Mechanisms in Risky Choice Framing

Affective Responses and Deliberative Processing

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Summary

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Background: The risky choice framing effect is a decision making bias, where people tend to be risk-averse when options are presented as gains and risk-seeking when options are presented as losses, although the outcomes are objectively equivalent. The mechanisms involved in risky choice framing effects are still not fully understood. Several individual differences are assumed to moderate the processing of framing tasks and the magnitude of framing effects. **Objectives:** The aim of the current study was to investigate the framing effect across six framing task in a within-subject design, and explore whether gain and loss frames were associated with different levels of affective responses and deliberative processing. An additional aim was to investigate how individual differences in emotion management ability and numeracy affected performance and processing of framing tasks. **Method:** The study was an independent research project and the author collected all the data. Eye-tracking technology was employed; number of fixations, duration of fixations, repeated inspections of options and pupil dilations were recorded from 80 predominantly young adults while performing on six framing tasks. Emotion management abilities and numeracy skills were collected by administering computerized questionnaires. **Results:** A significant framing effect was found across all items and participants. The loss frame was associated with a greater number of fixations (to the risky option), and more revisits to alternatives compared to the gain frame. There was no difference in fixation durations or pupil dilations between gain and loss frames. Risky options were however associated with greater pupil dilations than certain options across the frames. Higher levels of numeracy were associated with a minor decrease in the vulnerability to framing effects, although not significant. The emotion management scale did not reach a proper level of reliability, and no further analyses on emotion management ability were performed. **Conclusion:** The loss frame is assumed to involve deliberative processing, reflected in more fixations and revisits to alternatives. It is however only possible to speculate whether affective responses were the driving force of framing effects in the current study.

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Our lives consist of constant decision-making. We are faced with small and large decisions from the moment we wake up in the morning, to the moment we fall asleep in the night. We might think that we are responding to different options with a clear representation of what and why we prefer a certain option over another. But in fact, there is a wealth of research indicating that our preferences are not as stable as we might think. Our preferences can be a matter of how something is presented to us, or, in other words: How something is framed is likely to affect our decisions. Leaving the objective outcomes of options equal, small differences in the wording of options has been shown to influence our willingness to take risks. *Risky choice framing,* is a decision-making bias where people choose differently based on whether the information is presented as a gain or a loss. A majority tend to favor a certain outcome when the information is presented as gains, while more people favor a risky option when the information is presented as losses. The framing effect is a reliable finding in the literature on decision making, and has been shown to occur over a variety of tasks and populations (Levin, Schneider, & Gaeth, 1998). In order to make quick and efficient decisions, the human mind relies on mental short-cuts. These are influenced by the context the decision problem is embedded in, which consequently leads to inconsistent choices and preferences. This realization has questioned human rationality, and whether we in fact are able to make autonomous decisions at all.

The nature of the underlying mechanisms of the framing effect are still not fully understood. Prospect theory claims that people choose according to the subjective value of gains and losses, rather than the objective outcome. People are loss aversive, meaning that a loss looms larger than an equal gain. A sure gain is favored over a possible gain, and a possible loss is preferred to a definite loss (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). The framing effect has been explained as a result of relying on an affect heuristic, a mental short-cut where the overall affective reaction associated with a stimulus influence our decisions (Slovic, Finucane, Peters, & MacGregor, 2002). A loss is associated with a different affective reaction than a gain, which is why there is invariance between gain and loss frames. The affective reaction is fast and automatic, linked to system1 processing (Epstein, 1994). System 2 thinking may therefore intervene and reduce the framing effect due to more deliberative thinking (Kahneman & Frederick, 2007). Igou and Bless (2007) do however claim that deliberative processing can enhance framing effects through more constructive processing which leads to greater influence from irrelevant affective input (see

also Igou, 2011). Deliberative thinking might also be directly involved in the processing of framing tasks. Gonzalez, Dana, Koshino, and Just (2005) suggested that the negative feeling associated with the certain loss leads to more deliberative processing associated with calculation of the risky option.

The current thesis will look closer at different explanations for the framing effect, with a focus on the emotional and cognitive mechanisms, in addition to possible individual difference factors that might modify processing and choice in framing tasks. The research on how affective cues are involved in decision making and the framing effect will be reviewed, with a subsequent discussion of how deliberative processing might influence the magnitude of framing effects. Finally, predictions of how people will process frames and how this can be measured by the use of eye-tracking will be suggested.

The Framing Effect

When respondents are given a certain and a risky option, either phrased in terms of gains or in terms of losses, the robust finding is that people are risk-averse when the options are presented as gains, and risk-seeking when they are presented as losses. This decision-making bias is referred to as risky choice framing (Levin et al., 1998). The Asian disease problem (ADP), the prototypical example of the framing effect by Tversky and Kahneman (1981, p. 453), clearly revealed that people preferred different options depending on how the outcomes were phrased:

> Imagine that the U. S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows.

The first group, consisting of 152 participants, got the options presented in a gain frame:

> A: 200 people will be saved.
>
> B: 1/3 probability that 600 people will be saved, and 2/3 probability that no people will be saved.

The second group consisted of 155 participants, and got the options presented in a loss frame:

> C: 400 people will die.
>
> D: 1/3 probability that nobody will die, and 2/3 probability that 600 people will die.

Although option A is logically equivalent option C, and option B is logically equivalent option D, responses were completely different between the groups. The majority of participants in the first group preferred the certain option A (72 %), while the majority of the participants in the second group on the other hand preferred the risky option D (78 %).

The demonstration of framing effects challenged the assumption of the human being as a rational actor. Framing effects violate the normative principles of description invariance, the assumption that preferences should not be affected by irrelevant changes in features of the options (Arrow, 1982; Tversky & Kahneman, 1986). The dominant view on choice in economics had been that individuals base their choices on the exact outcomes of alternatives. According to expected utility theory, individuals faced with risky decisions calculate the exact outcomes and probabilities of the options, and thereby choose the option with the highest expected utility. Preferences should therefore be stable across different situations (Neumann & Morgenstern, 1944). As inconsistent behaviour could not be explained in the framework of expected utility theory, Kahneman and Tversky (1979) developed prospect theory, an alternative descriptive model explaining real-life behaviour. According to the latter theory, individuals are assumed to base their choices on the value of gains and losses, rather than the expected utility of outcomes. Framed information is encoded either positively or negatively, which determines how the subjective value of the information is perceived. This process leads to different reference points for gain and loss frames in guiding the decision. The value function (see Figure 1) is concave for gains, while it is convex and steeper for losses, meaning that people are more willing to take risk to prevent further loss than to take risks to achieve more gains (Tversky & Kahneman, 1981).

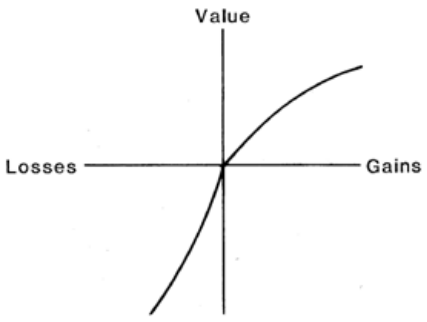

Figure 1. Hypothetical value function. Reprinted from "The Framing of Decisions and the Psychology of Choice" by A. Tversky, & D. Kahneman, 1981, *Science, 211*, p. 454. Copyright 1981 by American Association for the Advancement of Science.

Since Tversky and Kahneman (1981) initial demonstration of the framing effect, there has been extensive research in the area of framing. The effect is replicated by many different researchers, in different domains as traditional economic decision making (e.g., De Martino, Kumaran, Seymour, & Dolan, 2006) medical decision making (for a review see Moxey, O'Connell, McGettigan, & Henry, 2003) and in negotiation (for a review see Bazerman, 1983). The magnitude of framing effects are not always as large as originally found by Tversky and Kahneman (1981) (Kühberger, 1998). Two different approaches have traditionally been used in order to evaluate whether a framing effect is present or not (Druckman, 2001; Wang, 1996). A *preference reversal* or bidirectional framing effect is when significantly greater than 50 percent of respondents are risk-seeking when options are presented as losses, while significantly less than 50 percent are risk-seeking when options are presented as gains. This was the effect found by Tversky and Kahneman (1981), where 78 percent opted the risky option in the loss frame, compared to only 28 percent in the gain frame. A *preference shift* or a unidirectional framing effect compares the proportion risk-seeking responses in the loss frame, to risk-seeking responses in the gain frame. This effect thereby only looks at the relative impact of the frame instead of using the 50 % distinction. A framing effect would for instance be present as a preference shift, when 40 percent choose the risky option in the loss frame, compared to 12 percent risky choices in the gain frame. In a meta-analysis by Kühberger (1998) it was concluded that framing effects is a robust finding where preference shift, not necessarily a strict reversal, is found by several studies. In the current thesis, we will therefore evaluate framing effects both as preference reversals and as preference shifts.

Framing research has mainly been focused on the demonstration of whether the effect is present or not (Keren, 2011, p. 4). Although the effect is not always as large as first found, there is extensive literature supporting the existence of risky choice framing, where people are more sensitive to losses than gains in risky/riskless decisions (Kühberger, 1998; Levin et al., 1998). Less research has however been done in order to test why and when framing effects are more likely to occur. The precise underlying cognitive and affective mechanisms involved in framing are therefore still unclear. A prominent view is that framing effects are errors of intuitive reasoning, which specifically has been related to influence of irrelevant, but easily accessible affective cues created by the different frames (see Kahneman, 2003; Kahneman & Frederick, 2007), while emotional regulation seem to reduce the influence of frames (Miu & Crişan, 2011).

Affect as Accessible Cues for Decision Making.

One of the main features of prospect theory is that responses to losses are more pronounced than to gains, meaning that the displeasure of losing is greater than the pleasure of equivalent gains. People are loss aversive. The initial work on framing did however not explicitly focus on the emotional aspects of framing, although Tversky and Kahneman (1981) proposed that emotions probably would influence and modify the framing effect.

The role of emotions has received increasing attention in decision making research during the last few years (for a review see Lerner, Li, Valdesolo, & Kassam, 2015; Phelps, Lempert, & Sokol-Hessner, 2014). Many researchers now believe that emotional processes act together with cognition to guide decision-making behaviour. Affective responses, the consciously or unconsciously experienced feeling of the "goodness" or "badness" of a stimulus occur rapidly and automatically. Reliance on affect has been referred to as the affect heuristic, a mental short-cut that enables the individual to make quick decisions based on current emotions and affective reactions towards stimuli (Slovic et al., 2002; Slovic, Finucane, Peters, & MacGregor, 2004). The role of affect in decision-making has commonly been described through a dual-processing framework of human thinking. The distinction between two types of processing has been made by a broad range of researchers, using different labels for the two types of thinking (for a review see Evans, 2008; Evans & Stanovich, 2013), here referred to as system 1 and system 2 from Stanovich (1999). Although there are differences between the proposed theories, the general view is that system 1 is fast, automatic and intuitive, while system 2 is slow and deliberative. The experience of affect has been directly linked to system 1. Affective reactions occurs automatically and therefore efficiently influence further processing and behaviour (Epstein, 1994).

Several scholars have theorized that affect is an important part of decision making, as it may serve behaviour by being more efficient than deliberative cognitive evaluations in some situations. According to Antonio Damasios' Somatic Marker hypothesis, somatic markers, that is, emotional body signals, are critical to optimal decision making. These signals are assumed to be instances of emotions and feelings connected by previous learning, specifically assumed to be processed in structures of the ventromedial prefrontal cortex (VMPFC), and hence help predicting future outcomes. Negative somatic markers linked with future predictions therefore work as an alarm bell leading the individual to consider alternative options, while positive somatic markers function as incentives. Evidence for the somatic marker hypothesis came from observations of patients with VMPFC lesions, which

both demonstrated problems in decision-making behaviour and exhibited abnormalities in emotions (Bechara, Damasio, Tranel, & Damasio, 1997; Damasio, 1994; Damasio, Everitt, & Bishop, 1996).

There is considerable evidence supporting that judgements can arise from affect, also affective cues unrelated to the judgmental target and influence decision making. Affective reactions to stimuli occur rapid and might even occur without conscious awareness and influence our judgements (Zajonc, 1980). Subliminal presentations of emotional facial expressions has for instance been showed to influence subsequent judgments of the value of a beverage (Winkielman, Berridge, & Wilbarger, 2005) and influence preference ratings of cartoon drawings (Niedenthal, 1990). The overall affective reaction created the wording of options people get, may therefore serve as easily accessible cues for decision-making, and automatically influence the choice. The affect heuristic has therefore served as an useful explanation of how framing effects arises.

Intuitive Affective Responses and Regulation of Behaviour

Incidental emotion arising from contextual cues unrelated to current decisions is assumed to influence decision making, including choices in framing tasks. Neuroimaging studies have shown that neural correlates usually associated with emotional processes display enhanced activity when individuals are acting in accordance with a frame, that is, demonstrating framing effects. Importantly, being able to regulate emotions seems to counteract the framing effect. In a functional magnetic resonance (fMRI) study where participants responded to a financial gambling task, De Martino et al. (2006) demonstrated that framing effects, that is, choosing the certain-gain and the risky-loss options, were significantly associated with increased bilateral amygdala activity. Acting against this trend, that is, choosing the risky-gain and certain loss, was on the other hand associated with increased activity in the anterior cingulate cortex (ACC). These findings provide neurological support for the involvement of an affect heuristic in the framing effects, reflected in increased amygdala activity, an area that are assumed to play an important role in emotional processes, such as emotional learning and memory (Adolphs, Cahill, Schul, & Babinsky, 1997; Dolcos, LaBar, & Cabeza, 2004). When individuals occasionally choose against the frame, the anterior cingulate cortex (ACC), an area associated with cognitive control and conflict detection (Botvinick, Braver, Barch, Carter, & Cohen, 2001), indicates a conflict detection between the more “analytic“ and “emotional“ amygdala-based processing systems. Furthermore, De Martino et al. (2006) were able to anatomically distinguish between subjects

who were more or less susceptible to the influence of frames. The degree of susceptibility to framing effects was however not predicted by amygdala activity, but rather by activity of areas in the prefrontal cortices. Participants who were less affected by the framing effect, showed enhanced activity on the orbital and medial prefrontal cortex (OMPFC), especially in the right orbitofrontal cortex (R-OFC) and ventromedial prefrontal cortex (VMPFC). As suggested by the somatic marker hypothesis the VMPFC is critical to optimal decision making behaviour, and normal emotional reactions (Bechara et al., 1997), while the OMPFC in general are functionally linked to the amygdala by integrating emotional input and regulation of behavioural responses (Dolan, 2007; Gold, Morey, & McCarthy, 2015). This point towards that individual differences in the vulnerability to framing effects can be linked to the ability to regulate emotional input, reflected in greater activation of prefrontal cortices that exerting control over amygdala responses. This difference has later been linked to genetically mediated differences in prefrontal-amygdala interactions. A distinct genotype of the serotonin-transporter gene, usually associated with greater amygdala reactivity to emotional stimuli, was found to be associated with more frame consistent responses, greater amygdala activity during these choices, in addition to a decreased prefrontal-amygdala coupling (Roiser et al., 2009). Moreover, trait-anxiety seem to be associated both with a reduction in ACC-amygdala coupling and the vulnerability to framing effects (Xu et al., 2013).

The ability to successfully integrate emotional input seems to be an important factor in the resistance to framing effects. This ability varies across individuals, appears to be influenced by genetics, and moderated by emotional disorders such as anxiety. Consistent with such findings it has been demonstrated that successful emotional regulation reduces the influence of frames. Cognitive reappraisal, leads to a reduction in the vulnerability to framing effects compared to mere inhibition of emotional behaviour (expressive suppression) (Miu & Crişan, 2011), and instructions to be emotion focused (Cheung & Mikels, 2011). Cognitive reappraisal is an emotional regulation strategy that involves reformulating the meaning of a situation, and has been associated with early activation of prefrontal cortex, followed by subsequent reduction of amygdala responses (Goldin, McRae, Ramel, & Gross, 2008). Reappraisal might therefore moderate framing effects through the same mechanisms as seen in the more "rational" individual in the study of De Martino et al. (2006), and successfully modulate the experience of emotion and decrease the influence of frames by regulating inputs from emotional areas. Furthermore, it has been found that women seem to be more prone to framing effects compared to men. Fagley, Coleman, and Simon (2010) claim that women

often rely more on emotion than men during decision making. When men were instructed to engage in affective perspective taking, for instance to focus on what a person might feel in a given situation, they exhibited framing effects at the same magnitude as women did.

Converging evidence seem to support that intuitive emotional processing is one of the main mechanisms driving the framing effects, while regulating emotions reduce this behavioural tendency. The important role of affect in framing is in line with a dual-processing framework, where framing effects can be seen as a result of the affect heuristic stemming from intuitive system 1 processing. According to interventionist models of dual processing it is assumed that system 1 processing is the default response unless intervened by system 2 (Evans & Stanovich, 2013; Kahneman, 2003; Kahneman & Frederick, 2002). People do however vary in the susceptibility to framing effects, which can be explained as a result of varying ability to engage in a more deliberative system 2 processing, that enables the individual to counteract the tendency to rely on automatic and emotional responses (Kahneman & Frederick, 2007). This has led to a discussion of whether deliberative processing leads to more or less framing, and whether individual traits that should influence the engagement of such processing decrease the influence of frames on choice.

Deliberative Processing

According to dual-process accounts, deliberative thinking should reduce biases. In line with this, several studies have found that additional deliberative processing reduce framing effects. Framing effects have been found to decrease when individuals are assumed to be engaged in analytic and systematic processing compared to more holistic and heuristic processing (McElroy & Seta, 2003). Furthermore, individual differences associated with engagement of deliberative system 2 thinking, such as need for cognition, has been associated with more consistent choices across different frames (LeBoeuf & Shafir, 2003). The effect of deliberation on framing effects is however not straightforward. Igou and Bless (2007) argue that deliberation alone not is enough to reduce framing effects, and might in some circumstances lead to enhancement of framing effects. Deliberation has also been assumed involved in the processing of framing tasks by Gonzalez et al. (2005). The account differs according to whether they assume that the ambiguity of framing tasks lead to more effortful processing enhancing the influence of affective cues, or whether affective cues “forces” the individual to engage in effortful calculations needed to calculate the expected values of the decision option. In other words, whether the affect heuristic works through system 1 or system 2.

Igou and Bless (Igou, 2011; Igou & Bless, 2007) assume that framing effects are more likely to occur when individuals engage in *constructive processing* or "go beyond the information given", thus adding additional information to the problem based on contextual cues (Bless, Betsch, & Franzen, 1998). According to the Affect Infusion Model (AIM) (Forgas, 1995), constructive processing enhance the influence of affective cues, and are most likely to occur when a task is ambiguous. In a series of studies, Igou and Bless (2007) investigated the influence of deliberation and the need for constructive processing. Experimental conditions that stimulated effortful processing resulted in increased framing, measured as the amount of time allocated to the framing task. In line with the AIM, deliberation had less influence on framing when the task was made less ambiguous by labelling the framing task as *statistics*. Furthermore, deliberation was directly linked to increased framing, when deliberation was manipulated as processing motivation through accountability, and when manipulated as processing ability, by varying processing time. The researchers have therefore suggested that the ambiguous nature of framing tasks leads the individual to go beyond the information given, leading to framing effects, while deliberation enhances this tendency. They do not however, reject that framing effects can occur without deliberation (Igou, 2011).

A different approach linking processing effort to framing effects has been put forward in a model by Gonzalez et al. (2005). Based on information processing principles and cost-benefit trade-off theory, the researchers theorized that framing effects occur due to a trade-off between the cognitive effort required to calculate the expected value of an alternative and the affective value of the alternative. The certain alternative of the gain frame (e.g., 200 people will be saved) is easy to calculate and does not evoke feelings of displeasure. The certain alternative in the loss frame (e.g., 400 people will die), on the other hand, does evoke feelings of displeasure. People are therefore more willing to undertake more effortful calculations in the loss frame, and select the risky option in order to emotionally "improve" the outcome. Brain activation patterns in response to risky choice framing tasks supported the proposed model. Choosing the certain option in the gain frame was associated with significantly less brain activation compared to selecting the risky option, indicating that minimizing effort and feelings of displeasure is easily done in the gain frame. The loss frame was linked to higher brain activation regardless of the selected option, demonstrating that the tradeoff between minimizing effort and feeling of displeasure was more difficult to perform as both of the options involves costs.

These findings indicate that mere deliberative processing not necessarily is enough to

reduce framing effects, but are partly involved in the bias. The results do however not rule out an important role of affect when processing framing tasks. Igou and Bless (Igou, 2011; Igou & Bless, 2007) argues that deliberation leads to enhanced influence by affective cues, while Gonzalez et al. (2005) assumes that the initial affective reactions will lead to more deliberation in the negative frame. The difference is whether affect comes to play through deliberative system 2 processing or heuristic system 1 processing, respectively.

Individual Differences

As already indicated, people are more or less susceptible to framing effects. Much research has indicated that this is a result of individual differences in the ability to regulate emotions. From a dual-system approach it is therefore been of interest to explore under which condition corrective deliberative processing are more likely to occur, and which traits that facilitate system 2 thinking (Kahneman, 2003). Several researchers have investigated individual traits associated with more deliberative and effortful processing styles (Kahneman, 2003). As discussed, the findings regarding deliberative processing is however mixed. The present study therefore looked at one trait that is involved in automatic regulation of emotional responses, and one that is assumed to be associated with more deliberative processing.

Framing effects and emotional intelligence. Emotional intelligence (EI) has been conceptualized as a set of abilities which contributes to accurate perception, integration, understanding and management of emotions (Mayer, Roberts, & Barsade, 2008; Mayer & Salovey, 1997). Fiori (2009) suggested that individual differences in EI could be understood as differences in the way individuals automatically process emotional stimuli. Although individuals high on EI have greater awareness of affective cues during decision making, they also tend to integrate the emotional input better than individuals low on EI. Yip and Côté (2012) conducted an experiment where they found that individuals high on the emotion understanding ability of EI were less affected by irrelevant emotion during subsequent financial decision making. Participants were either assigned to an anxiety inducing task or a neutral condition where they were told to prepare a mental list for grocery items. Anxiety was induced by telling the participants that they should prepare a speech on why they were a good job candidate, and were told that their speeches would be video-recorded. Emotion understanding ability had been measured in a previous test session using the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) (Mayer, Salovey, & Caruso, 2002). The result showed that participants with low ability to understand emotion were more influenced by

incidental anxiety in the subsequent gambling tasks, as low EI individuals gambled more than individuals with high ability to understand emotions. It was decided to investigate whether individuals high on EI also would be less vulnerable to framing effects. Since emotion managing techniques such as cognitive reappraisal has been found to successfully regulate emotion and prevent the effect of frame on choice (Cheung & Mikels, 2011; Miu & Crişan, 2011), it was hypothesized that performance on framing tasks would be more related to the emotion management branch of EI. Individuals with a high score on the management ability branch of EI are assumed to automatically regulate emotions for better outcomes and to pursue self-regulating goals (Fiori, 2009), and are thus more able to integrate emotional cues elicited by the frames during the processing of framing tasks.

Framing effects and numeracy. Numeracy, the ability to understand and comprehend numbers has been found to influence performance in several tasks and situations, including framing tasks (for a review see Reyna, Nelson, Han, & Dieckmann, 2009). In a study by Peters et al. (2006), numeracy was found to moderate attribute framing. Attribute framing is characterized by that the frame is affecting the evaluation of an object or an event (Levin et al., 1998). Participants were asked to rate exam performance of five students on a scale from -3 to +3. The frames were manipulated between subjects as percentage correct or incorrect, as for example describing the exam score as 74% correct or 26% incorrect. A significant framing effect was found, where the exam score described as percentage correct elicited more positive ratings of the exam performance. More numerate individuals were less susceptible to framing effects, rating the performance of exam scores more consistent across the frames, compared to less numerate individuals. Moreover, it was found that highly numerate individuals were less influenced by irrelevant affective cues, and draw more precise affective meaning from numbers, compared to less numerate participants in task where participants had compare probabilities. The findings regarding numeracy and risky choice framing effect are however not as straightforward. Peters and Levin (2008) found that numeracy did not influence magnitude of framing effects, although there was a marginal tendency among reduced framing among more numerate participants. Instead it was assumed that different mechanisms are responsible for framing effects between more and less numerate. More numerate individuals were found to integrate more information from separate components when making judgments, while less numerate not based their choice on comparisons. Jasper, Bhattacharya, and Corser (2016) very recently demonstrated that individual differences in numeracy were associated with processing differences. By using a computerized process tracing method that involves hiding information in different boxes that participants need to open in order to

examine the information, it was found that highly numerate individuals attended more information, and processed it in greater depth than less numerate individuals. It might therefore be that numeracy influence the processing of risky choice framing tasks, instead of the magnitude of the framing effect.

Oculomotor Movements in the Investigation of Framing Effects

Cognitive effort and affect are assumed to be involved in framing effects. It is however not clear exactly how intuitive emotional and deliberative processing contributes to framing effects. Measures of eye movements and of pupil size can provide insight in how these processes interact during framing tasks.

Eye-tracking. The investigation of eye movements emerged over 200 years ago, when direct observation was used to investigate eye-movements during reading. While most research up to the 1970s focused on eye-movements per se, technological advancements of eye-tracking devices has made it possible to investigate moment-to-moment information processing (for a review see Rayner, 1998). It is now widely held that oculomotor movements provide a reliable measure of real-time cognitive processing (Rayner, 2009) and the eye-tracking methodology therefore yields an opportunity to measure levels of processing during framing tasks. Importantly, fixation duration has been considered as an index of the depth of processing. Fixation durations during reading are on average 225-250 ms, but there can be considerable variability in fixation durations. Single fixation durations can be as short as 50-75 ms, and as long as 500-600 ms or more (Rayner, 2009). Mean fixation durations have been demonstrated to increase with level of elaborative processing. It is assumed that long fixation durations, over 500 ms, are linked to more deliberative processes, while shorter fixation durations up to 250 ms are linked to more superficial processing (see for example Velichkovsky, Dornhoefer, Pannasch, & Unema, 2000). Fixation durations have also been shown to vary between gain and loss frames. Based on the assumption that frames induce emotions, which in turn affect the level of processing, Kuo, Hsu, and Day (2009) investigated level of processing in terms of number of fixations and processing time per word in the options between gain and loss frames. Their results indicated that the asymmetry in cognitive effort between the frames predicted extent of framing effects, where loss frames were associated with significantly higher level of effort, reflected in number of fixations and fixation durations. Kuo et al. (2009) did however not directly investigate whether the frames where associated with emotional responses.

Pupillometry. Another approach to the investigation of cognitive processing is

pupillometry, the study of changes in the diameter of the pupil as a function of cognitive processing (for a review see Sirois & Brisson, 2014). Changes in the pupil size are caused by the two smooth muscles in the iris, namely the constrictor and dilator. The dilator constitutes of cells controlled by the sympathetic nervous system, while the constrictor contains of cells connected to parasympathetic system (Goldwater, 1972). The pupil diameter varies from 1,5 mm to 9 mm, and reacts to stimulation in 200 ms (Lowenstein & Loewenfeld, 1962). In order to optimize vision, the eye dilates in response to darkness and constricts to brightness (Sirois & Brisson, 2014). It is however a long-held view that the pupil also changes in response to other factors than light. Pupil dilations have been shown to be a reliable measure of processing demands. Kahneman and Beatty (1966) did for instance demonstrate that the pupil dilated as a function of the number of digits the participant needed to keep in short-term memory, while Just and Carpenter (1993) demonstrated that more complex sentences where associated with in increased dilation compared to simpler sentences.

Pupillometry has also been useful in decision-making research, where pupil dilations has been suggested to reflect processing during decision tasks (de Gee, Knapen, & Donner, 2014). Importantly pupillometry can be used to investigate the interaction between cognition and emotion during decision-making. In a study by Prehn, Heekeren, and van der Meer (2011), participants responded to an analogical reasoning tasks, where participants had to identify both conceptual and emotional relation between two words presented simultaneously. Half of the items were analogous in their emotional and conceptual content, while in the other half of the items the conceptual and/or emotional relations did not correspond. Pupil dilations where shown to reflect increasing complexity of the comparison process, where the pupil was shown to dilate in response to all condition, but increased most in when conceptual and emotional relations corresponded. Moreover, items with negative emotional valence were associated with even greater pupil dilations compared to neutral and positive items.

Emotional pupil dilations have however been associated with the intensity of emotional arousal rather than its positive or negative valence. Bradley, Miccoli, Escrig, and Lang (2008) did for instance demonstrate that the pupil dilated more in response to both pleasant and unpleasant pictures compared to neutral pictures. Moreover, these changes in pupil diameter covaried with skin conductance changes, suggesting that the changes were mediated by sympathetic activity and reflected emotional arousal. Another study found that the pupil dilated in response to both negative and positive arousing sounds, such as for example a baby crying or laughing, compared to neutral sounds, such as regular office sounds (Partala & Surakka, 2003). Losses during gambling are found to be more emotionally

arousing than winning an equal amount. In a series of studies losses have been associated with increased autonomic activity, reflected in both greater pupil dilations and increased heart rate, compared to equivalent gains (Hochman & Yechiam, 2011; Yechiam & Telpaz, 2011).

Current Study

Although neuroimaging techniques have begun to reveal how both emotional and cognitive mechanisms are involved during the processing of framing tasks, the precise mechanisms in the framing effect are still unclear. Several theories states that framing effects arise from irrelevant affective cues. Whether this focus stem from an intuitive system, which can be intervened by deliberative thinking, or whether deliberative thinking leads to increased influenced on affective cues is still unclear. Alternatively, it might be that affective cues lead to an increased need for more effortful calculations.

Based on this, the aim of the present study was to investigate the underlying processes during framing tasks by the use of eye-tracking methodology. As framing effects tend to be a robust finding in the literature, it was hypothesized that most participants would choose the certain option in the gain frame, and the risky option in the loss frame. Building on Gonzalez et al. (2005) it was assumed that the frames would evoke different levels of cognitive effort based on different affective cues. Number and duration of fixations, alongside revisits to the different options were therefore recorded by the use of eye-tracking in order to investigate the decision process and the cognitive effort involved during framing tasks. This is an extension of Kuo et al. (2009) study, where it was found that the asymmetry in effort, measured in terms of fixations and fixation durations, between the frames predicted extent of framing effects. We hypothesized that processing of the loss frame would require more cognitive effort, reflected in more fixations, longer fixation durations, and more revisits than in the gain frame.

This may be the first study to investigate pupil dilations during standard framing tasks. An exploratory investigation of pupil dilations during framing tasks was therefore performed, as pupil dilations can give an index of emotional arousal (Bradley et al., 2008) and cognitive effort (Kahneman & Beatty, 1966). The preliminary hypothesis was that the pupil would dilate more during the loss frame, as losses are found to be associated with greater emotional arousal (Hochman & Yechiam, 2011; Yechiam & Telpaz, 2011) and because the loss frame is associated with more cognitive effort (Gonzalez et al., 2005; Kuo et al., 2009). Moreover, as the risky options are more difficult to calculate than the certain options, the pupil should also dilate more when processing risky options compared to certain options. The certain option in the loss frame is associated with feelings of displeasure, and should be associated with greater

pupil dilations than the certain-gain. It was therefore assumed that there would be an interaction between the frames and option due to the interplay between emotional arousal and cognitive effort in terms of pupil dilations.

As the vulnerability to framing effects seems to vary across individuals, and is likely to be modified by a number of individual difference factors, an additional aim of the study was to examine whether individual differences in numeracy and emotion management abilities affected processing and performance on framing tasks. Questionnaires were administered in order to investigate individual variations in emotion management and numeracy. As it has been found that individuals who score higher on emotion-understanding are less likely affected by the affect heuristic and irrelevant emotions when making decision involving risks (Yip & Côté, 2012), and that emotional regulation reduce framing effects (Cheung & Mikels, 2011; Miu & Crişan, 2011) we hypothesized that individuals with higher emotion management ability might be less susceptible to framing effects. Numeracy was measured, as this cognitive ability is assumed to influence the processing of framing task. Based on Peters and Levin (2008) it was however hypothesized that individuals high and low on numeracy will exhibit the same level of framing effect.

Methods

Participants

80 participants were recruited through the Department of Psychology (University of Oslo) research subject pool, seminars in first year psychology classes, and through web advertisements (social media and forums). The sample included 51women and 29 men between the ages of 18 and 51 years (M = 24.8, SD = 6.8). Participants from the research subject pool participated for partial course credit. Written consent was obtained from each participant prior to the experiment. The experiment was approved by the internal review board for research at the Department of Psychology, University of Oslo.

After a visual inspection of the eye-tracking scanpaths and gaze-replays, it was decided to exclude five participants from the eye-tracking analyses due to incomplete data, such as missing data-points in several trials, resulting from either technical problems with the tracking system or disturbance due to heavy makeup. The remaining sample included in the eye-tracking analyses consisted of 75 participants, including 49 women and 26 men between the ages of 18 and 51 years (M = 24.4, SD = 6.3). All participants had normal or corrected-to-normal vision and no neurological damage.

Materials

Risky choice framing tasks. Six standard framing tasks using the format of the Asian disease problem were included in the study: The fish disease problem (Kühberger & Tanner, 2010), the cancer problem (Fagley & Miller, 1987), the shareholding problem (Teigen & Nikolaisen, 2009), the swine flu problem (Haraldsen Nordbye, Teigen, & Riege, 2016), the plant problem (Bazerman, 1983, 1984) and the tax problem (Levin, McElroy, Gaeth, Hedgcock, & Denburg, 2014). All participants were given three gain framed problems and three loss framed problems, each including two options, one certain and one risky. As an example, in the cancer problem, participants were asked to choose between two different treatments for cancer. In the gain frame, the options were presented as:

> Treatment A: If the treatment is adopted, 400 out of 1000 people who get cancer will be saved for sure.
>
> Treatment B: If the treatment is adopted, there is a 40 % chance that all of the 1000 survive, and a 60% percent chance that nobody will survive.

In the loss frame, the options were presented as:

> Treatment A: If the treatment is adopted, 600 out of 1000 people who get cancer will die for sure.
>
> Treatment B: If the treatment is adopted, there is a 40% chance that nobody will die, and a 60% chance that all out of the 1000 will die.

The outcomes of the options are logically equivalent between the two frames, and difference in number of risky choices between the two frames can be used as indication of framing effect magnitude. All tasks were translated to Norwegian and adapted to suit a Norwegian sample. In order to ensure equivalence between the original and translated tasks, other people were back-translating the Norwegian versions to English. The tasks were also modified to be similar to each other in respect to form and length of alternatives, in order to be able to compare the eye-tracking measures across the tasks and frames (the full set of original and translated tasks can be found in Appendix A).

Emotion management questionnaire. All participants were given the 18-items version of the Situational Test of Emotion Management (STEM-B) (Allen et al., 2015; MacCann & Roberts, 2008). STEM-B measures emotion management ability through a scenario-based multiple choice questionnaire. An example of such a scenario is "Stian starts a new job where he doesn't know anyone and finds that no one is particularly friendly". Respondents are given four options and asked to pick the action they think is the most effective for the character in the given scenario. For this particular scenario options are (a) Have fun with his friends outside of work hours. (b) Concentrate on doing his work well at the new job. (c) Make an effort to talk to people and be friendly himself. (d) Leave the job and find one with a better environment. Items are scored based on expert ratings of the adaptive value for the chosen response. STEM-B is validated as a reliable indicator of emotion regulation ability, with a Cronbach's alpha of .84 (Allen et al., 2015). STEM-B was translated to Norwegian by two people (see Appendix B for the original and translated version).

Numeracy. Participants completed a 4-items version of the Berlin Numeracy Test

(BNT) (Cokely, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012), a tool that quickly measures statistical numeracy and risk literacy through four tasks involving percentage calculation. An example of one of these tasks is: Imagine that a five-sided dice is thrown 50 times. How many times on average, out of the 50 throws, will this five-sided dice show an odd number (1, 3 or 5) (see appendix C for the entire set of questions). BNT has been found to predict superior decision making, including risky decisions, measuring mathematical competency and metacognitive and self-regulated learning skills (Ghazal, Cokely, & Garcia-Retamero, 2014), with a Cronbach's alpha of .59 for the four-item version (Cokely et al., 2012). The tasks have previously been translated to Norwegian and used on Norwegian samples (see for example Riege & Teigen, 2013)

Design

The framing tasks were counterbalanced in two ways: Half of the participants were given three gain framed problems first, followed by three loss framed problems, while the other half were given three loss framed problem first and the gain framed problems last. This was done as few studies have used within-subjects design for framing tasks (Kühberger, 1998), possibly in order to avoid carry-over effects (see for example Levin, Gaeth, Schreiber, & Lauriola, 2002). The order of the tasks was also counter balanced. Half of the participants got the tasks in one (randomly determined) order, the other half got tasks 4, 5, and 6 first, followed by tasks 1, 2, and 3. The participants were only given either the gain or the loss framed version of each problem. Participants were therefore randomly assigned to one of four groups (see Table 1). The independent variable was the risky choice problem, with gain and loss as the two levels. The dependent variable was the participants' choice of either the risky or certain option to each problem. The participants were asked to fill out the numeracy test and the STEM-B questionnaire after the framing tasks were completed. The order of the questionnaires were randomized across participants.

Table 1

Overview of the Four Groups and the Framing Task Sequences in the Present Study.

	Group	Sequence of Tasks
Gain first, loss last		
Order 1	1	Fish (gain) → Cancer (gain) → Shareholding (gain) → Swine (loss) → Plant (loss) → Tax (loss)
Order 2	2	Swine (gain) → Plant (gain) → Tax (gain) → Fish (loss) → Cancer (loss) → Shareholding (loss)
Loss first, gain last		
Order 1	3	Fish (loss) → Cancer (loss) → Shareholding (loss) → Swine (gain) → Plant (gain) → Tax (gain)
Order 2	4	Swine (loss) → Plant (loss) → Tax (loss) → Fish (gain) →Cancer (gain) → Shareholding (gain)

Procedure and Apparatus

Each participant was randomly assigned to one of the four groups, and tested individually at the Cognitive Laboratory at the University of Oslo, using the same eye-tracking equipment. Each framing task was presented on a Dell LCD monitor, with a screen resolution of 1680x1050. The participants were seated approximately 60 cm from the screen, and asked to keep their eyes on it. Participants were given tasks instruction and were informed regarding the experimental procedure via the experimenter, continued by a standard 5-point calibration procedure. Stimuli were created using PowerPoint® software. At the beginning of each trial a fixation cross appeared on the screen (lasting for 500 ms), followed by a 1000 ms grey base slide. As the pupil diameter is affected by light emitted by the screen (Sirois & Brisson, 2014), the base slides were created as mosaic pictures of each experiment slide, in order to keep luminance levels constant. The problem description appeared on the screen, followed by a separate slide of its respective alternatives. This part of the procedure was self-paced and the participants were able to decide how much time their needed to read the problem description. When they were finished reading and understood the problem, the

participants continued to the alternatives by pressing the "space" tab. When they had made a choice, participants had been told to report whether they preferred alternative A (certain) or B (risky). This was done by telling it (orally) to the experimenter, who took note of it on a schema. Participants then pressed the "space" tab again in order to continue to the next task (see figure 1 for an illustration of the sequence of displays in one trial). This first part of the experiment procedure lasted on average 15 minutes. After the completion of the framing tasks, participants were guided to another room where they were asked to answer the BNT, STEM-B and some demographic questions, such as age, gender and education, on a regular computer. This part of the experiment was conducted using Qualtrics. After filling in the id-number, the experimenter left the room while the participant filled in the questionnaires. After finishing the questionnaires a debrief slide appeared on the screen (see appendix D). The whole experimental procedure lasted approximately 40 minutes.

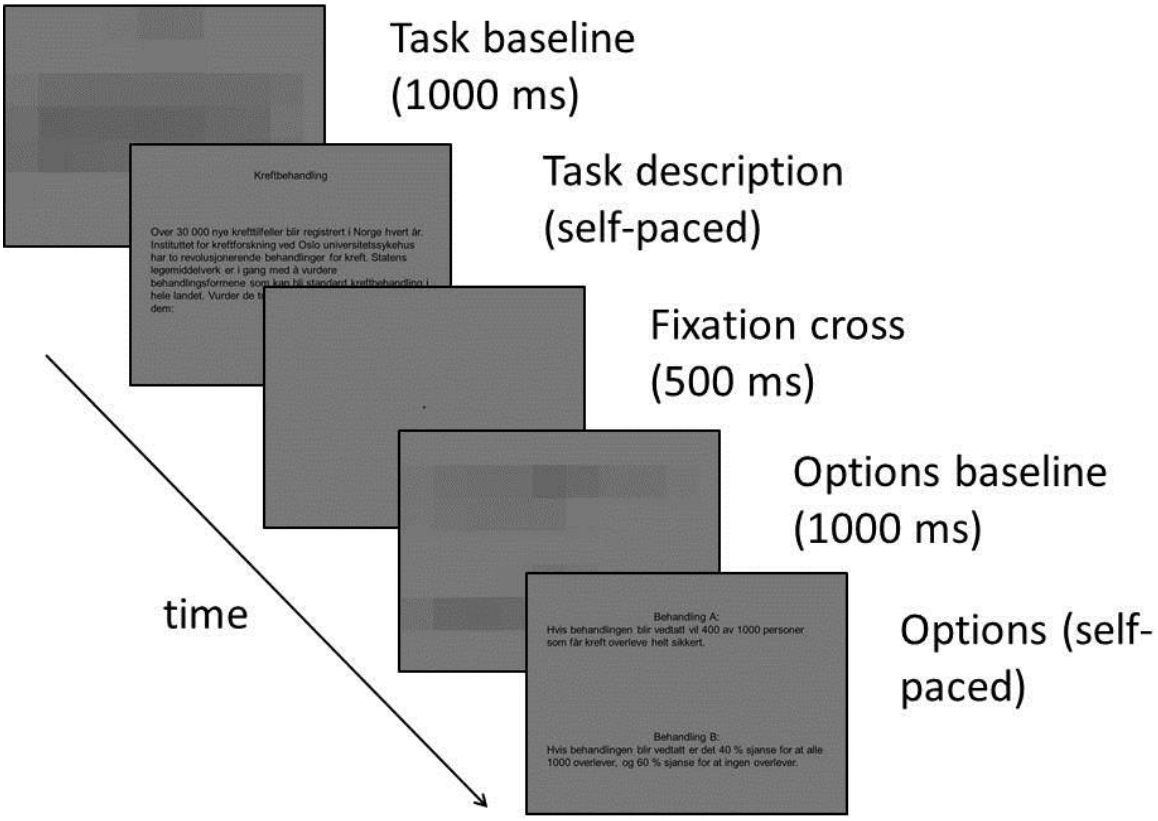

Figure 1. Schematic display of one trial of the framing tasks.

Eye-Tracking Methodology

The eye-tracking data was collected using a non-invasive infrared eye tracker (remote eye-tracking device (RED), SMI-SensoMotoric Intsrument®, Teltow, Germany), at a sampling rate of 240 Hz. The RED can operate at a distance of 0.5-1.5 m, and can detect changes as small as 0.004 mm. Data recording was done using iView X Software (SMI, Teltow, Germany). Two non-overlapping areas of interests (AOIs), one for each of the choice options (certain/risky) were predefined. The number of fixations, revisits (repeated inspection of the same information), fixation durations and pupil diameter (in pixels) were extracted for each participant and for each tasks by the AOIs, using SMI BeGaze^{TM} software. Pupil diameter during the baseline screen (for each tasks) were subtracted from pupil diameter during the subsequent presentation of each choice option to calculate baseline-corrected pupillary changes, expressed as pixels, for each task.

Results

Framing Effects at the Item-Level

Responses at the item level were coded either as 0 (*certain*) or 1 (*risky*). Chi-square tests of independence were performed on all six tasks to examine the relation between Frame (gain/loss) and Choice (certain/risky) at the item-level. The relation between these variables were significant for the fish disease problem, cancer problem, shareholding problem and plant problem (see Table 2).

As discussed previously, framing effects can be evaluated either as strict preference reversals or as preference shifts. Risky choices were therefore added together and averaged in order to compare the percentage of risky choices in the gain and loss frames. Table 2 shows the percentage of risky choices in gain and loss frames for all task items across all participants. A closer examination of the response patterns for the different items showed that framing effects as strict preference reversals were evident in two of the six tasks: The cancer problem and the shareholding problem. When using the more lenient definition of framing effect as preference shift, framing effects were also evident for the fish disease problem, the plant problem, and the swine flu problem, although the effect for the swine flu problem remained nonsignificant. For the tax problem however, there was a trend towards choosing the certain option in both frames, and even more certain options were observed in the loss frames compared to the gain frame.

Table 2

Average Risky Choices Across All Tasks in Gain and Loss Frames.

Task	*N*	Gain	Loss	*df*	χ^2	*p*
Fish Disease Problem	80	17.95 %	41.46 %	1	5.36	.022
Cancer Problem	80	23.08 %	65.85 %	1	14.78	.000
Shareholding Problem	80	25.64 %	53.66 %	1	6.54	.011
Swine flu Problem	80	51.22 %	61.54 %	1	.87	.352
Plant Problem	80	12.20 %	48.72 %	1	12.70	.000
Tax Problem	80	46.34 %	30.77 %	1	2.04	.153
Average	80	29.40 %	50.33 %			

Framing Effects Across all Tasks

In order to examine level of frame consistent choices across all six tasks, risky choices for each participant (N = 80) where added together for the three gain framed tasks (α = .04 for the fish disease problem, cancer problem and the shareholding problem, and α = .24 for the swine flu problem, plant problem and tax problem), and for the three loss framed tasks (α = .11 for the fish disease problem, cancer problem and the shareholding problem, and α = .20 for the swine flu problem, plant problem and tax problem). Consistent with previous findings, participants were overall more likely to choose the risky option when alternatives were presented as losses (M = 1.51, SD = 0.90), compared to when presented as gains (M = 0.89, SD = 0.83). This difference, - 0.63, 95% CI [- 0.84, - 0.41], was significant $t(79)$ = - 5.83, p < .001, and represented a medium effect size, d = 0.72 (see Figure 2). Due to the lack of significant framing effects in two out of the six tasks, we considered to exclude the tasks from the remaining analyses and treat it as a between-subjects design. Preliminary analyses indicated that the results pointed in the right direction, but it would involve a significant loss of power. As a significant framing effect was evident across all tasks, we therefore decided to keep all tasks in the subsequent analyses.

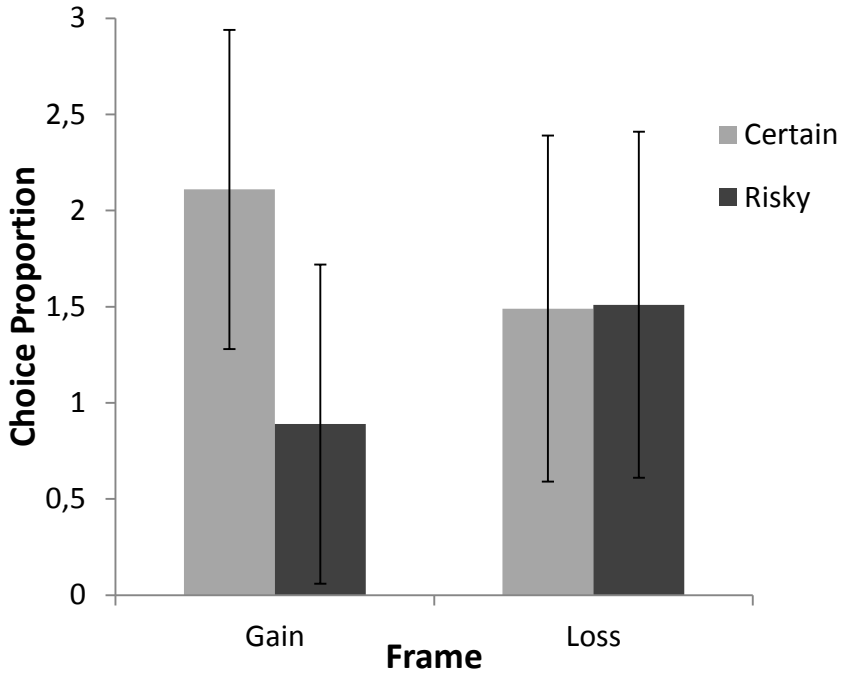

Figure 2. Means of risky and certain choices in both gain and loss frames. Error bars denote one standard deviation around the mean.

A mixed between-within subject analysis of variance was conducted in order to assess the impact of order and condition (gain or loss frame first) on number of risky choices across gain and loss frames, using Bonferroni correction. There was no significant interaction between the order and frame, Wilks' Lambda = .997, $F(1, 76) = 0.24$, $p = .627$, $\eta_p^2 = .003$, or between condition and frame, Wilks' Lambda = .99, $F(1, 76) = 0.61$, $p = .438$, $\eta_p^2 = .008$. The main effect of frame remained significant, Wilks' Lambda = .69, $F(1, 76) = 34.46$, $p < .001$, with all groups showing a significant increase in risky choices in the loss frame compared to the gain frame. The main effect comparing the two types of order was not significant $F(1, 76) = 0.04$, $p = .843$, $\eta_p^2 = .001$, neither was the main effect comparing gain or loss frames first $F(1, 76) = 0.04$, $p = .521$, $\eta_p^2 = .005$ or the interaction between order and condition $F(1, 76) = 3.74$, $p = .057$, $\eta_p^2 = .05$, suggesting there were no difference in risky choices between the four groups.

As some studies (e.g., Fagley et al., 2010; Fagley & Miller, 1990, 1997) have reported gender difference in the susceptibility to framing effects, we also checked for effects of gender on risky choices. A mixed between-within subject analysis of variance was conducted in to assess the impact of gender on number of risky choices across gain and loss frames, using Bonferroni correction. There was no significant frame by gender interaction, Wilks' Lambda = .96, $F(1, 78) = 3.06$, $p = .084$, $\eta_p^2 = .04$, but a substantial main effect of frame, Wilks' Lambda = .74, $F(1, 78) = 26.96$, $p < .001$, $\eta_p^2 = .26$ with both genders being more risk-seeking in the loss frame compared to the gain frame. The main effect comparing males and females was not significant $F(1, 78) = 1.14$, $p = .288$, $\eta_p^2 = .02$ suggesting that there were no difference in risky choices between females and males.

Individual Difference Measures

Emotion management. The scale was scored according to expert weights determined by the proportion of experts who select each option as the best answer (MacCann & Roberts, 2008). Total emotion management score was calculated by averaging responses across all 18 tasks. Participants scored on average 0.59 ($SD = 0.09$) on STEM-B. The mean score closely resembled the results of the original study, where participants average score was 0.59 ($SD = 0.25$) (Allen et al., 2015). Some major issues with the interpretation of the results did however arise. For the present study, Cronbach's alpha was .31, indicating low correlation between the

items in the test. Corrected item-total correlations were therefore examined. All corrected item-total correlations where under .3, indicating poor correlations with the total score for all items. Three items also yielded negative corrected item-total correlations (-.10, -.08 and -.02). Alternative dichotomous scoring of the scale, where the most correct answer was scored as 1 and the rest was scored as 0, did not improve the reliability of the test. Results from the STEM-B were therefore omitted from any further analyses.

Numeracy. The total numeracy score was computed for all participants based on number of correct answers on BNT. This meant that each participant could obtain a total numeracy score between 0 and 4. Participants scored on average 1.63 (*SD* = 1.15) correct out of four total possible. Cronbach's alpha in the present study was .50, which is normally considered as being an indication of poor internal consistency, but is common when a scale consist of few items (for a discussion of the interpretation of Cronbach's alpha see Tavakol & Dennick, 2011). Similarly, it was found a Cronbach's alpha of .59 in the original study by Cokely et al. (2012). To test whether a high numeracy score was associated with less vulnerability to framing effects, the numeracy score was run as a covariate in a repeated measure looking at the effect of frame (gain versus loss) on risky choices, using Bonferroni correction. There was a marginal effect, although not significant, of numeracy $F(1, 78) = 3.47$, $p = .066$, $\eta_p^2 = .04$. The effect of frame remained significant after controlling for numeracy $F(1, 78) = 22.66$, $p < .001$, $\eta_p^2 = .23$. The relationship between aggregated level of frame consistent answers and numeracy was investigated by Pearson product-moment correlation coefficient. The results showed that there was a tendency towards a negative, although not significant, relationship between the two variables, $r(78) = -.19$, $p = .098$ with a higher number associated with lower levels of numeracy.

Eye tracking Measures

Fixations. Number of fixations can be seen as indicators of information integration processes in eye-tracking studies (Horstmann, Ahlgrimm, & Glöckner, 2009). A two way repeated-measures analysis of variance (ANOVA) was conducted to compare the main effects of frame (gain versus loss) and option (certain versus risky) and the interaction between frame and option on the number of fixations, using Bonferroni correction. The means and standard deviation for the number of fixations for both options in gain and loss frames are shown in Table 3. As expected there was significantly more fixations in the loss frame compared to the

gain frame $F(1, 74) = 7.11$, $p = .009$, $\eta_p^2 = .09$. Additionally, there was a significant main effect of options $F(1, 74) = 76.14$, $p < .001$, $\eta_p^2 = .51$. Moreover, there was a significant interaction between frame and option, $F(1, 74) = 9.38$, $p = .003$, $\eta_p^2 = .11$, indicating that the difference in number of fixations was due to more fixations in the risky, but not the certain option, in the loss frame compared to the gain frame. There was no effect of order or condition on the number of fixations.

Revisits. Revisits are repeated inspections to the AOIs that do not follow each other in time. A two way repeated-measures analysis of variance (ANOVA) was conducted to compare the main effects of frame (gain versus loss) and option (certain versus risky) and the interaction between frame and option on the number of revisits. Means and standard deviations for revisits in each option in gain and loss frames are shown in Table 3. There was a significant main effect of frame $F(1, 74) = 7.32$, $p = .008$, $\eta_p^2 = .09$ (Bonferroni corrected), indicating that there were more revisits in the loss frame, regardless of the risky and certain option. There was no main effect of option on the number of revisits, and no interaction between frame and option.

Fixation Durations. Single fixation durations are found to be important indicators of the level of processing (Velichkovsky et al., 2000). A two-way repeated-measures analysis of variance (ANOVA) was conducted to compare main effects of frame (gain versus loss) and option (certain versus risky) and the interaction between frame and option on mean fixation duration, using Bonferroni correction. There was however no significant difference in mean fixation duration between gain and loss frames, $F(1, 74) = 0.70$, $p = .405$, $\eta_p^2 = .01$, or between certain risky options $F(1, 74) = 0.60$, $p = .440$, $\eta_p^2 = .60$. In order to investigate the influence of fixation durations more in detail, single fixations durations were divided into short (under 150 ms), medium (150 - 499 ms) and long (over 499 ms) fixation durations. Long fixations durations are thought to indicate higher levels of processing (Velichkovsky et al., 2000). Only around half of the participants ($n = 39$) displayed fixations durations over 500 ms, and there was very few long fixations both in the loss frame ($M = 5.03$, $SD = 2.92$) and in the gain frame ($M = 5.87$, $SD = 3.57$). There was no difference in long fixation duration between the gain and the loss frame $F(1, 38) = 1.08$, $p = .305$, $\eta_p^2 = .028$.

Table 3.

Means and Standard Deviations for Number of Fixations, Number of Revisits, and Fixation Durations, in Certain and Risky Options in Gain and Loss Frames.

		Gain frame		Loss frame	
	N	*M*	*SD*	*M*	*SD*
Number of Fixations					
Certain option	75	35.07	13.57	36.95	14.41
Risky option	75	48.36	24.62	57.55	27.25
Total	75	83.43	35.62	94.50	37.85
Number of Revisits					
Certain option	75	5.85	3.46	6.51	4.13
Risky option	75	5.26	3.34	6.35	4.29
Total	75	11.11	6.48	12.85	7.90
Fixation Duration					
Certain option	75	184	41.3	181	36.9
Risky option	75	185	38.3	185	36.9

Pupillometry

Pupillary changes has been interpreted as an indicator of emotional and cognitive arousal (Sirois & Brisson, 2014). A two-way repeated-measures analysis of variance (ANOVA) was conducted to compare main effects of frame (gain versus loss) and option (certain versus risky) and the interaction between frame and option on pupil diameter change (in pixels), using Bonferroni correction. Means and standard deviations for pupillary changes in each option in gain and loss frames are shown in table 4. A significant main effect of option $F(1, 74) = 6.33$, $p = .014$ $\eta_p^2 = .08$, was revealed. Greater pupil dilations were found for the risky option, compared to the certain option. Contrary to the expectations, there was no effect of frame $F(1, 74) = 0.10$, $p = .748$, $\eta_p^2 = .001$, and no significant interaction between frame and choice $F(1, 74) = 0.88$, $p = .350$, $\eta_p^2 = .01$, on pupil dilations.

Table 4.

Means and Standard Deviations for Pupillary Responses in Risky and Certain Options in Gain and Loss Frames.

		Gain frame		Loss frame	
	N	*M*	*SD*	*M*	*SD*
Certain option	75	0.057	0.732	- 0.004	0.692
Risky option	75	0.175	0.988	0.164	0.750
Total	75	0.116	0.810	0.080	0.687

Numeracy and Processing

In order to investigate whether numeracy influenced processing in framing tasks, numeracy was run as a covariate in several repeated measures ANOVAs. Numeracy was however not significantly related to differences in fixations $F(1, 73) = .04$, $p = .834$, $\eta_p^2 = .001$, Number of revisits $F(1, 73) = .02$, $p = .892$, $\eta_p^2 = .000$, average fixation durations $F(1, 73) = 1.16$, $p = .286$, $\eta_p^2 = .02$ or pupil dilations $F(1, 73) = .56$, $p = .446$, $\eta_p^2 = .01$ across gain and loss frames, and certain and risky options.

Discussion

The results from the current study show that participants demonstrated significant risky choice framing effects. The main hypothesis regarding a cognitive effort asymmetry between gain and loss frame was partly supported. As expected, the gain and the loss frame were associated with different processing levels, where processing in the loss frame was accompanied by more fixations and revisits to options. There was however no difference in mean fixation duration across the frames, and very few long fixations were made by the participants. There was no difference in pupil dilations during the loss frames compared to during the gain frames. Greater pupil dilations were however associated with the risky options across the frames. Individual differences in numeracy were not associated with differences in framing magnitude, neither were they linked to processing differences of the tasks. Due to the lack of reliability of STEM, it was not possible to investigate whether emotion management abilities were associated with individual differences in the vulnerability to framing effects or with processing differences in framing tasks.

Risky Choice Framing Effects

The present study demonstrated that participants were significantly influenced by the descriptions of options when making a choice. Consistent with the previous literature, framing effects were evident in the present study: Participants were overall more risk-seeking when options were presented as losses compared to when presented as gains.

Four of the six items produced significant framing effects. A closer examination of the response patterns for the individual framing tasks revealed that strict preference reversals were evident in two of the six. In the cancer problem and shareholding problem, more than 50 % of participants chose the risky options when presented as losses, while significantly less than 50 % of the participants were risk-seeking when presented as gains. When looking at the relative magnitude of risky selections between gain and loss frames, framing effects were also evident as preference shift for the fish disease problem, the plant problem and the swine flu problem, were participants made relatively more risky choices in the loss frame compared to the gain frame. The differences of risky choices in the swine flu problem was however not significant. Moreover, choices in the tax problem were reversed. Relatively more participants turned out to be risk-seeking in the gain frame compared to in the loss frame, the opposite of what is predicted during risky choice framing tasks.

How can the difference in the magnitude of framing between the tasks be explained?

Why did the swine flu problem not lead to significant preference shift, and importantly, why did the tax problem lead to a reversed response pattern? The finding that only two out of the six tasks resulted in strict preference reversal is substantiated by Kühbergers' (1998) meta-analysis, which showed that strict preference reversal are less common than preference shifts. It was concluded that the more similar a framing task is to the original ADP, the greater is the likelihood of finding preference reversals.

The tasks included in this study were derived from previous studies, and modified to keep the structure of the certain and the risky options as similar as possible across the tasks. It might be that subtle differences between the tasks resulted in differences in the magnitude of framing. It is surprising that the swine flu problem not resulted in significant framing effects as the payoffs and probabilities of the options are exactly the same as in the ADP. The same problem has previously been found to produce significant framing effects among Norwegian participants (Haraldsen Nordbye et al., 2016). One explanation might be that the certain options included the name of the subtypes of swine flu, H1N1 and H1N2. These names might have increased the complexity or the novelty of the certain option compared to the other tasks, which potentially influenced some of the participants' choice in this task.

It has been suggested that framing effect may vary across different task domains. It has previously been found that people tend to be more risk-seeking when faced with life-death problems, compared to problems involving money (Fagley & Miller, 1997; Kühberger, Schulte-Mecklenbeck, & Perner, 1999; Wang, 1996). This can however not explain the difference in magnitude of framing effects between the individual tasks in the current study. Although participants in fact made more risky choices in response to both frames when responding to swine flu problem, which is in the life-death domain, the other life-death cancer problem produced large framing effects, where participants were significantly risk-averse in the gain frame.

It is of concern why the tax problem led to a reversed response pattern. Overall, participants made less risk-taking choices across both frames, although risk-taking was higher in the gain frame. It has been found that preferences across tasks depends upon size and type of payoffs, where larger payoffs tend to produce risk aversion (Kühberger et al., 1999). Another study has found that gains loom larger than losses with smaller amount of money, leading to a reversed framing effect (Harinck, Van Dijk, Van Beest, & Mersmann, 2007). Risk taking in gain frames is however rare (Levin et al., 1998). It is likely that several task characteristics of the tax problem influenced the choices. Overall, the differences in the magnitude of framing across the tasks demonstrate that several factors influence the framing

effect. All tasks were however included for the subsequent analyses. This was done as the results demonstrated that there was a significant framing effect when responses across all six tasks and all participants were aggregated.

Individual Differences and the Framing Effect

Although significant framing effect was present across all tasks and participants, there were still several risk-seeking choices in the gain frame (29.20 %) and risk-averse choices in the loss frame (49.67%), indicating that participants occasionally chose against the frame. As it has been assumed that some individuals make choices against the frame more often than others (De Martino et al., 2006; Kahneman & Frederick, 2007), one of the goals of the present study was to investigate whether emotion management ability of EI and numeracy predicted individual differences in the vulnerability to framing effects.

There was no significant effect of numeracy on framing, although there was a small trend towards the more numerate to be less affected by the frames (p = .066). Similarly, Peters and Levin (2008) found that highly numerate individuals tended to be less vulnerable to framing effects, although not significant ($p.$ = .07). This point towards that individuals high and low on numeracy exhibit the same level of framing effects. It is however possible that the mechanisms involved in the effect might differ among these individuals, as also suggested by Peters and Levin (2008).

The STEM-B did not reach a proper level of reliability in this study, and was therefore excluded from further analyses. The STEM is related to the MSCEIT management score (r = .30) (Austin, 2010). The emotion management branch of the MSCEIT has however previously been found difficult to measure. Although MSCEIT has been extensively used and developed over a long period of time, it has been indicated that items included in the managing emotion subscale of MSCEIT inherent a large amount of variance due to inconsistencies across items. The management ability of EI might therefore be more complex than supposed or suffer from poor operationalization (Føllesdal & Hagtvet, 2009). The same might be true for the STEM-B, where items in the current study were weakly or even negatively correlated with each other, indicating that the items do not measure the same construct. The field of emotional intelligence is still relatively new, and research consist of inconsistencies in regards to how the EI concept should be defined (for a review see Cherniss, 2010). One advantage of the STEM and STEM-B, compared to the MSCEIT which is a commercial test, is the availability of the test and its scoring system. This opens the opportunity for other researchers to improve and validate the constructs. Future research

investigating the EI construct should therefore lead to more refined measurement methods. Fiori (2009) has for instance suggested that EI measurement would be improved by inclusion of measurements of how individuals automatically process emotional stimuli as individual differences in EI are assumed related to differences in processing.

Affective Responses in Gain and Loss Frames

Based on the assumption that losses produce a greater level of emotional arousal (Hochman & Yechiam, 2011; Yechiam & Telpaz, 2011), it was assumed that the pupil would dilate more in response to losses compared to gains during framing tasks. This effect was not found. A possible explanation might be that losses in framing tasks, are not experienced as arousing as actual losses, such as losses involving real money (e.g., Yechiam & Telpaz, 2011). Moreover, previous studies have shown that the pupil dilates in response to both positive and negative valenced stimuli (e.g., Bradley et al., 2008). One could therefore speculate whether the pupil in fact dilated due to emotional arousal in both frames. It was however not included any neutral decision tasks in the study, which would have enabled a comparison of emotional arousal in response to frames and neutral tasks.

Furthermore, it could be that frames not automatically induce affective responses. An alternative interpretation of the framing effect is that it is caused by the ambiguous nature of framing tasks, rather than the affect heuristic. Igou and Bless (2007) did for instance demonstrate that the framing effect was reduced when labeling the framing task *statistics*, in contrast to *medicine*. Framing tasks can be ambiguous in that they indirectly provide additional information. It has been suggested that the logical equivalent statements of a gain frame and a loss frame, not necessarily are equivalent in terms of the information conveyed to the listener in real-life. Frames are assumed to "leak" additional information about the relative status of a situation, where the listener infers an implicit recommendation provided by the speaker. A speaker is usually choosing a frame that has increased relative to its reference point. A half full glass is usually being filled up, while a half empty glass is usually currently consumed. Similarly, describing a treatment for an unusual disease in terms of its mortality is interpreted as no one had ever died from the disease before (McKenzie & Nelson, 2003; Sher & McKenzie, 2006). This is substantiated by the fact that brain activity usually associated with framing tasks not purely reflects emotional processes but is also linked with the processing of ambiguity. The prominent view is that amygdala is concerned with the processing of emotions, particularly fear. It has however been demonstrated that amygdala plays a role in modulating vigilance to ambiguous stimuli, which subsequently lead to

processing of additional stimuli in order to determine its biological relevance (Whalen, 1998). Although ambiguity also might be a possible mechanism driving framing effects, it does not exclude the possibility that affective responses are involved in the framing effect. Ambiguous tasks might lead to subsequent influence of irrelevant affective cues, especially if the individual constructively process the different options (Igou, 2011; Igou & Bless, 2007).

Based on the present study, it is however not possible to conclude whether affective responses where involved or not, and when they influences participants. Nevertheless it was found an effect of options, were the pupil tended to dilate more in response to the risky compared to the certain option, independent of the frame. The risky option includes probabilities, and is assumed to evoke more cognitive effort (Gonzalez et al., 2005). It is therefore speculated whether pupil dilations in the current study in fact reflected cognitive effort involved in calculations associated with risky options.

Deliberative Processing in Gain and Loss Frames

One of the main goals of the current study was to investigate whether the gain and loss frames produced differences in cognitive effort. Based on the cognitive-affective tradeoff theory (Gonzalez et al., 2005), it was hypothesized that participants would expend more cognitive effort in the loss frame compared to the gain frame. In line with the predictions, the loss frame was associated with a significant greater level of fixations and repeated inspections of the different options in the loss frame. Contrary to Kuo et al. (2009), there was no difference in mean fixation durations between the gain and loss frames. This is however not surprising, as fixation durations tend to be log-normal rather than normal distributed, meaning that fixations are skewed to the left with the mode lying below the mean. This means that different distributions of fixation durations can result in the same average (Velichkovsky et al., 2000). Fixation durations were however also categorized into small, medium and long fixation durations, as long fixation durations are assumed to indicate more deliberative processing (Velichkovsky et al., 2000). Very few long fixations over 500 ms were evident, and opposed to the predictions, there was no significant difference in long fixation duration over 500 ms between the gain and loss frame. Neither was there any difference in pupil dilations between the frames. It could therefore be questioned whether the loss frame in fact produced more cognitive effort than the gain frame.

The findings are however compatible with an interventionist approach of dual processing, where it is assumed that automatic processing is the default response, unless intervened by system 2. According to this model, processing should be similar across intuitive

and deliberative processing, but accompanied by additional operations during deliberative processing (Evans & Stanovich, 2013; Kahneman & Frederick, 2002, 2007). Consistent with this, Horstmann et al. (2009) found that processing between intuitive and deliberative response modes were very similar in regards to fixation durations. The deliberative mode was however accompanied by more fixations as a result of a greater amount of inspected information and more repeated inspections.

The findings of the current study can be explained through a dual-process framework, as it is reasonable to assume that the frames were associated with different levels of processing, despite the lack of long fixation durations and greater pupil dilations in the loss frame. The gain frame seem to be associated with more automatic processing, accompanied by additional operations in the loss frame, reflected in more fixations and repeated inspections of the options. Based on Gonzalez et al. (2005), it is possible that the additional processing were induced through the emotional displeasure associated with the certain option in the loss frame, which might have led the individual to engage in the more effortful calculations associated with the risky option. This is in line with other research assuming that the affect heuristic is the driving force of framing effects (e.g., De Martino et al., 2006). It should however be noted that there was no direct evidence of emotional arousal in our study, and it is therefore only speculated around whether the differences in processing was a result of different emotional reactions accompanied by the frames.

Moreover, the findings demonstrate that the framing effect does not seem to be reduced merely by deliberative thinking, but deliberative processing is partly involved in how the framing effect arises. Based on Igou and colleagues (Igou, 2011; Igou & Bless, 2007) it could be speculated that the affect heuristic will have even greater influence through the deliberative system, leading to enhanced framing effects when individuals think constructively. This means that individuals are even more influenced by the context, such as affective cues associated with the frames. This could also explain why more and less numerate individuals did not differ in the susceptibility to framing effects. Numerate individuals are assumed to be more able to integrate several pieces of information than their less numerate counterparts (Jasper et al., 2016; Peters & Levin, 2008) and are therefore assumed to process framing tasks more deliberatively. It is possible that less numerate individuals are influenced by the affect heuristic through the automatic system 1 pathway, while more numerate will be influenced by the affect heuristic through more deliberative system 2 thinking. We did however not find an effect of numeracy on the processing measures, and it might be that numeracy does not influence processing as much as assumed.

We did however only include numeracy score as a covariate, and future studies should therefore investigate numeracy and processing differences in greater detail.

Nevertheless, the findings cannot rule out that deliberative thinking can reduce the vulnerability to framing effects. Several studies have found that instruction to deliberate leads to greater resistance to framing effects (e.g., LeBoeuf & Shafir, 2003; Sieck & Yates, 1997). In these studies, the corrective thoughts are probably sufficiently accessible, through detailed instructions from the experimenter or by priming the participants with mathematical tasks, leading to corrective operations. When subjects merely are exposed to framing tasks without further instructions, as in this study, it is assumed that affective cues will exert greater influence on choice regardless of whether it is processed automatically or deliberatively. One might speculate whether more numerate individuals primed with the numeracy tasks before answering the framing tasks would have made more consistent responses. Riege and Teigen (2013) did for instance show that highly numerate individuals tended to make normative additive responses in probability estimates, after being primed with numeracy tasks.

Limitations and Future Directions

Framing effects are assumed to involve both emotional and cognitive processes. Still, it is difficult to disentangle the effect of cognitive effort and emotional responses especially on pupillary responses in standard framing tasks. The loss frame is assumed to evoke both cognitive effort associated with the calculation of the risky option, and emotional responses (Gonzalez et al., 2005). The eye can indicate processing, but not tell us exactly what is being processed (for a review see Sirois & Brisson, 2014). Future studies should therefore investigate the independent influence of cognitive effort and emotional responses during framing tasks in greater detail. Based on the current study, it is only possible to speculate whether the frames in fact induced affective responses. A suggestion for future studies would be to include self-reports of emotions after each framing task, which would give an index of participants overall affective reaction to each gain and loss framed task. Affective reactions are however not always a conscious experience (Zajonc, 1980). It is therefore proposed to include additional measures of arousal, such as skin conductance response (see for example Bradley et al., 2008), heart rate (see for example Hochman & Yechiam, 2011), in addition to pupil dilations in order to get a more precise measure of physiological emotional responses during framing tasks.

Results from the present study showed that the loss frame was associated with more fixations and repeated inspection of options. The asymmetry was however not directly

investigated in relation to the magnitude of the framing effect in the individual tasks. Kuo et al. (2009) did for instance demonstrate that the extent of asymmetry predicted whether the framing effect was present or not in individual tasks. It is therefore speculated whether the two individual framing tasks that did not produce significant framing effects in the current study, were processed differently than the other tasks.

It should be noted that number of fixations is a direct result of time spend on the task. As we did not control for the amount of time spend on the tasks, fixations per se might not directly reflect the level of processing. Time spend on a tasks is however linked to deliberation (Igou & Bless, 2007), and it is therefore assumed to be a reliable measure of deliberation in the current study. Future studies should however investigate deliberation under framing tasks more in detail, as the current study did not find any difference between long fixation duration between the frames. A suggestion is to look closer at circumstances that might lead to corrective operation and reduction of the framing effects, and investigate how this affects eye-tracking measures.

The findings have been discussed through the dual-process framework. The dual-processing framework has however been criticized for being an oversimplified account of human thinking (Evans, 2008). Especially, there is no clear distinction between emotional and cognitive areas in the brain (Phelps et al., 2014). The dual-process framework does however serve as a useful way to categorize human thinking in an understandable and intuitive way, and functions as a comprehensible way to organize the findings regarding how framing effects arises.

Conclusion

Much research has been conducted in order to examine what is being chosen, rather than how something is chosen during framing tasks. The current study therefore aimed to investigate the emotional and cognitive mechanisms in risky choice framing effects. In line with the previous literature, participants were demonstrating significant framing effects, being risk-averse during gain frames and risk-seeking during loss frames. Processing during loss frames was accompanied by additional fixations and repeated inspections of options. It is therefore assumed that the processing of framing tasks involve both automatic and deliberative processing, in line with a dual-process framework. Based on the results it is however only possible to speculate whether the framing effect was induced by emotional responses or by other factors such as ambiguity.

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Appendix A

Risky Choice Framing tasks

Norwegian	English
Velkommen! Denne studien inneholder noen hypotetiske situasjoner der du vil bli bedt om å velge mellom to alternativer. Du vil først bli presentert situasjonen, deretter klikker du deg videre til alternativene. Hver beskrivelse har to svaralternativer, A og B. Når du har bestemt deg for et av alternativene sier du om du har valgt A eller B	
The Fish Kidney Disease (Kühberger & Tanner, 2010)	
Det har blitt oppdaget en fiskesykdom i en innsjø i nærheten. Dette er et populært fiskested, og 12 fiskearter (blant dem den mest populære middagsfisken) har sykdommen som fører til at fisken dør. Ekspertene antar at menneskelige aktiviteter og forurensing av vann fremmer spredningen av sykdommen. Det finnes to ulike renseanlegg for å bedre vannkvaliteten, men man kan bare bruke en av dem. Forestill deg at du må bestemme hvilket renseanlegg som skal implementeres. Vurder de to renseanleggene og velg en av dem:	A committee found a fish disease in a nearby lake. About 12 fish species (among them the most popular dining fish) have the Proliferative Kidney Disease (PKD). This is a chronically developing infectious disease which can have deadly consequences for the fish. Young fish are especially susceptible, while others seem to be immune against an infection. Experts suggest that PKD is one cause of declining fish catches. The researchers assume human activities and water pollution foster the spread of the disease. They are considering releasing more fish into the lake to control the epidemic. Imagine that you are a government official of the adjacent village. Which of the following options would you favor? Assume that the estimates are as follows:

Gain	
Renseanlegg A: Med dette renseanlegget vil 4 fiskearter overleve helt sikkert. Renseanlegg B: Med dette renseanlegget er det 1/3 sjanse for at alle de 12 fiskeartene overlever, og 2/3 sjanse for at ingen av fiskeartene overlever.	Option A: If the release of fish is implemented, 4 fish species will survive. Option B: If the release of fish is implemented, there is 1/3 probability that all of the 12 fish species will survive, and 2/3 probability that none of them will survive.
Loss	
Renseanlegg A: Med dette renseanlegget vil 8 fiskearter dø helt sikkert. Renseanlegg B: Med dette renseanlegget er det 1/3 sjanse for at ingen av fiskeartene vil dø, og 2/3 sjanse for at alle de 12 fiskeartene vil dø.	Option A: If the release of fish is implemented, 8 fish species will die. Option B: If the release of fish is implemented, there is 2/3 probability that none of the 12 fish species will die, and 1/3 probability that all of the 12 fish species will die.
The Cancer Problem (Fagley & Miller, 1987)	
Over 30 000 nye krefttilfeller blir registrert i Norge hvert år. Instituttet for kreftforskning ved Oslo universitetssykehus har to revolusjonerende behandlinger for kreft. Statens legemiddelverk er i gang med å vurdere behandlingsformene som kan bli standard kreftbehandling i hele landet. Vurder de to behandlingene og velg en av dem:	The National Cancer Institute has two possible treatments for cancer, which could become standard treatments across the country.
Gain	
Behandling A: Hvis behandlingen blir vedtatt vil 400 av 1000 personer som får kreft overleve helt sikkert. Behandling B: Hvis behandlingen blir vedtatt er det 40 % sjanse for at alle 1000 overlever, og 60 % sjanse for at ingen overlever.	If treatment 1 is adopted, of every 1000 people who get cancer 400 will be saved. If treatment 2 is adopted, there is a two-fifths chance that 1000 of every 1000 will be saved and a three-fifths chance that no people of every 1000 will be saved.

Loss	
Behandling A: Hvis behandlingen blir vedtatt vil 600 av 1000 personer som får kreft dø helt sikkert. Behandling B: Hvis behandlingen blir vedtatt vil det være 40 % sjanse for at ingen dør, og 60 % sjanse for at alle av de 1000 vil dø.	If treatment 1 is adopted, of every 1000 people who get cancer 600 will die. If treatment 2 is adopted, there is a two-fifths chance that no people of every 1000 will die and a three-fifths chance that 1000 of every 1000 will die.
The Shareholding Problem (Teigen & Nikolaisen, 2009)	
Forestill deg at du har investert NOK 600,000 i et firma som nå er truet av konkurs. Dine investeringer inkluderer en stor aksjepost på NOK 400,000 og en mindre aksjepost på NOK 200,000. En finansrådgiver konkluderer med at det er to mulige strategier for å håndtere situasjonen. Vurder de to strategiene og velg en av dem:	Imagine that you have invested NOK 600,000 ($100,000) in a company that is now threatened by bankruptcy. Your investments include a large shareholding of NOK 400,000 and a smaller shareholding of NOK 200,000. A financial advisor concludes that there are two possible ways of handling the situation.
Gain	
Strategi A: Denne strategien innebærer å redde den mindre aksjeposten (NOK 200,000) helt sikkert. Strategi B: Denne strategien gir 1/3 sjanse for å redde begge aksjepostene (NOK 600,000), og 2/3 sannsynlighet for å ikke redde noe.	Strategy A: This strategy entails saving the smaller shareholding (save NOK 200,000 for sure). Strategy B: This strategy gives 1/3 chance of saving both shareholdings (save NOK 600,000) and 2/3 chance of not saving anything.
Loss	
Strategi A: Denne strategien innebærer å tape den store aksjeposten(NOK 400,000) helt sikkert. Strategi B: Denne strategien gir en 1/3 sjanse for å ikke tape noe, og en 2/3 sjanse for å tape begge aksjepostene (NOK 600,000).	Strategy A: This strategy entails losing the larger shareholding (lose NOK 400,000 for sure). (56%) Strategy B: This strategy gives 1/3 chance of no loss, and 2/3 chance of losing both shareholdings (lose NOK 600,000).

Swine Flu Vaccine (Haraldsen Nordbye et al., 2016)	
Forestill deg at Norge forbereder seg på et nytt utbrudd av svineinfluensa. Denne gangen eksisterer to typer av viruset: H1N1 og H1N2. Av disse er H1N2 farligere og antas å ta livet av 400 mennesker, mens H1N1 antas å ta livet av 200 mennesker. Helsemyndighetene har et valg mellom to vaksiner. Vurder de to vaksinene og velg en av dem:	Imagine that two equally large countries are preparing for a new outburst of swine flu. This time two types of the virus exist: H1N1 and H1N2. Of these, H1N2 is more dangerous and is expected to kill 400 people, while H1N1 is expected to kill 200 people. The health authorities have a choice between to vaccines.
Gain	
Vaksine A: Beskytter mot H1N1, men ikke H1N2. Med dette vaksinasjonsprogrammet vil 200 mennesker bli reddet helt sikkert. Vaksine B: Kan beskytte mot begge virusene, og har 1/3 sjanse for å redde alle 600, og 2/3 sjanse for at for at ingen vil bli reddet.	Vaccine A has an effect on H1N1, but not on H1N2. With this vaccination program 200 people will be saved. Vaccine B has a 1/3 probability to have an effect on both viruses. With this vaccination program it is therefore a 1/3 chance of saving 600 people, and a 2/3 chance that no one will be saved.
Loss	
Vaksine A: Beskytter mot H1N1, men ikke H1N2. Med dette vaksinasjonsprogrammet vil 400 mennesker dø helt sikkert. Vaksine B: Kan beskytte mot begge virusene, og har en 1/3 sjanse for at ingen vil dø, og en 2/3 sjanse for at alle 600 vil dø.	Vaccine A has an effect on H1N1, but not on H1N2. With this vaccination program 400 people will die. Vaccine B has a 1/3 probability to have an effect on both viruses. With this vaccination program it is therefore a 1/3 chance that no one will die, and a 2/3 chance that 600 will die.

The Plant Problem (Bazerman, 1984)	
En stor bilprodusent har nylig blitt rammet av en rekke økonomiske vanskeligheter og det ser ut til at tre fabrikker vil bli nedlagt og 6000 ansatte vil miste jobben som følge av nedleggelsen. Produksjonssjefen har undersøkt alternative løsninger for å unngå denne krisen og har utformet to planer. Vurder de to planene og velg en av dem:	A large car manufacturers has recently been hit with a number of economic difficulties and it appears as if three plants need to be closed and 6000 employees laid off. The vice-president of production has been exploring alternative ways to avoid this crisis and has developed two plans:
Gain	
Plan A: Denne planen vil redde 1 av de 3 fabrikkene og 2000 jobber helt sikkert. Plan B: Denne planen har en 1/3 sjanse for å redde alle 3 fabrikkene og alle 6000 jobbene, og 2/3 sjanse for å ikke redde noen av fabrikkene eller jobbene.	Plan A: This plan will save I of the 3 plants and 2000 jobs. Plan B: This plan has a 1/3 probability of saving all 3 plants and all 6000 jobs, but has a 2/3 probability of saving no plants and no jobs.
Loss	
Plan A: Denne planen vil resultere i tap av 2 av de 3 fabrikkene og 4000 jobber helt sikkert. Plan B: Denne planen har en har 1/3 sjanse for å ikke tape noen av fabrikkene eller jobbene, og 2/3 sjanse for å resultere i tapet av alle 3 fabrikkene og alle 6000 jobbene.	Plan C: This plan will result in the loss of 2 of the 3 plants and 4000 jobs. Plan D: This plan has a 2/3 probability of resulting in the loss of all 3 plants and all 6000 jobs, but has a 1/3 probability of losing no plants and no jobs.
The Tax Problem (Levin et al., 2014)	
Forestill deg at endringer i skattelovgivningen gjør det mulig å få tilbake inntil 10 200 kroner på skatten. Din regnskapsfører har undersøkt to muligheter for å dra nytte av denne situasjonen. Vurder de to strategiene og velg en av dem:	Because of changes in tax laws, you may get back as much as $1,200 in income tax. Your accountant has been exploring two ways to take advantage of this situation:

Gain	
Strategi A: Hvis du velger denne strategien, vil du få tilbake 3400 kroner (av 10 200 mulige) helt sikkert. Strategi B: Hvis du velger denne strategien, har du en 1/3 sjanse for å få tilbake alle de 10 200 kronene, og en 2/3 sjanse for å ikke få tilbake noe penger.	If Plan A is adopted, you will get back $400 of the possible $1,200. If Plan B is adopted, you have a 33% chance of getting back all of the $1,200, and a 67% chance of getting back no money.
Loss	
Strategi A: Hvis du velger denne strategien, vil du miste 6800 kroner (av 10 200 mulige) helt sikkert. Strategi B: Hvis du velger denne strategien, har du en 1/3 sjanse for å ikke miste noe penger, og en 2/3 sjanse for å miste alle av de 10 200 kronene.	

Appendix B

Brief version of the Situational Test of Emotion Management (STEM-B)

Norwegian	English
Nå kommer noen spørsmål som handler om forståelse av emosjoner. I dette spørreskjemaet vil du bli presentert for kortfattede emosjonelle situasjoner og spurt om å velge den mest hensiktsmessige handlingen for å håndtere både emosjonene personen føler og problemene de møter i situasjonen. Selv om flere av handlingene kan være akseptable, blir du bedt om å velge hva du synes er den mest virkningsfulle responsen for den gitte personen i den gitte situasjonen. Husk at du ikke nødvendigvis velger hva du ville ha gjort, eller det hyggeligste å gjøre, men hva som vil være det beste i den gitte situasjonen. Pass på at du besvarer alle oppgavene.	In this test, you will be presented with a few brief details about an emotional situation, and asked to choose from four responses the most effective course of action to manage both the emotions the person is feeling and the problems they face in that situation. Although more than one course of action might be acceptable, you are asked to choose what you think the most effective response for that person in that situation would be. Remember, you are not necessarily choosing what you would do, or the nicest thing to do, but choosing the most effective response for that situation.

1. Silje og Marthe har delt kontor i årevis, men Silje får en ny jobb og Marthe mister kontakten med henne. Hvilken handling vil være den beste for Marthe?
a) Bare akseptere at Silje er borte og at vennskapet er over.
b) Ringe Silje og be henne med på lunsj eller kaffe for å ta opp kontakten.
c) Kontakte Silje for å foreslå å ta opp kontakten, men også bli venner med erstatteren hennes.
d) Bruke tid på å bli kjent med andre personer på kontoret og innlede nye vennskap.

1. Wai-Hin and Connie have shared an office for years but Wai-Hin gets a new job and Connie loses contact with her. *What action would be the most effective for Connie?*
a) Just accept that she is gone and the friendship is over.
b) Ring Wai-Hin and ask her out for lunch or coffee to catch up.
c) Contact Wai-Hin and arrange to catch up but also make friends with her replacement.
d) Spend time getting to know the other people in the office, and strike up new friendships.

2. Jan er bare få år fra å pensjoneres når han finner ut at stillingen hans skal legges ned. Selv om han fortsatt vil ha en jobb, vil han få en mindre prestisjefylt rolle. Hvilken handling vil være den beste for Jan?
a) Overveie mulighetene sine nøye og diskutere det med sin familie.
b) Snakke med sjefen eller ledelsen sin om det.
c) Akseptere situasjonen, men fortsatt føle bitterhet over det.
d) Slutte i jobben.

2. Manual is only a few years from retirement when he finds out his position will no longer exist, although he will still have a job with a less prestigious role. What action would be the most effective for Manual?
a) Carefully consider his options and discuss it with his family.
(b) Talk to his boss or the management about it.
(c) Accept the situation, but still feel bitter about it.
(d) Walk out of that job.

3. Stian begynner i en ny jobb hvor han ikke kjenner noen, og det viser seg at ingen er spesielt hyggelige. Hvilken handling vil være den beste for Stian?
a) Ha det gøy med vennene sine utenfor arbeidstiden.
b) Konsentrere seg om å gjøre det bra i den nye jobben.
c) Gjøre en innsats for å snakke med folk og være vennlig selv.
d) Forlate jobben og finne en med et bedre miljø.

3. Surbhi starts a new job where he doesn't know anyone and finds that no one is particularly friendly. What action would be the most effective for Surbhi?
a) Have fun with his friends outside of work hours.
b) Concentrate on doing his work well at the new job.
c) Make an effort to talk to people and be friendly himself.
d) Leave the job and find one with a better environment.

4. Kristian flytter fra byen der han har venner og familie. Han oppdager at vennene hans gjør mindre innsats for å holde kontakten enn det han hadde trodd. Hvilken handling vil være den beste for Kristian?
a) Prøve å tilpasse seg livet i den nye byen ved å bli med i klubber og aktiviteter der.
b) Han burde gjøre en innsats for å kontakte dem, men også prøve å møte folk i den nye byen sin.
c) Gi slipp på de gamle vennene sine som har vist seg å være upålitelige.
d) Fortelle vennene sine at han er skuffet over at de ikke har kontaktet ham.

4. Andre moves away from the city his friends and family are in. He finds his friends make less effort to keep in contact than he thought they would. What action would be the most effective for Andre?
a) Try to adjust to life in the new city by joining clubs and activities there.
b) He should make the effort to contact them, but also try to meet people in his new city.
c) Let go of his old friends, who have shown themselves to be unreliable.
d) Tell his friends he is disappointed in them for not contacting him.

5. Joakim har vært utenlands i en lang periode og vender tilbake for å besøke familien sin. Mye har endret seg slik at Joakim føler seg utenfor. Hvilken handling vil være den beste for Joakim?
a) Ingenting - det vil ordne seg av seg selv snart nok.
b) Fortelle familien at han føler seg utenfor.
c) Bruke tid på å lytte og bli involvert igjen.
d) Reflektere omkring det at relasjoner kan forandres med tiden.

5. Clayton has been overseas for a long time and returns to visit his family. So much has changed that Clayton feels left out. What action would be the most effective for Clayton?
a) Nothing – it will sort itself out soon enough.
b) Tell his family he feels left out.
c) Spend time listening and getting involved again.
d) Reflect that relationships can change with time.

6. Daniel har fått tilbud om en prestisjefylt stilling i et annet land enn der familien hans bor, som han har et nært forhold til. Han og ektefellen hans bestemmer seg for at det er verdt å flytte. Hvilken handling vil være den beste for Daniel?
a) Innse at han ikke burde ha søkt på jobben dersom han ikke hadde lyst til å dra.
b) Sette opp et system for å holde kontakten, som ukentlige telefonsamtaler elle e-post.
c) Tenke på de store mulighetene denne forandringen tilbyr.
d) Ikke ta stillingen.

6. Daniel has been accepted for a prestigious position in a different country from his family, who he is close to. He and his wife decide it is worth relocating. What action would be the most effective for Daniel?
a) Realize he shouldn’t have applied for the job if he didn’t want to leave.
b) Set up a system for staying in touch, like weekly phone calls or emails.
c) Think about the great opportunities this change offers.
d) Don’t take the position.

7. Ida tar telefonen og får høre at noen nære familiemedlemmer er alvorlig syke og innlagt på sykehuset. Hvilken handling vil være den beste for Ida?
a) Tillate seg selv å gråte og uttrykke emosjoner så lenge hun føler for det.
b) Snakke med andre i familien for å roe seg selv ned og for å finne ut hva som skjer, så besøke sykehuset.
c) Det er ingenting hun kan gjøre.
d) Besøke sykehuset og spørre de ansatte om familiemedlemmenes tilstand.

8. Maria har ikke pratet med nevøen sin på flere måneder, til tross for at de sto hverandre veldig nært da han var yngre. Hun ringer ham, men han kan bare prate i fem minutter. Hvilken handling vil være den beste for Maria?
a) Innse at han vokser opp og at han kanskje ikke ønsker å bruke så mye tid på å være med familien lenger.
b) Planlegge å stikke innom og besøke han for en god prat.
c) Forstå at relasjoner forandres, men fortsette å ringe ham fra tid til annen.
d) Være opprørt på grunn av det, men innse at det ikke er noe hun kan gjøre.

7. Mei Ling answers the phone and hears that close relatives are in hospital critically ill. What action would be the most effective for Mei Ling?
a) Let herself cry and express emotion for as long as she feels like.
b) Speak to other family to calm herself and find out what is happening, then visit the hospital.
c) There is nothing she can do.
d) Visit the hospital and ask staff about their condition.

8. Shona has not spoken to her nephew for months, whereas when he was younger they were very close. She rings him but he can only talk for five minutes. What action would be the most effective for Shona?
a) Realize that he is growing up and might not want to spend so much time with his family any more.
b) Make plans to drop by and visit him in person and have a good chat.
c) Understand that relationships change, but keep calling him from time to time.
d) Be upset about it, but realize there is nothing she can do.

9. Mina og svigerinnen hennes kommer vanligvis godt overens, og svigerinnen sitter ofte barnevakt for en liten sum penger. I det siste har hun også vasket bort spindelvev og kommentert rotet, noe Mina finner fornærmende. Hvilken handling vil være den beste for Mina?
a) Fortelle svigerinnen at kommentarene fornærmer henne.
b) Få en ny barnevakt.
c) Være takknemlig for at huset blir vasket gratis.
d) Fortelle henne at hun kun skal være barnevakt, ikke vaske.

9. Mina and her sister-in-law normally get along quite well, and the sister-in-law regularly baby-sits for her for a small fee. Lately she has also been cleaning away cobwebs, commenting on the mess, which Mina finds insulting. What action would be the most effective for Mina?
a) Tell her sister-in-law these comments upset her.
b) Get a new babysitter.
c) Be grateful her house is being cleaned for free.
d) Tell her only to baby-sit, not to clean.

10. Anders er ganske sikker på at firmaet han jobber i er på vei nedover og at jobben hans er i fare. Det er et stort firma og det har ikke blitt sagt noe offisielt. Hvilken handling vil være den beste for Anders?
a) Finne ut hva som skjer og diskutere bekymringene sine med familien.
b) Prøve å holde selskapet oppe ved å jobbe hardere.
c) Begynne å søke på andre jobber.
d) Se på disse hendelsene som en mulighet for en ny start.

10. Juno is fairly sure his company is going down and his job is under threat. It is a large company and nothing official has been said. What action would be the most effective for Juno?
a) Find out what is happening and discuss his concerns with his family.
b) Try to keep the company afloat by working harder.
c) Start applying for other jobs.
d) Think of these events as an opportunity for a new start.

11. Anne flytter fra en liten bedrift til en veldig stor bedrift der det er lite personlig kontakt, noe hun savner. Hvilken handling vil være den beste for Anne?
a) Snakke med kollegaene sine, prøve å etablere sosiale kontakter og få venner.
b) Begynne å se etter en ny jobb så hun kan forlate det miljøet.
c) Bare gi det tid, så vil ting være i orden.
d) Konsentrere seg om vennene sine utenfor jobben og kollegaene fra den tidligere jobben.

11. Mallory moves from a small company to a very large one, where there is little personal contact, which she misses. What action would be the most effective for Mallory?
a) Talk to her workmates, try to create social contacts and make friends.
b) Start looking for a new job so she can leave that environment.
c) Just give it time, and things will be okay.
d) Concentrate on her outside-work friends and colleagues from previous jobs.

12. En krevende klient tar opp mye av Camillas tid og spør så om å få snakke med sjefen om Camillas prestasjon. Selv om Camillas sjef forsikrer henne om at hun presterer bra, føler Camilla seg opprørt. Hvilken handling vil være den beste for Camilla?
a) Snakke med vennene eller kollegaene sine om det.
b) Ignorere hendelsen og gå videre til den neste oppgaven.
c) Roe seg ned ved å puste dypt eller gå en liten tur.
d) Tenke at hun har prestert bra tidligere og at det ikke er hennes skyld at denne klienten var vanskelig.

12. A demanding client takes up a lot of Jill's time and then asks to speak to Jill's boss about her performance. Although Jill's boss assures her that her performance is fine, Jill feels upset. What action would be the most effective for Jill?
a) Talk to her friends or workmates about it.
b) Ignore the incident and move on to her next task.
c) Calm down by taking deep breaths or going for a short walk.
d) Think that she has been successful in the past and this client being difficult is not her fault.

13. Andreas og Espen går vanligvis på kafe etter arbeidsuken og prater om hva som skjer i bedriften. Etter at Andreas' jobb har blitt flyttet til en annen seksjon i bedriften, slutter Andreas å komme på kafeen. Espen savner disse fredagssamtalene. Hvilken handling vil være den beste for Espen?
a) Gå på kafeen eller sosialisere med de andre kollegaene.
b) Ikke bekymre seg for det, ignorere forandringene og la Andreas være.
c) Aldri snakke med Andreas igjen.
d) Invitere Andreas igjen, kanskje planlegge et annet tidspunkt.

13. Blair and Flynn usually go to a cafe after the working week and chat about what's going on in the company. After Blair's job is moved to a different section in the company, he stops coming to the cafe. Flynn misses these Friday talks. What action would be the most effective for Flynn?
a) Go to the cafe or socialize with other workers.
b) Don't worry about it, ignore the changes and let Blair be.
c) Not talk to Blair again.
d) Invite Blair again, maybe rescheduling for another time.

14. Mariannes venn Ingrid flytter utenlands for å bo med sin partner. Marianne og Ingrid har vært gode venner i mange år og det er usannsynlig at Ingrid kommer tilbake. Hvilken handling vil være den beste for Marianne?
a) Glemme Ingrid.
b) Bruke tid med andre venner for å prøve å holde seg selv opptatt.
c) Tenke at Ingrid og partneren hennes vil komme tilbake snart.
d) Passe på å holde kontakten gjennom e-post, telefon eller gjennom å skrive brev.

14. Michelle's friend Dara is moving overseas to live with her partner. They have been good friends for many years and Dara is unlikely to come back. What action would be the most effective for Michelle?
a) Forget about Dara.
b) Spend time with other friends, keeping herself busy.
c) Think that Dara and her partner will return soon.
d) Make sure she keeps in contact through email, phone or letter writing.

15. Hannas tilgang til nødvendige ressurser har blitt forsinket og arbeidet hennes ligger langt bak skjema. Fremgangsrapporten hennes nevner ikke manglende ressurser. Hvilken handling vil være den beste for Hanna?
a) Forklare sjefen eller ledelsen om de manglende ressursene.
b) Lære seg at hun burde planlegge på forhånd neste gang.
c) Dokumentere de manglende ressursene i fremgangsrapporten.
d) Ikke bekymre seg for det.

15. Hannah's access to essential resources has been delayed and her work is way behind schedule. Her progress report makes no mention of the lack of resources. What action would be the most effective for Hannah?
a) Explain the lack of resources to her boss or to management.
b) Learn that she should plan ahead for next time.
c) Document the lack of resources in her progress report.
d) Don't worry about it.

16. Kristines venn påpeker at barna hennes utvikler seg mye raskere enn Kristines barn. Kristine ser at dette er sant. Hvilken handling vil være den beste for Kristine?
a) Prate med en annen venn om situasjonen.
b) Sint konfrontere vennen sin om å komme med slike utsagn.
c) Innse at barn utvikles i ulikt tempo.
d) Snakke med legen om hva som er normalt tempo innen utvikling.

16. Reece's friend points out that her young children seem to be developing more quickly than Reece's. Reece sees that this is true. What action would be the most effective for Reece?
a) Talk the issue over with another friend.
b) Angrily confront her friend about making such statements.
c) Realize that children develop at different rates.
d) Talk to a doctor about what the normal rates of development are.

17. Morten har hatt en ny deltidsjobb ved siden av studiene. Uten å spørre ham, blir arbeidsskiftene hans for uken forandret i siste sekund. Hvilken handling vil være den beste for Morten?
a) Nekte å jobbe de nye skiftene.
b) Finne ut om det er en rimelig forklaring for forandringene i skiftene.
c) Fortelle lederen med ansvaret for skiftene at han ikke er fornøyd med det.
d) Grettent godta forandringene og jobbe skiftene.

17. Jumah has been working at a new job part-time while he studies. His shift times for the week are changed at the last minute, without consulting him. What action would be the most effective for Jumah?
a) Refuse to work the new shifts.
b) Find out if there is some reasonable explanation for the shift changes.
c) Tell the manager in charge of shifts that he is not happy about it.
d) Grumpily accept the changes and do the shifts.

18. Julie har ikke sett Anette på år og dag og ser frem til deres helgetur. Anette har imidlertid forandret seg mye og Julie synes ikke hun er et interessant reisefølge lenger. Hvilken handling vil være den beste for Julie?
a) Avlyse turen og dra hjem.
b) Innse at det er tid for å gi opp vennskapet og gå videre.
c) Forstå at folk forandrer seg, så gå videre, men huske de gode stundene.
d) Konsentrere seg om de andre mer givende vennskapene.

18. Julie hasn't seen Ka for ages and looks forward to their weekend trip away. However, Ka has changed a lot and Julie finds that she is no longer an interesting companion. What action would be the most effective for Julie?
a) Cancel the trip and go home.
b) Realize that it is time to give up the friendship and move on.
c) Understand that people change, so move on, but remember the good times.
d) Concentrate on her other, more rewarding friendships.

Appendix C

The Berlin Numeracy Test

English	Norwegian
Please answer the questions below. Do not use a calculator but feel free use the space available for notes (i.e., scratch paper).	Nå kommer noen generelle regneoppgaver. Pass på at du besvarer alle oppgavene! Det er ikke tillatt å samarbeide, bruke internett eller kalkulator, men kladd gjerne med penn og papir dersom du har behov for det.
Imagine we are throwing a five-sided die 50 times. On average, out of these 50 throws how many times would this five-sided die show an odd number (1, 3 or 5)? _____	Forestill deg at vi kaster en fem-sidet terning 50 ganger. I gjennomsnitt, hvor mange av disse 50 kastene vil denne fem-sidede terningen vise et oddetall (1, 3, eller 5). Oppgi antall ganger av 50 kast. _____
Out of 1,000 people in a small town 500 are members of a choir. Out of these 500 members in the choir 100 are men. Out of the 500 inhabitants that are not in the choir 300 are men. What is the probability that a randomly drawn man is a member of the choir? _____ % (please indicate the probability in percent)	Av 1000 mennesker i en liten bygd er 500 medlemmer av et kor. Av disse 500 kormedlemmene er 100 menn. Av de 500 innbyggerne som ikke er medlem av et kor er 300 menn. Hva er sannsynligheten for at en tilfeldig trukket mann vil være medlem av et kor? Vennligst oppgi svaret i prosent. _____

Imagine we are throwing a loaded die (6 sides). The probability that the die shows a 6 is twice as high as the probability of each of the other numbers. On average, out of these 70 throws, how many times would the die show the number 6? _____

Forestill deg at vi kaster en falsk (loaded) seks-sidet terning 70 ganger, der sannsynligheten for at terningen lander på 6 er dobbelt så stor som for hvert av de andre tallene. I gjennomsnitt, hvor mange av disse 70 kastene vil denne terningen vise tallet 6. Oppgi antall ganger av 70 kast. _____

In a forest 20% of mushrooms are red, 50% brown and 30% white. A red mushroom is poisonous with a probability of 20%. A mushroom that is not red is poisonous with probability of 5%. What is the probability that a poisonous mushroom in the forest is red? _____%

I en skog er 20% av soppen rød, 50% av soppen brun og 30% av soppen hvit. En rød sopp har 20% sannsynlighet for å være giftig. En sopp som ikke er rød har 5% sannsynlighet for å være giftig. Hva er sannsynligheten for at en giftig sopp i skogen er rød? Vennligst oppgi svaret i prosent. _____

Scoring = Count total number of correct answers. Correct answers: 1 = 30; 2 = 25; 3 = 20; 4 = 50. Reference:Cokely, E.T., Galesic, M., Schulz, E., Ghazal, S., & Garcia-Retamero, R. (in press). Measuring risk literacy: The Berlin Numeracy Test. Judgment and Decision Making.

Appendix D

DEBRIEFING

Du har nå deltatt i en studie hvor vi undersøker valg under usikkerhet og betydningen av framing, og hvordan emosjonelle og kognitive prosesser påvirker framing-effekten.

Framing-effekten er en velkjent bias som forekommer som et resultat av hvordan utfallene blir presentert i beslutningsoppgaver. Selv om utfallene er logisk ekvivalente, har flere studier funnet at de fleste personer velger det alternativet som gir et sikkert utfall når alternativene er presentert positivt (for eksempel som liv reddet), mens man velger alternativet med større risiko når alternativene er presentert negativt (for eksempel som tap av liv) (Tversky & Kahneman, 1981). Du ble presentert for slike oppgaver i eye-tracking delen, der halvparten av oppgavene hadde en positiv frame (liv reddet), og den andre halvparten hadde en negativ frame (liv tapt). Noen av dine medstudenter vil få oppgavene presentert motsatt rekkefølge, slik at vi kan kontrollere for eventuell påvirkning av å få den ene eller andre typen frame først/sist.

Vi ønsket å undersøke de underliggende prosessene som er tilstede ved beslutningsprosessen under framing oppgaver. En teori er at det er en underliggende **affekt heuristikk** (Slovic, Finucane, Peters, & MacGregor, 2002) som er involvert i framing effekten. Dette støttes av studier som har funnet at amygdala, en hjernedel ofte assosiert med emosjonelle prosesser, er aktiv når man blir påvirket av framing effekten (De Martino, Kumaran, Seymour, & Dolan, 2006; Roiser et al., 2009). Emosjoner innebærer både valens (positive og negative emosjoner) og aktivering (hvor intense emosjonene oppleves) (Russell, 1980). Pupill-utvidelse kan brukes som en indeks på emosjonell aktivering, og tidligere studier har vist at pupillene utvider seg etter beslutninger som medfører tap, sammenlignet med gevinst (Satterthwaite et al., 2007). Vi undersøker derfor om pupill-diameter er større i de negative oppgavene sammenlignet med de positive, og om det er en forskjell mellom de som oftere velger i henhold til framing effekten enn de som i mindre grad lar seg påvirke.
Andre studier har vist at det kreves større anstrengelse både emosjonelt og kognitivt for å løse problemet i de negative versjonene av framing oppgavene (Gonzalez, Dana, Koshino, & Just, 2005; Kuo, Hsu, & Day, 2009). Vi bruker derfor eye-tracking for å undersøke om man har flere og lengre fikseringer, og om man bruker lengre tid i den negative framing oppgaven sammenlignet med den positive. Dette vil da kunne gi en indikasjon på anstrengelse.

Den siste delen av studien innebar to spørreskjemaer. Den ene var en kortversjon av Situational Test of Emotion Management (STEM-B) (Allen et al., 2015) som gir et mål på emosjonshåndtering, en underkategori av emosjonell intelligens. Tidligere studier har funnet at de som scorer høyrere på emosjonell intelligens blir mindre påvirket av affekt-heuristikken og irrelevante emosjoner når de tar beslutninger som innebærer risiko (Yip & Côté, 2012). Vi vil undersøke om det også er en sammenheng mellom

STEM-B og beslutninger i denne studien. Det andre spørreskjemaet var The Berlin Numeracy Test (Cokely, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012) som måler tallforståelse, en kognitiv evne som har blitt knyttet til for eksempel risikopreferanse. Vi vil derfor undersøke om dette har en sammenheng med hvordan man svarer på framing oppgaver.

Vi setter stor pris på om du ikke forteller andre potensielle deltagere om formålet med denne studien.

Dersom du har kommentarer eller ønsker å vite mer om studien er du hjertelig velkommen til å ta kontakt med Anine Riege (a.c.riege@psykologi.uio.no) eller Liva Martinussen (livajm@student.sv.uio.no).

Tusen takk for din deltagelse!

I konvolutten på bordet finner du en utskrift av referanselisten som du gjerne kan ta med om du vil se nærmere på denne senere! Så lenge du er på UiO-nettet har du tilgang til disse artiklene.

Nyttige referanser

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