negative mood condition which makes it difficult to draw a clear

[1] A screenshot and a table of all choice pairs can be downloaded from http://scheibehenne.de/onlineSupplementScheibehenneVonHelversen2014.zip.

[2] See supplementary online material for a table with the means and standard deviations of all video ratings.

distinction between the sadness and the anger video clips. As a consequence, and because our main hypothesis does not necessarily require a distinction between anger and sadness, we collapsed participants into one negative mood condition and contrasted this against the positive mood condition. As shown in Figure 1 (upper panel), this contrast confirms a clear difference in the video ratings between the two conditions. Participants in the positive mood condition rated the movies as happier, $t(52) = 35.1$; $p < .001$; Cohen's $d = 6.05$,[3] less sad, $t(62) = -34.6$; $p < .001$; Cohen's $d = -5.97$), and less angry, $t(137) = -15.9$; $p < .001$; Cohen's $d = -2.74$, than participants in the negative mood condition.

Figure 1 (lower panel) further shows the mood ratings measured at the end of the experiment for the positive and the negative mood condition. As can be seen from the figure, by the end of the experiment participants in the positive mood condition were still happier as compared to participants in the negative mood condition, $t(84) = 5.48$; $p < .001$; Cohen's $d = 0.94$, whereas participants in the negative mood condition were significantly sadder, $t(126) = 6.15$; $p < .001$; Cohen's $d = 1.06$, and angrier, $t(142) = 5.58$; $p < .001$; Cohen's $d = 0.96$. Together, these patterns confirm that the mood manipulation was successful.

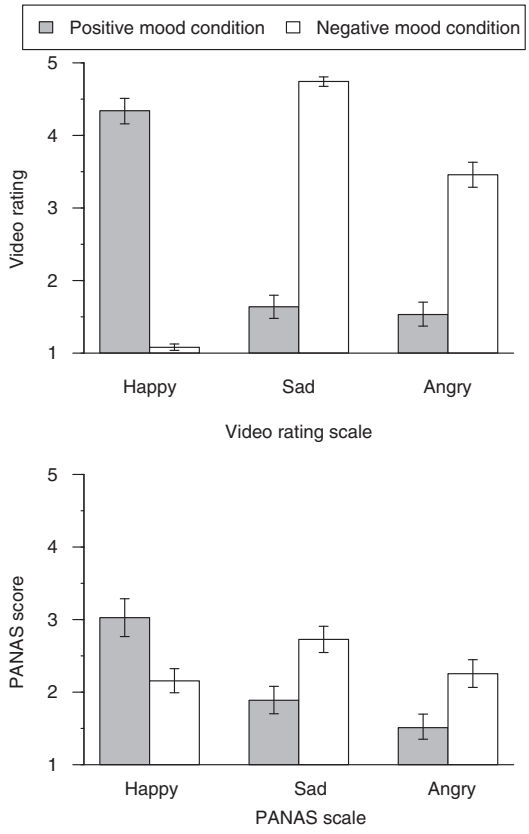

Figure 1. *Bars represent the mean happiness, sadness and anger ratings within each of the two experimental conditions. The upper panel indicates the video ratings averaged across both video clips. The lower panel indicates the emotion ratings at the end of the experiment assessed with the PANAS-X. Error bars indicate 95% confidence intervals bootstrapped across participants.*

Effect on choice strategies

For each participant, we counted the proportion of choices in accordance with the predictions of a non-compensatory decision strategy. In a next step, we estimated whether this proportion differed between the positive and the negative mood condition. This comparison was conducted using Bayesian hierarchical techniques which avoid the methodological limitations of conventional null hypothesis significance testing (Kruschke, 2011). The Bayesian approach was based on a statistical model originally proposed by Kruschke (2011) to compare proportions across groups. As in the original model, we used uninformative prior distributions that did not bias the results towards our hypotheses.[4] The model was estimated using numerical sampling techniques that yield reliable estimates of the posterior distributions.

Figure 2 plots the estimated posterior probability distributions separately for the two experimental conditions and thus allows for a direct comparison between them. For positive mood, the

[3] The degrees of freedom of the *t*-test were adjusted to account for the inequality of the variances between the two groups.

[4] A detailed description of the Bayesian model can be downloaded from http://scheibehenne.de/onlineSupplementScheibehenneVonHelversen2014.zip.

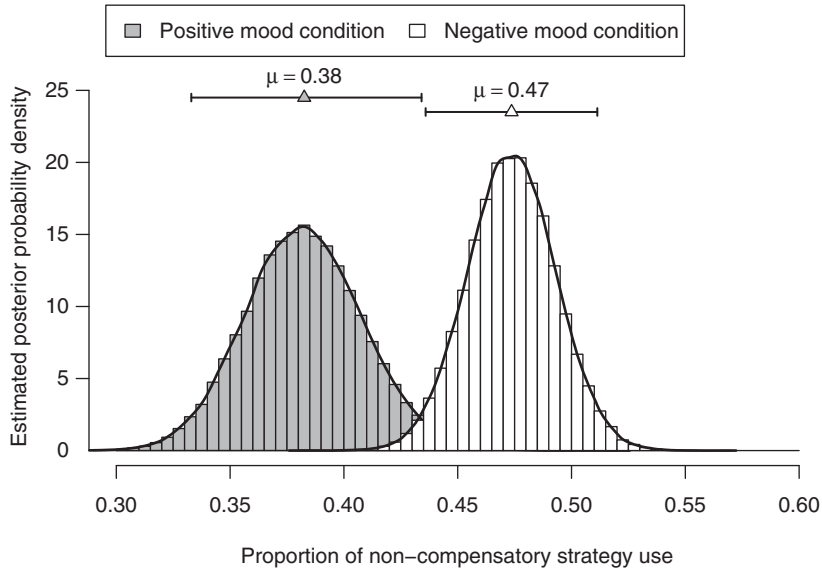

Figure 2. *Group-level posterior estimates of the proportions of non-compensatory choices for the positive and the negative mood conditions. Triangles indicate that posterior means and error bars are 95% highest posterior density intervals. The y-axis represents the estimated posterior probability density. Hence, proportions that score higher on the y-axis are more probable than those with lower scores.*

mean proportion of choices in line with a non-compensatory strategy was estimated at .38 and 95% of the most credible values (i.e., the 95% highest posterior density interval, HDI_{95}) were between .33 and .43. In the negative mood condition, the mean proportion of non-compensatory choices was .47 (HDI_{95}: .44–.51). Contrasting the posterior distributions of the two conditions indicated that 99.7% of the estimated probability mass in the negative mood condition was higher than in the positive mood condition and that the HDI_{95} of this difference excluded zero. Stated differently, this difference yields a Bayes Factor of 3.7, indicating that the odds in favour of the alternative hypothesis are more than three times higher after having observed the data. Together, these results indicate substantial evidence for the hypothesis that the mood manipulation exerted a credible influence on participants' strategy use.

DISCUSSION

Although decision-makers often select their strategies depending on the environment and the situations they face, researchers are only just beginning to understand the mechanisms underlying this selection process (e.g., Bröder & Newell, 2008; Marewski & Schooler, 2011; Rieskamp & Otto, 2006). Our results indicate that mood states exert a causal influence on strategy selection. In particular, participants in a negative mood were more likely to use a non-compensatory LEX decision strategy as compared to participants in positive mood.

These results correspond with the attention hypothesis predicting that mood influences strategy selection by changing the scope of attention. According to Friedman and Förster (2010), negative mood states narrow the focus of attention, which in turn fosters the use of non-compensatory strategies that require more selective attention towards details. In contrast, compensatory strategies such as WADD or EQW require the integration of many pieces of information, which demands a broader focus of attention (cf. Mata et al., 2007; Rieskamp & Hoffrage, 2008) and thus may be inhibited by negative mood states.

Past research indicates that in similar experimental tasks like the one on hand, where the relevant information is readily available and search

costs are low, decision-makers often use compensatory strategies (Bröder & Schiffer, 2003; Mata, von Helversen, & Rieskamp, 2011; Rieskamp & Otto, 2006). In our task, most participants also preferred compensatory strategies over non-compensatory strategies. Thus, to the degree that the use of compensatory strategies—and a broad attentional scope—was the dominant response, the results are also in line with the malleable mood effects hypothesis predicting that positive mood should increase and negative mood should decrease the reliance on currently dominant courses of action (Huntsinger, 2013a; Hunsinger et al., 2012).

One limitation of the current research is that we do not have a neutral condition, which makes it difficult to draw conclusions about the relative effect of negative and positive mood states in comparison to neutral mood. Furthermore, including a neutral condition would allow a more rigorous test for the malleable mood hypothesis because it would permit to measure the dominant response for the decision task in an independent sample.

Cognitive effort and depth of processing

Our results are not consistent with the processing hypothesis according to which negative mood fosters compensatory strategies whereas positive mood fosters non-compensatory strategies because positive affect leads to superficial processing and the reliance on heuristics (e.g., Schwarz & Clore, 2007). There are several possible reasons why we did not find this effect. For one, reformulations of the original work by Schwarz (1990), such as the malleable mood effect hypothesis, have suggested that the link between mood and depth of processing is highly context-dependent. Accordingly, positive mood should only lead to more superficial or heuristic processing if the heuristic is the most accessible or default strategy (Clore & Huntsinger, 2009; Hunsinger et al., 2012). In addition, the relative ease and difficulty of compensatory and non-compensatory strategies have been doubted (Bröder & Newell, 2008). Although non-compensatory strategies like LEX require little integration and processing of information, they may not necessarily require fewer cognitive resources. Indeed, focusing on the most relevant piece of information and screening-out information that is readily available may be cognitively demanding. In line with this, recent implementations of non-compensatory strategies in comprehensive cognitive architectures such as ACT-R suggest that these strategies may not necessarily be as easy as they seem but sometimes require considerable cognitive effort (Marewski & Mehlhorn, 2011). Furthermore, young children seem to have more problems relying on LEX than on a compensatory strategy, possibly because they have difficulty focusing on selective pieces of information (Mata et al., 2011). An alternative interpretation is that participants always applied a WADD strategy but in the negative mood condition changed the cue weighting to the log-odds of the given cue validities. In this case, the weights become highly skewed which makes the WADD predictions similar to LEX.

Besides this, differences in processing effort between the strategies might have been reduced in our study because we did not differentiate between choices of WADD and the simpler EQW strategy. While both are compensatory, WADD presumably requires more thorough information processing because it also takes importance weights into account. Thus, the importance of depth-of-processing might be more pronounced when compensatory choices require the use of only WADD. To test this prediction, choice pairs are needed where EQW and WADD make distinct predictions. In our choice set, there are 4 out of 30 pairs where EQW predicts indifference between the two options while WADD makes a clear prediction, thus providing too little data to draw reliable conclusions.

Distinguishing sadness and anger

In our paper, we focused on the difference between positive and negative moods. A growing body of research, however, suggests that anger and

sadness differ in how they influence information processing (e.g., Huntsinger, 2013b; Lerner & Keltner, 2000). While both moods have a negative valence, anger comes with high physiological arousal and feelings of control, whereas sadness is characterised by a low arousal and control. High levels of negative arousal have been found to reduce cognitive capacity which in turn has been associated with less analytical processing of information, narrowing of attention, more selective information search and reliance on simple cues (e.g., DeSteno, Dasgupta, Bartlett, & Cajdric, 2004), which would predict that anger yields a higher use of non-compensatory strategies as compared to sadness. On the other hand, it has been suggested that anger fosters the reliance on dominant responses (Bodenhausen, Sheppard, & Kramer, 1994; Huntsinger, 2013b), whereas sadness inhibits dominant responses (Hunsinger et al., 2012). This would suggest that angry participants should rely more on compensatory strategies. In our study, it is difficult to disentangle the influence of anger and sadness because the angry video clips also evoked sadness. Future research, however, should tackle the task of distinguishing the effects of anger and sadness on strategy selection, for example, by using mood manipulations that trigger one mood but not the other.

CONCLUSION

Researchers are only beginning to understand the mechanisms that can explain how decision-makers adapt their strategies depending on the situations they face. In line with past research, our results indicate that affect plays a crucial role in this process. In particular, we found that negative mood, notably anger, fosters the use of non-compensatory LEX decision strategies that rely on selective pieces of information whereas positive mood fosters the use of compensatory strategies that take more information into account. Together, these results suggest that gaining a deeper theoretical understanding of the cognitive mechanisms that govern decision processes requires taking affect into account.

Supplementary material

Supplementary Table A1 is available via the 'Supplementary' tab on the article's online page (http://dx.doi.org/10.1080/02699931.2014.896318).

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