The Influence of Mood on Decision-Making

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For Hyunjoo.

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Summary

The experience of negative or positive moods is ubiquitous in everyday life. Moods shape decisions, but often remain unnoticed in the background. This dissertation systematizes the theory of mood influence and shows how the effects of moods unfold in different domains of decision-making. The multitude of emotion theories is organized in this thesis along the three frameworks. First, content-related theories assume that moods influence the content of thoughts by incorporating new information into the decision-making process. Secondly, process-related theories focus on changes in information processing. Thirdly, regulation-related theories concern the study of the motivation to maintain positive and avoid negative moods. With regard to the empirical work, the dissertation comprises four experimental studies that manipulated the mood of the participants and examined the differences in their decisions or decision-making strategies.

The first project was dedicated to the study of decision strategies in a multi-attribute decision task. The experiment was designed to measure the use of compensatory and non-compensatory strategies in different moods and with different types of information representation (open and closed information boards). The findings supported the mood-as-information theory in the way that positive mood was associated with the use of non-compensatory strategies and negative mood with the use of compensatory strategies. These results suggest that mood impacts the integration of information by signaling the current state of the environment and the processing efforts required for the task.

The second project extended the research question to decisions based on experience. The foraging paradigm was applied to investigate how mood is related to exploration decisions. The participants of the experiment played the foraging task, where they had to decide whether to exploit the current depleting patch of resources or explore a new one. The mood was manipulated in a between-subjects design with the music, pictures, and cover story. The results showed that the informational value of mood influenced decisions whether to explore or exploit the current environment, as the negative mood was generally associated with higher exploration. These findings also support the mood-as-information theory, which considers the mood as a source of information about the current state of the environment.

The third project examined the mechanisms of mood regulation in relation to the default bias. In the experiment, participants in different moods faced different types of defaults: maintaining the status quo or introducing changes. The results demonstrated that the mood-regulating motivation influenced the acceptance of the default option. The preference for the status quo was stronger among people in the positive mood, while people in the negative mood preferred a change of tasks. This finding suggests that only the mood-as-information theory of mood is not sufficient to explain behavior, but the mood-regulating motivation should also be taken into

account in emotion research.

The fourth project applied the ideas of mood regulation to the methodological question of non-compliance in online studies. The participants of the online-experiment watched mood-inducing videos while the time spent on the web page was measured. It was found that people avoided the negative mood manipulation more often than the positive one, which, in turn, influenced the reliability of mood induction. This project demonstrates that objective behavioral measures of the time in Internet-based experiments can be used to improve the quality of methods.

In summary, this work has combined decision paradigms and mood theories to clarify mechanisms of interaction between affect and cognition. The thesis concludes that mood influences the decision-making through the informational value of mood and the mood-regulating motivation. The informational value of mood can cause the congruency effect – more favorable judgments in a positive than in a negative mood state. At the same time, mood can influence the way of information processing. In particular, the amount of information integrated into a decision is higher in negative than in positive mood. Finally, mood-regulating strategies can impact decisions in a way that people in positive mood want to protect their mood, while people in negative mood want to repair their mood. By specifying the mood mechanisms with regard to decision contexts, this thesis contributes to an increasing volume of research that integrates affect-related topics into the field of cognitive psychology.

Articles

This cumulative dissertation consists of two published articles and two manuscripts submitted for publication. The papers are discussed in the main text of the thesis and attached to it in the same order as listed below.

(1) Shevchenko, Y., & Bröder, A. (2018). The effect of mood on integration of information in a multi-attribute decision task. *Acta Psychologica, 185*, 136-145.

(2) Shevchenko, Y., & Bröder, A. (2018). *The effect of negative mood on exploration in decisions from experience.* Manuscript submitted for publication.

(3) Shevchenko, Y., von Helversen, B., & Scheibehenne, B. (2014). Change and status quo in decisions with defaults: The effect of incidental emotions depends on the type of default. *Judgment and Decision Making, 9(3)*, 287.

(4) Shevchenko, Y., & Bröder, A. (2018). *Non-compliance with online mood manipulations using film clips: How to detect and control for it.* Manuscript submitted for publication.

Chapter 1

Introduction and theoretical background

Moods in decision research have been ignored for many years, although decisions made in an emotional state are ubiquitous in daily life. The areas of emotion and decision-making research have remained mostly unfamiliar to each other if one considers the coverage of topics in journals and conferences. Whereas decision researchers have designed sophisticated paradigms and constructed cognitive models, emotion researchers have focused on affective states per se, often without applying them to a decision. This work is an attempt to develop an interdisciplinary study that not only connects theories of both fields but also combines paradigms of decision-making and methods of mood manipulation from emotion research.

The influence of mood on decision-making is an important question to study given the pervasiveness of mood in everyday life. Mood does not spur an immediate action, as intense emotions, such as anger and fear, can do, but it changes the way people think (Martin and Clore, 2001). Thus, the effect of mood is less visible but more enduring and complex. In addition, many decisions are made in contexts that elicit intense positive or negative affects. For instance, euphoria on the stock market can create overconfidence and fuel the growth of financial bubbles (Shiller, 2015). On the other hand, mood swings caused by illness or the perception of future risks can bias health-related decisions (Salovey and Birnbaum, 1989). By applying paradigms of decision-making, this work expands knowledge of the mechanisms by which mood can influence behavior. The results of this dissertation can be generalized to other situations, which can stimulate the development of new hypotheses.

The current state of the field is that no overarching theory explains how moods impact decisions. The effect of mood can take different paths depending on many factors including the type of decision and cognitive activity that the decision requires. As will be argued in this dissertation, mood can influence the content of thoughts, the way of information processing, and the motivation of mood regulation. Understanding some mechanisms underlying this influence is the goal of this work. Three different decision-making paradigms are at the heart of this thesis: the multi-attribute decision task, the exploration-exploitation trade-off, and the default heuristic. Three empirical studies characterize the influence of positive and negative mood in each of these paradigms. An additional study addresses the methodological problem of inducing mood on the Internet.

The introductory chapter gives an overview of the concept of mood and presents

three major theoretical frameworks: content-, process-, and regulation-related influence of mood. Furthermore, methodological questions such as mood induction and mood measurement are discussed in order to establish a basis for the empirical studies. Finally, the last section describes the online-experiment methodology in relation to mood induction techniques.

1.1 Mood

Emotion research is notoriously known for the confusion of different definitions of affective experience. In order to create a shared conceptual framework for the empirical studies, this section reviews the definition of mood and compares it with other affective phenomena: traits and emotions. Moreover, the distinction between positive and negative moods is discussed, as the effects of these two moods are contrasted in this work.

1.1.1 Defining mood and emotion

Affective states are characterized as reactions to significant life events (e.g., losses, frustrations, or dangers) that co-occur on different levels: subjective feelings, physiological activation and facial expressions, and help people to adapt to the environment (Lazarus, 1991; Reeve, 2009). A better adaptation is possible, for example, through the capacity of affect to facilitate learning and prediction of future situations (Damasio and Carvalho, 2013). The synchronization of cognitive, somatic and motivational responses is underlined in many emotion theories as a critical feature of affect, e.g., in the *component process model* (Scherer, 2005). How the components of affect relate to each other is a matter of debates between theories. The "bottom-up" and "top-down" approaches can be delineated to describe the subjective affective experience (Keltner and Lerner, 2010). The bottom-up approach emphasizes the role of the physiological system that detects significant changes in the environment and restores homeostasis (Damasio and Carvalho, 2013). Somatic alterations serve as an input for the ongoing evaluation of the environment and generate subjective emotional experience (Craig, 2002). On the contrary, the top-down approach considers the cognitive system as the main driver of emotional experience, where emotions are constructed through processes based on language and knowledge representation (Russell, 2003). The confrontation between "top-down" and "bottom-up" approaches seems obsolete in view of the neuroscience findings that both descending and ascending connections in the brain are important for affective experiences (Derryberry and Tucker, 1992). Descending paths shape the affective experience through cognitive processes such as attribution and appraisal. Ascending connections, on the other hand, allow the affect to influence cognition. From this perspective, the focus of this work on how moods influence decision-making behavior is more compatible with the ascending, or "bottom-up" approach.

The range of affective phenomena is broad and diverse. An optimistic person may feel gloomy on a particular day but can be cheered up after meeting a friend. For research purposes, the affective phenomena can be classified into traits, moods, and emotions as different *levels of affect* (Rosenberg, 1998). Whereas affective traits are stable predispositions for certain types of emotional reactions, moods and emotions are transient states that fluctuate depending on the environment. In contrast

to traits, which set the threshold in the background for the occurrence of certain affective states, moods and emotions can be consciously experienced in the foreground. Emotions are intense, acute, and short-lived experiences, whereas moods are weak, diffuse, and stable in time affective states (Cohen et al., 2008). While emotions are evoked by an event, moods usually lack specific triggers in the environment and represent a more general evaluation of the current state. In an experimental study, the effect of an emotion on behavior should be examined during or immediately after the emotion induction. The changes in mood, on the contrary, could have a more lasting impact and influence decisions even after some time.

As far as the effect of moods and emotions on behavior is concerned, one would expect people to be more affected by stronger emotions than diffuse moods. However, since emotions are more focused and consciously present, their effect could be limited in time (Rosenberg, 1998) or downgraded by self-regulation strategies (for a review, see Gross, 1998). For instance, a detached, analytical attitude toward an event can decrease stress and arousal in reaction to threats (Dandoy and Goldstein, 1990). Moods, on the other hand, are expected to have an indirect but more far-reaching influence on decisions due to their spread and the lack of an obvious trigger to which they can be attributed Rosenberg (1998).

1.1.2 Types of mood

There are two rival theoretical approaches to classifying affective experience. One is the dimensional approach that characterizes affective states as values along one or more continua. An example of the dimensional approach is the circumplex model of affect (Russell, 1980). This model suggests that affects emerge from two basic systems, one of which is the valence (a pleasure – displeasure continuum) and the other is arousal. Any affect can be seen as a mixture of these two dimensions. The alternative approach of "basic emotions" considers affects as discrete and independent entities. A number of basic affective states should have their unique facial expressions (Ekman, 1992) or neurophysiological representation in the brain in the form of neural structures and pathways (Panksepp, 2004). The "basic emotions" approach was criticized for not showing a one-to-one correspondence between a discrete affective state and an underlying neural system (Posner et al., 2005). Instead, the dimensional approach assumes that people interpret their physiological experience of valence and arousal, and this interpretation evokes an affect. With cognitive development and acquisition of experience, people learn to differentiate affective states on a finer scale. Empirically, this approach is supported by psychometric studies (e.g., factor analysis of subjective reports), which yield models with two dimensions of affective experience that correspond to valence and arousal (Feldman Barrett and Russell, 1998).

Following the dimensional approach, moods can be placed along the valence continuum and described as negative, aversive or positive, satisfying experience. However, the second dimension of arousal is not applicable to moods, since moods are characterized as slightly intense, diffuse affective states (Rosenberg, 1998; Schwarz, 2012). In fact, the induced mood in the previous research was mostly positive or negative (Westermann et al., 1996). Although some authors criticized the exclusion of the arousal dimension (e.g., Han et al., 2007; Raghunathan and Pham, 1999; Tiedens and Linton, 2001), this criticism pertains to the analysis of emotions, but

not moods. Furthermore, the positive vs. negative continuum corresponds to such fundamental evaluation of the current situation as benevolent or harmful, so that this core appraisal does not imply awareness or the principle of rationality (Lazarus, 1982).

This thesis focuses on the impact of mood on decision-making in contrast to studying the effects of specific emotions. The permeation of mood into the spheres of cognition makes it socially relevant to study the interaction between cognitive and emotional aspects of decision-making. Identifying mechanisms of this relationship can contribute to a better understanding how people make decisions in emotionally challenging situations: e.g., health-related choices, personal investments. In order to define research questions and hypotheses for the empirical studies, the next section reviews major theories of the influence of mood on decisions.

1.2 Theoretical frameworks of mood influence

There is an ample number of theories that explain how mood influences decision-making. In order to organize them, this thesis distinguishes between three theoretical frameworks. First, the distinction between informational and processing style accounts (Keltner and Lerner, 2010) is used to describe the mechanisms of the content- and process-related influence of emotions. Content-related theories assume that moods influence the content of thoughts by allowing new information to enter the decision-making process. Process-related influence theories, on the other hand, focus on changes in the way information is processed. The third theoretical approach concerns the study of mood-regulating strategies that aim to maintain positive and avoid negative moods. These theoretical frameworks emphasize different aspects of decision-making (e.g., judgment criteria, decision-making strategies, and motivation), which are not mutually exclusive and can occur together. In the following, each theoretical framework is considered in more detail.

1.2.1 Content-related influence of mood on decision-making

The content-related influence is a generic term used in this work for theories that assume that mood directly influences the judgment of the object as positive or negative. There are theories that emphasize memory retrieval processes (Bower, 1981) and informational theories that consider mood as a source of information about the object to be judged (Martin et al., 1993; Schwarz and Clore, 1983; Slovic et al., 2004).

The congruency effect is a robust finding in emotion research. People in positive mood make more favorable judgments than people in negative mood. For instance, subjective well-being is influenced by the current mood (Schwarz and Clore, 1983), so that people in a positive mood state are more satisfied with their lives. The congruency effect was demonstrated in various domains: e.g., consumer behavior (for a review, see Cohen et al., 2008) and political judgments (Forgas and Moylan, 1987).

The mechanism explaining the congruency effect is less clear than its empirical demonstration. One of the first theories, which emerged from memory research, was an *associative network theory* of memory and emotion (Bower, 1981). The theory assumes that memories can have associative connections with affective experience.

For example, memories of the first kiss can have a link to the joy that was experienced at the event. Later, the activation of an emotion node also distributes the activation to the memories to which it is connected, so that the emotion of joy can evoke memories of the first kiss. Empirical support for this theory was provided by studies, which demonstrated that people tend to recall information from memory that is consistent with their current mood (Bower, 1981). With regard to mood, this theory assumes that positive and negative moods also have connections with memories. When people are in a certain mood, it is easier for them to access memories of the same valence.

However, the general premises and applicability of the associative network theory for decision-making were questionable (e.g., Niedenthal and Setterlund, 1994). The theory assumes an automatic influence of mood on cognitive processes (Bower, 1981). However, the study of Schwarz and Clore (1983) showed that the congruency effect depends on awareness about the source of the mood. The authors proposed a simpler explanation, which was originally coined as *feeling-as-information theory*, but was also known as the *mood-as-information* model with respect to moods (Schwarz and Clore, 1983). People use their mood as a source of information about the current situation. If it is positive, then the judgment will also be positive. As soon as people realize that their mood has nothing to do with the object of evaluation, they can correct and adjust their judgments.

Why are people affected by an incidental mood and take their current feelings for granted? Humans perceive their current experience as being related to what is happening at the moment (Higgins, 1998). Although it is not always rational, the reliance on feelings could be adaptive, since feelings based on previous experience are typically relevant to a decision (Damasio, 1994). Furthermore, in a complex decision situation, the use of an emotional response (i.e., whether I like it or not) is a heuristic that allows comparing values of different decision options without the need for extensive elaboration of features, weights, or probabilities (Slovic et al., 2004). Other metacognitive experiences, such as feelings of effortlessness or physical arousal, can be used in a similar way as an additional input of information for a decision (Schwarz, 2012).

The further development of the mood-as-information theory has shown that the use of mood as a source of information depends on the question or the judgment criteria: e.g., whether a person enjoys the task or is satisfied with the result (*mood-as-input theory*, Martin et al., 1993). When happy people had to judge how sad a story was, they evaluated it more negatively since they did not feel touched (Martin et al., 1997).

The idea that people see and judge the world through the lenses of their emotional state is also reflected in the basic emotions approach, which studies specific effects of each emotion. From the perspective of the *appraisal-tendency framework*, it is not sufficient to measure the valence of an emotion to explain its predispositions (Angie et al., 2011; Han et al., 2007). Specific emotions influence judgments in a way that is consistent with their underlying appraisal tendency but only in domains that are related to the appraisal (Keltner and Lerner, 2010; Lazarus, 1991). Anger, for example, affects judgments of guilt and fairness, since the origin of anger is insult and injustice. The application of the appraisal theory has been studied, for example, in political judgments. Here, anger consequently leads to more support for punitive policy because of the appraisal of individual control and the tendency

to take action against the responsible party. In contrast, fear results in a preference for more protective measures, and sadness increases the support of social welfare (Angie et al., 2011).

In summary, the content-related theoretical framework emphasizes the informational value of moods and examines how people use and reflect on their moods in decision-making. Although the appraisal-tendency framework demonstrated benefits of studying specific emotions, this thesis focuses on moods that vary on the valence dimension.

1.2.2 Process-related influence of mood on decision-making

Mood not only influences *what* people think about the object to be evaluated but also *how* they think about it (e.g., how much information is taken into account). Previous research has been characterized by the debate between theories regarding positive mood as a benevolent booster of information processing (Fredrickson, 2001; Isen, 2001) and theories emphasizing the more frequent use of heuristics in a positive mood (Bless et al., 1996; Schwarz, 2000).

Isen (1984) argued that the impact of positive vs. negative affect is asymmetric since positive memories have a broader network of associations than negative ones. As a result, positive mood primes more diverse and unusual associations (Isen et al., 1985). In subsequent research, Isen (2001) regarded positive emotions as a benevolent and enhancing factor that leads to a more efficient decision-making process.

In the *broaden-and-build theory* of Fredrickson (2001), the influence of positive emotions is explained by evolutionary mechanisms – whereas negative emotions restrict attention to a problem, positive emotions, such as joy, interest, and contentment, expand attention. The broader attention focus increases the repertoire of possible behavioral reactions and promotes creativity and playfulness.

The effect of positive mood was not always seen as benevolent. As Mackie and Worth (1989) argued, broader associations in the positive mood could impair cognitive capacity. Too many associations could distract people in a happy mood from careful information processing. As supporting evidence for this theory, it was found that people in a positive mood did not differentiate strong and weak arguments under the exposure to persuasive messages for a limited amount of time (Mackie and Worth, 1989).

The extension of the mood-as-information theory explored the effect of mood not only on the judgment but also on the style of information processing (*cognitive tuning hypothesis*, Schwarz, 2000). Since the mood indicates the current state of the environment, cognitive processes are tuned to the requirements of the present situation. Sad moods signal that something is going wrong, which is why the processing style is more systematic than usual, and specific details of the apparently problematic situation are carefully considered (i.e., bottom-up processing style). Happy moods, on the other side, provide information about a benign environment so that people can use routines, heuristics, and existing knowledge structures (i.e., top-down processing style). In this way, happy people may have less focused attention, but higher playfulness and creativity that allow exploring new situations.

Similar ideas were proposed by Frijda (1988) that mood can signal the safety of the current situation (*safety-signal theory*). Also, in the control theory of self-

regulation (Carver and Scheier, 1990), mood indicates whether additional efforts are needed to reach a goal. The positive mood signals that progress is being made so that resources can be used for other tasks. The negative mood shows that progress remains unsuccessful, which is why additional efforts should be applied to reduce the discrepancy between the goal and the current state.

The idea of limited cognitive capacity in the positive mood (Mackie and Worth, 1991) and the different processing abilities in positive and negative moods (Schwarz and Bless, 1991) was later empirically refuted by showing that being in a good mood does not decrease cognitive capacity but rather improves performance on the secondary task in the dual-task situation (Bless et al., 1996). As Schwarz (2012) noted, task requirements or goals can also activate more analytic processing in happy people, so that the mood-as-information theory does not imply that happy people are unable or unwilling to engage in more elaborate or systematic decision-making strategies.

An alternative view of moods was proposed in the *dual-force framework* (Fiedler et al., 2003). Here, positive or negative moods are regarded as conditioned stimuli that evoke learning states, which are similar to actual appetitive and aversive conditions. Behavior in pleasant situations is distinguished by exploration and curiosity, which drives assimilation – the imposition of internalized structures on the environment. On the other hand, aversive situations elicit avoidance behavior and error minimization that causes accommodation – the gathering of new information and changing existing structures.

To summarize, the process-related theories agree that a positive mood does not necessarily presuppose the "lazy" processing of information. However, the mood-as-information approach expects happy moods to promote the use of heuristics, while the broaden-and-build theory emphasizes the extended attention span in a positive mood. These assumptions may conflict in situations where heuristic decision-making implies limited information processing. In order to test these contradictory hypotheses, the first study of this thesis has used a multi-attribute decision task paradigm and analyzed the differences in decision-making strategies in positive and negative moods.

Furthermore, if one considers both content- and process-related effects of mood, the relationship between these mechanisms is not clear: if mood biases the judgment according to the congruency effect, does it also change the way of information processing? In particular, the combination of these mechanisms should play an important role in decisions from experience, as these decisions involve the accumulation, integration, and evaluation of continuously collected, emotionally charged information. Previous studies have shown that the mechanisms of experience-based decisions can differ from description-based decisions (Hertwig et al., 2004). Therefore, the second study of this dissertation used the foraging task to examine the assumptions of the content- and process-related frameworks.

1.2.3 Regulation-related influence of mood on decision-making

In general, the philosophy of hedonism views humans as creatures that seek pleasure and avoid pain. Although the general premises of hedonism were criticized as misleading for building a psychological theory (Erber and Erber, 2000), they were fruitful for the development of motivational theories. Already in early studies, the

self-regulation aspect of emotions was underlined, e.g., through the "negative-state relief" mechanism (Cialdini et al., 1973). Since the experience of an aversive negative state motivates people to feel better again, the altruistic behavior can be a way to achieve the goal of mood improvement.

Isen (2000) points out the ability of positive affect to trigger mood-regulating behavior. Together with many other beneficial effects of increased flexibility, cognitive elaboration, creativity, and variety-seeking, positive emotions also elicit a tendency toward self-protection and safeguarding of the state of happiness. In empirical studies, the mood-maintenance idea was supported by the finding that if the situation was dangerous and a participant could lose something important, happy people preferred not to engage in the task (for review, see Aspinwall, 1998). For decision-making, it means that a person may avoid a decision as a consequence of mood regulation motivation. Therefore, it is important to analyze the relationship between moods and decision avoidance biases such as status quo bias, omission bias, and choice deferral (Anderson, 2003).

The extent to which the mood protection effect expands is unclear. In the *hedonic contingency framework* (Wegener and Petty, 1994), people in positive mood are motivated to avoid processing potentially depressive messages. On the contrary, Isen (2000) emphasizes that these cautious or avoidant reactions to negative material are the result of rational decisions of happy people, but not an automatic process or a blinding bias. As soon as a task requires attention to the negative content, the mood-maintenance effect should disappear.

The further development of the self-regulation ideas consisted in examining the effect of additional factors to reconcile previous contradictory empirical results. In the *moderated hedonic contingency hypothesis* (Aspinwall, 1998), the attention of people in positive mood to negative information is moderated by the usefulness of the information with regard to their goals. In other words, people in a positive mood would not consider negative information unless it is related to their aims.

The motivation to regulate the mood also depends on age and personality traits of participants (Larcom and Isaacowitz, 2009). Older adults might be better in emotion regulation compared with younger adults. Previous research has shown that older participants show preferences for attending to positive information and are more efficient in using positive reappraising for negative stimuli (Phillips et al., 2008). Moreover, people with a lower anxiety trait and a higher level of optimism are better in emotion regulation (Larcom and Isaacowitz, 2009). According to resource-based approaches to self-regulation, another factor that can play a role in personally relevant decisions is the level of subjective self-worth (Aspinwall, 1998). If the self-worth has fallen below the threshold (*hedonic deficit*), people are motivated to engage in mood-repairing and esteem-enhancing behavior. On the contrary, if the self-worth is above the threshold (*hedonic surplus*), people can use resources to consider negative goal-relevant information.

In a study of the impact of positive and negative moods on decision-making in consumer research, Andrade (2005) proposed the integrative framework for evaluation and regulation processes. The evaluation process denotes the congruent use of mood during a judgment (by associations or inferential reasoning) and changes in the processing style, which is similar to the content- and process-related mechanisms described in this thesis. The regulation process, on the other side, represents the tendency to pursue or protect a good mood. In the experimental study, Andrade

(2005) has demonstrated that the presence of a mood-changing cue can trigger the affect regulation process. For example, if the mood-changing cue was present (i.e., participation in a tedious survey in return for receiving a product), the willingness to try the product decreased both in negative and positive affect conditions. In this way, evaluation and regulation processes took place: people in the negative mood were reluctant because they rated the product less favorably, and people in the positive mood refused the offer since they wanted to protect their mood.

Following the idea of examining process- and regulation-related effects of mood, the third study of this thesis focuses on heuristic decision-making, i.e., the default and status-quo biases. While the mood-as-information theory predicts that people in a positive mood are more susceptible to take a default option regardless of its consequences, the mood-maintenance approach expects them to pay attention to the emotional outcomes of the decision and reject defaults that induce changes more often than defaults that maintain status quo.

The introduction has presented three main theoretical approaches for studying the impact of mood on decision-making. To facilitate the comparison between the theories, the main ideas and their relevance to the current research are summarized in Table 1.1. The next section of the dissertation will introduce the methodology of emotion research relevant to the empirical studies.

Table 1.1: Theoretical frameworks of mood influence

Theory	**Main idea**	**Relevance to the current research**
Content-related influence of mood on decision-making		
Associative network theory of memory and emotion (Bower, 1981)	Memories have associative connections with affective experience. The activation of a mood node distributes the activation to the memories to which it is connected.	
Mood-as-information theory (Schwarz and Clore, 1983, 2003)	People use their mood as a source of information about the current situation. Positive mood engenders more favorable judgment than negative mood.	The assumption of this theory (i.e., congruency effect) was investigated in Study 2 to find out the relationship between exploration and mood.
Mood-as-input theory (Martin et al., 1993)	The use of mood as a source of information depends on the question or the judgment criteria.	

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Theory	**Main idea**	**Relevance to the current research**
Process-related influence of mood on decision-making		
The theory of the beneficial effect of positive mood (Isen, 2001; Isen and Daubman, 1984)	Positive mood is a benevolent and enhancing factor of the decision-making process.	The assumptions of this theory were tested in Study 2 to determine whether positive mood increases the efficiency of exploration.
Broaden-and-build theory (Fredrickson, 2001)	Whereas negative mood restricts attention to a problem, positive mood broadens attention and increases the repertoire of possible behavioral reactions.	This theory was tested against the mood-as-information theory in Study 1 and Study 2 to find out how mood influences information processing in the multi-attribute decision and in the foraging task.
Limited cognitive capacity theory (Mackie and Worth, 1989)	Positive mood impairs cognitive capacity because of distraction from a wider range of associations with positive emotions.	
The extension of the mood-as-information theory (cognitive tuning hypothesis, Schwarz, 2000)	Negative moods signal a problem, which is why the processing style tends to be more analytic and systematic. On the contrary, positive moods inform about a benign environment so that people can use routines and existing knowledge structure.	This theory was tested against the broaden-and-build theory in Study 1. In addition, the assumptions of this theory (i.e., processing differences between moods) were examined in Study 2 and Study 3.
Safety-signal theory (Frijda, 1988)	Mood signals the safety of the current situation.	
Control theory of self-regulation (Carver and Scheier, 1990)	Mood indicates whether additional efforts are needed to reach a goal.	

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Theory	**Main idea**	**Relevance to the current research**
The dual-force framework (Fiedler et al., 2003)	Moods are conditioned stimuli that evoke appetitive or aversive learning states. Behavior in pleasant situations is distinguished by exploration and curiosity, while unpleasant situations elicit avoidance behavior and error minimization.	
Regulation-related influence of mood on decision-making		
Negative-state relief theory (Cialdini et al., 1973)	Aversive negative states motivate altruistic behavior in order to reduce the negative affect.	
Mood-maintenance theory (Isen, 2000)	Positive emotions elicit a tendency toward self-protection and safeguarding of the state of happiness.	
Hedonic contingency framework (Wegener and Petty, 1994)	People in positive mood are motivated to avoid processing potentially depressive messages.	
Moderated hedonic contingency hypothesis (Aspinwall, 1998)	The attention of people in positive mood to negative information is moderated by the usefulness of the information with regard to their goals.	
Resource-based approach to self-regulation (Aspinwall, 1998)	The level of subjective self-worth moderates the effect of mood on the mood-repairing motivation. If the self-worth has fallen below the threshold, people are motivated to engage in mood-repairing and esteem-enhancing behavior.	

Continued on next page

Table 1.1 – *Continued from previous page*

Theory	Main idea	Relevance to the current research
Affect regulation theory (Andrade, 2005)	The presence of a mood-changing cue in a decision situation can trigger the affect regulation process, i.e., protecting the current mood in the positive state and improving the mood in the negative state.	This theory was tested in Study 3 in contrast with the mood-as-information theory to find out how mood impacts the default bias. Also, the assumptions of this theory were investigated in Study 4 with regard to non-compliance in Internet-based experiments.

1.3 Methods

The aim of the following section is to describe the methods used in the empirical studies for mood induction and mood measurement. Realizing that description of the methods could easily evolve into a thorough and lengthy report, the following section illustrates chosen methods and explain their rationale rather than fully reviews them.

1.3.1 Mood induction

Three of the four experimental studies induced mood through the use of short movie clips before the experimental task where decision-making processes were measured. The rationale, which is further explained in detail, is that the film method is one of the most efficient mood induction methods. A different mood manipulation was used in Study 2 due to the nature of the foraging task, which lasted for 20 minutes. In this experiment, we combined music and images to change the mood during the task.

To elicit moods and emotions in experiments, researchers have invented a number of techniques, including reading a story, listening to music, watching images or videos, or engaging in social interactions. According to the meta-analysis done by Westermann et al. (1996), one of the most effective methods to influence the mood is to show a short movie clip. Movies are good at getting participants' attention, and they can generate strong emotional reactions. In addition to its efficiency, the video method is also a fast way to change the current mood – a movie clip is usually 1-3 minutes long. To compare different mood conditions, videos are matched on the dimensions of the length of the clip, its intensity, complexity, core themes, presence and number of people, color, brightness, picture motion, and theoretically critical categories, such as arousal level (Rottenberg et al., 2007). Nature scenery, animals, or travel movies are used in a baseline, neutral condition. As an additional control variable, it is recommended to ask participants whether they have ever seen the video before. A disadvantage of the film method is that priming effects can occur when the experimental task is semantically related to the content of the video. The method also has similar concerns as other mood induction techniques: i.e., specificity of induced affect, individual differences in sensitivity to different mood

induction contents, and demand effects. In addition, the changes in mood after positive and negative mood manipulation are not symmetrical, as the induction of a negative mood has a larger effect size than a positive mood across different methods (Westermann et al., 1996).

The music method causes less semantic priming since it is not as object and event-oriented as films or images. The music can also be played during the decision task to ensure continuous mood manipulation. Among musical compositions, classical compositions of 2-6 minutes are usually chosen, which can be presented one after the other in an experiment. Researchers can rely on pre-selected samples or give participants the opportunity to select music that they associate with a particular mood. The disadvantage of music induction is that it takes more time than with images or films to change the mood, e.g., 15-20 minutes on average (Eich et al., 2007). For this reason, the combination of music with other mood induction techniques can be used to increase the impact. For example, Kim et al. (2004) combined background music with a narrated story, light and color changes to elicit sadness, anger, stress, or surprise.

The images method has been used more often to induce a discrete emotion than positive or negative moods (Kory and D'Mello, 2015). The advantage of the method is the high level of experimental control and standardization that can be achieved with validated images: e.g., International Affective Picture System (IAPS, Bradley and Lang, 2007), Geneva Affective Picture Database (GAPED, Dan-Glauser and Scherer, 2011). However, since emotional reactions to pictures are shorter and more transient, the effect size of the image method is smaller than that of the film method. Therefore, the combination of music and image methods enables a more consistent and lasting change of mood during the experimental task.

Although the validated mood manipulation techniques were implemented in the empirical studies, a manipulation check was required to ensure that the desired mood has been successfully induced. For this purpose, mood measurement methods were used.

1.3.2 Mood measurements

Objective and subjective methods can be applied to measure the effect of mood manipulations (for a review, see Quigley et al., 2014). The objective measurements in the brain and body provide information about emotional processes, although with some methodological limitations. The activity of the autonomic nervous system, such as heart rate or skin conductance, can reflect the effect of emotions on the energy balance and homeostasis, but cannot exactly represent the affect itself. Quigley et al. (2014, p. 236) expressed this idea as follows: "peripheral physiology was not engineered to help us express emotion – it evolved for homeostasis and metabolic regulation". In addition, facial expressions (measured as muscle activity or observer ratings) are developed evolutionarily as communicative symbols, but not (solely) as an indicator of emotions. The facial expressions depend on the social context such as the real or implied presence of another person (Russell et al., 2003). Measuring the activity of the central nervous system can provide informative data on the processes that can be detected with a very high temporal (e.g., EEG, MEG) and local resolution (e.g., fMRI). However, objective methods of measurements show smaller effect sizes than self-report data, which may be due to measurements errors

(Westermann et al., 1996). To evaluate the content of feelings, there is no other way than to ask people to characterize their subjective experience.

There are a number of questionnaires used to assess the subjective experience: e.g., Multiple Affect Adjective Check List (MAACL, Zuckerman and Lubin, 1965), Beck Depression Inventory (BDI, Beck et al., 1961), Self-Assessment Manikin (SAM, Bradley and Lang, 1994), or two-dimensional affect grid (Russell et al., 1989). One of the most common methods is to present a series of adjectives and ask participants to evaluate how well each word describes their current emotional state: e.g., Positive and Negative Affect Schedule (PANAS-X, Watson and Clark, 1999), Differential Emotions Scale (DES, Izard et al., 1993).

When applying a self-report measure, a researcher must solve a dilemma – the mood manipulation check is necessary to claim that a mood change has taken place, but it may potentially alter the effect. Subjective scale ratings can reduce the present emotion by drawing attention to it, or even modify the experience by assigning it to an emotion category. The careful design of rating scales must take into account the ability of participants to access their feelings, understand and discriminate emotions (e.g., downhearted, sad, and gloomy). In the case of surveying participants' emotions after the experiment, memory-based biases should be taken into account. The demand effects, which cause potential distortions in responses, can be treated with deception about the purpose of the experiment (Westermann et al., 1996).

In the experiments, we have used rating scales as a method of measuring mood. To reduce the possible effect of measurements on subjective experience, a two-step procedure was used. First, the participants evaluated their general mood; then, they rated different emotions. In this way, the assessment of mood was not influenced by drawing attention to more specific emotional categories.

We have also used Internet-based experiments along with laboratory studies to collect data. The development and design of online experiments required resolving problems related to the reliability of mood induction techniques. The idea that participants of a web experiment can easily avoid mood manipulations motivated a separate methodological study. To clarify this motivation, the following section introduces the methodology of online experiments in emotion research.

1.3.3 Online-experiments in emotion research

Emotion research was no exception to respond to the technological development of recent years. The advancement of computers has led to new areas of scientific interest, as affective computing – computational modeling of the link between affect and machine-readable bodily/physiological responses (D'Mello et al., 2017; Picard, 2010). The ability to track behavioral and physiological data with portable devices in the real world has contributed to the development of the new study paradigm – the modeling of data patterns of individuals and clustering similar emotional experiences in everyday life (Picard, 2010).

With the development of the Internet, psychological research has broken away from the laboratory to be carried out wherever there are a computer and an Internet connection (Reips, 2002). With increasing flexibility and widespread access to the population, researchers should address the lack of control over the devices that people use or the context in which they find themselves. For example, results of a person taking a reaction test on the train can be very different from those of another

person performing the same test on a large monitor computer at home.

Previous emotion research examined the expression of emotions on the Internet, e.g., among Skype users (King-O'Riain, 2013). Schweitzer and Garcia (2010) have suggested to study the emergence and spread of emotions in online communities by modeling the behavior of online users. New methods for measuring the subjective emotional experience of Internet users were proposed: e.g., automated text analysis, subjective and physiological measures (Küster and Kappas, 2013). At the same time, less attention was paid to the issue of mood induction in an online experiment (for a meta-analysis, see Ferrer et al., 2015). Online studies mostly reproduced the techniques that induced moods in the laboratory: e.g., video (Gilman et al., 2017; Mills et al., 2017), texts (Verheyen and Göritz, 2009), or photographs (Göritz and Moser, 2006). The ability of the design and structure of websites to evoke emotions has also been investigated. For example, Hänggi (2004) showed that stress caused by time pressure and a non-functioning feature of the website could reduce the ability to recognize emotions in facial expressions. On the other hand, the use of round shapes and warm colors in the visual design can evoke positive emotions that enhance comprehension in the online educational environment (Plass et al., 2014).

Methodological aspects such as the reliability and validity of mood induction methods still require clarification. If emotions on the Internet influence people, how does this change the effectiveness of mood manipulation in an online experiment? Since the studies included in this thesis have induced moods in online samples, an additional methodological study was necessary to address the concern of reliability. Therefore, Study 4 has applied theoretical ideas from the domain of emotions (i.e., the regulation-related influence of mood) to elucidate mechanisms that can influence the non–compliance behavior in online experiments.

In summary, the effect of positive and negative moods on decision-making is the subject of this dissertation. Contrary to emotions that are specific and acute reactions to some events, moods are diffuse, weak, but persistent affective states. By applying one of the mood manipulation techniques (film, music, or images), we manipulated the mood of the participants and examined the differences in their decisions or decision-making strategies. The next chapter describes in more detail the results of the empirical studies.

Chapter 2

Summaries of articles

2.1 Decision-making strategies in a multi-attribute decision task

Shevchenko, Y., & Bröder, A. (2018). The effect of mood on integration of information in a multi-attribute decision task. *Acta Psychologica, 185*, 136-145.

The multi-attribute decision task is a choice from a range of alternatives defined by a set of attributes (Payne et al., 1993). This experimental paradigm allows the inference of participants' underlying decision strategies by analyzing processing characteristics (e.g., response time, confidence level) and decision outcomes (Bröder and Schiffer, 2003). The strategies differ in the amount of information that is taken into account: People who apply a compensatory strategy consider all available information, while those who use a non-compensatory strategy selectively process information. In the compensatory strategy, a good value of one attribute can compensate for a bad value of another, whereas this is not the case for the non-compensatory strategy (Luce et al., 1997).

The inference about decision strategies is important for process-related theories of mood influence, as it allows to specify the mechanisms of mood impact. The mood-as-information theory predicts that a positive mood promotes the use of heuristics, while a negative mood triggers more systematic information processing (Schwarz, 2000). For decision-making strategies, this means that the negative mood will lead to compensatory strategies, which are characterized by more extensive processing of all attributes (Payne et al., 1996). A heuristic processing in the positive mood will be correlated with the use of less extensive non-compensatory strategies, i.e., making a decision as soon as an attribute can discriminate between alternatives.

In the article, we contrast the mood-as-information theory with the broaden-and-build theory, which emphasizes the effect of mood on attention (Fredrickson, 2001). The broaden-and-build theory assumes that the positive mood broadens attention so that people can encompass and process more information at once. In regard to decision-making strategies, this will lead to the use of a compensatory strategy. People in a negative mood, on the other hand, will focus their attention on a subset of the information, which should result in a higher selectivity and application of a non-compensatory strategy.

The mood-as-information and broaden-and-build theories have been selected from different emotion theories since their presumptions permit to formulate speci-

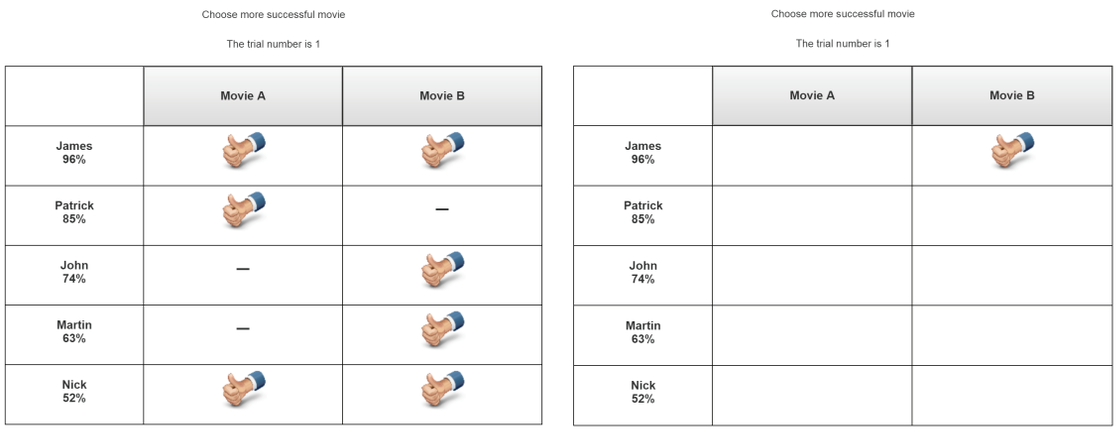
fic predictions. Isen's theory of positive emotions, on the contrary, is very flexible with respect to the decision-making strategies that people can apply. The theory assumes that positive moods cause more efficient information processing, but does not identify any precise differences in the processing styles between moods (Isen, 2001).

The relationship between moods and decision-making strategies was previously examined in Scheibehenne and von Helversen (2015), where the authors used the decision paradigm with open information boards, i.e., simultaneously available information about attributes. We went further to investigate whether the mood effect is also present in the closed information board paradigm, or the closed Mouselab (Payne et al., 1993). In the closed Mouselab, participants should open the boxes with information and can only see one box at a time. The decision task with open information boards allows fast integration of information, so it is particularly suitable for studying information integration processes. The closed Mouselab provides the data about information search so that we can examine processing differences between the moods. In addition, a closed Mouselab task is more cognitively demanding than a task with open information boards. The need to memorize the information in the closed Mouselab burdens the working memory and can lead to more systematic decision-making. Therefore, we hypothesized that the type of information presentation (open information board vs. closed Mouselab) could interact with mood effects.

In two experiments, the mood was induced before the multi-attribute decision task with either open or closed information boards. In order to ensure reproducibility of results, the design of the task in the open information board condition followed the design of Scheibehenne and von Helversen (2015). In the closed Mouselab condition, participants had to click on the boxes to see the information (see Figure 2.1). As soon as they left the box with the mouse cursor, the information disappeared. In each trial (15 trials in Experiment 1, 30 trials in Experiment 2), participants had to choose which movie raised more money at the box office. The recommendations of 5 experts were presented in the order of their validity. The percentage score next to each expert indicated how many times the expert had been correct in the past. No feedback was given to avoid influence on the strategies that people spontaneously adapted during the task. The task was incentivized by the lottery in Experiment 1 and by a money reward in Experiment 2. Experiment 1 was conducted online, and Experiment 2 in the laboratory.

The results of Experiment 1 showed that the participants had preferred a compensatory strategy over a non-compensatory one: 64% of the participants were classified as users of the Weighted-additive rule (WADD) and 36% of the participants were users of the "Take-the-best" rule (TTB). There were no significant group differences in the use of the compensatory strategy between moods or information presentation conditions. The lack of the mood effect could be a result of unreliable mood manipulation in the online study. First, there were no mood differences between the neutral and positive mood groups. Secondly, the variability of sadness scores was high in all groups. Addressing the individual differences in mood, a correlation analysis showed a significant positive relationship between the level of self-reported sadness and the use of the compensatory strategy, but only in the open information board condition. Therefore, we argue in the article that the correlation was supportive for the mood-as-information theory. Additionally, the type

Figure 2.1: Open information board and closed Mouselab multi-attribute decision tasks.



of information presentation also played a role, as mood effects were not present in the closed Mouselab with sequential information search. Experiment 2, which was carried out in the laboratory, confirmed the correlation found in Experiment 1. The use of decision-making strategies was characterized by the interaction between the type of information presentation and the mood: The participants made less compensatory choices in the open information board task when they were in the positive mood.

In the article, we conclude that the results of both experiments supported the idea that negative moods are associated with more systematic decision-making while positive moods elicit heuristic decision-making. This conclusion is consistent with other studies that have found that negative mood induces systematic information processing (Bless et al., 1996; Mohanty and Suar, 2014; Park and Banaji, 2000). However, it contradicts the original study by Scheibehenne and von Helversen (2015), which demonstrated that a negative mood could increase the use of the non-compensatory strategy. Some of the possible reasons for this controversy are discussed in the article.

In both experiments, there were no strategy differences between the moods conditions in the closed Mouselab task. In the article, we propose that the activation of a more systematic and deliberate processing style can be one of the explanations for these results. No differences in the length and order of information search can also be an indication that mood primarily influences the process of information integration, but not the search for information. Since the induction of mood was applied in a similar way in online and laboratory experiments, we analyzed the efficiency of mood manipulation on the Internet. The results showed that the online experiment was less efficient in creating positive and negative moods. We hypothesize that one of the possible reasons for efficiency differences is the non-compliance behavior in an online study, i.e., avoiding or skipping part of the mood manipulation. Since the reliability of online mood induction methods is an essential concern for emotion studies, we conducted a separate study (Study 4) to explore this question further.

2.2 Exploration-exploitation tradeoff in decisions from experience

Shevchenko, Y., & Bröder, A. (2018). *The effect of negative mood on exploration in decisions from experience.* Manuscript submitted for publication.

The experimental paradigm of Study 2 was a foraging task (Hutchinson et al., 2008; Mata et al., 2009). The decisions in the foraging task differ from decisions from description, which were traditionally studied in previous research. In decisions from description, people face different options with the information about the outcomes and their probabilities. The foraging decisions, on the contrary, are decisions from experience that are based on the information obtained as feedback from previous decisions. This implies that decision-makers without prior knowledge of the payoff distribution must choose one of the options and learn the distribution through the trial-and-error approach. In the foraging paradigm, participants have to decide whether they want to harvest a depleting resource or move to a new one, which represents the choice between exploitation and exploration (Constantino and Daw, 2015).

The study of the role of mood in the foraging task is important for several reasons. First, the foraging type of problem is ubiquitous in everyday life: e.g., Internet search, search for a job or a partner, purchasing decisions. Secondly, previous research has shown that the behavior of people in decisions from experience could be very different from decisions from description. For instance, people can underweight the likelihood of rare events since they rely on a small sample of information or overweight recently collected information (Hertwig et al., 2004). Thirdly, since decisions from experience are based on continuous feedback from the environment, people are more often relying on their cumulative assessment of the situation rather than on explicit rule-based strategies. In this situation, mood should have a higher propensity to influence the evaluation of the current condition.

The decision to explore or exploit (i.e., the exploration-exploitation tradeoff) can be affected by many factors (for a review, see Mehlhorn et al., 2015). The role of mood in exploration was not specifically addressed in previous research. However, there is indirect evidence that a positive mood can be associated with higher exploitation and a negative mood with higher exploration. In clinical samples, depression can increase exploration in a sequential decision task (von Helversen et al., 2011). Since the foraging task is also an established paradigm in ethology, some of the supporting findings come from animal studies. It was demonstrated that scarce resources (i.e., negative energy budget) increase the preference for variable or unknown outcomes in bird species (Bacon et al., 2010). High dopamine is associated with exploitation and low dopamine with exploration, presumably through the mechanism of goal-directed cognition (Hills, 2006).

Based on the theoretical approaches outlined in the introduction to the dissertation, we expected that the mood would have content- and process-related influence on the exploratory decision. We did not consider the regulatory influence of mood, as the experimental task in Study 2 did not indicate that exploration could change the mood of participants. Previous research has shown that the presence of a mood changing cue can be a critical factor that activates mood-regulating strategies (Andrade, 2005). Since mood manipulation has remained constant within the conditions

regardless of the exploratory decision, we did not expect that the mood management mechanism would impact the exploration.

In the article, we argue that the congruency effect of mood can be hypothesized on the basis of the mood-as-information theory. People in a negative mood should evaluate the current situation more negatively, which can lead to a higher exploration. On the other hand, people in a positive mood should be more optimistic about the current environment and explore less. Additionally, the informational theory of mood presupposes the differences in the information processing style (i.e., cognitive tuning hypothesis in Schwarz, 2000). People in a negative mood should process information more systematically and pay more attention to the details of the environment. Thus, people in the negative mood should react more sensitively to the distribution of resources in the foraging task. On the contrary, people in a positive mood should adopt a top-down approach, resulting in the use of heuristics. Their exploration behavior will, therefore, be less dependent on the distribution of resources in the environment.

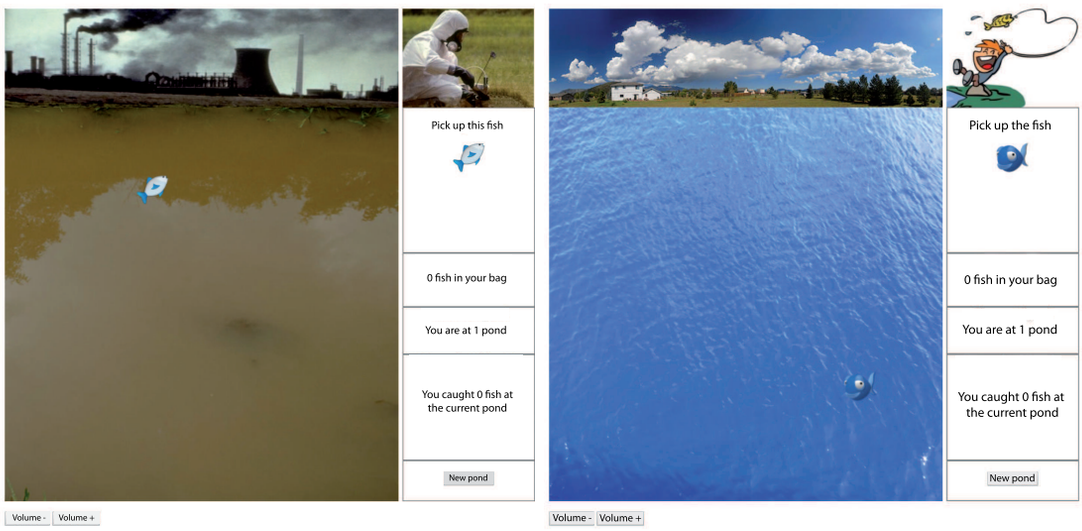
We operationalized the theoretical hypotheses in such a way that the main effect of the mood and the interaction between the mood and distribution of resources were tested in the foraging task. We assumed that these predictions were not mutually exclusive so that one could observe the main effect together with the interaction effect. Nevertheless, the test of the hypotheses was not trivial since there are theories that would predict opposite results: broaden-and-build theory (Fredrickson, 2001) and the theory of positive emotions (Isen, 2001). The broaden-and-build theory predicts that a positive mood will lead to more efficient exploration as it will expand attention and broaden the repertoire of possible behaviors. Isen's theory of positive emotions also expects that people in a positive mood will react more sensitively to the distribution of resource since positive emotions generally enhance the efficiency of decision-making and lead to creative solutions.

We conducted three experiments, two of which were online and one in the laboratory. In order to measure the exploration behavior, we have designed the emotional version of the foraging task (Mata et al., 2009). As in the classic version of this task, participants stayed at a pond and clicked on the fish that appeared on the pond, which was considered exploitation. People could learn about the quality of the current pond by experiencing the frequency of fish. Since the resources of the pond were running out, participants had to decide when to switch to a new pond with an unknown amount of fish. This transition, which also took waiting time, represented the exploration decision.

The emotional impact of the fishing task was made possible by the use of music, images, and a cover story (see Figure 2.2). Several mood manipulation techniques were combined to increase the likelihood of creating a target mood. There were two between-subjects conditions for negative and positive mood induction. In the negative mood group, the task was to collect dead fish, a dirty pond was presented on the screen, and sad music was played in the background. In the positive mood group, the instruction to fish was supplemented by pleasant music and cheerful pictures.

Since we have used combined methods of mood manipulation, one might be skeptical about confounding the mood manipulation with the cover story of the fishing task. In order to have a pure mood manipulation, we used only the music to induce the mood in Experiment 3. The task was devoid of any fish content

Figure 2.2: The fishing task in negative and positive mood groups.



and became a vigilance task – participants had to click circles and switch between boards. In other respects, the task logic was identical to Experiment 2.

In all three experiments, we tested the main effect and the interaction model by using the time that participants had spent at a pond as a dependent variable. The mood manipulation and resource quality of the current pond were independent variables. Since the data were nested within the subjects and were unbalanced (i.e., people visited a different number of ponds/boards), we used the hierarchical approach. In the article, we argue that we also had to control for other variables (e.g., fish/circle misses, initial mood) to make the models more robust.

In Experiment 1, we found tentative evidence for the congruency hypothesis, so that people in the negative mood explored more than people in the positive mood. There were no indications for the processing differences between moods. Regarding the mood manipulation check, there were clear differences in the negative emotions – only the negative condition induced the negative emotions. We observed the decline in the positive emotions in both conditions, but the decline in the negative group was more significant. Thus, the higher exploration could be interpreted in relation to the effect of the negative mood. To validate the results in the task with a different distribution of resources, we conducted Experiment 2. Experiment 2 confirmed that negative mood manipulation leads to higher exploration, regardless of the distribution of resources. In Experiment 3, we found no significant difference between the moods, which can be caused by the absence of negative emotions in the negative mood group (i.e., the music was not sufficient to generate negative emotions). However, the initial negative emotions increased the exploratory behavior in the task, supporting the congruency hypothesis. Analyzing the datasets from three experiments together, we showed that both negative mood manipulations and negative emotions at the beginning of the task increased the exploratory behavior. In regard to the process-related hypotheses, there was no evidence of significant interaction between mood and resource distribution.

We concluded that the findings from all the experiments were sufficient to support the idea that people in the negative mood tend to explore more than people

in the positive mood. In addition, the higher exploration was independent of the resource quality of the environment. This means that negative moods do not activate a more detailed, bottom-up strategy that sensitizes people to the distribution of resources in the foraging task. On the contrary, the mechanism of mood influence appears to be more universal. As we argue in the article, this mechanism can be described by the mood-as-information theory, which assumes the use of mood as a source of information about the current state of the environment.

2.3 Change and status quo in decisions with defaults

Shevchenko, Y., von Helversen, B., & Scheibehenne, B. (2014). Change and status quo in decisions with defaults: The effect of incidental emotions depends on the type of default. *Judgment and Decision Making, 9(3)*, 287.

Being in a certain mood can motivate people to make strategic decisions with regard to their feelings – trying to improve their mood when they feel bad and maintain their positive feelings when they feel good. As described in the introduction, not every decision will be consistent with the goals of mood management, but cues that point to the possibility of mood changes may activate this type of behavior (Andrade, 2005).

The third study was conducted to test the mood maintenance theory with respect to one of the most prominent heuristics in decision-making – the default bias. The default bias is a preference for a default option, i.e., the option that takes place if a decision-maker does not make an active choice. At the moment of writing the article, we used the organ donation policy as an example of a default bias. Until now, in 2018, the issue is still on the agenda. At the moment, the Netherlands is in the middle of the law transition that implements a new "donor by default" policy in 2020 (Lieber, 2018). The implementation will be done by sending a letter to all persons over the age of 18 who are not yet registered as donors. This time, not responding to the letter will result in that person will be considered a donor. The new policy is expected to increase the number of donors and, at the same time, to preserve the freedom to change the donor status at any time. However, even in this example, not everyone is satisfied with the new policy. During one week in October 2016, a month after the Dutch Parliament introduced the amendments, 87% of registered people explicitly stated they did not want to be organ donors (Pieters, 2016).

As we discuss in the article, there are various mechanisms of the default bias: implied recommendations, the status-quo bias, and action inertia. To disentangle the action inertia and the status-quo mechanisms, we designed two types of default options in the experiment: the default option, which maintained the status quo, and the default option, which led to changes. In the article, we explain how predictions of the mood-as-information and mood-maintenance theories would differ for these two default options. If people adhere to the informational value of their mood, people in a positive mood should follow the defaults more often regardless of whether it leads to changes of preserve the status quo. These predictions follow the premises of the cognitive tuning hypothesis, which are described in more detail in the introductory

chapter on the process-related influence of mood.

On the other hand, if people make decisions that take emotional consequences into account, acceptance of the default will depend on the type of default: people in a positive mood should prefer default options that uphold the status quo, but people in a negative mood should prefer default options that implement changes. We have derived this prediction from previous studies that showed that positive moods support the preference for the familiar option, while negative moods promote variety-seeking behavior (Lin and Lin, 2009; Yen and Chuang, 2008).

We conducted an online experiment in which we varied the mood (sad, happy, or neutral) and the type of decision (changes by default, status quo by default, or free choice) in a between-subjects design. As we argue in the article, the choice had consequences for participants – either they continued to work on the same task or they switched to the other task. The mood was induced by short film clips. As the mood manipulation check demonstrated, the happy group was happier than the neutral group, and the sad group was sadder than the neutral group.

The results showed that the change default was as effective as the status-quo default in the neutral condition. However, when people changed their mood, their choices were in line with the mood-maintenance hypothesis: sad people actively rejected the status-quo default, and happy people rejected the change default. Alternatively, one might interpret the findings as evidence of the congruency effect: i.e., people in the positive mood evaluated the old task more favorably than people in the negative mood, which is why they rejected the change default more often. If it were true, then we should observe the differences between positive and negative moods in answer to the question of how much the participants preferred the new task to the old one, which was asked after the decision but before the second task. However, the answers did not differ between positive and negative conditions. Furthermore, in the free choice condition, there was no difference between the number of people who preferred the new task in the negative (44%) and positive condition (46%). Only when the defaults were used, the choice was different between the moods.

We concluded that mood plays a role in the acceptance or rejection of defaults. People in a positive mood may exhibit more support for defaults that preserve status quo in order to avoid risks of potential negative consequences. On the other hand, a negative mood may shift preferences to defaults that bring changes, as the change can be seen as a way to improve the situation and mood. In this way, the results of Study 3 corroborate the findings of Study 2 that a negative mood prompts exploration (changes), while a positive mood leads to exploitation (status quo).

2.4 Non-compliance with online mood manipulations using film clips

Shevchenko, Y., & Bröder, A. (2018). *Non-compliance with online mood manipulations using film clips: How to detect and control for it.* Manuscript submitted for publication.

In all the studies presented in this dissertation, we have elicited positive and negative moods in online experiments. In Study 1, we applied the identical mood

induction paradigm both in the laboratory and in the Internet experiment and found that the effect size on the Internet was smaller than in the laboratory. This finding was in line with previous studies that showed that online methods are less efficient than laboratory methods, although mood effects are still significant in online experiments (for a meta-analysis, see Ferrer et al., 2015). Study 4 was designed to investigate participants' non-compliance as one of the reasons for less intense mood effects in an Internet-based experiment. We tested whether the participants of an online experiment would follow the instructions to watch a mood induction video to the end and either interrupt the video or let themselves be distracted by other activities during the video.

The distraction can be caused, for example, by multitasking, i.e., working on more than one task at the same time. Research on multitasking on a computer has shown that switching between tasks can happen at intervals of several minutes (Judd and Kennedy, 2011; Yeykelis et al., 2014). In addition, emotional factors play a role in the task-switching behavior: Yeykelis et al. (2014) discovered that people experienced an increase in arousal prior to switching to different content.

We argue in the article that non-compliance in online studies was not properly addressed in previous research. For instance, Reips (2000) discussed the problem of dropouts and suggested using a warm-up phase or the high entrance barrier technique to ensure that the dropout occurs before the experimental manipulation. However, the problem of non-compliance differs from dropouts, as even a motivated participant who has completed an entire experiment could ignore the instructions for mood manipulation. In the article, we discuss other control measures (e.g., accuracy questions) that have been proposed but are not sufficient to control for the level of non-compliance.

We suggest the time spent on a web page as an objective and more reliable indicator of the non-compliance. Any decrease in the residence time can interfere with mood manipulation if the time is shorter than the length of the film clip. The available experimental software, which mostly runs in an Internet browser, allows two sources of deviation from the intended residence time. First, if the experiment permits to proceed without completing the mood manipulation, participants can take the chance to interrupt the procedure. Secondly, participants can switch between browser's tabs, windows, or applications during the mood manipulation. In this case, the web page will be out of focus for some time. While the interruption depends on the accessibility of a continue button or an equivalent option, the temporary leave cannot be prevented due to the security settings of a browser. To investigate these two routes for non-compliance, we conducted two online experiments. In Experiment 1, both interruption and temporary leave were possible. In Experiment 2, only temporary leave was feasible, as the continue button was hidden until the end of the mood manipulation.

We posed several theoretical and methodological questions. Does non-compliance differ between positive and negative moods? Does non-compliance reduce the efficiency of mood manipulation? If so, how can a researcher prevent or control for non-compliance? In particular, does hiding the continue button improve mood manipulation or does it provoke people to switch between pages more often? To answer the first question, we have proposed the theory that highlights the regulation-related influence of mood. As discussed in the introduction to the dissertation, the mood-maintenance theory predicts that people will avoid negative moods and try to sustain

positive moods. First, this theory suggests that people in a negative mood should show a higher degree of non-compliance behavior than in a positive mood. Secondly, non-compliance should only attenuate the effect of mood manipulation in the negative group, while people in the positive group should retain their positive emotions regardless of non-compliance.

Experiment 1 demonstrated that 30% of the participants either interrupted the video or temporarily left the web page. The leaving rate was not different between the conditions and had no influence on the mood ratings. However, the interruption was more frequent in the negative condition and mitigated the effect of the negative mood manipulation. On the contrary, the cases of an interruption in the positive mood condition did not impair the positive mood manipulation effect. In Experiment 2, where the participants could not interrupt the experiment, we observed the increase in the leaving rate (from 16% of participants in Experiment 1 to 21% in Experiment 2). The leaving rate was higher in the negative than in the positive condition, but it did not influence the mood changes, probably because the absence time was relatively short for most of the participants. Although we asked the participants the open-ended question whether they were distracted during the video, we received very few positive answers. Perhaps, more precise multiple choice questions can help to gain more information in future research. In addition, the participants in the negative condition left the web page later than the participants in the positive condition, which we interpreted as a sign that the participants reacted to the emotional content of the video clip in the negative mood group.

We conclude in the article that the results of both experiments supported the mood maintenance hypothesis. This means that participants in a negative mood condition are more likely to avoid mood manipulation than in a positive condition. However, not every form of non-compliance is equally detrimental to the efficiency of mood manipulation. The opportunity to interrupt the mood manipulation procedure by using a continue button may lead to a drop in mood effects. In the article, we recommend hiding the continue button until the end of mood manipulation, since it has improved the engagement rate in our experiments. Although undesirable, the use of the continue button may be demanded by an ethics committee. In this case, a researcher can measure the residence time to filter the participants or include the time as an additional variable in the analysis.

The fact that participants can leave the web page for some time seems to be less harmful to the mood manipulation effect. Nevertheless, measuring the time a participant spends outside the web page is a very interesting technique for further research, as it enables testing hypotheses about reactions to certain fragments of the mood induction procedure (e.g., emotional episodes in a film). In addition, a researcher can use temporary leave measures as covariates in the analysis or filter the participants who completely missed the mood manipulation.

Chapter 3

General discussion and outlook

The central research question of this dissertation was how mood influences decision-making. The following section is a summary of the results of each empirical study, which were described in more depth in the previous chapter. The most important conclusions of the dissertation are then presented. Finally, the last section outlines the prospects for future studies.

3.1 General discussion

Study 1 showed that mood influenced decision strategies in the multi-attribute decision task. Positive mood was associated with the use of non-compensatory strategies and negative mood with the use of compensatory strategies. These results support the idea that mood impacts the integration of information by signaling the current state of the environment and the processing efforts required for the task. On the contrary, no differences in the information search between moods indicate that more deliberate strategies, which are required for the sequential information search, can reduce the influence of mood.

In Study 2, the use of foraging paradigm extended the research question to decisions from experience. The results showed that the informational value of mood influenced decisions whether to explore or exploit the current environment, as the negative mood was associated with higher exploration. This finding also points to the mood-regulating motivation as the other potential explanation of the effect – negative mood could motivate people to explore in order to improve their current state.

The mood management mechanisms were examined in more detail in Study 3 and Study 4. Study 3 demonstrated that the mood-regulating motivation influenced the acceptance of the default option. The preference for the status quo was stronger among people in positive mood, while people in negative mood preferred a change of task. This finding suggests that the informational theory of mood is not sufficient to explain behavior, but the mood-regulating motivation should also be taken into account in emotion research.

In Study 4, the ideas on mood regulation were applied to the methodological question of non-compliance in online studies. As predicted, we found that people avoided the negative mood manipulation more often than the positive one, which, in turn, influenced the reliability of mood induction. Study 4 shows that objective behavioral measures of the residence time on a web page can be used to improve the

quality of methods.

The presented results lead to the following three conclusions. First, in order to predict what effect the mood will have on behavior, we must consider both the informational value of the mood and the mood-regulating motivation. Secondly, the informational value of mood can create the congruency effect, but also influence the way information is processed. In particular, differences in information processing between moods may relate to the amount of information integrated into the decision. Lastly, mood-regulating strategies have a higher chance of occurring in situations where there is a possibility of changing the mood through a decision.

3.2 Outlook

This work has combined decision paradigms and mood theories to elucidate mechanisms of interaction between affect and cognition. Thus, this thesis contributes to a growing body of research that brings affect-related topics into the field of cognitive psychology. The methods and results presented in the empirical studies may foresee the prospects for future studies: experiential decision-making, online studies, and affective computing.

Experiential paradigms of decision-making, which are underrepresented in research at the moment, can be an interesting approach for future affective studies. In the field of risky decisions, the experiential paradigm allows participants to observe outcomes of the probability distribution and experience the risk associated with the decision. The idea of experiencing instead of reading a description can be also applied to other areas of affective decision-making: e.g., the affect heuristic (Slovic, Finucane, Peters, & MacGregor, 2007), risk-as-feeling theory (Loewenstein, Hsee, Weber, & Welch, 2001). The development of new experiential paradigms and models will allow to examine the affective mechanisms at different stages of decision: e.g., learning, representing the situation, or planning an action.

The development of Internet technologies can extend beyond just conducting online studies. Over the last ten years, the Internet has spawned the variety of online survey services: e.g., SurveyMonkey, Unipark, SoSci, LimeSurvey. Nowadays, complete experiments can be carried out online with the help of programming frameworks: e.g., jsPsych, PsyToolkit, lab.js. In the future, we will see further integration of research in everyday life, for example, through wearable computing devices developed in the MIT Media Lab. This will not only provide more behavioral and physiological data from more participants but also shift the research methods from controlled experiments to intervention designs (Picard, 2010).

Affective computing research takes decision-making to a new level, where knowledge about human decision-making processes is used to create artificial intelligence (AI) agents capable of interacting and making decisions. The emotional component of AI is acknowledged by large companies such as Google (Boston Dynamics) and Facebook, which invest in robotics. The research field also follows the trend of affective computing. For instance, the journal IEEE Transactions on Affective Computing (TAC) has recently announced the special issue on computational modeling of emotion, which is expected to appear in 2019. However, emotion researchers and computer scientists do not work closely together and, at best, remain customers for each other. Hopefully, the future will also bring more cooperation between these fields.

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Appendix: Copies of Articles

(1) Shevchenko, Y., & Bröder, A. (2018). The effect of mood on integration of information in a multi-attribute decision task. *Acta Psychologica, 185*, 136-145.

(2) Shevchenko, Y., & Bröder, A. (2018). *The effect of negative mood on exploration in decisions from experience.* Manuscript submitted for publication.

(3) Shevchenko, Y., von Helversen, B., & Scheibehenne, B. (2014). Change and status quo in decisions with defaults: The effect of incidental emotions depends on the type of default. *Judgment and Decision Making, 9(3)*, 287.

(4) Shevchenko, Y., & Bröder, A. (2018). *Non-compliance with online mood manipulations using film clips: How to detect and control for it.* Manuscript submitted for publication.

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The effect of mood on integration of information in a multi-attribute decision task

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ABSTRACT

The exact effect of different moods on choosing strategies in multi-attribute decision tasks is yet unknown since previous work has found apparently contradicting results. Furthermore, different theoretical accounts lead to opposite expectations. While the "mood-as-information" theory states that a positive mood leads to heuristic processing of information and application of non-compensatory strategies, the "broaden-and-build" theory expects more non-compensatory decision-making in a negative mood. To test the predictions of those two theories, we conducted two experimental studies, in which both the mood and the type of information search were manipulated. The results rather support "mood-as-information" theory, so participants in the positive mood made non-compensatory choices more often than participants in the negative mood. The effect was only present in the open information board, where the information was presented simultaneously, but not in the closed Mouselab, where the information had to be searched in a sequential manner.

1. Introduction

When it comes to taking an important decision, do you prefer to be in a good or a sad mood? While hedonism postulates that people prefer positive over negative emotional states, there may also be benefits of making a decision in a sad mood (for a review, see Forgas, 2013): being more attentive to the strength of arguments (Sinclair, Mark, & Clore, 1994) and more accurate in judgments (Sinclair & Mark, 1995). Being too positive, on the contrary, could lead to more stereotypical decisions (Bodenhausen, Kramer, & Süsser, 1994) and increase the reliance on the ease of retrieval heuristic (Ruder & Bless, 2003).

To investigate the systematic differences between how people make a decision in different moods, the current research focuses on the impact of negative mood on the use of decision-making strategies in a multi-attribute decision task. A multi-attribute decision involves the choice between at least two options based on the comparison of their attributes (Payne, Bettman, & Johnson, 1993). A decision-maker may apply compensatory or non-compensatory strategies to reach a decision (Bröder & Newell, 2008). To apply a compensatory strategy means to combine all available information about attributes' values of each option, such as a negative value of more important attributes can be compensated by positive values of other attributes. The attributes can be weighted equally (*Equal-weight rule*, *EQW*), or differently in accordance with their importance (*Weighted-additive rule*, *WADD*, Payne et al., 1993). The other strategy, that is non-compensatory, is to consider the most important attribute that differentiates between options and to ignore less important attributes (so a negative value of the important attribute cannot be compensated by positive values of other attributes, "*Take-the-Best*" *rule*, *TTB*, Gigerenzer & Goldstein, 1996).

The differences between strategies can be outlined in a choice of which movie to watch based on recommendations of friends. If a person applies a compensatory strategy, she can consider all recommendations (either watch or not to watch) and sum them up (*EQW*) or apply different weights indicating the trust into opinions of different friends and choose the movie with the highest (weighted) sum score (*WADD*). In the case of using the non-compensatory strategy (*TTB*), the decision-maker chooses the movie preferred by the friend who has the highest trust rating among others.

Numerous studies were dedicated to finding determinants of the strategy selection process: memory (Bröder & Schiffer, 2003), attention (Bröder, Glöckner, Betsch, Link, & Ettlin, 2013), time pressure (Rieskamp & Hoffrage, 2008), information costs (Bröder, 2000b), and emotional stress (Wichary, Mata, & Rieskamp, 2016; Wichary & Rieskamp, 2011). At the same time, there is a lack of studies that bridge strategy selection and mood. Although there has been research on mood effects on judgments (see review in Bless & Fiedler, 2006), studies of the influence of positive or negative moods on the strategy selection are underrepresented.

Previous research found contradicting results that support different theories. The first theoretical approach based on the "mood-as-

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information theory" (Schwarz & Clore, 1996) considers negative mood as a trigger of more analytical and systematic processes, which leads to detail-oriented attention and consideration of all available information. The second approach of "broaden-and-build theory" (Fredrickson, 1998) emphasizes the ability of people in a positive mood to integrate all available information in a more efficient way. In the following, we outline mechanisms and predictions of both approaches. Additionally, the role of information search in the multi-attribute decision task is discussed.

2. Mood-as-information theory

According to the "mood-as-information" theory (Schwarz & Bless, 1991; Schwarz & Clore, 1996), a negative mood provides a stop signal that informs people that they may be in a problematic environment that demands a careful examination. On the other hand, a positive mood signals that the current environment is benign and therefore no careful information processing is required. This line of research is summarized in the literature as emotion effects on depth of thought (Lerner, Li, Valdesolo, & Kassam, 2015), where positive affective states are associated with the use of heuristic cues and negative states are related to systematic decision-making strategies. However, the difference between positive and negative states in depth of processing could additionally result not only from the valence of emotions but from the sense of confidence that those states convey: happiness has a high certainty appraisal, whereas sadness has a low certainty appraisal (Tiedens & Linton, 2001). The high certainty can lead to heuristic processing of information, but low certainty demands a more systematic way of processing. Empirical studies found that people in a positive mood prefer simple heuristics over detail oriented judgmental strategies (Bless et al., 1996; Schwarz & Clore, 1996) and base their judgments on a smaller amount of evidence in a choice task with self-truncated information sampling (Fiedler, Renn, & Kareev, 2010). In line with that, a state of depression leads to longer information search in a sequential decision task than a non-depressed state (von Helversen, Wilke, Johnson, Schmid, & Klapp, 2011).

The use of the compensatory strategy in the multi-attribute decision task requires processing of all cues about given options. Since people in a negative mood apply more systematic and detail-oriented strategies, the prediction of the "mood-as-information" theory is that they would use compensatory strategy more often than people in a positive mood.

3. Broaden-and-build theory

The "broaden-and-build theory", formulated by Fredrickson (1998), emphasizes the adaptive value of emotions and states that negative emotions promote and support specific actions, or *specific action tendencies* that were described by Frijda (1986). By contrast, behavioral consequences of positive emotions (such as joy, interest, contentment, pride, or love) are vague, as far as they are not related to any problems in the environment. For instance, fear is linked with the desire to escape and anger motivates to attack, but joy is associated with aimless activation, interest with attending, and contentment with inactivity (Frijda, 1986). As a consequence of non-specific action tendencies, positive emotions broaden the scope of attention more than negative emotions (Fredrickson, 1998). Applied to multi-attribute decision making, broaden-and-build theory therefore predicts that people in a positive mood should incorporate more information into their decisions than people in a negative mood.

Fredrickson and Branigan (2005) found that a positive mood expands attention in the adapted version of the global-local visual processing task (Kimchi & Palmer, 1982), such as people in the positive mood group more often based their comparison judgments on a configuration of elements (instead of a shape of each element) relative to people in a neutral state. The broaden-and-build theory is also supported by findings that people in a positive mood produce patterns of thoughts that are unusual, flexible, and creative (Isen, Daubman, & Nowicki, 1987).

The same line of reasoning may lead one to expect more compensatory decision-making in a positive mood since the use of the compensatory strategy requires the integration of all available information. In line with that, Scheibehenne and von Helversen (2015) found support for this hypothesis using a multi-attribute decision task, in which participants had to select which movies were more successful at the box office. In an online experiment, the authors provided the participants with all information about the options on an open decision board without the need for search. The authors interpreted the finding that positive mood increased the use of compensatory decision strategies as evidence for a broader focus of attention. The current study employs the same multi-attribute decision task and replicates as well as extends Scheibehenne and von Helversen's (2015) procedure by comparing it to a task involving active information search.

4. Role of information search

We conjecture that the influence of mood on strategy selection in decision making also depends on how information search is structured. Glöckner and Betsch (2008b) suggested that immediate access to information triggers more automatic decision-making characterized by the ability to integrate a large amount of information in short time. Constraints on information search, on the contrary, lead to more systematic information acquisition behavior (Lohse & Johnson, 1996). Demand for information search might activate rather analytic processes of decision-making, which operate through the use of logic and evidence (Slovic, Finucane, Peters, & MacGregor, 2007) and reduces the reliance on emotions.

Differences in information search can be experimentally studied in two different paradigms: open information boards, where all information about options is presented at once, and a closed "Mouselab", where only one piece of information on the board can be inspected at a time (Payne, Bettman, & Johnson, 1988). The open information board paradigm focuses on studying the integration of information, whereas the closed Mouselab paradigm is primarily used to study information search processes. It was found that in open information boards people can quickly integrate information without deliberative calculation of weighted sums (e.g., Glöckner & Betsch, 2008a; Söllner, Bröder, & Hilbig, 2013). On the other hand, the closed Mouselab produces a serial mode of information search and fosters the application of deliberate, rule-based decision strategies (Glöckner & Betsch, 2008a). Additionally, higher costs in the closed Mouselab paradigm increase the probability to use a non-compensatory strategy (Bröder, 2003; Bröder & Schiffer, 2003). Therefore, decision-making strategies in both paradigms might be affected by the type of information presentation, which would consequently moderate the influence of mood.

The mood-as-information and broaden-and-build theories do not make specific predictions regarding the effect of positive and negative moods dependent on the way how information is presented in the task, and multi-attribute decision research has often relied on search data to infer decision strategies (see critique by Bröder, 2000a). Hence, building on Glöckner & Betsch's (2008a) important distinction between tasks that require a sequential search or not, an additional question of the current research is to analyze the interaction between the influence of mood and the type of task (open information board vs. closed Mouselab).

To investigate the potential role of mood and information search in strategy selection, we conducted two experiments, where the type of information processing and the mood were manipulated in a between-subject design. Experiment 1 was conducted as a web-study, and Experiment 2 was run in the laboratory.

5. Experiment 1

The goal of Experiment 1 was to analyze the influence of mood and the type of information search on the selection of decision-making strategies. To achieve a larger sample size of a diverse population, the study was carried on as a web-experiment.

5.1. Method

5.1.1. Design and materials

The online study used a between-subjects experimental design varying induced mood (negative, neutral, or positive) and the type of information search (open information board or closed Mouselab). The participants were randomly assigned to one of six experimental groups.

5.1.1.1. The multi-attribute decision task. The multi-attribute decision task consisted of choices between two movies named “Movie A” and “Movie B”. The task structure was designed on the basis of the experiment of Scheibehenne and von Helversen (2015). Whereas the original experiment consisted of 30 trials with two emotionally similar movie clips shown at the beginning and after 15th trial, the current study used only one movie clip at the beginning of the task and the first 15 trials from the original dataset (see Table A1, set 1). The current experiment also differed in the visual design of cues (a thumbs-up sign instead of a star) and experts (names instead of cartoon faces).

The task of participants was to select the more successful movie based on recommendations of movie experts (see Fig. 1). Each of five experts either recommended a movie (a thumbs-up sign in the box) or did not give any recommendation (a dash line in the box). The advisers differed in their level of expertise. Each expert was presented with a name and a percentage value, which indicated how often this adviser had been correct in the past. For example, “Eric 80%” meant that Eric's tips had been correct in 80% of the cases in the past. The experts were always presented in the same order of decreasing validity, and percentage values of their expertise remained fixed.

In the open information board condition, all information on the decision board was present. In the closed information board condition, the boxes were closed, and participants had to click on a box in order to see the recommendation of an expert. The information remained opened until participants moved a mouse pointer away. After each choice participants rated how confident they felt about their answer. The confidence scales were presented with screenshots from different movies, which emotional content matched the mood manipulation condition. The number of correct choices was shown after the mood manipulation check at the end of the experiment. The correct option in each trial was a choice that corresponded to the compensatory strategy (Table A1, set 1). The configuration of cues and the position of options on the screen were both randomized across trials, but the cues were composed in the way that the choice of one option always followed the compensatory strategy (Movie B on Fig. 1) and the choice of the other option followed the non-compensatory strategy (Movie A).

5.1.1.2. Mood induction. 3-Minute video clips were used as a mood induction method. All clips were pre-tested before either in our pilot studies or published reviews (Schaefer, Nils, Sanchez, & Philippot, 2010). In the positive mood condition, the scene with Scrat chasing nuts from the movie “Ice Age: Continental Drift” (2012) was used. In the negative mood condition, the participants saw an excerpt from the movie “Lion King” (1994) (the scene with the death of Mufasa). In the neutral condition, we used a movie clip consisting of traveling scenes. To maintain the mood manipulation during the task mood-congruent pictures were used when the participants rated their confidence after each choice. The screenshots from movies of different genres which matched the mood condition (comedy in the positive, drama in the negative, and scenes of different objects in the neutral condition) was placed under the confidence rating scale.

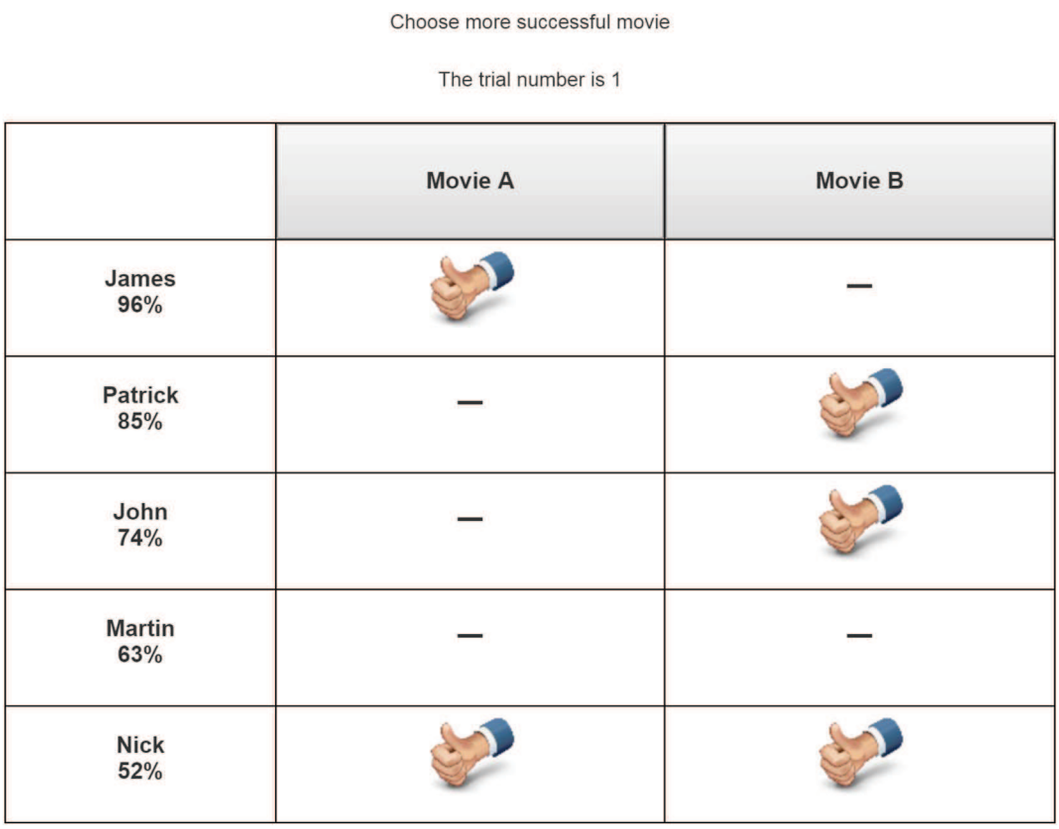

Fig. 1. Screenshot of the task.

5.1.1.3. Mood manipulation check. After the main task, a mood manipulation check was done by asking participants to characterize their current emotional state on a visual analog scale from "very depressed" to "very elated". On the next page, the participants were asked to rate their emotions on 10 different emotion items taken from the expanded version of the Positive and Negative Affective Schedule (PANAS-X, Watson & Clark, 1999). Participants had to indicate to what extent they felt at the present moment using separate analogous scales for each item. The instruction on the top of the page showed five marks of the scale: "very slightly or not at all", "a little", "moderately", "quite a bit", and "very much". The ratings were averaged for the scales of happiness ("happy", "delightful", and "joyful") and sadness ("sad", "downhearted", and "gloomy"). Four additional items were used to control for anger ("angry"), interest ("interested"), stress ("distressed"), and arousal (reversed "relaxed" scale). To facilitate the comparability of results with other studies, all ratings were transferred into the original PANAS-X scale from 1 to 5.

5.1.2. Procedure

The participants started the experiment by reading the informed consent form on the first web-page. After filling in their demographic data (gender, age, education, and country of residence) and answering the control question about their intention to participate in the experiment, the participants read the instruction to the main task. People in all experimental conditions saw an example of the open information board. Additionally, the participants in the closed information board group were told that during the task each box with information would remain closed until the participant clicks on it with the mouse and would be closed again, as the mouse pointer leaves the box.

The performance in the task was incentivized by a lottery for the 20 best players with the chance to win one of five 20 Euro online retailer vouchers. Three control questions with immediate feedback were given to make sure that the participants understood the instruction. After the instruction, the participants saw a 3-minute video clip related to their emotion condition. Immediately after the mood induction, the participants proceeded to the multi-attribute decision task. After making a choice in each trial, the additional window with a confidence scale and a picture matched to the emotion condition popped up on the screen. In case of skipping a question, the participants were politely asked to return and answer the question.

After all 15 trials were finished, the participants were asked about their mood: first, with a general question and then with 10 different scales of the PANAS-X. After the mood manipulation check, the participants were asked about their ideas of the goal of the experiment. At the last page of the web-experiment, they were allowed to leave their comments and email address in case if they wanted to participate in the lottery.

5.1.3. Methods of data analysis

All data exclusions, manipulations, and measures are reported in this study. The use of either non-compensatory or compensatory decision-making strategies was measured by actual choices of participants which could either confirm to TTB or WADD/EQW. To test the hypothesis about the differences in strategies between positive and negative mood, a multi-level logistic regressions model with a binary dependent variable was applied. The dependent variable was either a WADD/EQW-compatible or WADD/EQW non-compatible choice in each trial. Additionally, the length of information search in the closed Mouselab group was measured and compared across mood conditions.

5.1.4. Participants

The web-based experiment was conducted in October–November 2016. Both German and English versions were available online.[1] 383 people (median age 21 years, 289 female, 91 male, and 3 unknown) took part in the study. Among all participants, 182 people (48%) were students of the University of Mannheim recruited by the local participation management system. Others were recruited from different websites: "Psychologie Heute" (81), "Psychological research on the net" (79), "Circle" (16), "Call for participants" (10), and others (18).

5.2. Results

5.2.1. Ensuring data quality

Since the data were collected in the web-experiment, concerns about data quality should be addressed. We used the control question about participants' intention to participate in the experiment and time measurements to detect cases of inappropriate behavior, such as making a big pause between the mood induction and the main task or taking unrealistically long time to finish the decision-making task. 5 people either did not answer on the question "How do you intend to browse the Web pages of the study?" or chose the option "I would like to look at the pages only". We also discarded 17 people who took > 5 min to watch a movie clip, since the mood effect might dissipate or the participant was distracted by something else during that time. For the time spent on the main task, we used the threshold of 20 min that excluded 2 people. Overall, 24 participants were filtered out leaving 359 participants for the final analysis (see Table 1 for the number of people in different experimental groups).

5.2.2. Mood manipulation check

337 participants filled out all scales of the mood questionnaire.[2] The average scores for happiness and sadness were computed for each participant. Using the scores of positive mood (asked in the first general question), happiness, sadness, anger, stress, arousal and interest, we applied one-way between-subjects ANOVAs with the factor mood group (see Table 2). As far as the mood valence is a continuum between negative and positive mood with the neutral condition in the middle, we used the mood group as a linear predictor in the model.[3] As expected, the main linear effect of the mood manipulation was found for the sadness score, F (1, 335) = 10.8, MSE = 9.9, $p < .01$, but also for the arousal and interest, F (1, 335) = 5.5, MSE = 5.7, $p = .02$ and F (1, 335) = 4.4, MSE = 4.4, $p = .04$. However, the main linear effect of the mood manipulation was not significant for the positive mood scale, happiness, stress, and anger.

A post hoc Tukey test showed that the participants in the negative mood group were feeling more sad ($M = 2.4$, $SD = 1.1$) than the participants in the neutral group ($M = 2.0$, $SD = 0.9$) and the participants in the positive mood group ($M = 2.0$, $SD = 0.9$). However, there were no significant differences between neutral and positive mood groups for each of the scales. Therefore, the mood manipulation was successful with respect to the sadness score in the negative mood group, but did not elicit differences in the neutral and the positive mood groups. Furthermore, the mood manipulation in the positive mood group did not induce more positive emotions in comparison with the neutral group.

[1] The study was programmed in JavaScript and installed on the personal website of the first author http://yuryshevchenko.com/evaluation-of-movies/.

[2] 22 participants had at least one missing value and were excluded from the mood effects analysis. Among them, 7 participants did not answer on any item, 11 participants answered on the first question, but ignored all PANAS-X items, and remaining 4 participants missed some PANAS-X items.

[3] The between-subjects ANOVA with the main effect of the mood manipulation was also applied. The main effect of the mood manipulation was found for the positive mood scale, F (2, 334) = 4.0, MSE = 2.4, $p = .02$, the sadness score, F (2, 334) = 6.9, MSE = 6.2, $p < .01$, arousal, F (2, 334) = 3.1, MSE = 3.2, $p = .045$, interest F (2, 334) = 3.1, MSE = 3.1, $p = .046$, and stress, F (2, 334) = 3.8, MSE = 4.5, $p = .02$. There were no significant differences for the happiness scale, F (2, 334) = 1.6, MSE = 1.64, $p = .20$, and anger, F (2, 334) = 0.3, MSE = 0.2, $p = .74$.

Table 1
Number of people in different experimental groups.

	Closed Mouselab	Open information board
Negative mood group	53	60
Neutral group	60	61
Positive mood group	62	63

Table 2
Mood scores in the negative, neutral and positive mood groups (N = 337). The scores are reported on the PANAS-X scale from 1 ("very slightly or not at all") to 5 ("very much"), and standard deviations are given in the parentheses.

	Negative mood group	Neutral group	Positive mood group	ANOVA test of a linear effect of mood *df* (1, 335)		
				F	*MSE*	*p*
Positive mood	2.9 (0.8)	3.2 (0.7)	3.1 (0.8)	2.3	1.4	.13
Happiness	2.6 (1.0)	2.8 (1.0)	2.8 (0.9)	2.3	2.3	.13
Sadness	2.4 (1.1)	2.0 (0.9)	2.0 (0.9)	10.8	9.9	< .01
Anger	1.6 (0.8)	1.5 (0.8)	1.5 (0.9)	0.4	0.2	.55
Stress	2.5 (1.1)	2.1 (1.0)	2.3 (1.2)	1.9	2.3	.17
Arousal	3.0 (1.1)	2.7 (1.0)	2.6 (1.0)	5.5	5.7	.02
Interest	3.2 (1.1)	3.5 (0.9)	3.5 (1.0)	4.4	4.4	.04

5.2.3. Decision-making strategies

Since the data were nested inside of the participants, we applied multi-level logistic regressions with the binary choice (compensatory or non-compensatory) in each trial as the dependent variable (*lme4* package in R, Bates, Maechler, Bolker, & Walker, 2015). The multi-level approach with random effects for subjects is recommended over aggregation since it accounts for variation within participants (Woltman, Feldstain, MacKay, & Rocchi, 2012) and increases the statistical power of a test (Krzywinski, Altman, & Blainey, 2014). Whereas the baseline model included only random intercepts for each participant, the main effects model also contained the fixed effects of mood condition and the type of information board. Additionally, the third model included the interaction between mood condition and the type of information board. The log-likelihood ratio test showed that the main effects model is not significantly different from the baseline model, $\chi^2(2) = 2.62$, $p = .27$. The interaction model was also not significantly different from the main effects model, $\chi^2(1) = 0.11$, $p = .74$. In terms of predictions, the baseline model expected all participants to make a compensatory choice in 9 out of 15 trials (57%) on average (see Fig. 2). Hence, in the decision outcome data, we neither found a strategy difference based on mood nor on the information presentation.

We also classified participants as TTB or WADD users based on the majority of choices (see Table 3). The proportion of WADD users was higher than the proportion of TTB users in all groups, on average 64% vs. 36%. Using this dependent variable in a chi-square test of independence, there was also neither a strategy difference between mood groups (χ^2 (2, N = 359) = 0.49, $p = .78$) nor between presentation formats (χ^2 (1, N = 359) = 0.04, $p = .85$).

The lack of significant group differences can be attributed to potential problems with the mood manipulation in the online environment of the experiment. Although the participants of the negative mood group were sadder than the participants of the other two groups, there was high individual variability in the sadness and happiness scores in all groups. To account for individual differences in the level of sadness and happiness, we computed the correlations between the sadness and happiness scores and the number of compensatory choices of each individual. There was a small, but marginally significant positive correlation between the sadness score and the number of compensatory choices, t (336) = 1.94, $r = 0.10$, $p = .054$, suggesting that people who were more sad at the end of the experiment made more compensatory choices. The separate analysis of correlations in the different versions of information boards paradigms showed that the correlation was only present in the open information board condition, t (168) = 2.51, $r = 0.19$, $p < .05$, but not in the closed Mouselab, t (166) = −0.21, $r = -0.02$, $p = .83$. There was no correlation between the happiness score and the number of compensatory choices, t (336) = 0.01, $r = 0.001$, $p = .99$.

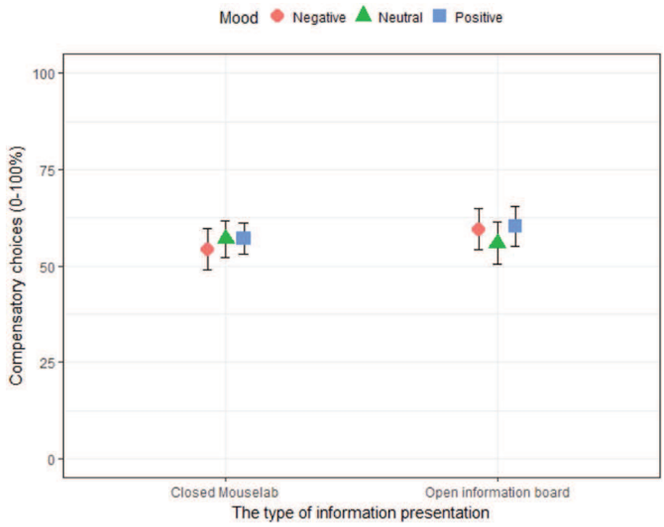

Fig. 2. The predicted probability of compensatory choice based on the parameters of the baseline model with only random intercepts for each participant (N = 359). The group means and 95% CI are shown.

Table 3
Number of people in each condition classified as TTB or WADD strategy users (N = 359). Proportions of strategy users for each group are written in the parentheses.

Paradigm	Mood	TTB	WADD
Closed Mouselab	Negative	21 (40%)	32 (60%)
	Neutral	21 (35%)	39 (65%)
	Positive	21 (34%)	41 (66%)
Open information board	Negative	18 (30%)	42 (70%)
	Neutral	26 (43%)	35 (57%)
	Positive	24 (38%)	39 (62%)
		131 (36%)	228 (64%)

5.2.4. Reaction time analysis

The median time (in seconds) spent in a trial was computed for each participant. 2 × 2 between-subjects ANOVA showed a significant main effect of the type of information board paradigm, F (1, 353) = 120.15, MSE = 3379, $p < .001$, so people in the closed Mouselab condition (M = 12.67, SD = 6.29) spent more time in a trial than in the open information board condition (M = 6.50, SD = 4.17). There was a marginally significant main effect of mood, F (2, 353) = 2.96, MSE = 83, $p = .053$, but subsequent post-hoc Tukey tests showed no significant differences between different mood conditions, all $p > .10$. There was no significant interaction between mood and the type of information board, F (2, 353) = 0.22, MSE = 6, $p = .80$.[4]

5.2.5. Length of information search in the closed Mouselab

Additionally, we compared the number of opened information boxes in closed Mouselab paradigm (N = 175) between different mood

[4] Confidence ratings were averaged for each participant. A 2 × 2 ANOVA with a confidence score as a dependent variable showed no significant main effects of the type of information board condition (F (1, 352) = 0.30, MSE = 79.00, $p = .59$) and mood (F (2, 352) = 0.16, MSE = 41.60, $p = .85$). The interaction of the type of information board and mood was also not significant (F (2, 352) = 1.55, MSE = 410.60, $p = .21$). The average confidence judgment was 58.97% (SD = 16.23).

conditions. The median number of opened cues was computed for each subject, and then a one-way ANOVA was used. There was no significant main effect of mood, F (2, 172) = 2.25, MSE = 55, p = .11. The length of information search was not different between negative mood (M = 9.68, SD = 4.34), neutral (M = 10.00, SD = 4.76), and positive mood conditions, (M = 11.48, SD = 5.57).

5.3. Discussion

We did not find any differences in decision-making strategies (as assessed by the probability of the compensatory choice) dependent on the mood manipulation. The lack of an effect may probably be attributed to the only partially successful mood manipulation in the web-experiment. People in the negative mood group were sadder than the participants of the other two groups, but there were no mood differences between the neutral and the positive mood groups. One potential reason for that is that the neutral condition was positive as well. However, the movie clip in the neutral condition did not show an increase in positive emotions in a separate pilot-study (N = 50). The second reason for no differences between neutral and positive conditions is that positive emotions are harder to elicit than negative ones (Ferrer, Grenen, & Taber, 2015). This disproportion of effects could be the result of self-selection in an online-study: If people were already in a negative mood, they might choose to avoid participation in the study. Given the initial positive mood state of the remaining participants, it was easier to upset them than to make happier. Moreover, the web-study settings allowed participants to avoid the mood manipulation by temporary leaving or switching to another web-page that could interfere with the desired mood state.

Although the experimental manipulation of mood in this study did not work as expected, drawing on the natural mood variation between participants yielded evidence that overall, sadness was correlated with more compensatory choices as expected by mood-as-information theory. A closer look, however, revealed that this correlation was absent in the closed Mouselab (involving search), but more pronounced in the open information board (focusing on information integration). This finding provides an insight into differences between simultaneous and sequential ways of information processing and supports the “mood-as-information” account that predicts that people in the negative mood apply more detailed-oriented and analytical strategies. Since the feedback to the main task was shown only after the mood manipulation check, we can rule out the possibility that performance in the task influenced the reported emotions. However, the link between compensatory decision-making and reported sadness in the open information board paradigm remains correlational and should be interpreted cautiously.

As a conclusion of Experiment 1, we found preliminary support for the “mood-as-information” hypothesis in the open information board paradigm. In order to increase the effect of the mood manipulation and to avoid problems of self-selection, we replicated the study in a laboratory setting in Experiment 2.

6. Experiment 2

The aim of Experiment 2 was to test the effect of mood and type of information search in the laboratory environment, which allowed probably a more efficient mood manipulation because of reduced opportunities to be distracted from the mood-inducing film-clips. To maintain a decent statistical power with a smaller sample, the theoretically less important neutral condition was left out.

6.1. Method

6.1.1. Design and materials

The multi-attribute decision task was the same as in Experiment 1, but the length of the task was extended to 30 trials to increase the reliability of measuring the dependent variables. A second mood manipulation was added after the 15th trial. Hence, this lab study was structurally identical to Scheibehenne and von Helversen's (2015) web-based study. The cues in each trial were composed in the way that the choice of one option always corresponded to the compensatory strategy and the choice of the other option corresponded to the non-compensatory strategy (Table A1). The display order of options was randomized in each trial.

6.1.1.1. Mood induction. 3-Minute video clips were presented in a random order at the beginning of the main task and after the 15th trial. In the positive mood condition, “Ice Age: Continental Drift” (2012) (the scene of Scrat chasing nuts) and “The Visitors” (1993) (two characters from the medieval time crashing a car) were used. In the negative mood condition, “Lion King” (1994) (the death of Mufasa) and “Léon: The Professional” (1994) (separation of two main characters) were shown.

6.1.1.2. Mood manipulation check. The mood manipulation check was identical to the questionnaire in Experiment 1 and consisted of the general mood question and 10 emotion scales.

6.1.2. Procedure

The experiment was run as a laboratory study that used a between-subjects experimental design varying induced mood (negative or positive) and the type of information search (open information board or closed Mouselab). The participants were randomly assigned to one of four experimental groups.

Upon arrival to the lab, the participants were seated in front of one of 8 computers and read the informed consent form. The following instructions appeared in the web-browser application. The participants could choose whether they want to receive money or a certificate of participation (for course credit) at the end. In both scenarios, the performance in the main task was incentivized: either by giving 10 cents for each correct answer or by five 20 Euro online retailer vouchers for winners of the lottery among 20 best performers. The rest of the procedure was identical to the procedure in Experiment 1. At the end, the participants were remunerated either with money or participation certificates.

6.1.3. Participants

121 people (median age 23 years, 82 female and 39 male) took part in the laboratory experiment at the University of Mannheim in November 2016.

6.2. Results

6.2.1. Ensuring data quality

This time, no one was filtered out based on the criteria that we established in Experiment 1: participation intention, a pause between the movie and the decision task, or time spent in the task. Therefore, 121 participants were selected for the final analysis.

6.2.2. Mood manipulation check

The participants in the negative mood group were feeling more sad, angry, distressed, and aroused and less positive, happy, and interested than the participants in the positive mood group (see Table 4).

Since the same mood questionnaire was used in both Experiments, we compared the mood manipulation effects in the online study (Experiment 1) and in the laboratory (Experiment 2). The effect on different emotion scales was tested in a linear regression where experimental mood condition (positive or negative as a dummy variable), experiment (online or laboratory as a dummy variable) and their interaction were included as predictors. The dependent variable was a score on the PANAS-X scale (1–5). The laboratory experiment was more efficient in inducing positive mood and happiness in the positive mood

Table 4
Mood scores in the positive and negative mood groups (N = 121). The scores are reported on the PANAS-X scale from 1 ("very slightly or not at all") to 5 ("very much"), and standard deviations are given in the parentheses.

	Negative mood group	Positive mood group	Independent groups t-test (df = 119)		Cohen's d
			t	p	
Positive mood	2.8 (0.8)	3.5 (0.7)	−5.3	< .001	0.96
Happiness	2.5 (0.9)	3.3 (0.8)	−5.1	< .001	0.92
Sadness	2.5 (1.0)	1.7 (0.7)	4.9	< .001	0.89
Anger	1.7 (0.9)	1.3 (0.6)	2.3	.02	0.42
Stress	2.6 (1.1)	1.9 (0.9)	3.7	< .001	0.68
Arousal	3.0 (1.0)	2.3 (0.8)	4.0	< .001	0.73
Interest	3.3 (0.9)	3.8 (0.7)	−3.1	< .01	0.56

group (the interaction effect between Mood and Experiment: $b = 0.52$, $SE = 0.18$, $t = 2.97$, $p < .01$ and $b = 0.59$, $SE = 0.21$, $t = 2.73$, $p < .01$). For the ratings of sadness and stress, the interaction effect between Mood and Experiment was marginally significant, $b = -0.36$, $SE = 0.21$, $t = -1.66$, $p = .098$ and $b = -0.47$, $SE = 0.25$, $t = -1.89$, $p = .059$. The presence of interaction effects suggests that the laboratory setting was more effective in eliciting both positive and negative mood as intended.

6.2.3. Decision-making strategies

The specification of models was identical to Experiment 1, so we tested the main effects model against the baseline model with random intercepts for each participant, and the interaction model against the main effects model. The log-likelihood ratio test showed that the main effects model was not significantly different from the baseline model, $\chi^2(2) = 3.24$, $p = .20$; however, the model with the interaction between fixed effects was significantly different from the main effects model, $\chi^2(1) = 3.85$, $p < .05$ (see Fig. 3 for predicted probabilities of compensatory choice). The parameter estimates of the interaction model were not significant for main effects of mood, $b = 0.12$, $z = 0.36$, $p = .72$, and the type of information board, $b = 0.20$, $z = 0.58$, $p = .56$, but significant for the interaction between mood and the type of information board, $b = -0.94$, $z = -1.98$, $p < .05$. In terms of predictions, the interaction model expected the participants in the positive mood group and open information board condition to make a compensatory choice in 11 out of 30 trials (38%) on average, whereas the general rate for all other participants was 16 out of 30 trials (52%).

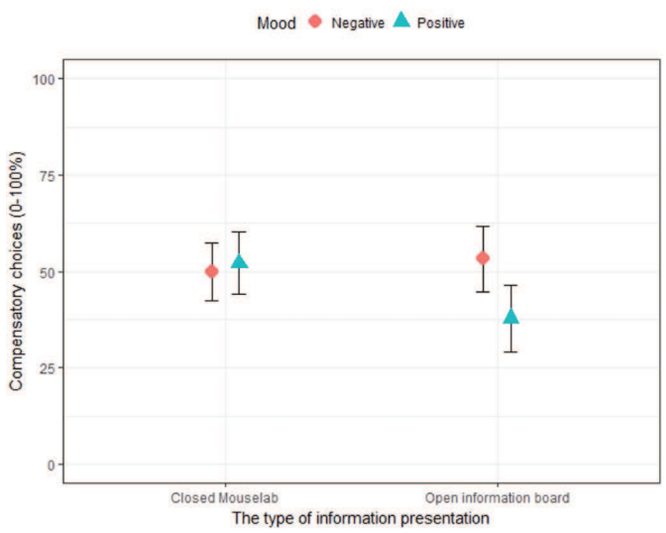

Fig. 3. The predicted probability of compensatory choice based on the parameters of the interaction model with random intercepts for each participant, fixed effects of mood and type of information board and their interaction (N = 121). The group means and 95% CI are shown.

Table 5
Number of people in each condition classified as TTB or WADD strategy users (N = 121). Proportions of strategy users for each group are written in the parentheses.

Paradigm	Mood	TTB	WADD	Random strategy
Closed Mouselab	Negative	14 (45%)	15 (48%)	2 (7%)
	Positive	14 (47%)	15 (50%)	1 (3%)
Open information board	Negative	12 (40%)	15 (50%)	3 (10%)
	Positive	20 (67%)	8 (27%)	2(6%)
		60 (50%)	53 (44%)	8 (6%)

Classification of participants as TTB or WADD users was based on the majority of choices (more than in 15 out of 30 trials) yielding three categories of participants: TTB, WADD, and random strategy users who had an equal number of TTB and WADD choices. The proportion of WADD users in the positive mood was lower than in negative mood in the open information board condition (χ^2 (1, N = 55) = 4.11, $p < .05$), whereas there was no difference in the closed Mouselab (χ^2 (1, N = 58) = 0, $p = 1$) (see Table 5).[5]

To account for individual differences in the level of sadness and happiness, we computed the correlations between the sadness and happiness scores and the number of compensatory choices. This time, there was no significant correlation between the sadness score and the number of compensatory choices, t (119) = 1.33, $r = 0.12$, $p = .18$. The separate analysis of correlations in the different versions of information boards paradigms showed no significant correlations neither in the open information board condition, t (58) = 0.97, $r = 0.13$, $p = .34$, nor in the closed Mouselab, t (59) = 0.86, $r = 0.11$, $p = .39$. Concerning the happiness score, there was no significant correlation between the happiness and the number of compensatory choices, t (119) = −0.19, $r = -0.02$, $p = .85$.

6.2.4. Reaction time analysis

The median time (in seconds) spent in a trial was computed for each participant. 2 × 2 between-subjects ANOVA showed a significant main effect of the type of information board paradigm, F (1, 117) = 99.29, $MSE = 984.90$, $p < .001$, so people in the closed Mouselab condition ($M = 10.98$, $SD = 3.69$) spent more time in a trial than in the open information board condition ($M = 5.28$, $SD = 2.42$). There was neither a significant main effect of mood, F (1, 117) = 0.03, $MSE = 0.20$, $p = .88$, nor an interaction between mood and the type of information board, F (1, 117) = 0.21, $MSE = 2.10$, $p = .65$.[6]

6.2.5. The length of information search in closed Mouselab

Additionally, we compared the number of opened information boxes in closed Mouselab paradigm between mood conditions. The median number of opened cues was computed for each subject, and then t-test was applied. There was no significant difference between the positive

[5] As pointed out by one of the reviewers, one could interpret the finding that positive mood leads to more non-compensatory strategies as an attentional effect so that participants in a positive mood made more errors in the experiment. One way to address this problem is to consider only those participants who were clearly classified as using one strategy. The problem is, however, where to draw the line between non-classified and classified participants facing the trade-off between strictness of criteria and the sample size as a stricter criterion decreases the amount of subjects for analysis. For example, when 80% of choices should be in line with a strategy, 12 people are classified as TTB users, 8 people are classified as WADD users, and the proportion of WADD users in the positive mood (n = 2) was lower than in negative mood (n = 6) in the open information board condition (χ^2 (1, N = 20) = 4.85, $p < .05$). This suggests that the found effect was not only driven by participants who made more errors in the positive mood condition.

[6] Regarding confidence ratings, a 2 × 2 ANOVA with a confidence score as a dependent variable showed no significant main effects of the type of information board condition (F (1, 117) = 1.36, $MSE = 308.50$, $p = .25$) and mood (F (1, 117) = 2.08, $MSE = 472.80$, $p = .15$). The interaction of the type of information board and mood was also not significant (F (1, 117) = 0.15, $MSE = 35.10$, $p = .70$). The average confidence judgment was 59.16% (SD = 15.12).

mood group ($M = 11.67$, $SD = 3.63$) and the negative mood group ($M = 11.27$, $SD = 4.63$), $t\ (59) = -0.37$, $p = .71$, $d = 0.09$.

6.3. Discussion

More non-compensatory decision making was present in the positive mood than in the negative mood in a situation with simultaneous information presentation. At the same time, there were no differences between moods in the closed Mouselab group. These data are in line with the correlational pattern found in Experiment 1 and rather support the "mood-as-information" theory that states that a positive mood triggers a heuristic mode and negative mood induces a more systematic mode of information processing. Furthermore, it shows that mood affects decision making only when information is presented simultaneously, whereas the impact of mood is reduced during the sequential way of processing the information.

The observed effects of mood on strategy selection may be attributed to a more efficient mood manipulation in the laboratory (Experiment 2) than in the web-experiment (Experiment 1). The participants of the laboratory experiment differed in the positive mood measured by the general question and on all of the emotion dimensions, so the people in the negative group were more sad, stressed, aroused, and angry, and less happy and interested than the people in the positive group. The comparison of mood effects in Experiment 1 and Experiment 2 showed that the mood manipulation in the laboratory was significantly more efficient in inducing positive mood and happiness.

7. General discussion

7.1. Strategy selection

The current research investigated how mood and type of information presentation (either simultaneous in the open information board or sequential in closed Mouselab paradigm) might affect the selection of decision-making strategies. The results of two experiments suggest that the effect of mood depends on the type of information presentation in the task. Mood plays a role in the task with the open information board, where the information is presented simultaneously. However, if the information is hidden and has to be searched for in a sequential manner, the effect of mood on the decision-making strategy is weakened. The reason for that is different ways of information processing in the open information board and closed Mouselab paradigm. The closed Mouselab paradigm promotes deliberate decision making and application of controlled cognitive operations, so people become aware of their strategies and can verbalize them (Glöckner & Betsch, 2008a). Moreover, a step-by-step decision strategy hinders the activation of automatic processes, which are more closely related to emotions (Kahneman & Frederick, 2002). The simultaneous presentation of information in the open information board, on the contrary, does not impose restrictions and allows mood differences to affect the way of information integration rather than information search.

In both experiments we found that people in the positive mood processed information in a more non-compensatory manner in the open information board than people in the negative mood. We interpreted this as evidence in line with mood-as-information theory, but contradicting broaden-and-build theory. According to the "mood-as-information" account, the negative mood is used as an informative signal about a problematic state of the environment that requires the use of more systematic strategies. Positive mood, on the contrary, as an indicator of the benign state of the environment, might trigger the application of available heuristics.

The results of the current study are in line with findings of Bless et al. (1996) that happy people are more likely to rely on general knowledge structures, whereas sad individuals more systematically elaborate presented information. Park and Banaji (2000) found that the processing differences between positive and negative moods affect social categorization judgments as a positive mood increases the use of stereotypes. In the domain of risky choices, Mohanty and Suar (2014) showed that people in a negative mood process information with more fluency, originality, and flexibility than people in a positive mood.

However, the results of the current study are opposite to findings of the online experiment of Scheibehenne and von Helversen (2015) that positive mood increases the probability to use a compensatory strategy. A potential reason for the contradiction of results is currently unexplained. One might search for the cause of contradictory findings in the differences in the visual design of the task or the type of the environment in which the experiment was carried out (laboratory vs. online experiment). Although there is no explanation of why the differences in the visual presentation should be responsible for the results, previous research has found that even subtle variations of context factors can influence the strategy selection process, presumably by guiding visual attention to specific aspects of a task (Bröder et al., 2013). As another possible reason for differences in the results one could suspect the way of data analysis: while Scheibehenne and von Helversen (2015) used the Bayesian approach, the current study employed multi-level modelling. However, even the conventional analysis of the original experiment would show the trend that is opposite to the current result – the average proportion of non-compensatory choices in the positive mood condition was 38% in the original study versus 67% in the current study. Alternatively, since the positive mood activates heuristic processing of information according to the "mood-as-information" account, the availability of heuristics in a sample could have an impact on the results. As previous studies have shown that people can learn how to apply decision-making strategies (Rieskamp & Otto, 2006), participants with more experience in decision experiments might use a compensatory strategy as a default strategy.

Regarding the choice of strategies in the open information board and Mouselab paradigms, we did not find any differences in decision-making strategies. It was expected that the non-compensatory strategy would be used more often in the closed Mouselab if people had higher cognitive costs of storing the cue information in working memory (Bröder & Newell, 2008). However, the absence of differences may be the result of a relatively moderate number of cues to remember in our experiments (eight pieces of advice). Additionally, cues were presented as pictorial stimuli, which might help people to store information more efficiently. We would still expect the differences in strategies if the closed Mouselab condition had more options or cues with a more complex representation of values (Queen, Hess, Ennis, Dowd, & Grühn, 2012).

7.2. Mood manipulation in online studies and in the laboratory

Mood manipulation effects are considered to be not very stable and having relatively small effect sizes. Therefore, replication studies are required to figure out the potential role of different settings (online, laboratory) or moderators (e.g., information search) in mood manipulation. As expected, we found that laboratory settings were more efficient in inducing both positive and negative emotions than an online experiment. One potential reason for that is that people can avoid the mood manipulation by switching between web-pages in an online study. This confounding variable can be measured and controlled in further studies by applying an algorithm to detect the absence behavior.

7.3. Further research

Further research is required to identify mechanisms and practical implications of the effect of moods on the information integration process. One suggestion of a more powerful experiment to detect strategy changes at first glance would involve a within-subjects paradigm measuring individual differences in strategy preference before a mood manipulation and again after the manipulation. However, we recommend to be cautious with a within-subject design as it introduces

strong effects of routinization (Bröder & Schiffer, 2006) that interfere with expected effects of mood. Another set of unpublished studies from our lab ($N = 122$) with a within-subject design showed no systematic effect of mood in the closed Mouselab, but the question whether the effect is present in open information boards remains open.

As a conclusion, the current study shows that mood influences strategy selection and the way how people integrate information. This finding contributes to the body of research on the effect of emotion on decision-making processes, such as investigating the role of emotion in consumer behavior (Cohen, Pham, & Andrade, 2008), identifying neural mechanisms underlying the relation between emotions and decisions (Phelps, Lempert, & Sokol-Hessner, 2014), or building one general model of emotional influences on decision making (Lerner et al., 2015). Answering the question which mood is more beneficial for making an important decision, our results suggest that the effect of mood might be mitigated in the environment that demands sequential information search. However, if the information is processed simultaneously, the propensity of a positive mood for the non-compensatory decision-making strategy might lead to the disregard of less important information.

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Appendix A

Table A1
The task structure is taken from the supplemental materials of Scheibehenne and von Helversen (2015) (Table A1) from http://scheibehenne.de/onlineSupplementScheibehenneVonHelversen2014.zip.

Set	Option 1					Option 2					Predictions		
	C1	C2	C3	C4	C5	C1	C2	C3	C4	C5	LEX	WADD	EQW
1	1	1	0	0	0	1	0	1	1	1	1	2	2
1	1	0	1	0	0	0	1	1	1	1	1	2	2
1	1	0	0	1	1	0	1	1	1	0	1	2	–
1	1	0	0	0	1	0	1	1	0	1	1	2	2
1	1	0	0	0	0	0	1	0	1	0	1	2	2
1	1	0	0	0	0	0	1	1	0	0	1	2	2
1	0	1	0	0	0	0	0	1	1	1	1	2	2
1	1	0	1	1	1	1	1	0	0	1	2	1	1
1	1	0	1	1	0	1	1	0	0	0	2	1	1
1	0	1	1	1	1	1	0	0	1	0	2	1	1
1	0	1	1	1	0	1	0	0	1	0	2	1	1
1	0	1	1	0	0	1	0	0	0	1	2	1	–
1	0	1	0	1	1	1	0	0	0	0	2	1	1
1	0	0	1	1	1	0	1	0	0	1	2	1	1
1	0	0	1	1	0	0	1	0	0	0	2	1	1
2	1	1	0	0	1	1	0	1	1	1	1	2	2
2	1	1	0	0	0	1	0	1	1	0	1	2	2
2	1	0	0	1	0	0	1	1	1	0	1	2	2
2	1	0	0	1	0	0	1	1	1	1	1	2	2
2	1	0	0	0	1	0	1	1	0	0	1	2	–
2	1	0	0	0	0	0	1	0	1	1	1	2	2
2	0	1	0	0	1	0	0	1	1	1	1	2	2
2	0	1	0	0	0	0	0	1	1	0	1	2	2
2	1	0	1	1	1	1	1	0	0	0	2	1	1
2	0	1	1	1	1	1	0	1	0	0	2	1	1
2	0	1	1	1	0	1	0	0	1	1	2	1	–
2	0	1	1	0	1	1	0	0	0	1	2	1	1
2	0	1	1	0	0	1	0	0	0	0	2	1	1
2	0	1	0	1	0	1	0	0	0	0	2	1	1
2	0	0	1	1	1	0	1	0	0	0	2	1	1

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The Effect of Negative Mood on Exploration in Decisions from Experience

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Abstract

This research examines the effect of negative mood on the exploration decision in foraging behavior. Two potential mechanisms of mood influences are investigated: incorporation of a mood into a summary evaluation of a currently available object and impact of mood on the processing of information. We conducted three experimental studies that used tasks with exploration-exploitation dilemmas. In two web-based experiments participants played the Fishing pond task, in which they could either collect fish at the current pond or switch to a new one which incurred opportunity costs. Mood was manipulated by music, pictures, and the cover story. In the third laboratory experiment the task was devoid of semantic content, and mood was manipulated only by music. The results showed that negative mood promotes a general tendency to explore rather than to exploit. At the same time, there was no evidence for the impact of the mood on the processing of information. This finding supports the idea that emotions influence the exploration behavior by changing the perceived value of the current environment.

Keywords: negative mood, exploration, decision making, online-experiment, mood manipulation

The Effect of Negative Mood on Exploration in Decisions from Experience

Introduction

For thousands of years our ancestors have sustained themselves by gathering food from their natural environment. To survive, particularly as hunters and gatherers, humans should have developed the ability to decide when to stay longer at the current place of foraging and when to move further. The dilemma between exploitation and exploration is also familiar to modern gatherers: if you ever picked mushrooms or did fishing, you know the choice between staying on your favorite route or spot and moving to a new place. As it was a long time ago when our ancestors were searching for nutrition, you decide whether to stay in a known area or take the risk of trying something new (Mehlhorn et al., 2015).

The foraging problem can be understood as a problem of utility maximization in a situation where choices are initially unknown, but can be explored (Hills & Hertwig, 2010). It is a tradeoff between exploration, which can be potentially rewarding but is risky and costs energy and time, and exploitation, which takes advantage of currently available resources but eventually depletes them and elicits boredom (J. D. Cohen, McClure, & Yu, 2007). Modeling of foraging behavior can be applied to various domains, such as Internet browsing (Pirolli & Card, 1999), dating behavior (Saad, Eba, & Sejean, 2009), memory search (Hills & Pachur, 2012), or shopping behavior (Riefer & Love, 2015).

The emotional regulation of tradeoffs in exploration and exploitation is not yet well understood, although, from an evolutionary perspective, one might speculate that emotional mechanisms to regulate foraging behavior have evolved before explicit cognitive strategies. Researchers agree that the purpose of the affective system is to monitor the exterior environment of the human body, signal changes and maintain homeostasis (Damasio & Carvalho, 2013). The subjective component of an affective reaction is a feeling that has the adaptive value of forcing an organism to care about its current state and facilitate learning and predicting future situations (Scherer, 2005). Affective reactions, known as emotions, are intense and short-lived experiences triggered

by an event (J. B. Cohen, Pham, & Andrade, 2008). Moods, on the other hand, are vague, diffuse and long-lasting affective states. The most important dimension for distinguishing affective states is their valence, which ranges from negative to positive (Russell & Pratt, 1980). In the current research we investigate how exploration behavior is influenced by negative mood. The predictions for the exploration behavior are derived from theoretical approaches that address two aspects of the decision-process: evaluation of a currently accessible object and processing of information.

Impact of Mood on the Evaluation of an Object

The impact of mood on the evaluation of an object (content-related influence of mood) is associated with the incorporation of a mood into a summary evaluation of a currently accessible object and described by the mood-as-information theory, which considers mood as a source of information for inferences about the current situation (Schwarz & Clore, 1983). The typical finding in studies of the relationship between mood and judgment is the congruency effect: people in a negative mood evaluate currently available objects less favorably than people in a positive mood. Evidence of the congruency effect has been demonstrated in studies on the evaluation of brand products (Barone, Miniard, & Romeo, 2000), political candidates (Isbell & Wyer, 1999), perceived risks (Johnson & Tversky, 1983), and future consumption episodes (Gilbert, Gill, & Wilson, 2002).

Since mood influences the evaluation of objects in the current environment, the mood-as-information theory assumes that participants in a negative mood evaluate the current state more negatively than participants in a better mood. Therefore, people in a negative mood are expected to explore more than others.

The alternative hypothesis that people in a negative mood will be less explorative than others is justified by studies showing higher risk aversion in negative moods (Johnson & Tversky, 1983). In this way, the congruency effect is produced by the match between the negative mood and the more pessimistic evaluation of a possible future state following the exploration decision.

Impact of Mood on Information Processing

Previous research has shown that mood states also affect the way how information is processed (Bless & Fiedler, 2012). The extension of the mood-as-information theory, cognitive tuning hypothesis (Schwarz & Clore, 2007), proposes that mood can influence the processing style by informing the individual about the nature of the current situation. Positive mood signals that the current environment is benign and therefore does not require careful information processing. In line with that, it has been found that a positive mood promotes superficial thinking, for example, in a persuasion task (Bless, Mackie, & Schwarz, 1992). On the other hand, negative mood provides a stop signal alerting people that they are in a problematic environment that needs a careful and detailed examination. Therefore, people in a negative mood may search for more information and have higher thresholds to accept options (von Helversen, Wilke, Johnson, Schmid, & Klapp, 2011).

According to the cognitive tuning hypothesis, the demand for careful information processing in a negative mood results in changes in decision-making strategies, such as a more thorough search for information. For this reason, people in a negative mood should be more sensitive to the actual distribution of resources in the environment than people in a better mood. As a result, people in the negative mood will discriminate more accurately between advantageous and disadvantageous environments. Therefore, they are expected to stay shorter in low-resource environments and stay longer in high-resource environments. Hence, the exploration-exploitation tradeoff in a negative mood should depend more on the resource quality of the current environment.

The cognitive tuning hypothesis contrasts with an opposite assumption that a more positive mood should increase the efficiency of decision-making. This alternative is a corollary of two theories that emphasize the beneficial effects of positive mood on information processing. First, the broaden-and-build theory assumes that positive mood expands attention and broadens the repertoire of possible behaviors, while negative mood narrows down and limits attention (Fredrickson, 2001). Secondly, in her theory of positive emotions, Isen (2001) also expects people in a positive mood to work more

efficiently and find more creative solutions that can offer them advantages in finding high-resource environments. Since the effect of mood is dependent on the task and the foraging task has not been tested from the emotional perspective in previous research, it is difficult to conceive how exactly the expanded attention or creativity could unfold in the foraging task. Therefore, the current research is necessary to find out whether negative mood increases or decreases the efficiency of exploration.

The present research

The aim of the current empirical study is to examine how content- and process-related influences of mood unfold if both resource quality of the environment and mood are manipulated. First, based on the congruency effect explained by the mood-as-information theory, we expect people in a negative mood to explore more than people in a better mood at every level of resource quality. Secondly, under the assumption of the cognitive tuning hypothesis, participants in a negative mood should be more sensitive to the resource distribution than others. Cast in data analysis terms, the mood-as-information hypothesis predicts a main effect of negative mood on the exploration behavior, whereas the cognitive tuning hypothesis predicts an interaction of mood and resource quality.

To test the hypotheses, both the mood and the distribution of resources were factorially manipulated in three experiments. The uncertainty of the resource distribution varied, being high in Experiment 1 and low in Experiments 2 and 3. The mood was induced by music and either a pleasant or an unpleasant semantic framing of the tasks that were otherwise identical in Experiments 1 and 2. To eliminate possible effects due to the content of tasks, only the music mood manipulation was used in Experiment 3.

Experiment 1

Method

Materials and Procedure. The experiment was conducted as an online study in which we induced a negative or positive mood by a cover story, images, and music in a between-subjects design. The quality of resources was varied as a within-subjects random factor. The experiment was programmed in JavaScript and installed on the personal website of the first author[1]. The fishing pond task was chosen as the main experimental paradigm (Mata, Wilke, & Czienskowski, 2009). In this task, participants have to collect fish from a pond, but can switch to a new pond and incur a cost of constant travel time (15 s.) between the ponds whenever they decide that the current pond is too depleted to exploit it in a profitable way. Therefore, people constantly face the dilemma between exploitation (staying at the current pond and waiting for another fish) and exploration (moving to a new pond with the hope of finding more fish). The quality of pond resources was manipulated as a within-subjects factor so that the number of fish in each new pond was independently drawn from a Poisson distribution with an average of 10 fish.

The participants were recruited from various Internet sources including social networks, forums, and online newspapers. After agreeing to a declaration of consent, the participants filled out a questionnaire with demographic data and answered control questions. After that, they evaluated their current mood and read the instructions for the fishing game. Depending on the mood condition, the instruction was either to fish at ponds or to collect dead fish in a polluted area. To adjust the volume of speakers or headphones, the participants heard a short piece of music. The mood induction music also played during the 20-minute game. After the game, the participants answered a mood questionnaire and described how they decided to switch to a new pond. The next page contained rating scales for the use of cues for switching decisions such as the number of fish caught at the pond, the total time at the pond and the waiting time

[1] The experiment and the program code are available at http://yuryshevchenko.com/

since the last catch. Finally, the participants could leave their contact details to take part in a lottery and write comments about the study. Their responses and behavioral data were recorded at each phase of the experiment by periodic file transfer to the server. After the study was completed, five people from 20 participants with the best results were randomly selected, and each winner received 20 Euro Amazon voucher.

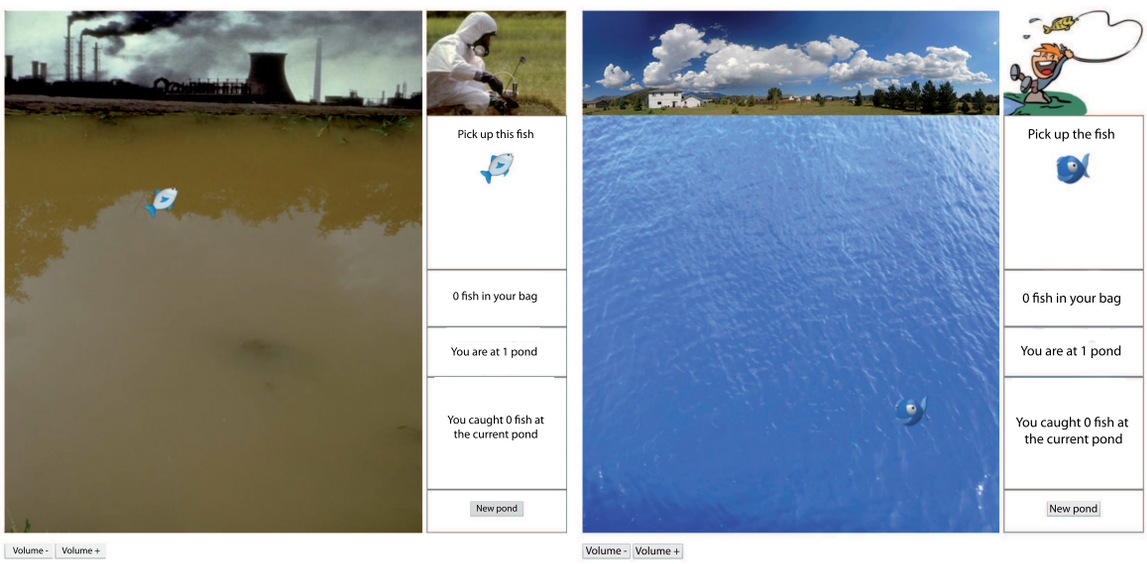
Mood induction materials. A cover story, images, and music were used together to induce a target mood, as a combination of methods can produce more intense effects (Kory & D'Mello, 2015). The cover story in the positive mood group described the situation of fishing on a warm and sunny summer day. In the negative mood group, we told the participants that the area was heavily polluted and they had to collect dead fish. In both groups, the aim was to collect as many fish as possible.

We used mood-inducing imagery to decorate ponds in both conditions (see Figure 1). In the negative mood condition, the top of the screen was covered with two images from the International Affective Picture System (IAPS, Bradley & Lang, 2007): the upper part of the image "Kids" (№9520, mean valence 2.46, mean arousal 5.41) was on the left side, the image "Toxic waste" (№9270, mean valence 3.72, mean arousal 5.24) was on the right side. In the positive mood condition, the upper part of the screen was covered by two pictures depicting a landscape with white clouds in the blue sky on the left side and a funny cartoon character with a fish on the right side.

Eight pieces of music (see Appendix A1) were selected from the study by Mitterschiffthaler, Fu, Dalton, Andrew, and Williams (2007), in which respondents had chosen happy and sad classical compositions from a database. The order of the musical pieces was randomized for each participant in our experiment.

Mood manipulation check. A mood manipulation check was carried out by asking participants before and after the fishing game about their current mood using a short form of the Positive and Negative Affective Schedule (PANAS, Watson & Clark, 1999). Participants had to rate 14 emotions on the visual scale that recorded responses from 0 to 500. The questionnaire contained three groups of emotions: positive emotions (alert, active, inspired, attentive, interested), negative emotions (afraid, upset, nervous,

Figure 1. The fishing task in negative and positive mood groups.



irritable, distressed, disgusted), and joviality (joyful, happy, cheerful). The scores on each of three scales were later averaged and converted into a percentage scale (0 - 100%).

The fishing game. The fishing game was presented as a sequence of ponds with different (unknown) amounts of fish. The instruction in the positive mood condition was: "In the following task you will see a fishing pond. The summer brought warm and sunny weather, so you go fishing. From time to time fish will appear on the surface of the pond. Please click on the fish as soon as you see it to catch it. Your goal is to catch as many fish as possible". In the negative mood condition, people read the instruction: "In the following task, you will see a pond. The area around was badly polluted, so you have to collect dead fish. From time to time dead fish will appear on the surface of the pond. Please click on the fish as soon as you see it to pick it up. Your goal is to collect as many fish as possible". The rest of the instruction was identical for both conditions: "The more fish you get from the pond, the less fish remain there and the more time you have to wait. You can go to a new pond if you click on the button 'New pond'. Note that traveling to a new pond takes some time. Ponds are different in the amount of fish. There are ponds that contain only a few fish and ponds with a lot of fish. Some music will be played during the game. Before you start the task, please make sure that your speakers or headphones are working. Use the test music sample to adjust

the volume that is comfortable for you".

The number of fish per pond was determined by a Poisson distribution with an average of 10 fish. Fish appeared at a rate that linearly depended on the number of fish in a pond but also included a random error. Using computer simulation we calculated that the Poisson distribution and the variance in the appearance of fish produced the mean waiting time for the first fish of 11.31 sec. in the range between 3.90 and 109.30 sec. ($SD = 5.14$ sec.). A fish popped to the surface of the pond, and a participant had to click on the image of the fish to catch it. The task has been programmed to end after 20 minutes. We saved participants' data for each event in the game, such as a click on the pond or a click on the fish. To prevent participants from reloading the web page, if a participant refreshed the page, she had to wait for 1 minute to continue the task.

Methods of data analysis. We report all data exclusions (if any), all manipulations, and all measures in the study. In order to measure exploration behavior, we used the time spent at each pond. First, the analysis of the residence time has often been considered in previous studies to show that the resource quality of a pond influences the exploration decision (Hutchinson, Wilke, & Todd, 2008). Secondly, the use of aggregated measures such as the number of visited ponds is less conclusive, as the total number depends largely on the resource quality of the attended ponds, which are selected randomly for each participant. Therefore, the analysis should take into account differences between ponds and unequal sample sizes of pond qualities. To meet these requirements, we applied a linear-mixed model. The log-transformed residence time at each pond was used as a dependent variable. The main predictors were the mood and the pond quality.

Participants. The online experiment took place from December 2015 to March 2016. There were five language versions of the fishing task: German, English, Russian, Korean, and Italian. 264 participants (175 females, 89 males) completed the experiment[2]. The average age of the participants was 25.26 years ($SD = 8.22$).

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[2] 238 participants did not complete the fishing task, but interrupted it by closing the web page. Since we did not intend to analyse incomplete data, these participants were not included in the final sample,

Results

Testing for engagement. A common concern in online studies is that the experimental design lacks control and precision (Ferrer, Grenen, & Taber, 2015). To ensure that the data were correctly recorded and the participants were fully engaged in the experiment and understood the instructions correctly, we used the following criteria to analyze their behavior: the time in the experiment, the number of visited ponds, missing fish, and the amount of page reloads. To detect multiple participation in the experiment, the information of the web browser (i.e., cookies) was saved.

Due to a missing Internet connection, two participants stayed in the fishing game for more than 25 minutes, so they were excluded from the final sample. One participant visited more than 50 ponds. A detailed examination revealed that she had misunderstood the instructions, so she was also excluded from the final sample[3].

Another criterion for ignoring the task was how often a participant did not click on the fish when it appeared on the screen. As far as the distribution of the fish miss was not Gaussian, $Median = 3$, $M = 5.49$, $SD = 7.21$, we applied a non-parametric Mann-Whitney test to analyze the differences between the mood groups. There was no significant difference between the negative and the positive mood groups in the number of missing fish, $W = 9179$, $p = .24$. Thus, we did not exclude participants based on the total number of fish misses, but used the number of fish misses at a pond as a control variable in the further analysis.

Regarding the number of page reloads, nine participants refreshed the web page with the task at least once (four participants in the positive mood group). As far as we had saved the data before reloading, the participants could continue playing at the same

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although their data could be stored and considered in the further analysis (see Experiment 2). The exploratory analysis showed that there was a significant interdependence between the mood condition and the interruption of the game, χ^2 (1) = 4.31, $p = .04$, suggesting that people in the positive mood group interrupted the experiment more often (63%) than people in the negative group (37%).

[3] The participant visited 61 ponds without catching fish. At the beginning, she made 77 clicks on the first three ponds and then constantly changed to a new pond.

pond after one minute, so we did not exclude these participants.

Consequently, the filtering was applied to two participants who stayed in the game for more than 25 minutes and to one participant who visited more than 50 ponds, resulting in 261 participants for the final analysis (Table 1).

Table 1

Characteristics of the final sample. Standard deviations are written in parentheses.

	Sample size	**Age**	**Females**	**Fish misses**	**Visited ponds**	**Collected fish**	**Time at a pond in seconds**
Positive condition	140	24.42 (6.41)	89	5.52 (7.79)	8.12 (5.04)	27.98 (8.46)	129.67 (130.24)
Negative condition	121	26.25 (9.93)	84	5.45 (6.51)	9.02 (5.59)	28.98 (8.16)	115.54 (121.87)
All	261	25.27 (8.27)	173	5.49 (7.21)	8.54 (5.31)	28.44 (8.32)	122.71 (126.35)

Mood manipulation check. We computed the difference between the pre- and post-task mood measurements for 258 participants who completed both mood questionnaires. Independent t-tests were used to analyze the differences between two groups on each of three emotion scales: positive, negative, and jovial emotions. The values for the emotions were calculated as average scores on the following scales: positive emotions (alert, active, inspired, attentive, interested), negative emotions (afraid, upset, nervous, irritable, distressed, disgusted), and joviality (joyful, happy, cheerful). The scores are given on a percentage scale (0 – 100%). There were differences in the decline of positive emotions between the positive group (M = -10.60, SD = 15.67) and the negative group (M = -15.63, SD = 16.96), t (256) = -2.47, $p < .05$, d = 0.31. The same pattern was observed in the decrease of jovial emotions in the positive group (M = -7.43, SD = 19.45) and in the negative group (M = -15.08, SD = 17.05), t (256) = -3.34, $p < .01$, d = 0.42. The increase in negative emotions was observed only

in the negative group (M = 5.22, SD = 14.90), while there were no changes in the positive group (M = -0.05, SD = 12.89), t (256) = 3.05, $p < .01$, d = 0.38. We concluded that the mood manipulation was successful because the negative mood during the task was only induced in the negative group.

Residence time at a pond. 261 participants have changes ponds at least once in the game. The residence time at a pond was log-transformed to eliminate the skewness of the distribution. We used lme4 package in R (Bates, Mächler, Bolker, & Walker, 2015) to perform a linear mixed-effects analysis. To test the mood-as-information hypothesis, a baseline model (Model 0) and a main effect model (Model 1) were compared with a Likelihood ratio test (see Appendix A2 for the models' parameters). The baseline model included the fixed effects of the pond resource quality and the number of fish misses at the pond. To control for the influence of the initial emotional state of participants, the individual ratings of negative, positive, and jovial emotions before the experiment were also included in the model[4]. The random effects were modeled for each subject and the interaction between a subject and the pond quality.

The main effect model was similar to the baseline model, but in addition contained the fixed effect for the mood manipulation. The Likelihood ratio test between the baseline and main effect model showed the marginally significant difference, χ^2 (1) = 3.09, p = .08, indicating the presence of the main effect of the mood, b = -0.20, p = .08 (see Figure 2 for effects' estimates and Figure 3 for predicted values). In the main effect model, pond resource quality (i.e., each additional fish) also positively affected the time spent at a pond, b = 0.04, $p < .001$, as did the number of fish misses at the pond, b = 0.08, $p < .001$. The negative emotions before the task also tended to shorten the residence time, which was indicated by a marginally significant effect, b = -0.01, p =

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[4] Comparing simpler versions of the models (without the fixed effects of the number of fish misses at the pond and the initial emotions ratings) did not change the significance level of the main and interaction effects (p = .08 and p = .22) and led to identical conclusions. Therefore, we report the results for the most complex models.

.08. The effects of the positive and jovial emotions before the task were not statistically significant ($p = .43$ and $p = .41$).

To assess the cognitive tuning hypothesis, the main effect model (Model 1) was compared with a similar model that additionally included the interaction between the mood and the pond resource quality (Model 2), which is a standard way to test an interaction effect (Bates et al., 2015). The interaction model also contained the main effects, since in models that do not control for the main effects, the significance of interaction may depend on the levels of predictors chosen for the model (J. Cohen, Cohen, West, & Aiken, 2003; Rouder, Engelhardt, McCabe, & Morey, 2016). In fact, purely additive factors can show a significant interaction if the additive main effects are not controlled for in the analysis. Comparing the models with the likelihood ratio test, we found that the interaction model does not differ significantly from the main effect model, $\chi^2(1) = 1.71$, $p = .19$, indicating the lack of interaction between the mood and the pond resource quality, $b = 0.02$, $p = .19$[5]. All interactions between jovial, positive and negative emotions at the beginning of the experiment with the pond resource quality were also not significant ($p > .10$).

Performance analysis. As an exploratory analysis, we checked whether the main performance indicator, the amount of collected fish, was different depending on the mood. There were no significant differences between people in the positive ($M = 27.98$, $SD = 8.46$) and negative group ($M = 28.98$, $SD = 8.16$), $t\ (258) = 0.97$, $p = .34$, $d = 0.12$.

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[5] One might argue that the test of the cognitive tuning hypothesis should be done with an interaction model without corresponding main effects (Model 3). The interaction effect between the mood condition and the pond resource quality in Model 3 was not significant, $b = 0.01$, $p = .18$. Additionally, the model fit of Model 3 (AIC = 5978.0, BIC = 6033.5) was worse than the model fits of other models, corroborating the previous finding that the cognitive tuning hypothesis was not supported by the data.

Figure 2. Fixed effects for predictors of the main effect model with the log-transformed residence time as a dependent variable. The estimates are sorted by effect size.

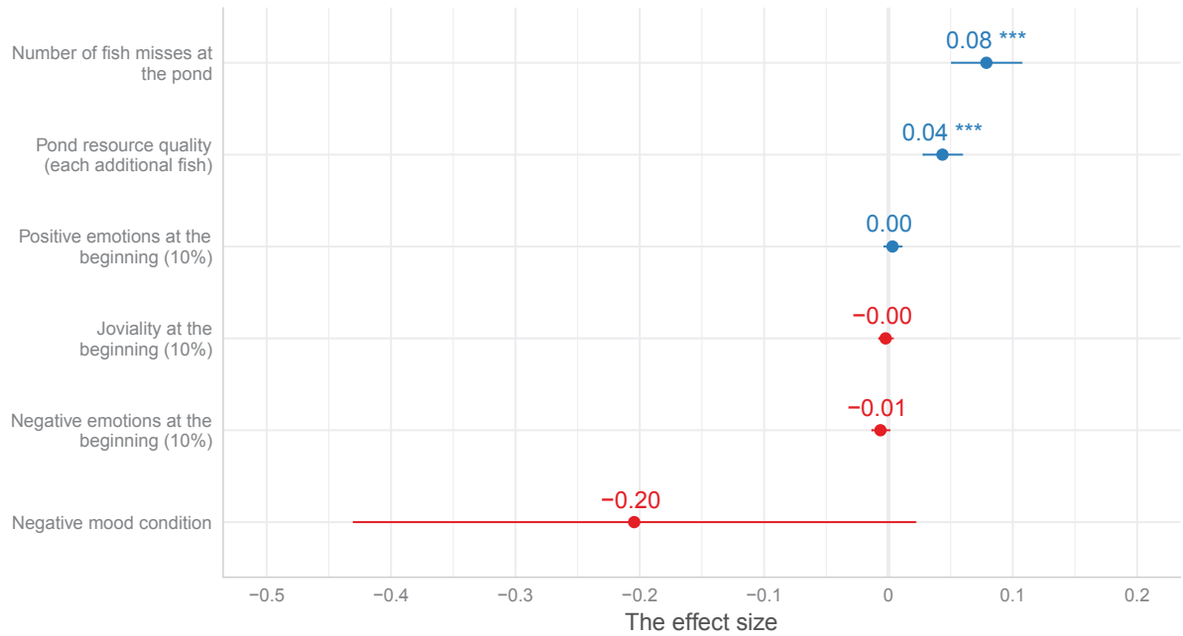
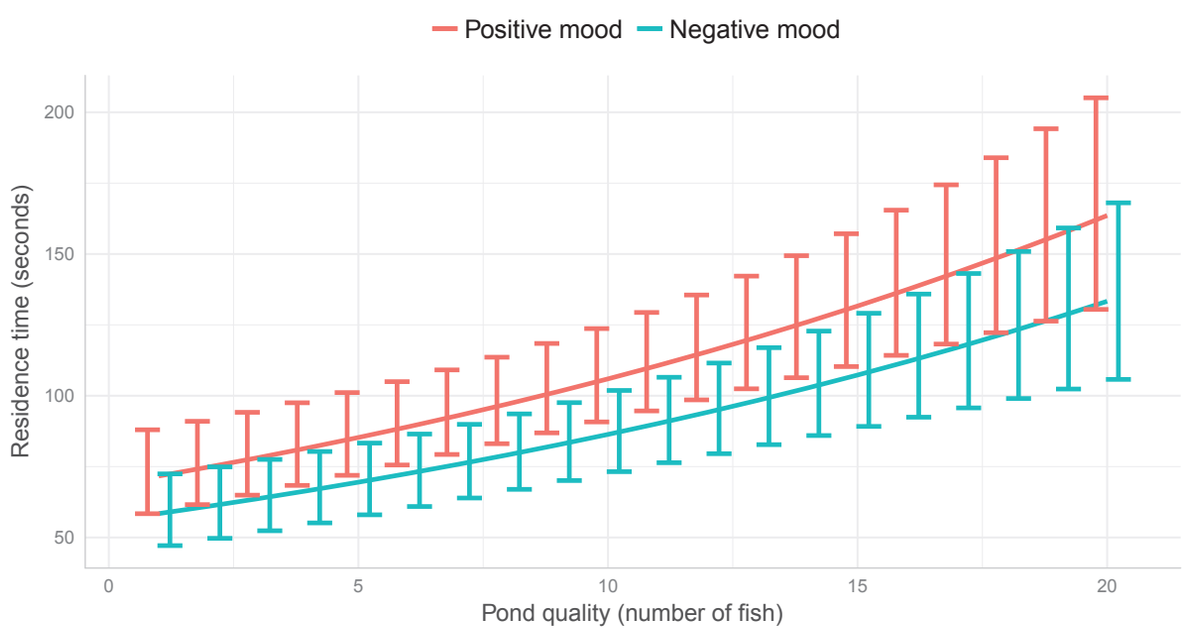


Figure 3. Predicted values with 95% confidence intervals for the residence time conditioned on fixed and random effects of the main effect model. The pond resource quality is on the X-scale with two lines depicting the positive and negative mood group.



Discussion

We found a tendency for participants in the negative mood group to spend less time at ponds than other participants, which we interpreted as a sign of higher exploration. Additionally, participants in a more negative emotional state before the task were more explorative than others. These results support the mood-as-information hypothesis that implies the congruency effect between mood and evaluation of the currently accessible environment: People in a negative mood had a more negative evaluation of the current state, so they explored more than people in a better mood. The data speak against the alternative idea that negative mood impacts the assessment of future risks, which in turn increases risk aversion and reduces exploration. With regard to the process-related influence of mood, there was no significant interaction between quality of the current pond and mood, and the performance level was similar for both mood conditions. Hence, participants in a more negative mood were not more sensitive to environmental differences than those in a better mood, as predicted by the cognitive tuning hypothesis. The alternative assumption that a positive mood should improve the decision-making could not be evaluated since the positive group did not show an increase in the positive mood, although the mood contrast between groups was found.

The mood measurements after the task revealed a decline of positive mood in both the positive and negative mood groups. The potential explanation for that may be the length of the task and that people were feeling bored or tired after playing the game. However, the principal difference between groups was the increase of negative emotions in the negative mood group and no significant changes in the negative mood in the positive mood group. Also, the drop in positive emotions was much larger in the negative condition. This asymmetry between positive and negative emotions coincides with the previous findings that negative emotions are easier to elicit than positive ones (Ferrer et al., 2015).

The support for the mood-as-information theory was only marginally significant at conventional levels. This may be due to the low motivation to participate in an

online study and non-compliance behavior, which was also confirmed by the high drop-out rates. In Experiment 2, to assure participants' motivation to follow the study's instructions, we restricted the sample to university students participating for credits. Additionally, we wanted to rule out potential floor effects to be responsible for the lack of an interaction effect. Therefore, we applied another form of resource distribution at fishing ponds. As indicated in the literature, people are less sensitive to a Poisson resource distribution than expected in rational models of behavior (Hutchinson et al., 2008), so the application of resource distributions that are somewhat easier to discriminate would be a further way to test the predictions of content- and process-related theoretical approaches.

Experiment 2

In Experiment 2, we examined the relationship between mood and exploration behavior in a different form of resource distribution at ponds. To boost the effect of the pond quality, the resource distribution of ponds was made more distinguishable in Experiment 2.

Method

Materials and Procedure. Whereas the manipulation of mood as a between-subjects factor remained the same, the within-subjects manipulation of the resource quality of ponds was changed. There were three pond qualities (with zero, ten, and twenty fish) that were equally likely to occur after a pond change. Compared to Experiment 1, the distribution of fish per pond in Experiment 2 provided waiting times for the first fish with a lower standard deviation. No fish were shown at the low-quality ponds, 10 fish popped up at the ponds of the average quality with the mean waiting time for the first fish of 10 sec. ($SD = 0.96$), 20 fish appeared at the ponds of the high quality with the mean waiting time of 5 sec. ($SD = 0.48$).

The procedure was identical to Experiment 1, except that participants were allowed to deliberately stop the fishing game before its end, which prevented data loss.

When participants pressed the stop button, they proceeded to the questionnaires and could complete the experiment.

The mood induction material and the fishing task remained essentially the same as in Experiment 1. To alleviate boredom, we doubled the fish encounter rate and reduced the travel time between ponds to 7 seconds.

Participants. The second online experiment took place from March 2016 to June 2016. To ensure data quality, the sample was limited to students from the University of Mannheim in Germany and the Radboud University Nijmegen in the Netherlands who took part in the study for participation credits. There were two language versions of the fishing task: German and Dutch[6]. 138 people completed the experiment. Among them, 81 people (43 in the positive mood condition) played the fishing game till the end, and 57 participants (34 in the positive mood condition) used the stop button in the fishing game.

Results

Testing for engagement. There were no participants whose time variables were incorrectly recorded, which could be the indicator for the missing Internet connection. Concerning the number of visited ponds, there were no outliers. One participant missed more than 90 fish and was excluded from the analysis. The median number of missed fish was 3, $M = 5.40$, $SD = 10.55$. A Mann-Whitney test indicated no difference between negative and positive conditions in the number of missed fish, $W = 2453.5$, $p = .65$. Regarding the number of page reloads, three people (two in the positive mood group) refreshed the fishing game page at least once.

The participants who finished the game missed more fish than the participants who used the stop button, $W = 2896.5$, $p < .05$. Regarding the time in the game and the number of visited ponds, 81 participants who played the fishing game to the end spent 20.23 min. in the game ($SD = 0.44$) and visited 13.58 ponds ($SD = 4.82$). 57

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[6] We thank Dieuwertje van de Schoot for translating the task into Dutch language and recruiting participants at the Radboud University Nijmegen in the Netherlands.

participants who used the stop button spent 9.85 min. in the game (SD = 5.41) and visited 8.18 ponds (SD = 5.36). There was no interdependence between the mood condition and interruption of the game with the stop button, χ^2 (1, N = 138) = 0.58, p = .44. Therefore, we retained participants who used the stop button in the final sample but included the interruption of the game as a control variable in the further analysis.

There were also 14 participants who interrupted the task by closing the web page (time in the game, M = 6.31 min., SD = 7.49; the number of visited ponds, M = 4.93, SD = 5.12). As far as this sample was rather small and mainly consisted of the participants who did not complete the first mood questionnaire, we excluded them from the analysis.

Thus, filtering was only applied to the participant who missed more than 90 fish, resulting in 137 people for analysis (Table 2).

Mood manipulation check. The scores are presented on a percentage scale (0 - 100%). There were no differences in the decline of positive emotions between the positive group (M = -10.64, SD = 19.23) and the negative group (M = -13.05, SD = 17.32), t (135) = -0.83, p = .45, d = 0.13. However, the decrease in joviality was larger in the negative group (M = -13.03, SD = 17.61) in comparison with the positive group (M = -4.58, SD = 18.76), t (135) = -2.69, $p < .01$, d = 0.46. An increase in negative emotions was only observed in the negative group (M = 4.92, SD = 11.63), while there were no changes in the positive group (M = -0.74, SD = 12.01), t (135) = 2.77, $p < .01$, d = 0.48. Hence, the mood manipulation was again successful with respect to the negative mood.

Residence time at a pond. 135 participants have changed ponds at least once. The same models as in Experiment 1, but including the fixed effect of the interruption, were applied to the log-transformed time data. The baseline model, the main effect model, and the interaction effect model were compared using Likelihood ratio tests (see Appendix A3 for parameters). With regard to the mood-as-information hypothesis, we found that the main effect model was significantly different from the baseline model, χ^2 (1) = 4.24, p = .039, indicating that the inclusion of the mood

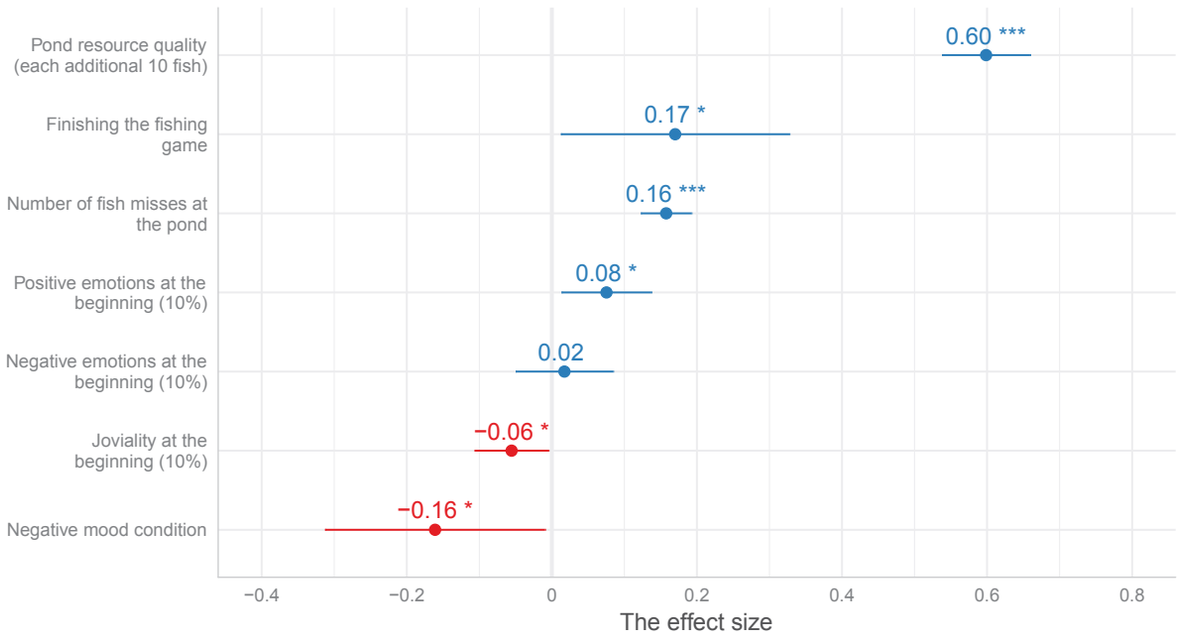
Table 2

Characteristics of the final sample. Standard deviations are written in parentheses.

	Sample size	**Age**	**Females**	**Fish misses**	**Visited ponds**	**Collected fish**	**Time at a pond in seconds**
Used the stop button							
Positive condition	34	22.50 (6.59)	36	2.94 (4.17)	7.15 (3.62)	33.67 (19.95)	73.96 (65.11)
Negative condition	23	24.09 (9.91)	27	5.04 (9.18)	9.96 (6.85)	35.87 (24.72)	56.05 (48.42)
Played till the end							
Positive condition	42	20.86 (3.10)	28	4.74 (6.48)	13.40 (5.10)	72.52 (21.18)	84.17 (71.77)
Negative condition	38	25.37 (11.00)	22	6.11 (8.15)	13.79 (4.62)	76.24 (19.56)	80.06 (68.03)
All	137	23.06 (8.09)	113	4.72 (7.06)	11.41 (5.67)	57.93 (28.68)	82.19 (69.99)

manipulation effect improves the fit of the model. The participants in the negative condition remained at ponds shorter than the participants in the positive condition, b = -0.16, p = .037 (see Figures 4 and 5). The pond resource quality also positively affected the residence time, b = 0.60, $p < .001$, as well as the number of fish misses at a pond, b = 0.16, $p < .001$, and positive emotions at the beginning of the experiment, b = 0.08, p = .017. However, joviality at the beginning of the experiment was negatively related to the time at a pond, b = -0.06, p = .033. The participants who completed the task had longer residence times, b = 0.17, p = .034.

Figure 4. Fixed effects for predictors of the main effect model with the log-transformed residence time as a dependent variable. The estimates are sorted by effect size.



With respect to the cognitive tuning hypothesis, the main effect model and the interaction model did not differ in their fit, χ^2 (1) = 0.41, p = .52, suggesting that there was no interaction between the mood condition and the resource quality of a pond, b = 0.04, p = .52[7]. All interactions between jovial, positive and negative emotions at the beginning of the experiment with the pond resource quality were not significant (p > .10)[8].

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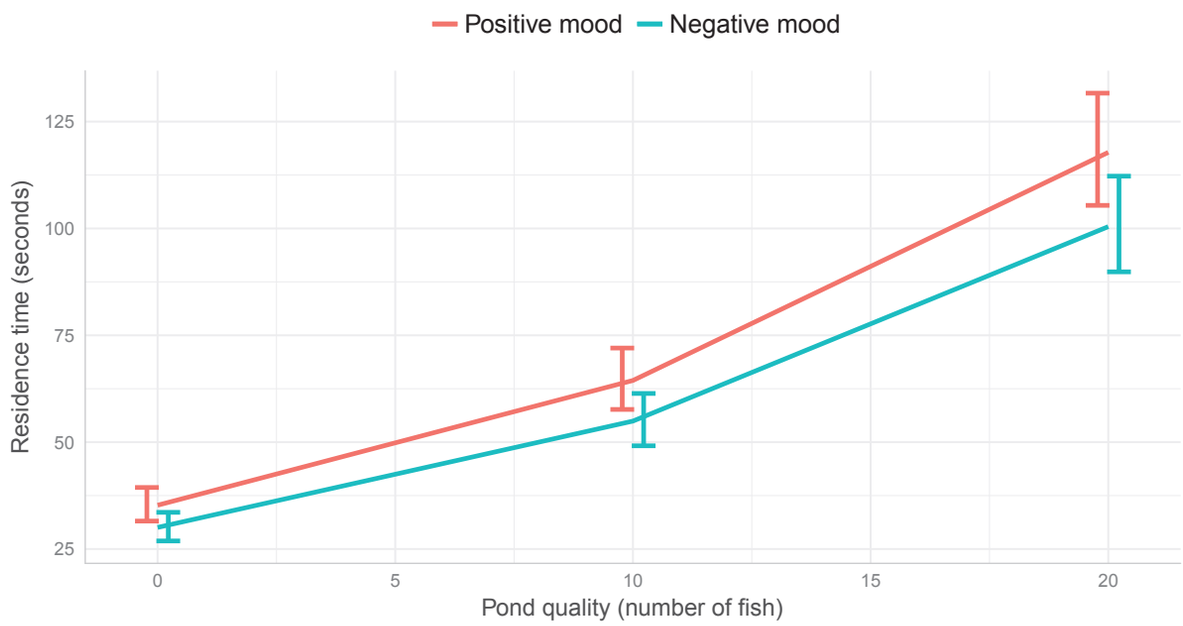
[7] The interaction effect between the mood condition and the pond resource quality in Model 3 with the interaction but without corresponding main effects was also not significant, b = -0.02, p = .68. Moreover, the model fit of Model 3 (AIC = 3084.3, BIC = 3142.0) was worse than the fit of other models.

[8] Comparing simpler versions of the models (without the fixed effects of the number of fish misses at the pond and the initial emotions ratings) led to identical conclusions. The main effect of the negative mood was still significant, b = -0.17, p = .044, and the interaction effect remained not significant, b = 0.06, p =.30.

Figure 5. Predicted values with 95% confidence intervals for the residence time conditioned on fixed and random effects of the main effect model. The pond resource quality is on the X-scale with two lines depicting the positive and negative mood group.



Performance analysis. Regarding the amount of collected fish, there were no significant differences between people who finished the task in the positive ($M = 72.52$, $SD = 21.18$) and negative group ($M = 76.24$, $SD = 19.56$), $t\ (78) = 0.97$, $p = .42$, $d = 0.18$. In the group of participants who interrupted the task, the number of collected fish was also not significantly different: $M_{pos} = 33.67$, $SD_{pos} = 19.95$ vs. $M_{neg} = 35.87$, $SD_{neg} = 24.72$, $t\ (54) = 0.37$, $p = .71$, $d = 0.10$.

Discussion

Analyzing the residence time at ponds, we found that participants in the negative mood explored more than participants in the other condition, which again supported the mood-as-information account. Finding a statistically significant effect in the sample, which was smaller than in Experiment 1, may be attributed to the higher compliance rate and more homogeneous characteristics of university students. For instance, in a sample with more considerable age differences, exploration can be influenced by reduced learning performance in old age (Mata, Josef, Samanez-Larkin, & Hertwig, 2011).

Furthermore, the inclusion of participants who interrupted the task in the analysis can be informative, as the effect of mood manipulation can dissolve over time and alternative emotions such as boredom can influence the exploration. The lack of differences in the interruption rate between conditions speaks against the idea that people in the negative mood simply did not like or avoided the negative mood manipulation.

There was no hint to an interaction between quality of the current pond and mood, so the cognitive tuning hypothesis was not supported by the data. Given the lack of contrast in the positive mood between groups, the alternative hypothesis that the positive mood increases the efficiency of exploration cannot be evaluated. As in Experiment 1, negative emotions increased only in the negative condition, and positive and jovial emotions decreased in both conditions. Whereas the joviality level dropped more in the negative mood condition, the decline in positive emotions was not different between groups. The increased speed of the game can explain the reduced gap in the loss of positive emotions between negative and positive groups. We conclude that the fishing task can be a reliable trigger for a negative mood. However, an increase in the positive mood (i.e., being more alert, active, inspired, attentive, and interested) can hardly be achieved in the current version of the task. First, participants may already be in a good mood when they start the experiment. Secondly, the task itself is not a source of delight for participants but requires cognitive effort to remain vigilant for twenty minutes.

One possible confound in both Experiments 1 and 2 was the semantic context involved in the cover story of the fishing task. People in the negative condition were asked to collect dead fish, which could promote thoughts about death, whereas people in the positive condition could think about fishing. Hence, apart from mood, semantic or conceptual priming effects could have caused the main effect in both experiments rather than the mood itself. A rigorous test for the mood-as-information and the cognitive tuning hypotheses would be to use only music as a mood manipulation method but to keep the semantic context of the task constant across conditions. To

achieve this goal, we replicated Experiment 2 with a modified version of the fishing task devoid of semantic content.

Experiment 3

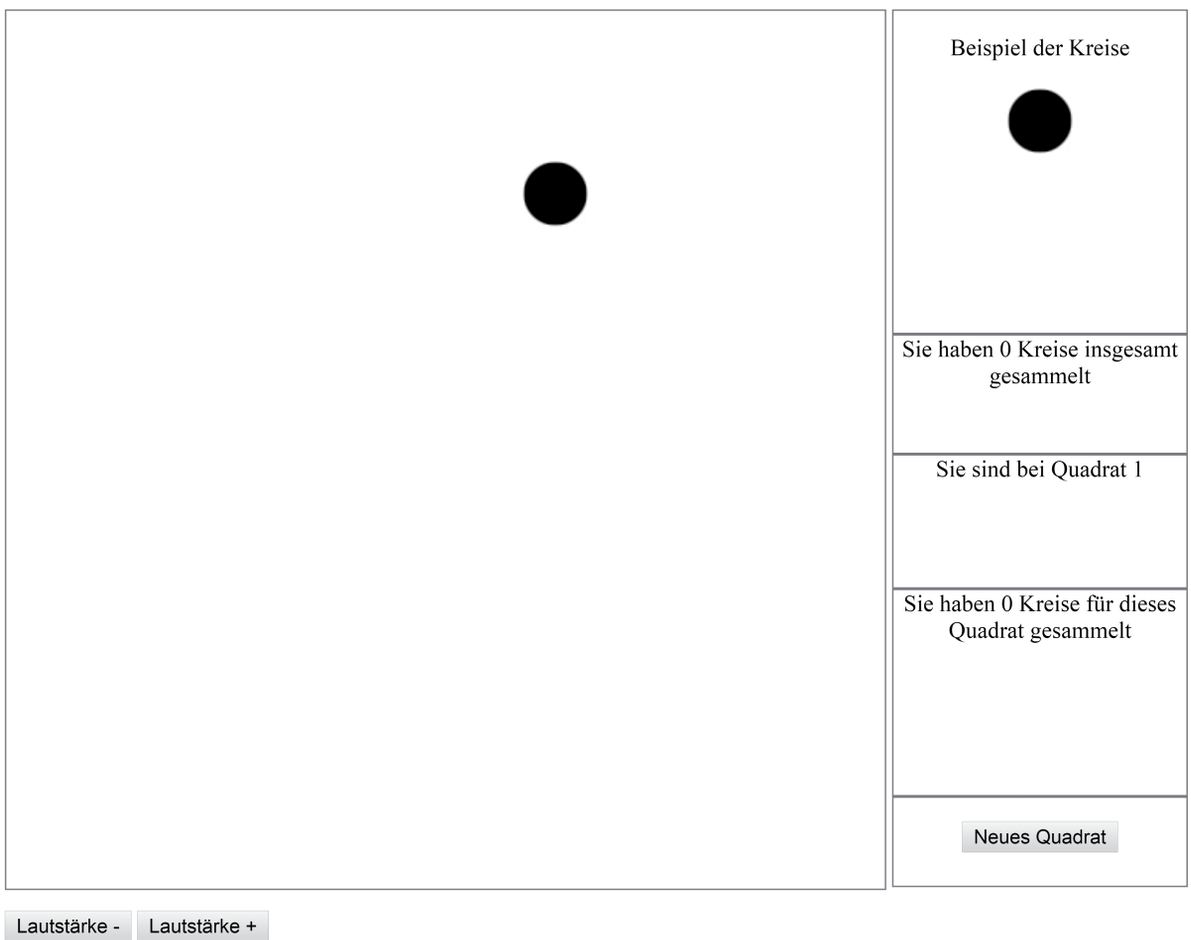
Experiment 3 was conducted in the laboratory to increase the effect of the mood manipulation, which was performed with music only. The content of the fishing task has been transformed into the task of clicking on circles that appear on the board.

Method

Materials and Procedure. The procedure and logic of the main task in Experiment 3 were identical to Experiment 2. The fishing game was modified to a "perception task" in which participants had to remain vigilant to click on each circle that was shown on the surface of the board (see Figure 6). The instructions were written in German and were identical in positive and negative conditions: "In the following task you will see a white square board. From time to time a black circle figure will appear on the surface of the board. Please click on the circle as soon as you see it to take it. Your goal is to collect as many circles as possible. The player, who collects more circles, wins. The more circles you collect on the board, the fewer circles remain there and the more time you have to wait. You can switch to a new board by clicking on the 'New board' button. Note that changing a board takes some wait time. Boards are different in the number of circles. There are boards that contain only a few circles and boards with many circles. Some music will be played during the game. Before you start the task, please make sure that your speakers or headphones are working. Use the test piece of music to adjust the volume that is comfortable for you."

Participants. The laboratory experiment took place at the University of Mannheim from February 2017 to March 2017. 62 participants (32 in the positive mood condition) have completed the experiment.

Figure 6. The vigilance task in Experiment 3. Participants had to click on the black circle, as soon as it appeared on the board. The instructions were presented in German.



Results

Testing for engagement. Since Experiments 2 and 3 were conducted in the same university, we screened for repeated participation and excluded two people who already took part in Experiment 2. There were no outliers regarding the number of visited boards and the total time in the task. 40 participants missed at least one circle in the task. The median of the number of missed circles was 1, $M = 1.43$, $SD = 1.83$. A Mann-Whitney test indicated no differences between the negative and positive group in the number of missed circles, $W = 383.5$, $p = .31$. There were no cases where the task was interrupted by pressing the stop button.

Thus, filtering was only applied to the participants who had already taken part in

Experiment 2, which led to 60 people for analysis (Table 3).

Table 3

Characteristics of the final sample. Standard deviations are written in parentheses.

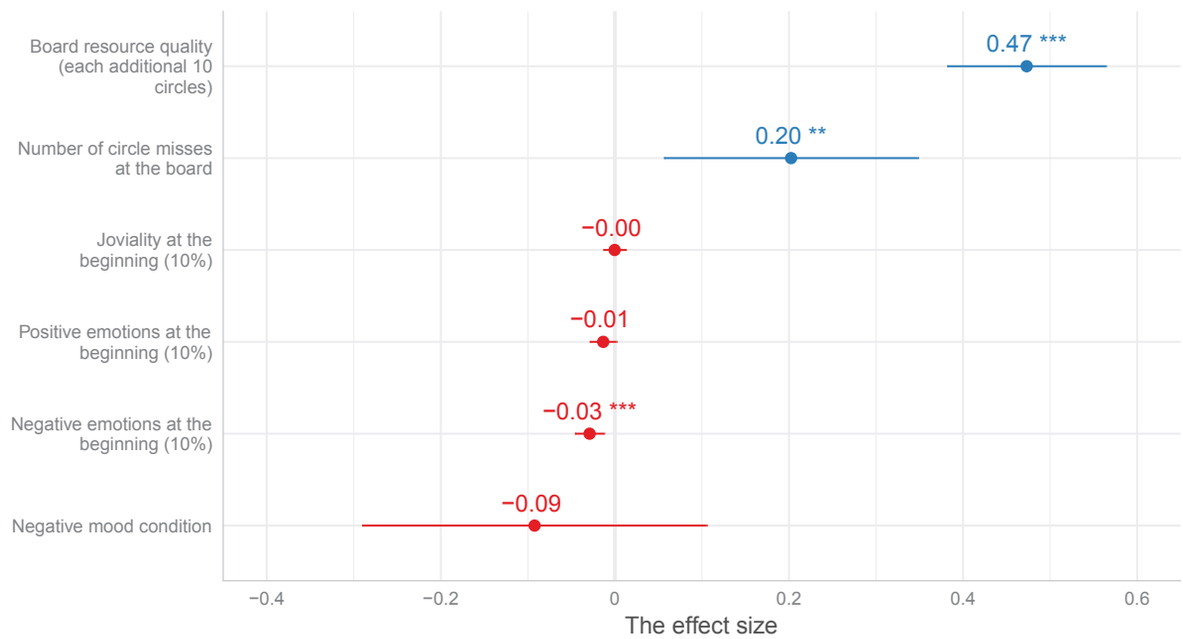
	Sample size	**Age**	**Females**	**Circle misses**	**Visited boards**	**Collected circles**	**Time at a board in seconds**
Positive condition	30	20.33 (1.60)	26	1.07 (1.08)	11.23 (4.22)	62.17 (23.55)	103.70 (94.03)
Negative condition	30	20.63 (2.87)	26	1.80 (2.31)	11.43 (5.40)	64.07 (23.56)	94.35 (73.16)
All	60	20.48 (2.31)	52	1.43 (1.83)	11.33 (4.81)	63.12 (23.38)	98.98 (84.20)

Mood manipulation check. The scores are presented on a percentage scale (0 – 100%). There were differences in the decline of positive emotions between the positive group (M = -5.33, SD = 18.61) and the negative group (M = -15.24, SD = 17.88), t (58) = -2.10, $p < .05$, d = 0.54. The decline of joviality was also larger in the negative group (M = -10.58, SD = 19.13) in comparison with the positive group (M = -1.05, SD = 15.45), t (58) = -2.12, $p < .05$, d = 0.55. However, there were no significant differences in the increase of negative emotions in the negative group (M = 1.17, SD = 9.28) and the positive group (M = -1.71, SD = 10.30), t (58) = 1.14, p = .26, d = 0.29. Hence, the mood manipulation was only successful in respect to creating a contrast in positive and jovial emotions between the groups.

Residence time at a board. All participants switched between boards at least once. The same model as in Experiment 2 was applied to the log-transformed residence time data. The baseline model, the main effect model, and the interaction effect model were compared using Likelihood ratio tests (see Appendix A4 for parameters). With regard to the mood-as-information hypothesis, the main effect model was not significantly different from the baseline model, χ^2 (1) = 0.81, p = .37, showing that the

inclusion of the mood condition does not improve the fit of the model, b = -0.09, p = .36. However, the negative emotions at the beginning of the experiment decreased the residence time, b = -0.03, $p < .001$ (see Figures 7 and 8). Regarding the cognitive tuning hypothesis, the main effect model and the interaction model did not differ in their fit, χ^2 (1) = 0.54, p = .46, suggesting that there was no interaction between the mood condition and the resource quality of a board, b = -0.03, p = .46[9]. All interactions between joviality, positive and negative mood at the beginning of the experiment with the board resource quality were not significant ($p > .05$).

Figure 7. Fixed effects for predictors of the main effect model with the log-transformed residence time as a dependent variable. The estimates are sorted by effect size.



[9] With regard to the model with the interaction without corresponding main effects, the interaction effect between the mood condition and the board resource quality in Model 3 was not significant, b = -0.03, p = .27. The fit of Model 3 (AIC = 1407.9, BIC = 1465.5) was worse than the fits of other models.

Figure 8. Predicted values with 95% confidence intervals for the residence time conditioned on fixed and random effects of the main effect model. The board resource quality is on the X-scale with two lines depicting the positive and negative mood group.

Performance analysis. The number of collected circles did not significantly differ between participants in the positive (M = 62.17, SD = 23.55) and negative group (M = 64.07, SD = 23.56), t (58) = 0.31, p = .76, d = 0.08.

Joint analysis of the three datasets. Since all three experiments manipulated the mood in a conceptually identical way (with less pronounced mood manipulation in Experiment 3), we analyzed the effect of the mood in all three studies together to increase the statistical power of the tests. The specification of the linear-mixed model was similar to the interaction model in Experiment 3. Additionally, a fixed effect of the experiment was estimated.

Confirming the previously found results, both the negative mood manipulation (b = -0.18, $p < .05$) and negative emotions at the beginning of the task (b = -0.06, $p < .05$) decreased the residence time, which was a sign of a higher exploration (see Appendix A5 for parameters). Moreover, there was a tendency for positive emotions at the beginning of the task to increase the residence time, b = 0.05, p = .07. Missing fish or circles increased the residence time, b = 0.10, p = < .001, which can imply that the

participants stayed longer at ponds or boards when they did not pay attention to the task. As expected, the higher pond (board) quality also increased the residence time, $b = 0.06$, $p < .001$. There was still no significant interaction between the mood condition and pond (board) quality, $b = 0$, $p = .35$. The residence time in Experiment 2 ($b =$ -0.95, $p < .001$) and Experiment 3 ($b =$ -0.59, $p < .001$) was shorter than in Experiment 1, reflecting the changes in the speed of the game after Experiment 1.

Discussion

The mood manipulation in Experiment 3 was to a certain extent successful. Although the music induced changes in positive and jovial emotions, there were no differences in negative emotions between groups. Perhaps, the influence of music was not strong enough to put people in a more negative mood, i.e., more afraid, upset, nervous, irritable, distressed, or disgusted. The variation in these emotions in Experiments 1 and 2 can be attributed to the use of images and the manipulation of the task frame (either fishing or collecting dead fish).

With respect to the mood-as-information hypothesis, we found no differences between positive and negative mood conditions. First, the unsuccessful negative mood manipulation can explain why we did not observe the mood effect. Secondly, the laboratory experiment with the smaller sample size ($n = 60$) had less statistical power than Experiments 1 and 2. Hence, even if the mood manipulation was successful in terms of the manipulation check, the effect on exploration behavior was probably too weak to be detected with this sample size. However, the negative emotions score at the beginning of the experiment increased the exploration, which is again supported the mood-as-information hypothesis.

The joint analysis of the data from all three experiments showed that both negative mood manipulations and negative emotions at the beginning of the task increased the exploration behavior.

General Discussion

The current study examined how mood impacts exploration behavior. Previous research has shown that negative mood increases the length of information search in sequential decision tasks (von Helversen & Mata, 2012) and that exploratory decision-making differs between depressed and healthy participants (Blanco, Otto, Maddox, Beevers, & Love, 2013). The current research has investigated two potential mechanisms of negative mood that can account for that: the influence of mood on the evaluation of a currently accessible object and the effect of mood on the processing of information.

Concerning the evaluation mechanism, experiments 1 and 2 revealed the effect of higher exploration in the negative mood with respect to the residence times at each pond. Although the effect in Experiment 1 was only marginally significant, it can be attributed to the low motivation of the participants, which was also confirmed by high dropout rates. Furthermore, the effects in experiments 1 and 2 were in the expected direction, statistical significance notwithstanding. The laboratory Experiment 3, which used only the music mood manipulation, did not successfully induce a negative mood, but the emotional state of participants at the beginning of the experiment significantly influenced the exploration behavior. As predicted by the mood-as-information hypothesis, people in a more negative mood showed higher exploration. Hence, it is fair to say that there was evidence in favor of the congruent influence of mood on the assessment of the current environment in our data, although the expected effect was not always provoked by the mood manipulation.

We conclude that the mood-as-information mechanism of mood influence contributes to the exploration behavior, such that negative emotions might promote a general tendency to explore more, irrespective of the current resource quality. As an alternative idea, the observed patterns also support the idea that people in a negative mood might change their decision-making strategies by setting a higher acceptance threshold. One can speculate that the adaptive value of a negative mood is to make an organism more sensitive to the amount of currently available rewards. An alternative

post hoc explanation of the findings could be derived from the motivational differences between moods: as far as negative mood motivates people to apply efforts to repair a problematic situation, people in the negative mood invested more efforts into the task than people in the positive mood. Hence, they were searching only for ponds or boards of high quality in the experiments. This hypothesis is plausible and should be investigated in future research.

Our findings suggest that negative mood is unlikely to increase risk aversion and inhibit exploration, although previous research has discussed this possibility (Johnson & Tversky, 1983; Loewenstein, Hsee, Weber, & Welch, 2001). One explanation is that the influence of a negative mood on exploration can depend on the motivation to focus more on possible rewards or risks, such as sad people can accept higher risks in favor of high-reward options, but anxious people prefer to avoid risks (Raghunathan & Pham, 1999). The other explanation concerns the structure of the foraging task. While decisions based on descriptions provide easily accessible information about future risks and benefits, decisions based on experience can relate the mood to the current condition rather than to an uncertain future state.

With respect to the process-related influence of mood, the interpretation of our results is limited by the efficiency of mood manipulation. Irrespective of mood changes we found no evidence of the impact of mood on information processing. The lack of the interaction between mood manipulation and pond quality was consistent in all experiments. To do justice to the process-related emotion theories, we suppose that the foraging task may not be suitable for identifying the differences in the processing style. In general, experience-based decisions can be made in different circumstances that do not depend on more data-driven processes or a larger attention span.

Overall, this study expands our understating of how cognition operates with different sorts of ecologies, in particular environments that elicit negative emotions. The findings are informative for the Information foraging theory (Pirolli & Card, 1999) that postulates similarities between the external search for resources and the search in memory. If the balance between exploration and exploitation is controlled by common

neurobehavioral mechanisms across different domains (J. D. Cohen et al., 2007), then emotional regulation is likely to impact the decisions that people make in other areas.

In line with our finding that more positive emotions are correlated with exploitation, Hills (2006) suggested that dopamine plays a role in goal-directed cognition. The high level of dopamine, which is associated with pleasant feelings of getting a reward, promotes exploitation behavior. On the contrary, when the dopaminergic activity is low, the behavior is unfocused and fails to persist. From the evolutionary point of view, dopamine regulation allows an animal to stay longer at places with higher rewards and start to explore as soon as the level of rewards is going down.

Mood Induction

We used several mood inductions techniques combined to manipulate the mood during the task. Whereas the frame of the task was different (either to fish or to collect the dead fish), the goal and organization of the game were the same, so participants had to wait and make decisions about switching a pond in both conditions. We found out that the mood induction was most effective for negative emotions. However, in Experiments 1 and 2 the participants were feeling less positive at the end, which might be affected by their performance or the long waiting time at the ponds. In Experiment 3 only the music manipulation of mood was used. Although there were differences in positive emotions, the music was not enough to induce negative emotions.

Online-experiment

Conducting an online-experiment in addition to a laboratory study has a number of advantages, as far as it allows to test a hypothesis in geographically and linguistically diverse populations. An interactive game as the experimental paradigm may diminish concerns that participants in online studies are not fully engaged in the task. By analyzing participants' behavioral data, it is also possible to ensure that participants understand the instruction and do not misuse an experimental paradigm.

Further studies have to address drawbacks of online-experiments: high rate of dropouts, missing data due to technical problems and lack of control over participants' environment. The possibility of skipping the part of the experimental task can help to prevent dropouts and save the data if a researcher collects them at the end of the experiment. Missing information in an online-experiment can be a result of loss of Internet connection or non-compliance of participants, such as reloading or skipping web pages. The problem of disconnection can be solved by transferring data to a server twice: at each event of a task and at the end of the experiment. If the connection is interrupted during the task, the data is saved at the second transfer. By saving event-related data, it is also possible to recreate the game, if a participant reloads the web page or leaves the experiment to come back later. The problem of skipping web pages can be solved by introducing unique and non-informative web address for each page, so that participants cannot enter the name of a web page directly into the address field of a browser. The lack of control over the environment, in which participants take part in the experiment, can be compensated by collecting information about the context. The possible options are to ask people which devices they use (phone, tablet, laptop, stationary computer) and where they are (home, office, transport).

Conclusion

The current research demonstrated that a negative mood increases exploration behavior in comparison to a more positive mood. This finding supports the idea that an informative value of mood can be incorporated into the evaluation of a currently available object, such as people in a negative mood evaluate the environment less favorably than people in a positive mood. At the same time, there was no evidence of the impact of mood on the processing of information, i.e., the influence of a negative mood on the sensitivity to resource distribution in the environment. The effect of mood may be weakened by the non-compliance behavior of participants in a web study, requiring future research to improve the methodology of mood manipulation on the Internet.

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Appendix

Table A1

Musical compositions used for mood manipulation

	Composer	**Length**
Positive mood condition		19:39
Carmen: Chanson du toreador	Bizet	4:59
Allegro - A little night music	Mozart	5:50
Blue Danube	Strauß	5:43
Radetzky march	Strauß	3:05
Negative mood condition		23:38
Adagio in sol minor	Albinoni	5:51
Solveig's song - Grieg	Peer Gynt	6:03
Concerto de Aranjuez	Rodrigo	6:02
Suite for violin & orchestra A minor	Sinding	5:40

Table A2

Comparison of three models in Experiment 1: Baseline model (model 0), Main effect of mood manipulation (model 1) and the model 2 with the interaction between mood manipulation and pond resource quality. Unstandardized regression coefficients are presented.

	Model 0			**Model 1**			**Model 2**		
	Baseline model			**Main effect of mood**			**Interaction effect**		
	b	***CI***	***p***	***b***	***CI***	***p***	***b***	***CI***	***p***
Intercept	4.60	4.16 – 5.03	<.001	4.66	4.22 – 5.10	<.001	4.65	4.21 – 5.09	<.001
Negative emotions	-0.01	-0.01 – 0.00	.081	-0.01	-0.01 – 0.00	.080	-0.01	-0.01 – 0.00	.083
Positive emotions	0.00	-0.00 – 0.01	.43	0.00	-0.00 – 0.01	.38	0.00	-0.00 – 0.01	.36
Joviality	-0.00	-0.01 – 0.00	.41	-0.00	-0.01 – 0.00	.44	-0.00	-0.01 – 0.00	.44
Fish misses	0.08	0.05 – 0.11	<.001	0.08	0.05 – 0.11	<.001	0.08	0.05 – 0.11	<.001
Pond quality	0.04	0.03 – 0.06	<.001	0.04	0.03 – 0.06	<.001	0.03	0.01 – 0.06	<.01
Negative mood				-0.20	-0.43 – 0.02	.076	-0.20	-0.42 – 0.03	.089
Negative mood x Pond quality							0.02	-0.01 – 0.05	.19
Random parts									
σ^2	1.07			1.07			1.07		
τ_{00}	0.65			0.64			0.64		
ρ_{01}	0.22			0.28			0.27		
N	258			258			258		
ICC	0.38			0.38			0.38		
Observations	1900			1900			1900		
R^2 / Ω_0^2	.54 / .53			.54 / .53			.54 / .53		
AIC	5956.9			5955.8			5956.1		
BIC	6012.4			6016.9			6022.7		

Table A3

Comparison of three models in Experiment 2: Baseline model (model 0), Main effect of mood manipulation (model 1) and the model 2 with the interaction between mood manipulation and pond resource quality. Unstandardized regression coefficients are presented.

	Model 0			**Model 1**			**Model 2**		
	Baseline model			**Main effect of mood**			**Interaction effect**		
	b	***CI***	***p***	***b***	***CI***	***p***	***b***	***CI***	***p***
Intercept	3.78	3.47 – 4.10	<.001	3.88	3.56 – 4.20	<.001	3.87	3.55 – 4.20	<.001
Negative emotions	0.03	-0.04 – 0.09	.46	0.02	-0.05 – 0.08	.61	0.02	-0.05 – 0.08	.62
Positive emotions	0.08	0.01 – 0.14	.019	0.08	0.01 – 0.14	.017	0.08	0.01 – 0.14	.017
Joviality	-0.05	-0.11 – -0.00	.042	-0.06	-0.11 – -0.00	.033	-0.06	-0.11 – -0.00	.032
Pond quality	0.60	0.54 – 0.66	<.001	0.60	0.54 – 0.66	<.001	0.58	0.50 – 0.66	<.001
Fish misses	0.16	0.12 – 0.19	<.001	0.16	0.12 – 0.19	<.001	0.16	0.12 – 0.19	<.001
Finishing the experiment	0.17	0.01 – 0.33	.04	0.17	0.01 – 0.33	.034	0.17	0.01 – 0.33	.035
Negative mood				-0.16	-0.31 – -0.01	.037	-0.15	-0.31 – 0.01	.059
Negative mood x Pond quality							0.04	-0.08 – 0.16	.52
Random parts									
σ^2	0.38			0.38			0.38		
τ_{00}	0.16			0.16			0.16		
ρ_{01}	0.35			0.35			0.35		
N	135			135			135		
ICC	0.30			0.29			0.29		
Observations	1403			1403			1403		
R^2 / Ω_0^2	.60 / .59			.60 / .59			.60 / .59		
AIC	2917.0			2914.7			2916.3		
BIC	2974.7			2977.7			2984.5		

Table A4

Comparison of three models in Experiment 3: Baseline model (model 0), Main effect of mood manipulation (model 1) and the model 2 with the interaction between mood manipulation and board resource quality. Unstandardized regression coefficients are presented.

	Model 0			**Model 1**			**Model 2**		
	Baseline model			**Main effect of mood**			**Interaction effect**		
	b	***CI***	***p***	***b***	***CI***	***p***	***b***	***CI***	***p***
Intercept	4.50	4.01 – 4.99	<.001	4.55	4.05 – 5.05	<.001	4.51	4.02 – 5.02	<.001
Negative emotions	-0.03	-0.05 – -0.01	<.001	-0.03	-0.05 – -0.01	<.001	-0.03	-0.05 – -0.01	<.001
Positive emotions	-0.01	-0.03 – 0.00	.089	-0.01	-0.03 – 0.00	.086	-0.01	-0.03 – 0.00	.077
Joviality	-0.00	-0.01 – 0.01	.96	-0.00	-0.01 – 0.01	.96	-0.00	-0.01 – 0.01	.99
Board quality	0.47	0.38 – 0.57	<.001	0.47	0.38 – 0.56	<.001	0.51	0.38 – 0.63	<.001
Circle misses	0.20	0.05 – 0.35	.007	0.20	0.06 – 0.35	.007	0.20	0.06 – 0.35	.006
Negative mood				-0.09	-0.29 – 0.11	.36	-0.00	-0.31 – 0.31	.99
Negative mood x Board quality							-0.07	-0.25 – 0.11	.45
Random parts									
σ^2	0.42			0.42			0.42		
τ_{00}	0.25			0.25			0.25		
ρ_{01}	-0.85			-0.84			-0.84		
N	60			60			60		
ICC	0.37			0.37			0.37		
Observations	620			620			620		
R^2 / Ω_0^2	.53 / .52			.53 / .52			.53 / .52		
AIC	1355.7			1356.9			1358.3		
BIC	1413.3			1418.9			1424.8		

Table A5

The model with the interaction between mood manipulation and pond (board) resource quality. The dependent variable is the log-transformed residence time in all three experiments (N = 453). Unstandardized regression coefficients are presented.

	Interaction model		
	b	***CI***	***p***
Intercept	4.77	4.42 – 5.12	<.001
Negative emotions	-0.06	-0.11 – -0.01	.022
Positive emotions	0.05	-0.00 – 0.10	.067
Joviality	-0.03	-0.07 – 0.01	.12
Pond (board) quality	0.05	0.03 – 0.06	<.001
Fish (circle) misses	0.10	0.08 – 0.12	<.001
Negative mood	-0.18	-0.33 – -0.04	.014
Negative mood x Pond (board) quality	-0.00	-0.01 – 0.00	.35
Experiment 2	-0.95	-1.12 – -0.79	<.001
Experiment 3	-0.59	-0.83 – -0.35	<.001
Random parts			
σ^2	0.73		
τ_{00}	0.46		
ρ_{01}	-0.56		
N	453		
ICC	0.39		
Observations	3923		
R^2 / Ω_0^2	.54 / .54		

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Change and status quo in decisions with defaults: The effect of incidental emotions depends on the type of default

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Abstract

Affective states can change how people react to measures aimed at influencing their decisions such as providing a default option. Previous research has shown that when defaults maintain the status quo positive mood increases reliance on the default and negative mood decreases it. Similarly, it has been demonstrated that positive mood enhances the preference for inaction. We extend this research by investigating how mood states influence reliance on the default if the default leads to a change, thus pitting preference for status quo against a preference for inaction. Specifically, we tested in an online study how happiness and sadness influenced reliance on two types of default (1) a default maintaining status quo and (2) a default inducing change. Our results suggest that the effect of emotions depends on the type of default: people in a happy mood were more likely than sad people to follow a default when it maintained status quo but less likely to follow a default when it introduced change. These results are in line with mood maintenance theory.

Keywords: default bias, incidental emotions, status quo, mood induction.

1 Introduction

When introducing a new product, for instance a new cellphone plan, marketing companies have different strategies at hand to influence customers. One powerful instrument to influence people towards making a specific decision is to provide a default option (Goldstein, Johnson, Herrmann, & Heitmann, 2008; Johnson, Bellman, & Lohse, 2002). Default options are automatically chosen when individuals make no active choice (Brown & Krishna, 2004). Defaults are sometimes considered as nudges because they exert a substantial influence on choice without restricting decision makers' freedom to choose (Sunstein & Thaler, 2003). The differing rates of organ donation across European countries provide an impressive example of the power of defaults (Davidai, Gilovich, & Ross, 2012; Johnson, & Goldstein, 2003). Although Germany, the Netherlands, Belgium and Austria all grant their citizens the right to freely decide whether they are willing to donate their organs in the case of a fatal accident, the countries differ if the default is to be an organ donor (opt-out) or if the default is not to donate (opt-in). In countries such as Germany and the Netherlands that have an opt-in policy, organ donation rates are around 20% (Johnson & Goldstein, 2003). In contrast, in Austria and Belgium where there is an opt-out policy, donation rates frequently exceed 90% (Davidai et al., 2012; Johnson & Goldstein, 2003).

Although the power of defaults has been demonstrated in many areas ranging from choices about retirement investments (Cronqvist & Thaler, 2004; Madrian & Shea, 2001) to energy suppliers (Pichert & Katsikopoulos, 2008) and consumer goods (Goldstein et al., 2008), they do not always lead to the desired outcome. For instance, in 2007 Facebook launched a program that displayed members' purchases by default, forcing users to "opt-out" if they did not want to share their shopping history. However, after an immense backlash from irate users, only nine days after the program's inception Facebook had to change the default so that users would have to actively choose to participate (Goldstein et al., 2008).

Several theoretical explanations have been offered to account for the power of defaults and that may provide insight into when people decide against a default. For one, it has been suggested that default options are preferred because they are interpreted as recommendations of the policy makers, suggesting a socially desired behavior (McKenzie, Liersch, & Finkelstein, 2006) or a choice designed to meet the requirements of the average customer (Irwin & Baron, 2001). Secondly, defaults frequently preserve the status quo. Research shows that people often make choices such that the current state of the world remains intact. This preference has been named the status quo bias (Masatlioglu & Ok, 2005; Samuelson & Zeck-

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hauser, 1988). For instance, Hartman, Doane, and Woo (1991) found that people preferred their current electricity service provider to other providers, even if these would provide a more reliable or cheaper service. Thirdly, defaults are usually associated with absence of physical or mental efforts. Making a decision can be effortful, particularly when people do not have a preexisting preference (Tversky & Kahneman, 1974). Thus people may use defaults heuristically to reduce the cognitive effort required to reach a decision. In line with this, most people prefer options that do not require action as compared to options they have to actively pursue, and a negative result that occurs as the consequence of an action is often perceived as more reprehensible than a negative result caused by an omission (Baron & Ritov, 1994; Prentice & Koehler, 2002; Ritov & Baron, 1992).

All these theories can explain why people follow a default if it maintains the current state of the world. However, if the default introduces a change, as in the Facebook example, the status quo bias suggests that people should decide against the default. In contrast, explaining a default choice in terms of a policy recommendation or a preference for an omission suggests that people should follow the default even if it induces change. Thus, depending on the mechanisms underlying the default choice, the effectiveness of a default may hinge on whether it promotes the status quo or introduces a change. Schweitzer (1994) provided evidence that the omission and the status quo bias provide an independent, but similarly sized, influence on behavior (see also Baron & Ritov, 1994). This suggests that defaults that introduce change should be less effective than defaults that maintain the status quo. However, when pitting both biases against each other Ritov and Baron (1992) found that people only preferred an option that upheld the status quo as long as it was the result of inaction, but opted for change when upholding the status quo required action. This suggests that the effectiveness of a default option does not depend on whether it maintains or changes the current state of the world. Following up on this issue, the first goal of the current work is to investigate whether the effect of defaults is reduced when the default introduces a change or maintains the status quo when the task involves real decisions.

2 The influence of emotions on default decisions

Emotions have been shown to exert an important influence on decision making in general (Aspinwall, 1998; Cohen, Pham, & Andrade, 2007; Scheibehenne & von Helversen, 2014) and on decisions involving a default specifically (Yen & Chuang, 2008; Garg, Inman & Mittal, 2005). Yen and Chuang (2008) showed that the probability with which people choose an option that upheld the status quo increased with positive affect and decreased with negative affect. The same held true for the option of choosing neither of two offered options (e.g., two apartments). In a similar vein, Garg and colleagues (2005) showed that, in decisions with emotionally difficult trade-offs, angry participants showed a stronger preference for the status quo than sad participants. Here, we aim to extend their research by testing how positive and negative affect influence how frequently a default is accepted if the default introduces a change and thus pits the preference for the status quo against the preference for inaction.

Two prominent theories, directly related to the present research, provide an explanation of how emotions influence decision-making: the "affect-as-information" theory and the "mood-maintenance" theory. These theories yield predictions on how affect will interact with the two types of defaults.

2.1 Affect-as-information theory

The affect-as-information theory predicts how emotions and moods influence information processing. Specifically, it suggests that people use their current affective condition to evaluate the state of the world and if their current mode of thinking is appropriate (Hunsinger, Isbell & Clore, 2012; Schwarz & Clore, 1983). For example, negative affect may signal that the situation is problematic and therefore the current dominant response should be abandoned in favor of a more careful and systematic processing of the available information (Bless et al., 1996). In support of this theory, people in a negative mood have been found to rely less on strategies that are often triggered automatically such as scripts and stereotypes (Bless et al., 1996; Bodenhausen, Kramer, & Süsser, 1994) and to process substantive information more carefully (Sinclair, Mark, & Clore, 1994). In this vein, Garg and colleagues (2005) suggested that individuals in a sad mood tend to consider options more closely and show relatively little bias towards the status quo.

According to the affect-as-information theory, positive affect may signal that the situation is benign, which permits to follow the currently dominant course of action. In line with this, past research has found that positive mood induces a less effortful and more superficial processing of information (Bless, Bohner, Schwarz, & Strack, 1990; Bohner, Chaiken, & Hunyadi, 1994; Park & Banaji, 2000). Furthermore, positive emotions have been shown to increase reliance on global knowledge structures such as scripts (Bless et al., 1996), stereotypes (Bodenhausen et al., 1994), and judgmental heuristics (Ruder & Bless, 2003) and decrease the depth with which people process substantive information in persuasion and attitude formation (Batra & Stayman, 1990; Mackie & Worth, 1989).

In some situations, the default option may induce a strong emotional reaction that could serve as a dominant response. However, research suggests that relying on the default is usually the dominant course of action (e.g. Goldstein, et al., 2008; Johnson, et al., 2002; Ritov & Baron, 1992), and thus may serve as a global knowledge structure or script people can follow (Yen & Chuang, 2008). In contrast, deciding against a default is generally perceived as a decision against the dominant response and has been characterized as requiring more systematic processing of information and more effort (Garg, et al. 2005; McKenzie et al., 2006; Tversky & Kahneman, 1974; Yen & Chuang, 2008). Thus, to the degree that going with the default is the dominant response in the task, according to the affect-as-information theory, positive affect should increase reliance on defaults, independent of whether the default is maintaining the status quo or introducing a change.

2.2 Mood-maintenance theory

In contrast, the "mood-maintenance" theory emphasizes the importance of emotion regulation and its influence on decision-making. Specifically, it posits that people are motivated to experience positive affect (Aspinwall, 1998; Clark & Isen, 1982; Isen, 1984). Accordingly, people in a positive mood may strive to maintain this affective state by choosing options that promise positive consequences (Wegener & Petty, 1994) and by avoiding losses and high-risk options (Arkes, Herren, & Isen, 1988; Isen & Geva, 1987). People in a negative mood may be motivated to "repair" their mood, for example by choosing options that they believe will improve their mood, such as hedonic goods (Garg, Wansink, & Inman, 2007, but see Wegener & Petty, 1994). This suggests that people in a positive mood may prefer options that maintain the status quo, because they are seen as less threatening (Riis & Schwarz, 2003) and thus allow maintaining positive affect. In contrast, people in a negative mood may prefer a new option to the status quo because it has the potential to uplift their emotional state. For instance, Lin and Lin (2009) found that when choosing between hedonic goods such as food items, people show more variety-seeking behavior during a negative than a positive mood. This also resonates with the finding by Yen & Chuang (2008) that people in a negative mood are less willing to choose a status quo option, whereas people in a positive mood are more likely to choose a status quo option.

Correspondingly, the mood-maintenance theory predicts that people in a positive mood should rely more on a default if it leads to upholding the current state of the world, but rely less on a default when it involves change. In contrast, in a negative mood people should rely more on a default that involves change and less on a default that leads to maintaining the status quo.

Table 1: Number of participants in each condition.

	Happy (N=105)	Neutral (N=101)	Sad (N=107)
Status quo by default (N=105)	34	35	36
Change by default (N=103)	36	32	35
No default (N=105)	35	34	36

2.3 The present research

The lack of empirical evidence how mood influences decisions in situations where the status quo bias and the omission bias are pitted against each other prompted us to conduct an experiment that involved real choices in which we manipulated participants' mood and then presented them with a choice situation where following a default either maintained the status quo or introduced a change.

3 Method

3.1 Participants

A total of 336 participants residing in the US were recruited from the online labor market Amazon Mechanical Turk (MTurk) in exchange for a payment of $1. Previous studies ascertained the reliability of Mturk to obtain high-quality data (Buhrmester, Kwang, Gosling, 2011; Paolacci, Chandler, Ipeirotis, 2010). Completing the study required approximately 15 minutes. Twenty-three participants did not pass the control questions that checked whether they had read the instructions and thus were excluded from the analysis. The final sample consisted of 179 men and 134 women, with a mean age of M = 33.75 years (range 18–66). The majority of participants (about 80%) were White American, with the remaining 20% indicating Hispanic (6%), African American (6%), Asian, and Native American origins. All research was conducted in compliance with APA ethical standards.

3.2 Design and Procedure

The study used a 3 x 3 between-subjects experimental design varying induced affect (happy, neutral, and sad) and the type of default ("Status quo by default", "Change by default", and "No default"). The type of default was manipulated by presenting participants with a choice between two visual perception tasks. Specifically, participants could choose whether they would like to work on a task they had worked on before or work on a new task. Participants were randomly assigned to one of the nine conditions, resulting in about 30 participants in each condition (see Table 1).

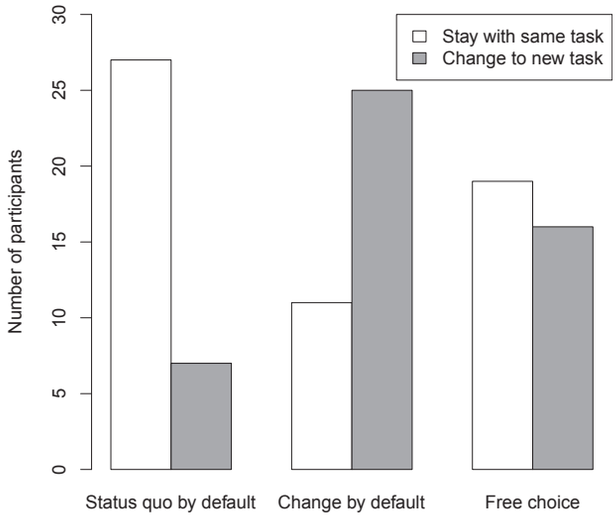
After giving their consent to participate in the study, participants received instructions about the experimental task and filled out a questionnaire measuring demographics and their current mood. Additionally, we included control questions to ensure that participants were paying attention to the instructions. Next, participants were randomly assigned to one of the two visual perception tasks. Once they had completed 15 items of the first task, we manipulated participants' mood state by showing them a 3 min movie clip, a standard procedure to induce different affective states (Schaefer, Nils, Sanchez, & Philippot, 2010; Westermann, Spies, Stahl, & Hesse, 1996). After watching the movie clip, participants were asked to answer a few questions regarding the content of the movie and to again rate their current mood. Next, participants had to choose whether they wanted to continue working on the same task as before or on a new task. This choice was our main dependent variable. Instructions for that choice differed depending on the experimental condition. In the "no default" control condition, participants were presented with the two options next to each other and had to select the option they preferred before they could move on by pressing the "continue" button. The order in which the options were presented was counterbalanced. In the "status quo by default" condition, participants were told that they would work on the same task as before if they pressed the "continue" button but that they could opt out and work on a new task if they checked a box before they pressed "continue". In the "change by default" condition, participants were told that they would work on a new task if they pressed the "continue" button but that they could opt out and work on the same task as before if they checked a box before they pressed "continue". After they had completed the second visual perception task, participants were again asked to rate their mood.

3.3 Materials

Tasks. Both tasks involved the visual processing of information. We chose visual perception problems because they are comparable to tasks that are offered on Amazon Mechanical Turks. One task involved counting trees. In this task, participants had to indicate how many trees were shown on a series of the photos depicting nature scenes. In the other task, participants saw photos of different types of buildings (i.e., churches, restaurants, shops) and they had to provide a one-word "tag" for each photo that best described the type of building shown. Both tasks were counterbalanced to allow us to control the relative preference for the two tasks.

Mood induction. Mood was induced through short video clips taken from Youtube.com. Participants in the neutral condition saw a 3 min clip from a documentary about Norway informing about historical facts and local customs, in the positive condition they saw a clip with a compilation of the funniest moments in the comedy movie *Ice Age 2: The Meltdown* (2006), and in the negative condition they saw a clip from the film *City of Angels* (1998, 01:38–01:41) depicting the death of the main character.

Figure 1: Number of participants in neutral mood condition (N=101) that choose to stay with the same task or to change to the new task in the three "type of default" conditions.



Mood questionnaire. To measure participants' mood state we asked them to rate their current mood on 10 items taken from the expanded version of the "Positive and Negative Affect Schedule" (PANAS-X, Watson & Clark, 1999) and the "Differential Emotions Scale" (DES-IV; Izard, Libero, Putnam, & Haynes, 1993) using a 5-point answer scale (1=very slightly, 5=extremely). Specifically, we used 3 items to measure happiness (glad, happy and joyful), 3 items to measure sadness (downhearted, sad and gloomy) and 4 further items to measure anger, anxiety, curiosity and excitement (angry, jittery, curious, and excited). Participants rated their mood states 3 times: at the beginning of the experiment, after the mood induction, and at the end of the experiment.

4 Results

A chi-square test indicated that the random assignment to one of the two visual perception tasks at the beginning of the experiment had no significant influence on choice, $\chi 2$ (1, 313) = 0.27, p = .60. Therefore, we merged the two conditions for the subsequent data analyses.

Figure 2: Level of happiness and sadness for each mood condition and for each of the three measurement time points: at the beginning of the experiment, after the mood induction and at the end of the experiment. Error bars represent standard errors of the mean.

4.1 Influence of different types of defaults

As an initial test to see whether the default was more effective when it maintained the status quo than when it introduced a change, we focused only on participants in the neutral condition (N = 101). For this group, the default condition had a strong influence on choice as indicated by a chi-square test: $\chi 2$ (1, 101) = 33.42, $p < .001$. As illustrated in Figure 1, in the "status quo by default" condition 83% of participants chose to stay with the same task, whereas only 13% did so in the "change by default" condition. This suggests that the default was effective regardless of whether it maintained the status quo or introduced a change. In the "no default" condition, participants were equally likely to choose the same task as before (44%) or to choose a new task (56%), showing no evidence for a status quo bias.

4.2 Influence of incidental emotions on participants' choices

In a next step we analyzed the influence of mood state on participants' choices. We first report results of the manipulation check of the mood induction and then how mood influenced participants' choices when presented with different types of defaults.

Manipulation check. We created two scales to determine participants' happiness and sadness by averaging the ratings of the respective items at the three measurement points (Cronbach's $\alpha > .82$ for both scales at all time points).

As illustrated in Figure 2, after the mood induction participants in the happy condition were happy (M = 3.27; SD = 0.95) and not sad (M = 1.12; SD = 0.37), participants in the neutral condition were somewhat less happy (M = 2.78; SD = 0.94) and also not sad (M =1.2; SD = 0.45), and participants in the sad condition were not very happy (M = 1.72; SD = 0.83) and moderately sad (M = 2.52; SD = 1.10). These data are in line with the intended manipulation of mood although in absolute terms, no extreme levels of emotions were induced.

To test for differences among the experimental conditions, we ran a repeated-measures analysis of variance with mood condition as a between-subjects factor and measurement time as a within-subject factor on the happiness and sadness ratings, using Greenhouse–Geisser corrections of the degrees of freedom if necessary. This analysis indicated a significant main effect of mood condition for happiness, $F(2, 310) = 27.77$, $p < .001$, and for sadness, $F(2, 310) = 59.08$, $p < .001$. Post hoc Tukey's HSD tests revealed that participants in the happy condition were happier than participants in the sad condition, ($p < .001$), and in the neutral condition, ($p = .003$). In the same vein, participants in the sad condition were sadder than participants in the happy condition ($p < .001$), and the neutral condition ($p < .001$). Significant interactions of mood with measurement time indicated that ratings of happiness, $F(3.56, 551.26) = 50.33$, $p < .01$, and of sadness, $F(3.73, 578.54) = 67.05$, $p < .01$, changed over time depending on the mood condition. Importantly, follow up analyses showed that in the happy condition participants became more happy, $F(1,104) = 10.71$ $p = .001$, and less sad, $F(1,104) = 12.50$, $p = .001$, after the mood manipulation. In contrast, in the sad condition, participants became less happy, $F(1,106) = 112, 78$, $p < .001$, and more sad ($F(1,106) = 115.61$, $p < .001$, whereas in the neutral condition mood did not change ($ps > .18$). Pairwise contrasts after the mood induction confirmed that participants were happier in the happy condition as compared to the sad condition, *Contrast* = 1.55, *SE* = 0.12, $p < .001$, and the neutral condition, *Contrast* = 0.49, *SE* = 0.13, $p < .001$. Similarly, participants in the sad condition were sadder as compared to the happy condition, *Contrast* = 1.40, *SE* = 0.10, $p < .001$, and the neutral condition, *Contrast* = 1.31, *SE* = 0.10, $p < .001$. These results suggest that the mood manipulation was successful.

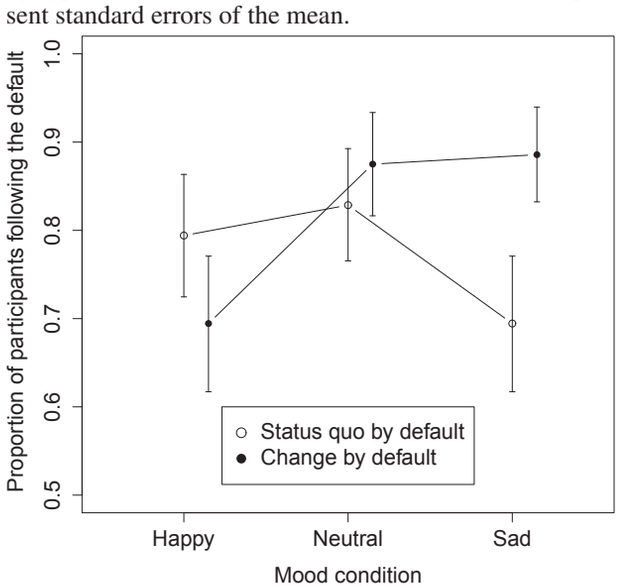
The mood induction also influenced excitement and anger. Post hoc Scheffé tests comparing the three mood conditions after the mood induction showed that participants in the sad condition reported being less excited ($ps <$ .001) and curious ($ps < .001$), but more angry ($ps < .001$) than participants in the neutral or happy condition. Par-

Table 2: Logistic regression analyses predicting following default behavior.

		95% CI for odds ratio			
Predictors	B (SE)	Lower	Odds ratio	Upper	p-value
Constant	0.88 (0.55)				.11
Mood	1.26 (0.67)	0.95	3.51	12.98	.06
Default type	0.35 (0.36)	0.70	1.42	2.91	.33
Default type by mood	−0.97 (0.44)	0.16	0.38	0.90	.03

Note: N=208, R^2(Nagelkerke)= .05. Model $\chi^2(1) = 6.12$, $p = .11$.

Figure 3: Proportion of participants following the default by type of default and mood condition. Error bars represent standard errors of the mean.



ticipants in the happy condition were more excited than participants in the neutral condition ($p = .004$), but did not differ from them in their ratings of anger and curiosity. There were no differences in how jittery participants felt. Mean and standard deviations of all affect measures can be found in the Appendix.

Influence of incidental emotions on following a default.

To analyze whether participants' mood states influenced their choices of defaults preserving the status quo and defaults introducing a change, we ran a logistic regression on participants' choices with mood condition (happy, neutral and sad), type of default ("status quo by default" and "change by default"), and their interaction as predictors.

As shown in Figure 3, we found a main effect of mood on the likelihood to follow a default, qualified by a significant interaction between the type of default and the induced mood, $b = -0.97$, Wald $\chi^2(1, 208) = 4.8$, $p = .03$ (see also Table 2), suggesting that the effect of mood depended on the type of default: Participants in a positive mood were more likely to follow a default maintaining the status quo, whereas sad participants were more likely to follow a default introducing change. Additional analyses for each type of default showed that mood affected whether participants followed the default in the change by default condition, $b = -0.68$, $SE = 0.33$, Wald $\chi^2(1,103) = 4.12$, $p = .04$, but not in the status quo by default condition, $b = 0.29$, SE = 0.29, Wald $\chi^2(1,105) = 1.01$, $p = .32$.

A follow-up analysis showed that participants in the neutral condition did not differ from participants in the sad condition (default status quo: $\chi 2\ (1, 71) = 1.75$, $p = .19$, default change: $\chi 2\ (1, 67) = 0.02$, $p = .89$) or participants in the positive condition (default status quo: $\chi 2\ (1, 61) = 0.13$, $p = .71$; default change: $\chi 2\ (1, 68) = 3.21$, $p = .07$).

5 Discussion

The main goal of this paper was to investigate how the choice to follow different types of defaults is affected by incidental affect. We found that the effect of mood depended on the type of default. In particular, when defaults introduced a change, participants were more likely to follow it when in a sad mood than when in a happy mood. In contrast, when the default maintained the status quo the opposite pattern was found.

These results extend the research by Yen and Chuang (2008) and Garg et al. (2005) to a situation where the status quo bias and the omission bias are pitted against each other and real consequences follow — even if the consequences are of relatively little importance. Yen and Chuang (2008) reported that positive mood increased the status quo and the tendency not to choose either of the offered options, whereas sadness decreased both effects. When the default maintained the status quo and thus a preference for an omission and a preference for the status quo were aligned, we found a similar pattern. However, when the default induced a change, we found that people

in the happy condition were more likely to continue with the old task than sad participants — even though it forced them to go against the default. This suggests that the effect of mood on status quo may persist in the face of more effortful processing.

Participants in a positive and a negative mood did not differ significantly from participants in a neutral mood. In particular, neither participants in the happy condition were more likely to follow a default introducing a status quo nor were sad participants more likely to follow a default that induced a change than participants in a neutral mood. However, the percentage of people following a default in the neutral condition was already very high, suggesting that the lack of difference could be caused by a ceiling effect.

Overall, our results are in line with the idea that mood-maintenance considerations influence choices involving defaults. Specifically they resonate with the idea that people make decisions to reach or maintain a positive affective state (e.g., Garg et al., 2007; Isen, 1984). In line with Lin and Lin (2009) who showed that people in a sad mood are more willing to try out new alternatives than people in a positive mood, we found that sad people more frequently chose to follow the default when it introduced a new option. These results extend the research by Lin and Lin (2009) and Garg et al. (2007) by showing that a mood related preference for new alternatives can even be found in the presence of defaults, one of the most potent nudges identified in the literature. Furthermore, they suggest that mood maintenance concerns can also influence decisions involving options with a low hedonic value.

The degree to which mood-maintenance concerns determine participants' choices may, however, depend on the options that are introduced by a default. When the default introduced a change in our task participants would work on a new task on which they had only little information and thus could hope that it would improve their mood. In contrast, if the default would introduce a change to a familiar but undesirable option, mood-maintenance concerns should not increase reliance on the default.

In terms of the affect-as-information theory, our results suggest that mood states did not influence how much people relied on the default as a global heuristic to make the decision. On the one hand this could suggest that the "affect-as-information" theory played only a minor role in participants' decisions. According to this theory, positive affect signals that the current environment is safe and it is possible to rely on the currently active thinking mode, whereas negative affect signals that a careful analysis of provided information is required and the currently active thinking style should be abandoned (Bless & Fiedler, 2006; Hunsinger et al., 2012). Thus, to the degree that defaults are the dominant response, happy participants should have a stronger preference for the default option than sad participants regardless of the type of default. However, in our study we found that when the default introduced change, sad participants were more likely to follow the default than happy participants. On the other hand, it is possible that people used other affective cues than the default to guide their choices. For instance, mood and emotions can influence how much people rely on task related affect (e.g. Garg et al., 2005). Thus, if the task itself provides a strong negative cue and people rely more on affective cues in positive mood, this could influence participants' choices against the default in positive mood. In our task this seems not very likely though because in the condition without a default participants were equally likely to switch tasks, suggesting that both tasks were similar attractive or tedious. Nevertheless, in future it would be useful to measure task related affect such as how difficult, tedious, or attractive the tasks were perceived. This would allow ruling out this hypothesis and to test more directly whether participants switched tasks in order to improve their mood.

Our results indicate a strong effect of the default that was independent on the specific type of default. Eighty-three percent of subjects chose the default option when it promoted the status quo and 87% subjects chose the default when it promoted change. These results suggest that the status quo bias played no or only a minor role for choices involving defaults. This resonates with research showing that people often prefer inaction over action when making decisions (e.g., Asch et al., 1994; DeScioli, Christner, & Kurzban, 2011). Our results also provide further evidence to support the idea that the omission bias is largely responsible for the effect of defaults on choice (Baron & Ritov, 1994; Ritov & Baron, 1992). One reason that participants followed the default to such a strong degree could be that both tasks were similarly attractive. Indeed, when no default was provided participants were roughly equally likely to choose the same task as before or to choose the new task. Furthermore, participants only had to work on the tasks for a short time, which could have decreased the importance of the decision. This relatively low importance of the task may have hindered the development of a status quo bias and it may have increased reliance on the default. Future research should replicate our results with more consequential and emotionally involving decisions.

In sum, our results suggest that defaults have a strong influence on choice even if they are used to introduce a change; however, this influence may differ depending on decision makers' emotional state. Whereas, defaults maintaining the status quo are chosen more frequently in a positive mood, defaults inducing a change may be more easily accepted in a sad mood.

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Appendix: Overview of the affect measures

Means and Standard Deviations (SD) for the affect measures in the three mood conditions: at the Beginning of the experiment – after the mood induction – at the end of the experiment.

Scale	Statistics	Happy (N=105)	Neutral (N=101)	Sad (N=107)
Happiness	Means	3.05 – 3.27 – 2.97	2.73 – 2.78 – 2.58	2.77 – 1.72 – 2.17
	SD	1.02 – 0.95 – 1.06	0.89 – 0.94 – 1.01	1.00 – 0.83 – 0.84
Sadness	Means	1.25 – 1.12 – 1.12	1.25 – 1.20 – 1.17	1.51 – 2.52 – 1.80
	SD	0.55 – 0.37 – 0.36	0.54 – 0.45 – 0.47	0.84 – 1.10 – 0.90
Angry	Means	1.14 – 1.11 – 1.10	1.11 – 1.13 – 1.08	1.28 – 1.44 – 1.30
	SD	0.54 – 0.42 – 0.44	0.45 – 0.44 – 0.37	0.80 – 0.86 – 0.77
Jittery	Means	1.45 – 1.30 – 1.38	1.33 – 1.29 – 1.27	1.50 – 1.41 – 1.40
	SD	0.78 – 0.59 – 0.75	0.62 – 0.65 – 0.65	0.91 – 0.81 – 0.80
Curios	Means	2.86 – 2.65 – 2.44	2.74 – 2.93 – 2.46	2.92 – 2.01 – 2.06
	SD	1.14 – 1.21 – 1.13	1.01 – 1.15 – 1.15	1.09 – 1.03 – 1.04
Excited	Means	2.46 – 2.70 – 2.33	2.22 – 2.24 – 1.99	2.38 – 1.55 – 1.67
	SD	1.11 – 1.17 – 1.17	1.07 – 1.10 – 1.09	1.00 – 0.72 – 0.86

Non-compliance with online mood manipulations using film clips: How to detect and control for it

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Abstract

The reliability of online mood manipulations is potentially undermined by participants' non-compliance behavior, e.g., skipping a part of the experiment or switching between web pages during the mood manipulation. The goal of the current research is to investigate (1) whether and how mood manipulations are threatened by non-compliance behavior, (2) whether it is confounded with the induced mood state as predicted by Affect Regulation Theory, and (3) what measures can be taken to control for this. In two online-experiments, non-compliance behavior was assessed during the mood manipulation with movie clips by tracking interruptions of watching and page switches. The results support the affect regulation hypothesis demonstrating that people confronted with negative emotional content interrupted watching the video and switched between pages more often than people with positive content. Methodologically, this causes a threat to the internal validity of internet-based mood manipulation studies. To decrease the risk of non-compliance, the current study recommends to block skipping a part of the mood manipulation, detect page focus events and measure the time people stay on a page.

Keywords: non-compliance, mood induction, online study

Non-compliance with online mood manipulations using film clips: How to detect and control for it

The development of the Internet has opened a new way to conduct psychological experiments. An online study enables fast data collection, gives access to diverse population groups, extends the sample size and saves laboratory resources. However, it also introduces new challenges such as the lack of supervision of participants and control over the presentation of stimuli (Gureckis et al., 2016; Reips, 2002). The validity of a web study may be undermined by non-compliance behavior, e.g., skipping a part of the experiment or switching between web pages during the mood manipulation. As more researchers use online tools to elicit emotions, it is critical to develop techniques for detecting and preventing cases of non-compliance. The current research suggests such a method and assesses how large the effect of non-compliance during a mood induction procedure is and whether it depends on the emotional state.

The present experimental study employs short videos as a mood induction method, which is one of the most efficient and widely used means to induce an emotion both in a laboratory (Westermann, Spies, Stahl, & Hesse, 1996) and in an online experiment (Ferrer, Grenen, & Taber, 2015; Gilman et al., 2017). Previous research on online mood manipulation by movies hardly addressed the problem of the non-compliance behavior. One simple assessment is to ask people whether they closed their eyes or looked away during the video (Rottenberg, Ray, & Gross, 2007). In another online study, participants' engagement was assessed by open-ended accuracy questions about film content (Gilman et al., 2017). However, participants can guess the right option or write a vague answer, so the questionnaire does not ensure the reliability of the mood induction. Moreover, people who recognize the movie that they watched before can skip the mood manipulation, but answer correctly on the accuracy question.

Residence Time as a Measure of the Non-Compliance Behavior

As a measure of the non-compliance, we propose the residence time – the time people stay on a web page with the movie clip. The opportunity to interrupt the video

and proceed to the next part of the experiment depends on the type of the service provider and the design of the study. The implementation of sophisticated algorithms that show a continue button only when the video is ended is possible but requires programming skills. The default option of many survey services (e.g., LimeSurvey, Unipark) is to embed a video into the web page together with a continue button. Therefore, one of the purposes of the current experimental study is to analyze whether people will use the option to proceed without watching the movie clip until the end.

Even if the continue button can be hidden until the video is over, there are no algorithms that prevent a user from switching to another web page, which might decrease the mood manipulation effect (if people do not watch the video) or even reverse it (if people encounter another mood eliciting content). However, the browser can detect the moment of page defocusing and record the time people spend out of the page focus (e.g., the PageFocus algorithm in Diedenhofen and Musch (2017) to detect cheating in online tests).

In summary, the non-compliance behavior measured by the residence time can be affected by an early quitting or by temporary leave of a page. Both forms represent avoidance behavior, as participants withdraw from the part of the experiment that induces emotions.

The Role of Emotions in Non-Compliance Behavior

The emotional content of a movie clip might activate emotion regulation responses (Gross, 1998). From the perspective of affect regulation theories, people in a negative mood engage in activities because of their mood-lifting consequences, but people in a positive mood avoid situations with mood-threatening consequences (Andrade, 2005, but for a critique see Wegener & Petty, 1994). The affect regulation account predicts that people will escape from the negative mood manipulation situation to avoid negative thoughts, but stay within the positive mood manipulation situation to protect their current good mood induced by a video. Therefore, people in a negative mood condition should have a higher level of non-compliance than in a positive mood condition.

The non-compliance also mediates the relationship between the induction procedure and changes of mood. Since skipping a part of negative mood induction video occurs because people want to avoid feeling negative emotions, the non-compliance behavior should attenuate the reported negative emotions at the end of the experiment in the negative mood group. However, in the positive mood group, the reason to avoid the mood manipulation would be different. People might perceive the present environment as mood threatening (e.g., boring or annoying) and escape from the mood manipulation situation to protect their good mood. Therefore, the reported positive emotions at the end should not be attenuated by the non-compliance behavior.

To summarize, the purpose of the current research is to investigate (1) whether and how mood manipulations are threatened by non-compliance behavior, (2) whether it is confounded with the to-be-induced mood state, and (3) what measures can be taken to control for this. To achieve these goals, we conducted an online-experiment where non-compliance behavior was measured during the mood manipulation with movie clips.

Experiment 1

Method

Participants. 472 cases (mood group: 257 positive (54%), 215 negative (46%)) of participation were registered. Because of page reloads, repeated participation, leaving the experiment before the end, and reported problems with the video, 126 records were filtered out (see Table A1 in Appendix). The exclusion rate was not different between mood conditions, χ^2 (1, $N = 472$) = 0.08, $p = .77$. The final sample comprised 346 participants (see Table 1).

Design. The experiment was conducted online on the website of the first author[1]. The mood was manipulated in a between-subjects design, so one group of participants watched a sad movie clip, the other one watched a funny one. Two forms of non-compliance behavior that affected the residence time were measured: the

[1] The link to the experiments http://yuryshevchenko.com/online-study/emotional-movies/

Table 1

Sample characteristics

	Sample size	**Mean age (SD)**	**Females**	**German**	**English**
Negative	159	25.87 (8.70)	120	98	61
Positive	187	26.12 (10.54)	144	111	76
All	346	26.01 (9.72)	264	209	137

interruption of the video before its end by clicking the continue button and temporary leaving of the page. The mood manipulation check was done by comparing the mood before and after watching the movie clip. The study was approved by the Mannheim University Ethics Committee.

Procedure. Participants read the general information about the study and the consent form. After filling in demographic data, they rated their current emotional state. On the next page with the video, participants were instructed to click the play button to start the clip which would play for around three minutes. They were asked to watch the video until the end, and then press the continue button at the bottom of the page. After the video, the general mood rating question and a more precise questionnaire with ten different emotions followed. After that, participants had to answer whether they watched the video before, watched the video until the end and were distracted by other activities while watching the video. At the last page, participants could leave an email address if they wished to take part in a lottery.

Mood induction. Positive mood was induced by amusement emotions since amusement is often correlated with happiness but different from other emotions (Gilman et al., 2017). We used the scene with Scrat chasing nuts from the movie "Ice Age: Continental Drift" (2012, 2:30) that was validated in our previous studies. Negative mood was elicited by showing the scene with the death of Mufasa from the movie "Lion King" (1994, 3:10) (Rottenberg et al., 2007). We chose sad emotions to induce negative mood since sadness has a decreased level of arousal (Bonanno, Goorin,

& Coifman, 2008) and is not associated directly with avoidance motivation as other high-arousal negative states of anxiety, fear or disgust.

Mood manipulation check. Before and after watching the video, a mood manipulation check was done by asking participants about their current mood using a general question on a visual analog scale from "very depressed" to "very elated" recording answers from 0 to 500. Additionally, after the second general mood question after the video, participants rated their current mood on ten different emotion scales of the Positive and Negative Affective Schedule (PANAS, Watson & Clark, 1999). We did not present this questionnaire before watching the video not to elicit mood regulation thoughts or demand effects. The analog scale of the PANAS had five marks: "very slightly or not at all", "a little", "moderately", "quite a bit", and "very much", and the answers were recorded in the range from 0 to 500. Later, the answers were averaged for the scales of positive (happy, joyful, delighted, and interested) and negative emotions (downhearted, gloomy, sad, distressed, and angry). One additional item was used to control for arousal (relaxed).

Results

243 participants (70%) did not interrupt the video and did not temporarily leave the web page, 47 participants interrupted the video (14%), 49 people temporarily left the page (14%), and 7 people did both (2%).

Interruption of the mood induction procedure. In general, 54 participants (16%) spent less time on the video web page than they should to watch all the video. The number of participants was higher in the negative mood condition ($n = 33$, 21%) than in the positive mood condition ($n = 21$, 11%), χ^2 (1, $N = 346$) = 5.92, $p = .014$ (see Table 2).

A 2 x 2 between-subjects ANOVA was applied to analyze the effect of the mood manipulation and interruption of the video on the mood score. Since 10 participants did not fill in the mood questionnaire, the analysis was done for 336 participants. The mood score was normalized to correspond to a percentage scale from 0 to 100%. The

Table 2

Residence time in the mood groups. Row percentages are written in parentheses.

	The residence time is shorter than the length of the video	**The residence time is longer than the length of the video**	**Total**
Negative	33 (21%)	126 (79%)	159
Positive	21 (11%)	166 (89%)	187
All	54	292	346

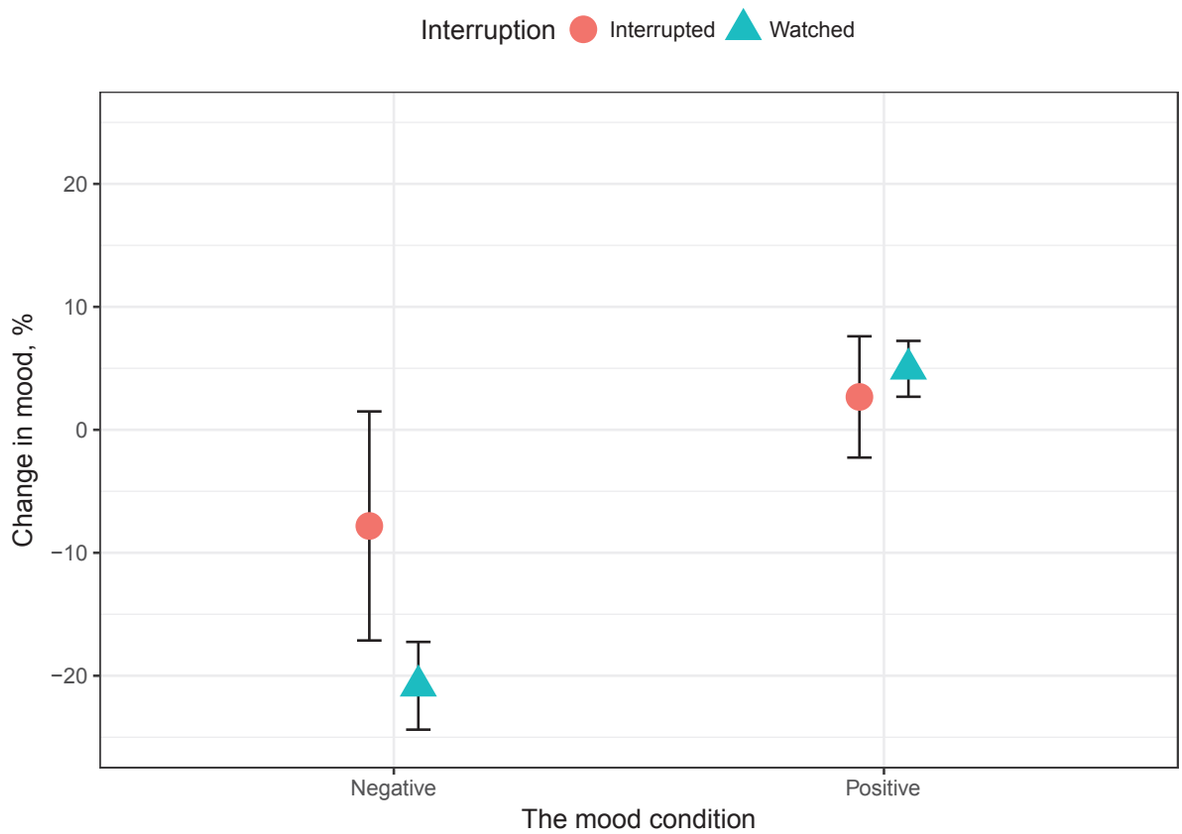
analysis showed both main effects of the manipulation, F (1, 332) = 138.84, MSE = 43720, $p < .001$, and the interruption, F (1, 332) = 6.06, MSE = 2355, $p < .05$. Importantly, there was a significant interaction between the manipulation and the interruption, F (1, 332) = 7.48, MSE = 2355, $p < .01$. A post-hoc Tukey test showed that in the negative mood condition people who did not interrupt the video decreased their mood in comparison with people who interrupted it, $p < .01$. In the positive mood condition, there were no significant differences between people who interrupted and who watched the whole video, $p = .95$ (see Figure 1).

The separate analysis with positive and negative emotions measured by PANAS showed that the interaction effect was only significant for negative emotions, F (1, 327) = 4.14, MSE = 50459, $p < .05$, but not for positive emotions, F (1, 327) = 0.89, MSE = 9745, $p = .35$[2].

Temporary leave. 56 participants (16%) at least once temporarily left the web page with the video (Mdn = 12 sec.). There were no differences between the number of people who did it in the positive (n = 31) and in the negative mood condition (n = 25), χ^2 (1, N = 346) = 0.05, $p = .83$. Regarding the mood ratings, a 2 x 2 ANOVA with main effects of the mood condition and temporary leave showed that only the effect of mood was significant, F (1, 332) = 134.54, MSE = 43720, $p < .001$. Neither the effect

[2] The number of people for the analysis was 331, since 5 people did not complete the PANAS questionnaire.

Figure 1. The changes in mood dependent on the mood condition and the interruption of the video ($N = 336$). The group means and 95% CI are shown. A negative score indicates that participants declined in mood, a positive score shows that they improved their mood.



of the leave nor the interaction between the mood and the leave were significant, F (1, 332) = 0.41, $MSE = 135$, $p = .52$ and F (1, 332) = 2.44, $MSE = 794$, $p = .12$.

Discussion

In Experiment 1, 30% of the participants who finished the experiment either interrupted the video or temporarily left the video page. Whereas the temporary leave was relatively short and did not influence mood ratings, interruption of the video was different between mood conditions and affected the mood ratings afterward. The results support the affect regulation hypothesis so that people confronted with the negative emotional content interrupted watching the video more often than people with the

positive content. Additionally, the people in the negative mood condition who interrupted watching the video were less affected by the mood manipulation, while there were no differences for the positive mood condition.

Regarding the mood manipulation check results, the size of the effect was larger for the negative (20% decrease) than for the positive mood condition (5% increase). That result is in line with previous research finding that negative emotions are easier to elicit than positive ones (Ferrer et al., 2015). However, we did not observe any ceiling effect for the positive mood score – people in the positive mood condition significantly increased their mood as well.

Experiment 1 showed that the differences between negative and positive conditions were more prominent in interrupting the mood manipulation procedure by clicking the continue button than in the temporary leave of the web page. However, both forms of non-compliance might be caused by the same avoidance motivation. So if we hide the continue button until the end of the video, we would expect the increase of the differences in the temporary leave between conditions. To investigate this hypothesis, we conducted Experiment 2 where participants could not use the continue button before the end of the video.

Experiment 2

Method

Participants. 208 cases (mood group: 104 positive (50%), 104 negative (50%)) of participation were registered. Filtering was applied to 28 records (see Table A2) leaving 180 participants for the analysis (see Table 3).

Design and Procedure. The design and procedure of the experiment were similar to Experiment 1 except the continue button at the web-page with the video was hidden until the end of the video. Therefore, only one form of non-compliance behavior, that is a temporary leave of the page, was registered. Additionally, three accuracy questions about the content of the video were added to examine whether they can distinguish non-compliance behavior.

Table 3

Sample characteristics

	Sample size	**Mean age (SD)**	**Females**
Negative	89	20.99 (3.11)	73
Positive	91	21.32 (4.18)	84
All	180	21.16 (3.68)	157

Mood induction. Positive mood was manipulated by the fragment with the character played by Ben Stiller fighting with a dog in the movie "There's something about Mary" (1998, 3:25) (Gilman et al., 2017). Negative mood was induced by the scene with a man losing his wife in a car accident from the movie "Return to me" (2000, 3:25) (Rottenberg et al., 2007).

Mood manipulation check. As in Experiment 1, before and after watching the video, participants answered a general question about their current mood. Additionally, they rated their emotions on ten different scales of the PANAS after the video (Watson & Clark, 1999).

Results

37 participants (21%) temporarily left the web page during the video. The number of participants was higher in the negative mood condition (n = 25, 29%) than in the positive mood condition (n = 12, 13%), χ^2 (1, N = 180) = 6.00, p = .01 (see Table 4).

As an explorative analysis, we compared the time spent out of the focus of the web-page between conditions. Since dependent variables were not normally distributed, a non-parametric Mann-Whitney U-test was applied. The length of missing time was not different between negative and positive conditions, W = 140, p = .90. However, there was a tendency for participants in the negative condition (Med = 29.8 sec.) to leave the web-page later than the participants in the positive condition (Med = 7.7 sec.), W = 204, p = .08 (see Figure 2).

A 2 x 2 between-subjects ANOVA was applied to analyze the effect of the mood

Table 4

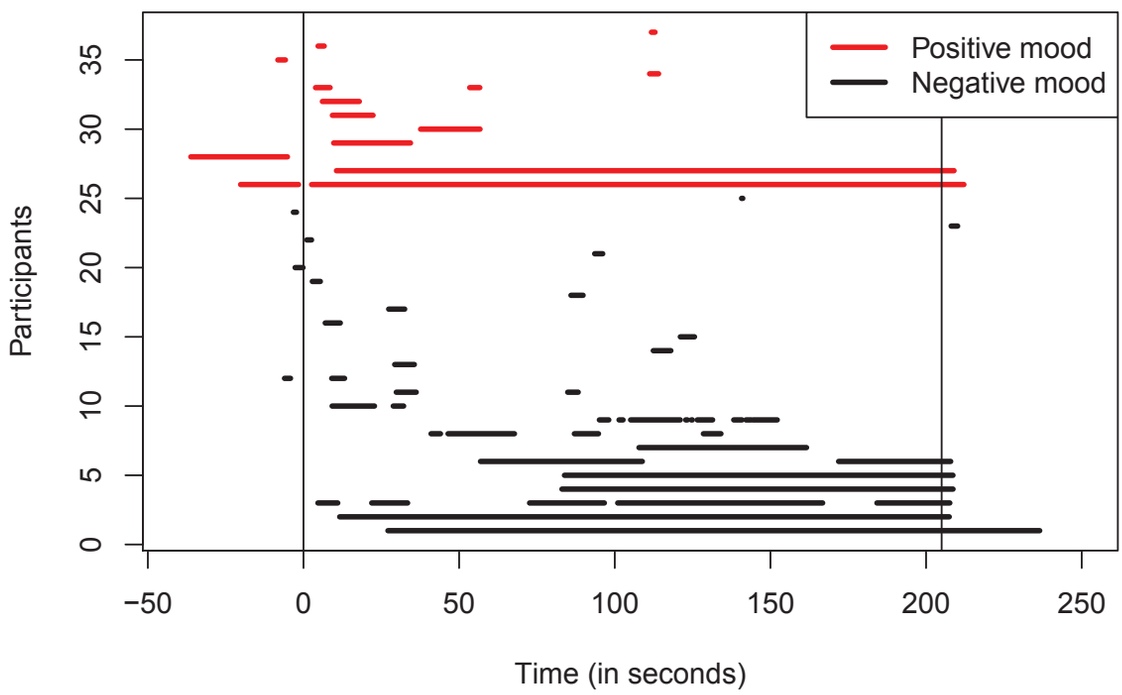
The temporary leave in the mood groups. Row percentages are written in parentheses.

	Stayed on the page	**Left the page at least once**	**Total**
Negative	64 (72%)	26 (28%)	89
Positive	79 (87%)	12 (13%)	91
All	143	37	180

manipulation and temporary leave on the mood score. Since two participants did not fill in the mood questionnaire, the analysis was done for 178 participants. The mood score was normalized to correspond to a percentage scale from 0 to 100%. The analysis showed the main effect of the mood manipulation, F (1, 174) = 170.02, MSE = 50188, $p < .001$, but there were neither effects of temporary leave, F (1, 174) = 2.34, MSE = 691, $p = .13$, nor the interaction between the mood condition and temporary leave, F (1, 174) = 0.14, MSE = 42, $p = .71$. The separate analysis with positive and negative emotions measured by PANAS showed no significant interaction effects for negative emotions, F (1, 174) = 0.67, MSE = 238, $p = .42$, and for positive emotions, F (1, 174) = 0.88, MSE = 311, $p = .35$.

Regarding the results of control and accuracy questions, only one person in the group of participants who left the web-page admitted being distracted by other activities while watching the video. Four people (two in the positive and two in the negative condition) reported technical problems while watching the video, which might be related to their temporary leaves (see Table A3). The number of people who gave at least one wrong answer in three accuracy questions was not different in the group who stayed on the webpage (n = 7, 5%) and who switched between pages (n = 3, 8%), χ^2 (1, N = 180) = 0.58, $p = .47$.

Figure 2. The time (in sec.) spent out of the focus of the web-page with the video. Two vertical bars show the start and the end of the video.



Discussion

The results of Experiment 2 supported the idea that people in the negative mood condition avoid the video more often than people in the positive mood condition. This result is in line with the affect regulation theory that expects people to regulate their emotions by escaping from the situation with negative emotional content. The finding conceptually replicates Experiment 1, which showed that people in the negative mood condition interrupted the video by clicking the continue button more often than people in the positive condition. Since Experiment 2 was void of the opportunity to interrupt the video, participants who wanted to withdraw from the negative emotional content used the chance to switch between web pages.

Additional explorative analysis showed that the participants in the negative mood condition were leaving the webpage at a later moment than in the positive condition.

This might be related to the fact that the emotionally adverse event in the negative condition video (injured wife of the main hero in a hospital) appeared only at 20th second, whereas the positive condition video did not have any negative episodes and could be recognized from the beginning as an excerpt from a comedy.

Although there were differences between conditions, the temporary leave did not affect the mood ratings as the interruption of the video did in Experiment 1. The possible reasons are that the leave was not long enough to avoid the mood manipulation or switching to another web page was not sufficient to restore the previous mood.

The answers to accuracy questions were not related to objective measures of the residence time on the web-page. However, the accuracy questions could filter people who completely missed the video or, perhaps, did not understand the instructions. As in Experiment 1, asking participants whether they were distracted during the task could not guarantee the reliable answer. The motivation to get credit points or participate in the lottery might prompt participants to give socially desirable responses. Also, the participants might not recognize their switches back and forth between web pages during the video as a distraction that they should report.

General Discussion

The current research investigated the non-compliance behavior in an online mood manipulation with movie clips. The filtering applied to participants with incomplete data is not enough to tackle the non-compliance behavior. There is a proportion of participants (30% in Experiment 1 and 21% in Experiment 2), not traceable with standard measures (e.g., accuracy questions), who do not follow the mood-manipulation instruction: they interrupt the video by using the continue button or switch between web pages during the video. This proportion might differ depending on the sample characteristics. Our experiments used a university sample of students, who participated for credit points. However, the more heterogeneous and less motivated sample might result in more cases of non-compliance, as indicated by the higher dropout rates with less committed samples (Reips, 2002).

Our research shows that the non-compliance behavior depends on the emotional content of the mood manipulation. Supporting the affect regulation theoretical account, participants preferred to avoid negative emotional stimuli more often than positive ones. The finding is in line with previous research that has demonstrated attentional deployment strategy of mood regulation, that is to look away of negative stimuli (van Reekum et al., 2007). In an online study, there are other possible strategies to avoid the mood manipulation, which are contingent on the design of an online-study, i.e., accessibility of the continue button. We recommend hiding the continue button until the end of a mood manipulation to prevent participants from interrupting the procedure. In case if the continue button cannot be removed, the residence time on the web page can be measured and used as a control variable in the analysis. Additionally, the inclusion of the time of the web page staying in focus into the analysis is an exciting avenue for future research. Contrary to a laboratory experiment, where a participant is confined to the use of experimental software, online experiments are executed in the web-browser environment where participants can transition between multiple windows or tabs.

In conclusion, people might regulate their emotions by avoiding certain mood eliciting content on the Internet which poses a threat to the internal validity of Internet-based mood manipulation studies. To decrease these risks, future research should adopt the following techniques: preventing participants from skipping a part of the mood manipulation, detecting page focus events, and measuring the time people stay on a page.

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Appendix

Table A1

Number of excluded participants in Experiment 1

	Negative	**Positive**	**Overall**
Beginning N	215	257	472
Page reloads	17	17	34
Repeated participation	2	2	4
Did not answer the intention question	0	0	0
Left at the first mood question	2	8	10
Left during the movie	18	23	41
Left at the second mood question	2	5	7
Left at the emotions questionnaire	13	8	21
Left at the debriefing questions	1	4	5
Left on the final page with emails	1	1	2
Problems with video	0	2	2
Final N	159	187	346

Table A2

Number of excluded participants in Experiment 2

	Negative	**Positive**	**Overall**
Beginning N	104	104	208
Page reloads	3	2	5
Repeated participation	3	3	6
Did not answer the intention question	3	0	3
Left at the first mood question	2	1	3
Left during the movie	4	6	10
Left at the second mood question	0	0	0
Left at the emotions questionnaire	0	1	1
Left at the accuracy questions about the video	0	0	0
Left at the debriefing questions	0	0	0
Left on the final page with emails	0	0	0
Problems with video	0	0	0
Final N	89	91	180

Table A3

Number of people who answered positively on the control questions in Experiment 2

	The participants who stayed on the webpage (n = 143)	**The participants who left the webpage at least once (n = 37)**
"Have you seen this video before?"	15 (10%)	3 (8%)
"Have you watched the video until the end?"	143 (100%)	37 (100%)
"Have you experienced any technical problems while watching the video?"	0 (0%)	4 (11%)
"Were you distracted by other activities while watching the video?"	3 (2%)	1 (3%)