Preliminary Master Thesis Report

- The Influence of Emotions on Cognitive Processing in Decision-Making - A New Approach to the Analysis of Emotional Responses -

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Content

Summary

The present thesis looks further into how emotions influence cognitive processes in decision-making. Research suggest that the concept of emotions is comprised of valence and arousal, which may explain how different emotions results in the engagement in either intuitive or analytical processing in a decision-making context. In relation to this, EDA is suggested as a measurement of emotional arousal, and this measure is therefore discussed in the context of individuals' baselines and response windows. Essentially, the present thesis aims to analyse data obtained from the subjects' SCRs while being presented with emotional stimuli, and subsequently assessing subjective arousal. The analysis of this data will apply the use of different response windows, as well as taking individuals' baselines into consideration in order to assess arousal, and the coherence between physiological arousal and subjects' subjective experience of arousal.

Introduction

The field of judgment and decision-making is of great concern in organizations today. The factors that are thought to constitute decision-making include emotions and their effects on cognitive processing (Blanchette & Richards, 2010). The present thesis aims to further investigate this relationship by considering how components of emotions influence cognitive processes in decision-making.

Research has focused on emotions and its influence on the different cognitive processing systems, and argue that emotions play an important role in applying different thinking styles (Epstein,1994), explained by the dual process theory of cognitive processing, which constitutes two different ways of processing information, known as intuitive processing (System 1) and analytical processing (System 2). System 1 operates faster and more effortless than does System 2. Importantly, both of these systems are subject to the influence of emotions (Kahneman, 2003a; Kahneman, 2003b; Stanovich, West, & Hertwig, 2000).

The concept of emotions may be explained by means of the Circumplex Model proposed by Russel (1980), in which emotions are described in terms of valence and arousal, and a close link between these two is established. In terms of emotions, research suggest valence as having inconsistent effects on processing style, whereas arousal show a clear relation with System 1 processing (e.g. Epstein, 1994; Arnsten, 2009). Arousal has also been suggested to play a role in the link between the physiological and subjective experience of emotion, as it may contribute to a coherence between these two (Sze, Gyurak, Yuan, and Levenson, 2010).

A common assessment of the physiological measure of emotional response is captured with the use of electrodermal activity (EDA), or more specifically by measuring the individual's skin conductance response (Boucsein, 2012). The use of these methods have led to the somatic marker hypothesis (Damasio and Bishop, 1996), which support the notion of how physiological signals as arousal assist cognitive processes as decision-making. To measure these signals, several things needs to be considered. Firstly, internal and external influences during electrodermal recording may influence individuals' baselines. Secondly, the use of different approaches to the analysis of skin conductance response (SCR) including time latencies, response windows may be crucial when analysing the results (Boucsein, 2012). In this thesis, we will analyse the data in terms of normative and heuristic views on response windows of the SCRs (Miron-Shatz, 2009;

Kahneman, Fredrickson, Schreiber & Redelmeier, 1993). We believe that by considering individual baselines, together with the different approaches of response windows, the new approach to analysing the data will have a great influence on how results are interpreted in terms of establishing the emotional arousal of the subjects in the experiment.

Based on the aforementioned, our research question is as follows: *How does valence and/or arousal, as dimensions of emotions, influence cognitive processing in a decision-making task? Further, how will examining individuals' baselines, and the application of different response windows in the SCR data obtained, contribute to the establishment of arousal arising from the emotional stimuli presented?*

Cognitive Processing

A generous amount of research distinguish between two fundamentally different systems for cognitive processing (Stanovich, West, & Hertwig, 2000; Johnson, 2005; Sinclair, 2011), one which operates fast, automatic, and effortless, and another where operations are slower, effortful and more likely to be controlled and consciously monitored (Kahneman, 2003a). The former system has collectively been referred to as *System 1* and the latter *System 2* (Stanovich et al. 2000). Further, research suggest that dual process models of are more successful in terms of explaining behaviour in a wide range of settings, than are unitary models (Mukherjee, 2010). By applying the process of thinking and decision-making into two distinguished systems, Kahneman (2003a) argued that system 1 corresponded to the everyday concept of intuition, while system 2 correspond to reasoning.

Cognitive Processing in Judgment and Decision-Making

In relation to judgment and decision-making, the differences between the two systems have been used to explain contradictory results in studies. Further, Kahneman (2003a) suggests that intuition (System 1) is often associated with poor performance in decision-making tasks. Nevertheless, he also acknowledges intuitive thinking as powerful and accurate, and research points to skilled decision makers as often performing better when trusting their intuition, than when engaging in a thorough analysis (Kahneman, 2003a). Further, the operating characteristics of System 1 are comparable to features of perceptual processes. Thus, System 1 generates impressions of the attributions of objects of perception and thought. In contrast, System, 2 is involved in all judgments, as these are always intentional and explicit. An important distinction between the two systems is that System 1 is applied to judgments directly reflecting impressions, which are not modified by System 2.

Further Kahneman (2003a) argued that intuitive judgements cause judgement heuristics. The heuristic process is explained by Kahneman and Frederick (2002) who proposed that "Judgment is said to be mediated by a heuristic when the individual assesses a specified target attribute of a judgment object by substituting another property of that object—the heuristic attribute—which comes more readily to mind" (Kahneman and Frederick, 2002, cited in Kahneman, 2003a). Thus, by relying on heuristics, people make mental shortcuts which simplifies the judgement or decision tasks. In certain cases, this leads to predictable biases and inconsistencies (Plous, 1993). One of these heuristics are the "affect heuristic" which in the past few decades has become increasingly important. Slovic, Finucane, Peters, and MacGregor (2007) suggest that the affect heuristic influence people to make judgements and decisions (either conscious or unconscious) based on feelings of "goodness" or "badness". Further, Slovic et al. (2007) argue that affect plays a central role in dual-process models and decision-making, as the intuitive system relies on affect and emotion as an "quicker, easier, and more efficient way to navigate in a complex, uncertain, and sometimes dangerous world." (Slovic et al., 2007, p.1334). Moreover, the importance of emotions' influence on decision-making is recognized by Kahneman (2003a) and should therefore be further studied in the field of judgement and decision-making. The present thesis aims to further investigate the association between emotions and cognitive processing during judgment and decision-making (in risky situations). The subsequent paragraph will address the concept of emotions, which has been explained through the label of affect (Russel, 1980).

Emotions

Emotions are generally defined as "internal, mental states representing evaluative, valenced reactions to events, agents, or objects that vary in intensity (Nabi, 1999, p. 295). Additionally, Forgas (1995) argues that emotions are "intense, short-lived, and usually have a defined cause or clear cognitive content" (Forgas, 1995, p.41). As previously mentioned, emotions can be explained through the label of core affect, which according to Russel (2009) is a "pre-conceptual primitive process, a neurophysiological state, accessible to consciousness as a simple non-reflective feeling: feeling good or bad, feeling lethargic or energised" (Russel, 2009, p. 1264) . In other words, affect is accessible as feelings evident in emotions.

Russel (1980) suggests that core affect is a circumplex, or a combination, of two underlying dimensions, namely; pleasure-displeasure (referred to as valence) and activation-deactivation (referred to as arousal). Along these dimensions, different variables (of emotion) as excitement, contentment, depression and distress falls into the two-dimensional space. Thus, he explains emotions as related to each other in a highly systematic fashion. Previous research has typically concluded that factors of affect are independent from each other, and treated them as separate or discrete dimensions (Ekman, 1992). These theories support the notion that basic emotions have different neural structures and pathways. However, by explaining affect in a circumplex model, one is able to plot the specific emotional states (as e.g. joy) according to the level of arousal and valence, as products of two different neurophysiological systems. Thus, according to the circumplex model, these two underlying systems subserve all affective states (Posner, Russell, and Peterson, 2005). By providing this spatial model, the existence of a relationship between arousal and valence is established.

As discussed above, the circumplex model explains emotions as a product of valence and arousal combined. In fact, the state of arousal is central in emotion theories (Bodenhausen, 1993), and the psychological construct of emotions has physiological arousal as one of the main components (Nabi, 1999). Russel (1980) also support the valence-arousal combination with the circumplex model, arguing that emotions and degree of arousal is closely linked, and that the level of arousal states may be high - in preparation for action, or low - times of inaction. Moreover, according to Boucsein (2012) emotions and arousal is closely linked. Thus, considering the level of arousal is of great importance when studying emotions.

Emotions, Cognitive processing and Decision-Making

Further, it is argued that emotionally loaded information exerts an influence on, and becomes incorporated into, the judgment and decision-making processes (Forgas, 1995). Thus, it can be argued that emotions, and especially anticipatory emotions (emotions experienced during the decision-making process) is important to consider in terms of cognitive processing, as it may influence the cognitive processing and thereby, decision-making behaviour (Loewenstein, Weber, Hsee, and Welch, 2001; Blanchette & Richards, 2010). The link between emotions, cognitive processing and decision-making is demonstrated below, by means of valence and arousal (the two dimensions of emotions) (Russel, 1980).

Valance and Cognitive Processing

According to Lerner and Keltner (2000) the majority of research on emotions have focused positive and negative feeling states and how they differ in their influence on decision-making. For example, different research have found evidence of positive moods triggering use of top-down, heuristic or intuitive processing, and decreases analytical processing. Further, negative emotions may provoke more bottom-up analytical and systematic thinking styles, which suggests that negative emotions produce analytical cognitions. Moreover, sad or negative moods have shown a tendency for people to produce a more systematic and careful reasoning style, showing evidence for negative feelings to producing a more analytical processing style (Lerner and Keltner, 2000). However, research on other negative emotions and decision-making as anger have produced different results, showing that the participants rely more on a heuristic processing style, similar to what has been found for people induced with positive happy emotions (e.g. Forgas, 2013; Blanchette & Richards, 2010). The aforementioned findings demonstrate an inconsistency when it comes to the effects of valence on cognitive processing. This is supported by Cassotti, Habib, Poirel, Aïte, Houdé and Moutier (2012) who also argue that the influence of emotions of positive and negative valence in decision tasks have yielded different results. In their study they primed participants with unpleasant and pleasant pictures before proceeding to a gambling task. They found people in the positive condition were less prone to making decision biases, than individuals in the negative condition. However, this study, as most, have usually focused on negative and positive feelings, without much focus on how emotions of the same valence, but different arousal, may influence decision-making differently (Lerner and Keltner, 2000). This issue will be addressed below.

Arousal and Cognitive Processing

As briefly indicated above, research on decision-making should also consider the level of arousal, and not only the valence of emotions. According to Posner, Russell, and Peterson (2005), amygdala activity will increase with the arousal regardless of whether the arousal associated with the stimuli is labelled as positive or negative. This has also been supported by Detenber, Simons and Bennett (1998) who showed pictures of different valence and arousal to participants in a study. By obtaining both measures of physiological response, or skin conductance response (SCR), and self-report ratings, their results indicated that the physiological response was related to the arousal properties of the image stimuli. However, the interaction between SCR and image valance was not significant. Further, a study by Bodenhausen, Sheppard and Kramer (1994) found that different kinds of negative affect result in different types of cognitive processing, as there was significant difference between the angry and sad subjects' engagement in heuristic processing. Thus, the researchers argued that their findings may be applied to positive emotional states as well. In fact, the authors emphasised that looking beyond valence is required in order to understand the influence of emotional influence of information processing. It may be argued that the different level of arousal of emotions with the same valence may be one of the factors influencing different cognitive processing.

Furthermore, Epstein (1994) supports the dual-process theory of cognitive processing and suggests there is a big difference in the way people think when they are emotionally aroused, compared to when they are unemotional. When highly emotional, individuals typically think in a way that is categorical, unreflective, action oriented and concretive. Epstein relates these attributes to the experiential system (System 1). Along a similar line, it has been argued that increased arousal leads to attentional selectivity. This is supported by Arnsten (2009) who argues that increased levels of stress (which has been defined as "a state of high general arousal" (Boucesein, 2012, p.381), can impair cognitive abilities quite dramatically. This may be explained by the prefrontal cortex (PFC), which is involved in the decision-making process (e.g. Posner et al., 2005; Arnsten, 2009). According to Arnsten (2009), when psychological stress occurs, higher-order PFC functions will become impaired, while stress pathways are activated, which in turn strengthens the amygdala function, resulting in more reflexive, rapid and emotional thinking. On the contrary, lower level of stress will interfere less with PFC and induce a more thoughtful and deliberate thinking. This demonstrates the connection between emotions and decision-making. One may also assume that the degree of arousal/stress can have an impact on the two systems of cognitive processing: as the stress/arousal level increase, System 1 may be involved to a higher degree as it operates fast. Further, lower levels of stress may engage system 2, where operations are slower.

In sum, the aforementioned demonstrates the importance of taking both arousal and valence into account when studying emotions in relation to cognitive processing and decision-making, as these two components (valence and arousal) together constitute emotions. As various research points to high levels of arousal as a factor causing System 1 engagement, there are contradictions as to the effect of valence on cognitive processing. Therefore, based on previous research we hypothesis that:

H1: *Different levels of arousal together with valence (positive or negative) will moderate the relationship between emotions and cognitive processing in a decision-making task*

H1a: *Higher levels of arousal with valence (positive or negative) will result in the use of intuitive processing in a decision-making task*

H1b: *Lower levels of arousal with valence (positive or negative) will result in the use of analytical processing in a decision-making task*

Difference between physiological and subjective reports of emotions

As emphasised above, arousal may be considered an important dimension of emotions. The role of arousal in the link between physiological and subjective reports of emotions will be discussed further. According to emotion theory, the main components of psychological emotions are 'the physiological component of arousal' and 'a subjective feeling state' (Nabi, 1999). In support of this, Boucsein (2012) argues that emotional states should be measured by applying both physiological measures and subjective reports. The reason behind this is that the subjective reports address the emotional experience of the individual, and his/her awareness of signals from the autonomic nervous system (ANS). Some research points to these two components as correlating (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005) However, other research have found no coherence between the two experiences of emotions (Jakobs, Manstead & Fischer, 2001). This inconsistent view of how the objective and subjective experience of emotion correlate have therefore been of interest.

According to Kahneman (2003b) individuals tend to memorize salient moments of the affective experience, typically the peak and the end. Importantly, participants' global evaluation of the experience may be based on the peak or the end of the affective episode, instead of the total affective experience. Hence, one may assume that the memory of a past affective experience may differ from the actual somatic arousal. Other research argues that individuals will vary in their bodily awareness, resulting in some being more able to report their emotions more accurately compared to others. In relation to this, a study by Sze, Gyurak, Yuan, and Levenson (2010) investigated whether individuals high in body awareness would demonstrate greater coherence between subjective emotional experience and physiological responding during emotion. The results found that body awareness training is associated with increased emotional response coherence during film-induced emotional episodes. The authors explain these findings by suggesting that this relationship reflects the role of the organs controlled by the autonomic nervous system (ANS) in emotion and the importance of these organs in the construction of subjective emotional experience. Thus, one may assume that the objective and subjective experiences of emotion are closely related. In addition, Sze et al. (2010) found that when films contained violent high-arousal segments, the coherence between the subjective and bodily arousal was higher compared to other films with non-violent low-arousal segments. Thus, it might be that the coherence between the subjective and physiological experience of emotion depends on the level of arousal. Therefore, one may assume that arousal is an important factor when comes to the coherence between subjective evaluations of emotions and physiological responses.

Considering the aforementioned research, and the contradictions in research we hypothesise that:

H2: *The coherence between subjective emotional experience and physiological emotional experience will be moderated by the level of arousal.*

H2a: *Higher levels of arousal will lead to greater coherence between subjective emotional experience and physiological emotional experience*

__H2b:__ Lower levels of arousal will lead to less coherence between subjective emotional experience and physiological emotional experience

A New Approach to the Analysis of Emotions

The remainder of the present thesis will focus various aspects of emotions such as its measurement, influence of individual differences, and analytical procedures, in relation to decision-making. Thereby, the complexity of physiological responses to emotional stimuli with regards to data analysis is considered.

Measure of Emotion

The measure of emotion has long been a topic of interest. According to Levenson (2014) the autonomic nervous system (ANS) is central in generating, expressing, experiencing and recognizing emotions. In relation to this, research suggest that Electrodermal activity (EDA) is the only ANS response that is a direct representation of sympathetic activity, and may therefore be related to emotional and cognitive states. More specifically, it is claimed that the physiological measure of an emotional response may be captured by detecting EDA in the individual (Boucsein, 2012). As such, scholars have concluded that activity of the sweat glands are critical for EDA (e.g. Darrow, 1927; Fowles, 1986, cited in Boucsein, 2012). In other words, the measurement of EDA is primarily concerned with psychologically induced sweat gland activity (Dawson, Schell, & Filion, 2007). EDA is measured by passing a current through a pair of electrodes located on the skin surface. This is referred to as the exosomatic method, which can record Skin Conductance Responses (SCR), which again measures sweat gland activity. The SCR arise from the firing rate of multiple sudomotor fibres in the skin that creates a sudomotor nerve burst (a single spike in nerve activity), which corresponds to the skin conductance response (SCR). Further, SCR amplitude may be regarded as the index of sympathetic activity, as the amplitude of the nerve burst (the spike density) is linearly related to the amplitude of the corresponding SCR (Benedek and Kaernbach, 2010). Moreover, the skin conductance (SC) time series may be divided into the skin conductance level (SCL) which is a slowly varying tonic activity, and the skin conductance response (SCR) which is fast varying phasic activity. Benedek and Kaernbach (2010) argue that decomposing the SC into continuous data of tonic and phasic activity provides an unbiased data analysis, reducing the risk of underestimating SCR amplitude.

EDA, Emotions and Decision-Making

As mentioned above, the quantitative properties of emotions are measured by ANS parameters such as EDA, and research consider SCR as a reliable measure of autonomic expressions of emotions, as it is under the control of the sympathetic branch of the nervous system (Khalfa, Isabelle, Jean-Pierre, & Manon, 2002). For instance, Bernat, Patrick, Benning & Tellegen (2006) presented participants with pictures from the International Affective Picture System (IAPS) to 58 male participants. Pictures from positive valence (erotic, adventure) and negative valence (victims, threat) were subjectively rated with respect to low, medium and high intensity (arousal). The results found that stimuli of high intensity prompted increased SCRs, and provides evidence for EDA as indicator of autonomic expressions of emotions. Further, research suggests a relation between EDA and cognitive processing. More specifically, EDA is used as an indicator for decision-making in the context of the Somatic Marker Hypothesis (SM) (Boucsein, 2012). According to Damasio (1994) the expression of emotions can be explained by changes in the representation of the body state. This is explained further by SM, proposed by Damasio (1994) after studying decision-making in patients with damage to the ventromedial prefrontal cortex (VMPFC) (Damasio, 1994, cited in Boucsein, 2012). Damasio's findings indicated that VMPFC patients were unable to use physiological signals that usually assist cognitive processes, such as decision-making. This was especially evident in uncertain and complex conditions. Thus, the results demonstrate that during decision-making tasks, individuals with damage to the VMPFC were unable to use the psychological signals which normally arises to assist their cognitive processing. Moreover, the term somatic marker ''suggest that underlying somatic arousal works as a characteristic signal for both the emotional response to, and the anticipation of, a specific decision option" (Boucsein, 2012, p 325). In other words, emotional reactions guide the decision-making as somatic markers (Loewenstein et al., 2001). Damasio and Bishop (1996) therefore argue that psychological arousal is a neurobiological process, that influence reasoning and decision making, and thus, one may assume a relation between EDA and cognitive processing as being evident.

Taking the aforementioned research into consideration, one may assume that the emotions arising from humans' bio-regulatory processes, regulate individuals' cognitive processes (Hofman, Heering, Sawyer & Asnaani, 2009; Russel, 1980), which may lead to decisions being made. This is supported by various other research (Suzuki, Hirota, Takasawa, & Shigemasu, 2003; Bechara, Damasio, Damasio, & Anderson, 1994).

Influences on Electrodermal Recording and Individuals' baseline

As mentioned earlier, EDA is useful in measuring physiological responses in terms of emotions which in turn may influence the cognitive processes in decision-making. As the present thesis aims to take individual differences in EDA into account, there are various variables which may influence the data collected during electrodermal recording. We distinguish between internal and external influences on EDA.

In terms of internal variables, research suggest there are differential effects of age, gender differences, and bilateral differences in participants, which may easily distort the measure of SCR, and have implications for the results obtained. An example of this is left- and right-handedness of the participants, as the skin of the dominant hand tends to be more physically stressed, thus the outermost layer of the epidermis (stratum corneum) of the dominant hand may be thicker than the contralateral hand (Boucsein, 2012). In regards to external influences, Boucsein (2012) points out an association between EDA and room temperature and seasonal temperature (Boucsein, 2012). In sum, the abovementioned emphasize the importance of considering individual differences and possible influences on EDA recordings. These factors are important to take into account in EDA research, as they may affect individuals' baseline prior to EDA recordings. Further, individuals' baseline may have implications in EDA recordings.

According to the Law of Initial Values (LIV) proposed by Wilder (1931), it is suggested that the magnitude of phasic psychophysiological response depends on the initial baseline level (cited in Boucsein, 2012). Further, according to Boucsein (2012) if baseline dependency is already very high (or low), EDA will be formed by the ceiling and bottom effect, meaning that if the skin conductance level (SCL) is already high in the beginning of the experiment, SCL will only increase to a limited degree. Thus, when comparing groups, individual differences in baselines must be considered as they generally will have different electrodermal levels (EDLs), due to internal influences. Hence, Boucsein (2012) argues that "if necessary, the baseline scores should be taken into consideration on an individual basis for the evaluation of electrodermal reactivity" (Boucsein, 2012, p.240).

Therefore, it may be advantageous to compare the baseline of the individual prior to being exposed to the emotional stimuli, to the subject's SCR during exposure of the stimuli. This way, the amount of error arising from natural variance between individuals, is reduced (Bryman and Bell, 2013). Importantly, we believe that taking the individual baselines into consideration will yield a better and more precise data analysis of the participants' arousal.

Response Windows according to normative and heuristic models

According to Boucsein (2012), regarding the measure of EDA, different research have discussed the appropriate time window and possible range of latencies of an Electrodermal Response (EDR) following a distinct stimulus. These latencies arise due to previously discussed external influences, as the temperature and recording site (Boucsein, 2012). Further, when measuring the SCR time latencies it is important to take the response window to a stimulus into account, as EDR responses have relatively long latencies of 1 to 2 seconds (s). However, 5 s long latencies have also been observed (Edelberg, 1967, cited in Boucsein, 2012). Further, Levinson and Edelberg (1985) argue that a response window of 1 to 4 s, or 1 to 5 s have been the most common response window used in published studies found in the journal of *Psychophysiology.* Thus, there appears to be an ongoing discussion among researchers concerning the appropriate length of a response window due to the time latencies of physiological responses to emotional stimuli.

Furthermore, normative and heuristic evaluations may be useful in interpreting physiological responses resulting from an emotional stimulus. When targeting a feeling, the moment, or the response window, will include many moments, or spikes, of nerve activity in the skin. According to normative models, a retrospective evaluation of individual's experience of a feeling is best assessed with a duration-weighted measurement (Miron-Shatz, 2009). This means that the spikes are included to a duration-weighted average of the entire experience of the affective state. In contrast, the heuristic evaluation of a feeling may override the duration-weighted average of affective reports (Miron-Shatz, 2009). This may be explained by the peak-and-end rule which posits that individual's global evaluations of past affective episodes may be predicted by the two moments of peak affect intensity and the ending, or sometimes independently by applying only the peak or only the end (Fredrickson, 2000). Thus, the peak and end moments of the episode are dominating for such evaluations, and thus the duration of the whole experience is neglected. For instance, Kahneman, Fredrickson, Schreiber & Redelmeier (1993) exposed participants to two aversive experiences, where the majority of the participants failed to take the duration of the experiments into account, and rather weighted the end of the experiment when evaluating the experience in terms of pleasantness. This research points the salient moments of the affective experiences as coming more easily to mind, as well as the affect associated with those moments. Supporting these findings, Redelmeier & Kahneman (1996) studied patients undergoing colonoscopy. The results indicated that participants had momentary pain levels that varied a great amount from minute to minute. However, in the end of the experiment the researchers added an extra minute for half of the participants, making sure that the pain was notably reduced. Thus, when the patients were to make a global evaluation of the experience, the participants that underwent the more pleasant end of the colonoscopy procedure had a significantly less painful memory of the experience, compared to the participants that did not have an extra minute with reduced pain.

The abovementioned research on normative and heuristic evaluation indicate that an exact criteria for an appropriate response window may vary, and can be based on either a duration-weighted average, in which the feeling is based on the whole emotional response, i.e. from the emotional stimuli is first presented, to after a decision is made. On the other hand, one may consider the feeling as being based on the peak within the response recording window, the end of the response recording window, or the time interval following the presentation of the emotional stimuli. Moreover, there exist inconsistencies as to the specific moments of arousal within a particular response window (Boucsein, 2012). Therefore, the present thesis aims to test which of the aforementioned methods is the most suitable when analysing SCRs to a given emotional stimuli. The different approaches have a great influence on how results are interpreted in terms of establishing the emotional arousal of the subjects in the experiment. Due to the novelty of this area of research, we take a more explorative view and therefore hypothesise the following:

H3: *The capture of changes in phasic activity (SCR) caused by an emotional stimulus will depend on the type of applied response window used in the data analysis*

> ***H3a****: In accordance with the normative view, SCR to an emotional stimulus must be analysed as a duration-weighted average of the response window*
> ***H3b:*** *In accordance with the heuristic view, SCR to an emotional stimulus must be analysed as the peak of maximum phasic intensity of the response window*
> ***H3c:*** *In accordance with the heuristic view, SCR to an emotional stimulus must be analysed in the end of the response window*
> ***H3d:*** *In accordance with the heuristic view, SCR to an emotional stimulus must by analysed in the following interval after the presentation of the emotional stimuli has ended*

Methodology

In order to test the suggested hypothesis, we will perform a within-subjects analysis of data obtained from approximately 130 participants, mostly recruited from BI Norwegian Business School. The main study aims to investigate how different emotions with subjectively and physiologically assessed measures will influence subject's cognitive processing in a decision-making task.

In order to induce different emotional states, pictures have been retrieved from the IAPS (Lang, Bradley and Cuthbert, 2008). Five pictures have been chosen for the present experiment (happy baby, soldier, leaves, starving child, and skysurfer). Each picture triggers a different combination of valence and arousal (Lang et al., 2008). Thus, the experiment comprised five different experimental conditions. Furthermore, participants were introduced to the Asian Disease scenario in the gain frame dilemma (Tversky and Kahneman, 1981) as the decision-making task where the subjects are equally likely to apply either analytical or intuitive processing. Thus, we consider this to be a suitable task to investigate the subject's type of cognitive processing.

Procedure

The experiment's procedure was as follows: Participants were placed in front of a computer and electrodes to measure SCR will be attached to the participants' arms. Subsequently, the computer will provided the participants with the experiment's instructions. The participants were randomly assigned to one of the aforementioned conditions. Thus, they will be induced with either: high arousal positive emotions, high arousal negative emotions, low arousal positive emotions, low arousal negative emotions, or neutral emotions, which was instructed on the computer screen. Further, the participants were presented to a decision-making task in form of the Asian Disease Dilemma in the gain frame. After responding to this, participants will be instructed to respond to a self-assessment questionnaire of arousal level and valence and a self-assessment questionnaire of cognitive processing style.

Measures

Based on the previous discussion regarding self-reported and physiological response, the present study will apply both measures to see if there are differences/similarities between these experiences. The following measures will be utilized;

To investigate the subjective rating of emotions, a self-assessment questionnaire of arousal level and valence will be applied. The SAM will be used to rate of arousal and valence with the use of pictures on a 9-point scale, which indicates whether the participant felt "unhappy - happy" (valance), and "calm - excited" (arousal) (Bradley and Lang, 1994)

A Self-Assessment Questionnaire of Cognitive Processing will be used to assess whether the participant engages in analytical or intuitive cognitive processing when engaging in the decision-making task. This thesis use a self-reported cognitive processing inventory (CPI) develop by Bakken, Haerem and Kuvaas (2013).

As previously argued, to measure the EDA of the participant, the Skin Conductance Response (SCR) was used to measure the emotional arousal response of the participant. This measure has already been obtained from a sample of 130 participants. To analyse the data we will use Ledalab software to conduct a

Continuous Decomposition Analysis (CDA). In the data analysis, different response windows mentioned in the literature review will be applied to measure the emotional arousal of the participants.

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