

Andreas Kiste

Expectations, Decision-Making, and Emotional Reaction

Effects of an Unexpected Negative Outcome

Master's thesis

Risk Psychology, Environment and Safety

Supervisor: Britt-Marie Drottz-Sjöberg

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Norwegian University of Science and Technology

Faculty of Social Sciences and Technology Management

Department of Psychology

Preface

This thesis takes on the discussion of reason and emotion, i.e. the heart and the head, the soul and body, in an attempt to outline human behavior in complex risky environments that demand rationality to achieve success. To which extent do we let our negative affective reactions guide behavior, and restrain our ability to make rational decisions?

I chose this topic because I consider the influence on behavior of emotion and rational thinking to be one of the very basic human challenges, and it made me curious about which mechanisms that are in charge when I decide whether to follow my “gut feeling”, rely on objective facts, or act on the basis of a combination of the two. Having said that, understanding these mechanisms seems to be especially urgent when a decision-maker is involved in extreme or dangerous situations, because the significance of such situations’ potential or real consequences may involve life changing experiences, e.g. the loss of monetary value, emotional distress, and/or the threat to one’s health or life.

This thesis’ review of findings and suggestions from selected theories is compared to the case of the complex, monetary game of poker, where an affective reaction, e.g. of anger, disappointment and hostility, is a common feature.

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Andreas Kiste

Abstract

This thesis is a theoretical review of the effects of an unexpected negative outcome on a decision-maker that may occur in spite of prior decisions supported by normative rules or probability estimates such as expected value. The main research question focuses on whether the decision-maker becomes risk-averse (similar to a flight response) or risk-taking (similar to a fight response) following an unexpected negative outcome of a prior decision. The hypothesis, influenced by Prospect Theory, is that a person in such a situation would be inclined to take risks rather than avoid risks. The “tilt” reaction due to a “bad beat,” an incident observed in the monetary game of poker, is used as an example of the reviewed phenomena. The literature selected to investigate the hypothesis involves theories of emotions, moods, feelings or affects as well as aspects of cognitive processing. It is assumed that the interaction between emotional experience and logical thinking is the key to understanding the effects on decision-making of an unexpected negative outcome. The thesis suggests that a decision-maker's behavior is influenced by the degree of experience of a similar outcome, the degree of violation of an expected outcome, the significance of the investment, and the personal ability to process information in a rational manner. The thesis concludes that an experienced decision-maker who experiences a possible but not probable negative outcome loses both monetary value and personal utility (reputation as an experienced decision-maker), will feel deprived of a probable outcome, and show risk-taking behavior. The thesis further concludes that a novice decision-maker who experiences an unexpected negative outcome, and loses monetary value, will feel disappointed, and show risk-averse behavior. Violations of an expected outcome create varied degrees of arousal and negative mental states, e.g. anger, surprise and disappointment, basically because the outcome violates (false) expectations of fairness. Such a violation might in some cases result in strong physical reactions such as violent behavior. It is suggested that extreme reactions, or "hot tilts," would be more likely among experienced players because they are expected to experience greater surprise or violation and have higher personal investments at stake. The less experienced player, however, would more probably display a "cold tilt" and risk-averse behavior. The interpretations are discussed in relation to theories available in the literature.

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1.0 Introduction

1.1 Central aspects

The situation of risk and safety in today's society is complex. Therefore, understanding how people react in risky situations is an important field of study. One of many challenges is the cognitive and emotional limitation which humans have. Significant mistakes often stem from these limitations, and experts, who are expected to be rational decision-makers, are no exception.

According to Socrates in the *Gorgias*, doing wrong is worse than suffering from others' wrongdoing, and it sickens the soul. The only way to fix the sick soul is to be punished for this wrongdoing, and he compares it to a doctor's healing of a sick body. Socrates insists that every man must strive to get punished if he do wrong; if not, the soul will be out of balance, and life will be of lower value (Kolstrand, 2006). In the *Gorgias*, Socrates also criticizes the art of speech, i.e. "rhetoric." He sees "rhetoric" as an unreflective, experience-based skill that only aims to please the public and has a subjective motivational goal. Further, he sees the art of medicine as a good example of rational, objective science. We might not like what the doctor says about our health, but it is knowledge based on natural science. A politician aims to say the right things at the right time, trying to make the majority agree with his/her point of view. He or she must play on the public's emotions to make voters side with them. Socrates says that rhetoric is not an art but a skill without any higher purpose. In other words, Socrates appears to suggest that striving towards objective science must be preferred over subjective preferences, even though it does not feel right or result in personal achievement.

Socrates' distinction between objective science and subjective preferences is central in this thesis. These phenomena can be compared to two different processes in the human mind: cognition and emotion. Scientists do not agree on the explanations of these terms, or on how these influence human decisions. As noted by Slovic and Peters (2006): "Additional research is needed to understand the circumstances in which affect protects us, and the circumstances in which it leads us astray" (p. 325).

The most central question in this thesis relates to the psychological reactions following a rational decision that has a surprising effect, with negative consequences. A person invests a thousand dollars on a bet that involves a winning chance of 99%, and loses. This person made

a correct choice based on the probability or the likelihood of winning - and the outcome was therefore, unexpected. How will this outcome influence this person's next move? Will s/he be willing to take another gamble with the same winning chance, or decline another perceived possibility of loss? The thesis will investigate what happens in the decision-making process after we make a rational choice that results in an unexpected negative consequence; what does the literature tell us about predictors of risk-taking and risk aversion, and how do the consequences affect our decision-making process?

1.2 Historical notions of emotional and cognitive decision-making

According to Hardman (2009), most historical economic and psychological accounts of risky decision-making have taken a quantitative approach, and assume that people make risky decisions as an attempt to maximize expected value or expected utility. Yet much of human decision-making behavior is not fully explained in this approach, and there are theories that account for some violations of presented maximizing theories, e.g. prospect theory (Kahneman & Tversky, 1979). Prospect theory suggests that risk attitudes depend on whether the possible outcomes ("prospects") are gains or losses, and whether the probability of the outcome is small, medium or large. According to Hardman (2009), "expected value theory" presents a representation of the basic decision strategy in decision-making involving probabilities and monetary outcome, i.e. calculation of the value of each possible outcome, and weighting of the result using the probability of occurrence. The best decision is based on the course of action that gives the highest expected value (Hardman, 2009). Problems with this theory were spotted as long as 200 years ago, however. As observed by Bernoulli (1738/1954 cited in Hardman, 2009), people do not act to maximize expected value in their behavior. He suggested the St Petersburg Paradox, a monetary game that (itself) has infinite expected value, and argued that a point in the game would arrive where one would only achieve "utility" if the game ended. Utility here represents a sense of pleasure or usefulness, but not wealth (Hardman, 2009). As described by Hardman (2009), when a person's wealth increases, each unit of money adds utility, but for each added unit of wealth, the unit of utility decreases. Rational decision-makers should therefore weigh the utilities of outcome according to their probability of occurrence and not the monetary value (Hardman, 2009).

A different view on decision-making involves how people feel about their choices, and how decisions are taken, under influence of affect. History often describes this as deciding with the heart/body, and not the rational head/soul. Socrates' point of choosing objective

science (Kolstrand, 2006) was a start, but many philosophers and psychologists have discussed emotions/feelings and the strife between rational and irrational behavior since then. Aristotle argued that the definition of feelings must account for the lust/disgust dimension (Teigen, 2004). He calls this the “affective quantity” and the “hedonic tone”, and, according to him, this dimension is a central element in the discourse on feelings and emotions. Back in the seventeenth century, René Descartes argued that the soul was pure reason and the flesh was the home of “mechanical passions” (Teigen, 2004). As Descartes phrased it himself: “Cogito ergo sum” (I think, therefore I am), which he saw as proof of his own existence as a human being (Teigen, 2004). Descartes’ quest was to give an example of pure rationality, with no connections to the obscure emotions and intuitions. He argued that what separate humans from animals is our ability to reason and think, whereas animals are driven by instinct and intuitions. Later, Baruch Spinoza used the perspective of Descartes as a baseline but argued against the distinction between body and mind. Spinoza suggested that reason cannot defeat emotion in any way. An emotion can only be overrun by a stronger emotion. Spinoza was a determinist, and believed that everything happens of necessity. Humans do have a free will, but only in the sense of understanding the way things happen and not in terms of influencing the way they happen (Teigen, 2004).

In 1829, James Mill (Teigen, 2004) explained the term “affect” as pleasant/unpleasant sensations attached to imagined cause and consequence. In the case of affect, Mill sees consequence as either certain or uncertain: experiencing an unpleasant sensation with a certain consequence produces sorrow, but when facing an uncertain consequence a person will experience fear (Teigen, 2004). Teigen (2004) says that Mill defined motivation as an association between the conception of an action and the expectation of pleasure to be experienced after the action itself. Troland described the “hedonic theory of motivation” more closely in 1928. Troland (1928) brings the “hedonic” aspect into modern psychology by dividing “hedonism” into three phases. “Hedonism of the present” means that our desire/discontent is decided in the present moment and that this influences our behavior. People strive to maintain pleasant circumstances and will try to change a current unpleasant situation into a pleasant one (Troland, 1928). “Hedonism of the past” suggests that our behavior is decided upon what made us pleased in the past; at the same time we distance ourselves from the things that brought us pain. According to Troland (1928), our behavior is shaped by the content/discontent consequence of our past decisions. Further, “Hedonic of the future” states that we choose actions that we know (from experience) have pleasant

consequences, and in the future we avoid those actions that have made us discontented (Troland, 1928).

Teigen (2004) writes that in the nineteenth century both terms, “emotions” and “affect,” were considered as interchangeable, although “affect” was used for especially strong and dominant states of mind associated with desire and lust. A person could make an affective decision in anger or by desire. Emotions, on the other hand, were seen as simple feelings like contempt or pleasure, feelings related to a distinct object or behavior (Teigen, 2004).

To what extent can people be considered rational when taking actions? According to Hardman (2009), rationality is normally seen as adherence to a normative model, such as probability theory. Scholars often disagree on how to explain research showing that people do not follow normative rules, and discuss to what degree, e.g. psychological experiments conducted in the laboratory, are appropriate bases for real-world situations. The discussion of how affect influences decision-making or action is an appropriate theme for this thesis.

1.3 Thesis aim and disposition

The core theme of this thesis relates to effects of unexpected negative outcomes following rational decision-making. It aims at a theoretical review of effects of negative, unexpected outcomes in spite of prior decisions justified by probability estimates or normative rules dictated by logic. It is assumed that emotional reactions will interfere in subsequent decision-making. The main research question is whether the decision maker becomes risk-averse or risk-taking following the negative outcome of a prior, rationally justified decision. The hypothesis, influenced by prospect theory, is that such a person is inclined to take risks rather than avoid risks.

To provide a theoretical basis for investigating this theme in some depth requires both inclusion of materials from several, very specific, subareas of psychology and well-motivated, but severely restricted, selection of theoretical perspectives to make the task manageable.

The core theme relates to theories of emotions or affects and cognitive processing. In the former subarea, a main distinction is made between basic or biologically oriented theories and affective or experiential theories.

The subarea of cognition involves a multitude of specific topics. The perspectives and theories chosen here reflect contributions to the understanding of cognitive processing more

generally, as well as of preferences and choices, judgments and decision-making. With respect to the latter aspects, both normative theories and various forms of descriptive theoretical models are included.

It is assumed in this work that the interaction between emotion and logical thinking is key to understanding the effects on decision-making after experience of an unexpected negative outcome. The nature of that interaction, however, is by no means simplistic. Although there may be important personality factors involved in a more complete explanation, related for example to the need for cognition or emotional management skill, the personality trait literature is not especially relevant here. Instead, the contents of the theoretical review involve short historical introductions to studies of emotion and affect as well as thinking and rationality, giving a broader base for understanding the core theme. The theoretical review also contributes examples from the research area of risk behavior, specifically literature dealing with management of loss and gain in monetary games. The relationship between emotions and cognitive processes is also viewed from the perspective of intuition, e.g. current literature on naturalistic decision-making (Klein, Orasanu, Calderwood, & Zsombok, 1993), formed through experience in field settings in contrast to heuristics inferred from experiments. In an attempt to exemplify the core theme, the phenomena of “bad beat” and “tilt” are presented from research conducted in the monetary game of poker. Here, a “bad beat” illustrates the unexpected negative outcome, whereas “tilt” is the term for the behavior following the “bad beat.” The chosen example will provide an approach to the investigation of how a negative outcome (“bad beat”) influences the decision-maker’s behavior and approach to future decisions.

The thesis discusses the contributions and the validity of selected theoretical approaches with reference to the major hypothesis that individuals react with increased risk-taking to an unexpected negative event; first in the area of the poker game and then in a more general sense.

2.0 Theories

2.1 Judgment and decision-making

This section presents normative and empirical views on decision-making, i.e. rules for how people should make rational decisions, as well as how decisions are made in an experimental environment.

In 1944, Von Neumann and Morgenstern published the book *Theory of Games and Economic Behavior*, which describes the theory of expected utility. According to Von Neumann and Morgenstern (1944/2004) there are four axioms that should govern the preferences of a rational decision-maker: completeness, transitivity, independence and continuity. Consequently, a rational decision-maker must have well-defined preferences and must be able to choose between two alternatives (completeness: $A < B$, $A > B$ or $A = B$); the choices must also be consistently decided (transitivity: $A > B$ and $B > C$, then $A > C$). Independence states that the decision-maker will maintain the same preference order even if two gambles are mixed with a third one or two gambles are presented independently of the third one: ($A > B > C$, then $AC > BC$). The axiom of continuity says that in three gambles where a player's preference is gamble A to gamble B, and gamble B to gamble C, then a possible combination of A and C is approximately as good as gamble B ($A > B > C$, then $A + C / 2 \approx B$) (Von Neumann & Morgenstern, 1944/2004, p. 26.). As described in the book, (Von Neumann & Morgenstern, 1944/2004, pp. 32-34) when satisfying these axioms, the decision-maker is rational, and the preferences can be represented by a utility function. The central hypothesis in expected utility theory is that a decision-maker always chooses the highest expected utility, not the highest expected value. According to Von Neumann and Morgenstern (1944/2004, p. 33), the expected utility of any gamble is an expressed linear combination of utilities for the outcome, with the weights representing probabilities.

Expected utility theory by Von Neumann and Morgenstern (1944/2004) predicts that if a rational decision-maker chooses between two bets, s/he will choose the one that would give a greater value or higher rating. Experimental work since the 1970s, however, has complicated the picture. According to Lichtenstein and Slovic (1971) such decisions do not rely solely on expected utilities. Their study demonstrates that a gamble is a multidimensional stimulus with diverse attributes, which have various degrees of effect on an individual's decision-making behavior. Lichtenstein and Slovic (1971) also argue that "choices and attractiveness ratings are determined primarily by a gamble's probabilities, and that bids are

most influenced by the amount to be won or lost” (p. 46). Kahneman and Tversky (1984) differentiate between normative and descriptive analyses of decision. Normative analyses represent the nature of rationality and the logic of decision-making, whereas descriptive analyses take on people's beliefs and preferences as they are, not as they should be (Kahneman & Tversky, 1984). Furthermore, Kahneman and Tversky (1984) suggest that all analysis of rational choice contains two principles, that is, “dominance” and “invariance.” Dominance requires that if gamble A is at least as good as gamble B in every respect, and better than B in at least one respect, then gamble A should be chosen over gamble B. Invariance demands that the preference order between gambles should not depend on the presentation of the gambles (Kahneman & Tversky, 1984). Additionally, Kahneman and Tversky (1984) argue that outcomes of decisions described as expressions of total possible wealth are psychologically unrealistic; people rather see outcomes in terms of gains or losses or as neutral (win, lose or status quo). They further suggest that gains and losses rather than total possible wealth should be the baseline for the psychological analysis of outcome. Moreover, in 1979 Kahneman and Tversky found indications of a preference for an uncertain gamble over a certain or sure outcome in a rigged experiment with small stakes. Being presented with two choices, one gamble with no variance and sure loss (highest expected value), and one gamble with large variance and small possible gain, subjects preferred the game with the larger variance, despite the fact that the first choice had both lower variance and higher expected value.

In 1979, Kahneman and Tversky suggested prospect theory as an alternative theory of choice. The results of experiments suggested that, in general, subjective value is a nonlinear function of size in both gain and loss situations. According to Kahneman and Tversky (1984), the value function is concave in the domain of gains, and convex in the domain of loss; further, the value function is much steeper in losses than in gains. This indicates that the subjects in the mentioned study were more averse to losses than attracted to gains. As Kahneman and Tversky (1984) argue, “the attractiveness of the possible gain is not nearly sufficient to compensate for the aversiveness of the possible loss” (p. 342). Choosing a sure outcome over a gamble that has higher or equal expectation is “risk aversion,” and rejecting a sure outcome in favor of a gamble of lower or equal expectation is “risk seeking” (Kahneman & Tversky, 1984). When risky decisions are made, people tend to place higher weight on overweigh small probabilities and smaller weight in relation to moderate and large probabilities, which indicate that people weigh probability in a nonlinear manner. According

to Kahneman and Tversky (1979), this might help to explain why people are attracted to both insurance (risk aversion with gain) and gambling (risk-seeking with loss). They further suggest, “a person who has not made peace with his losses is likely to accept gambles that would be unacceptable to him otherwise” (p. 287).

2.2 Emotions, feelings, arousal, and cognitive affect

To present the core theme fully, it is of importance to present relevant theories on emotions, feelings and affect, and outline their relevance to both emotional and cognitive affect.

Schwarz and Clore (1996) describe three broad classes of feelings: bodily feelings (hunger and pain), affective feelings (happiness and sadness) and feelings associated with knowing (familiarity, confusion and amazement). They suggest that all classes provide information from their respective domains. Bodily feelings indicate the state of various bodily systems, and affective feelings reflect appraisals of situations with respect to the individual’s goals and concerns. Lastly, feelings related to cognitive contents, e.g. subjective certainty or realizing that you “do not know,” help us make metacognitive judgments about our insight (Schwarz & Clore, 1996). Fiske and Taylor (1991) describe “emotion” as a term for a complex affect, beyond simple good or bad feelings. Emotions can imply intense feelings with physical manifestations, including physiological arousal. Emotions can be of relatively short or long duration, but they do not usually last as long as moods. Negative emotions are regarded as more complex than positive emotions because of the known rich variation of negative emotions. As an example, Fiske and Taylor (1991) ask us to consider the differences between anger, sadness, fear, disgust, anxiety, shame and hate.

Fiske and Taylor (1991) describe affect as a generic term for a range of preferences, evaluations, moods and emotions. Preferences include relatively mild subjective reactions that are essentially either pleasant or unpleasant. The most studied preference is evaluation; simple positive or negative reactions to other persons or objects. According to Fiske and Taylor (1991), preferences and evaluations can be distinguished from “moods.” The latter are seen as affects with a less specific target, and although moods can also be considered simply as positive or negative, however such descriptions of the feeling state do not capture the varying intensity and complexity.

The history of research on emotion reveals a long struggle over the role of cognitive processes in affect. The disagreement seems to originate from the dilemma of influence of cognition on affect, the influence of affect on cognition, and the occurrence of affect and

cognition in a simultaneous mix.

Early theories of emotion pose the question whether physiological responses precede or follow the experience of differentiated emotions. Fiske and Taylor (1991) observe that both William James and Carl Lange saw the human body as a generator of autonomic and muscular feedback; when it is stimulated, the feedback constitutes the experience of emotion. It is the bodily alteration that is the basis of what we feel, also known as the James-Lange theory of emotion (Teigen, 2004). This presented theory presumes that different emotions are guided by bodily patterns of reaction in order to demarcate emotions (Teigen, 2004). As James (1884) puts it, it is not that we see a bear, fear it, and run. We see a bear and run and consequently we fear the bear. Further, James (1884) also claimed that we have two distinct thinking systems, one rational and deliberate, and one effortless, quick and emotional. The secret of good decision-making is to know when to rely on which of the two (James, 1884). According to Fiske and Taylor (1991), Walter Cannon strongly disagreed with the James-Lange theory of emotion. He argued that visceral (intuitive) sensations are too diffuse to account for all the different emotions and that the autonomic system responds too slowly to account for the speed of emotional response. Cannon (1927) instead suggested that emotions are produced simultaneously with the reaction to a specific stimulus, known as the “Cannon-Bard theory of emotion.” Cannon (1927) argued that humans are able to react to a stimulus only after cognitively experiencing the related emotion. He also suggested, however, a highly non-emotional reaction: the “fight or flight response.” The “response” describes how animals react to threats with various defense responses; either fighting off the threat or flight to safety. The response is highly physical, and arguably charged by the system that controls most of the body’s internal organs, the “sympathetic nervous system.” (Cannon, 1915)

Both the James-Lange theory of emotion and the Cannon-Bard theory of emotion are often seen as a baseline for two distinct types of explanations of emotion by modern emotion/cognitive psychologists. Thus, Fiske and Taylor (1991) differentiate between a cognitive view (resemblance to the Cannon-Bard theory of emotion), and a physiological view (resemblance to the James-Lange theory of emotion).

Before the presentation of the different views, an example of the central role of arousal is given. As the example will outline, physiological reactions do not necessarily create emotional responses.

2.2.1 Arousal

In 1962, Schachter and Singer presented their Two-factor theory of emotion. This theory involved an experiment wherein subjects were given an injection of epinephrine (adrenaline) to enhance arousal reactions in the body (Schachter & Singer, 1962). The subjects were informed that this was a test of a new eye drug, “Suproxin.” One group of subjects was told that the injection had the same side-effects as epinephrine (epinephrine-informed), one group was told that the injection had no side-effects (epinephrine-ignorant), and the last group was misinformed about the side-effects (epinephrine-misinformed). After the injection, the subjects engaged in assignments within different social conditions, in a waiting room with a humorous person, and answering a complex and personal survey in collaboration with an annoying person (who expressed more and more aggression and dissatisfaction with the survey). According to Schachter and Singer (1962) the results from the experiment showed that the epinephrine-informed group acted calmly and was emotionally balanced. The epinephrine-ignorant and the epinephrine-misinformed groups, however, reacted with euphoria or anger in relation to the humorous person and the annoying person. The results suggest that raw bodily reaction alone does not create emotional responses, but depends on how we interpret the bodily reactions that produce emotions (Schachter & Singer, 1962). According to Schachter and Singer (1962), the epinephrine-informed group had an appropriate explanation for their arousal and did not need to find another explanation for physical experience. The example suggests, as supported by Fiske and Taylor (1991), “that physiological arousal combines with evaluative cognition to produce emotion. Visceral activation provides the intensity and particular emotional ‘feel’ of the experience, while evaluative cognitions provide the quality of differentiated emotional experience” (p. 423).

According to Zillmann (1983), arousal (emotional excitation of the sympathetic nervous system) has both autonomic and learned sources. He argues that emotions depend on three initially independent factors; a dispositional factor (learned and non-learned skeletal-motor reactions), an excitatory component (that creates learned and unlearned arousal reactions) and finally the experiential aspect (evaluation of initial reaction and analysis of the situation. Fiske and Taylor (1991) observe that the core of the Excitation Transfer Theory (Zillmann, 1983) is that arousal is non-specific, and if the arousal diminishes, we are all but useless in terms of explaining the source of arousal. Fiske and Taylor (1991) further claim

that residual arousal builds up, and new arousal (in a new situation) adds to the existing level of arousal, and the emotional reaction might therefore become more intense.

2.2.2 Physiological affect

In the physiological approach, sample theories are Facial Feedback Theory (Tomkins, 1962) and Hard Interface Theory (Zajonc, Adelman, Murphy, & Niedenthal, 1987). Tomkins (1962) argues that events trigger certain innate configurations of muscles, and that we first become aware of our feelings after the brain receives feedback from the face. This suggests that the feedback from facial expressions induces emotional experience and influences behavior. Further, Tomkins (1962) argues that emotions are activated by the changes in density of neural stimulation, and occur as a result of an innate discharge, or by another emotion. Zajonc et al. (1987) state that the whole body's motoric system responds to stimuli represented by both emotion and cognition. The body stores representations of motoric memories of emotion, such as muscular memory of riding a bike, or running because of fear. Izard (1977) argues that basic emotions (i.e. anger, disgust, fear, joy, sadness, distress, contempt, shame, interest, guilt and surprise) might emerge as early as ten weeks of age, and he reports appearances of each emotion in the face. Further, infants might be able to make facial discriminations, because they show different smiles to familiar and unfamiliar faces. According to Izard (1979), affective reactions in face discrimination in infants show similarity between emotional expression and subjective experience. Izard (1979) assumes that some emotion is always present in consciousness, and that the emotion of "interest" dominates behavior. This emotion directs and maintains attention and exploration (in a person), and "interest" is only absent when other emotions like distress or anger conquer consciousness (p. 165).

Ekman and Friesen (1969) argue that facial expressions of some emotions are not culturally determined (although they can be culturally controlled) but universal across human cultures and are the result of biological origin. Such universal expressions involve anger, disgust, fear, joy, sadness, and surprise, which comprise Izard's (1977) basic emotions. Later, Ekman (1999) expanded the list to include contempt, amusement, contentment, excitement, guilt, pride in achievement, relief, sadness/distress, sensory pleasure, surprise and embarrassment. The expanded list is not universal. Ekman (1999) also argues that there can be what appears to be an expression without genuine emotion. Humans can deliberately or by habit fabricate an exact copy of an emotional expression, both facially and vocally. The cause

of this behavior is not exactly known, but it probably functions to mislead others, or to refer to an emotion that is not currently experienced (Ekman, 1999).

In contrast to mentally and socially controlled emotions, Damasio (1994) observed unusual behavior in patients with frontal lobe damage in decision-making situations. He found that patients with such damage had great difficulties in experiencing emotions, and that they had problems in making decisions – even trivial ones. Damasio experienced difficulty setting up appointments with the patients, because of their indecision. He concluded from this research that anticipatory emotions, i.e. somatic markers, play a critical role in decision-making by tangibly encoding a summary of the likely consequences of a particular action. Lacking such somatic markers, the frontal lobe-damaged patients were not able to take account of the future consequences of their choices and therefore had problems with decision-making (Damasio, 1994).

2.2.3 Cognitive affect

Cognition is a faculty for the mental processing of information, e.g. memorizing, knowing conditions, applying knowledge, and changing preferences, either consciously or unconsciously. Bluma Zeigarnik, one of Kurt Lewin's students, claims that people tend to remember half-finished or disrupted assignments better than completed tasks. According to Lewin (1927), Zeigarnik gave her subjects a huge list of different small assignments, and in the experiment, 50 percent of the assignments were stopped before they were completed. After the experiment, the subjects were asked to write down the assignments they remembered. The results indicated that the group with disrupted tasks remembered more of the tasks than the group with completed tasks (Lewin, 1927). This tendency is called the "Zeigarnik effect."

According to Mandler and Cowan (1962), appraisal results in personal meaning. Cognitive affect refers to unexplained arousal that leads people to search their environment for cognitive labels for their emotions (cf. Schachter & Singer, 1962). Lewin (1927), Mandler and Cowan (1962) and Fiske and Taylor (1991) argue that arousal originates from a perceptual or cognitive discrepancy or the interruption of ongoing action (or expectation). The degree of discrepancy or interruption determines the extent of experienced pleasantness or unpleasantness. Mandler and Cowan (1962) argue that arousal and emotion is produced as a result of discrepancy or interruption of present activity. According to Mandler and Cowan (1962), disruptions violate the expectations of outcome in the ongoing activity, and the

complexity of the interrupted activity relates to the level of arousal produced. Further, the interpretation of arousal (affective quality, either positive or negative) forms a lasting mental representation of the disruptive event (Mandler & Cowan, 1962).

According to Fiske and Taylor (1991), arousal might intensify emotion, as “the complexity of the interrupted activity corresponds to the amount of arousal one feels” (p. 424). The feeling of arousal sets off cognitive interpretation of the interruption, and is interpreted as either positive or negative. The interpretation of arousal (negative or positive) plus the intensified emotion provides the basis for an affective response (Fiske & Taylor, 1991). Thus, according to Fiske and Taylor (1991), disrupted expectations create arousal and cognitive interpretations. The interpretations determine the quality of affect, whereas the extent of the interruption and subsequent arousal determine the intensity of affect. Further, the cognitive interpretation shapes not only the quality of one’s immediate affect but also one’s lasting mental representation (Fiske and Taylor, 1991).

Cognitive dissonance and Appraisal Theory

A Theory of Cognitive Dissonance by Leon Festinger (1957) describes “cognitive dissonance” as a phenomenon occurring when thoughts, observations, feelings and perceptions are not in harmony, balance or consonance. This creates a feeling of unpleasant “dissonance” of impressions, and a person in such a situation will try to relieve this discomfort by thought or by action (Festinger, 1957). When dissonance is eliminated, there will be “consonance” between the impressions. Further, when consonance is present in the person, he or she will actively try to avoid similar situations or similar information to that which earlier produced the dissonance. Festinger (1957) sees the term “cognitive” in this discourse as any knowledge, opinion or belief about the environment, about oneself or about one’s behavior.

Appraisal theory holds that every stimulus is evaluated by a person’s own personal experience and in the interest of their own well-being in relation to the environmental reality. As described by Lazarus (1966) we first perform a “primal appraisal,” which is seen as a simple reaction to a perceived harm or benefit. Does this motivate me? And does it facilitate achievement of my personal goal? Then we make a “second appraisal” that produces more specific emotions (guiding us to cope with the situation) and these include two paths of response strategies: first, a problem-focused coping strategy, when a person tries to change their relationship with the environment; second, an emotion-focused coping strategy, when a

person attempts to avoid the threat or changes the significance of the threat (attempts to make it less dangerous) (Lazarus, 1966).

2.3 Various views on independently existing systems

Zajonc (1980) suggests that there are two different systems with effects on information processing. He argues that within milliseconds a certain feeling arises without any prior evaluation of a situation, and therefore affective reactions are not dependent on extensive perceptual and cognitive encoding. His title states: “Preferences need no Inferences,” and he argued that preferences exist without elaborate cognitive processing. Further, choices made on the basis of these affective reactions are evaluated with confidence and are made more rapidly than cognitive judgments (Zajonc, 1980). He also demonstrates that reliable affective discriminations can be made without recognition memory, and concludes that affect and cognition are controlled by two independent systems providing different sources of effects on information processing, and that these systems may influence each other. Thus, Zajonc (1980) differentiates between a non-cognitive affective system, and cognition. Chaiken (1980) suggests a heuristic-systematic model for social judgments. This dual-process framework proposes two basic modes for processing; a heuristic mode, and a (cognitive) systematic mode. Chaiken (1980) describes the heuristic mode as the use of rules or “heuristics (knowledge structures learned or stored in memory)” in judgments, and claims they reflect easy processing of cue information, which demands minimal cognitive effort. The heuristic mode is usually constrained by activation of knowledge, such as the availability, accessibility and applicability of processed information. Chaiken (1980) further argues that systematic processing is a more comprehensive and in-depth analysis of relevant information for making a judgment, and it requires cognitive ability and capacity. Petty and Cacioppo (1986) suggest that these systems may act alone in a judgment, but often information is processed in both systems at the same time – creating a possible conflict between the two.

Another scientist who describes a dual process is Sloman (1996). He suggests that “*two systems of reasoning*” occur within the cognitive system. He argues that we have one associative system and one rule-based system. The systems perform complementary functions and simultaneously generate different solutions to a reasoning problem – where the rule-based system can suppress the associative system, but not completely inhibit it (p. 3). Sloman (1996) refers to James’s (1890) work as the most thought through idea of the distinction between the two systems. James writes that associative thoughts are just images suggested by others, and

are merely reproductions, i.e. elements of or abstractions from past experience, and do not always concur with observation. On the other hand, the rule-based system or “true reasoning” is productive and can deal with novel data (Sloman, 1996).

Epstein (1994) presented the personality cognitive experiential self-theory (CEST), which calls attention to two interactive modes of information processing, the rational and experiential system (see Table 1). The theory, according to Epstein (1994), is as much a theory of emotion as of cognition. Epstein (1994) views emotions in everyday life as almost consistently produced by a preconscious interpretation:

People are angry, sad, or frightened, not as a direct result of what objectively occurs but because of how they interpret what happens. If a person interprets an action directed at him or her as unwarranted and deserving of punishment, the person will most likely feel angry. (p. 710)

Epstein (1994) sees common language as proof that people are intuitively aware of two basically different ways of processing information: one is related to feelings and experience and one is related to the intellect. According to Epstein (1994), assessments are products of cognitions, and conflicts between “the heart” and “the head” are necessarily between two types of processes. In other words, Epstein (1994) argues that there is always friction between emotion and reason. Epstein (1994) argues that irrational fears provide evidence of a non-rational way of processing information. People often maintain their irrational worrying beliefs at great personal cost, despite recognizing that they are irrational, and sometimes they also find them more compelling than the results of their rational reasoning (Epstein, 1994).

Epstein (1994) further describes the experiential/rational system as compatible with the view of an affective and non-affective dichotomy. Processes in the experiential system (and its influence on rational thinking) can lead people to judge events that are only randomly related as causally related. Moreover, Epstein (1994) suggests that experiential processing relative to rational processing is increased when perceived emotional consequences are increased. He exemplifies this by suggesting that evaluating people as “good” or “bad” on the basis of a randomly produced outcome is a high-priority heuristic.

Table 1 Comparison of the Experiential and the Rational Systems

Experiential System	Rational System
Holistic	Analytic
Affective: pleasure/pain-oriented (what feels good)	Logical: reason-oriented (what is sensible)
Associationistic connections	Logical connections
Behavior mediated by “vibes” from past experiences	Behavior mediated by conscious appraisal of events
Encodes reality in concrete images, metaphors, and narratives	Encodes reality in abstract symbols, words, and numbers
More rapid processing: oriented toward immediate action	Slower processing: oriented toward delayed action
Slower to change: changes with repetitive or intense experience	Changes more rapidly: changes with speed of thought
More crudely differentiated: broad generalization gradient; stereotypical thinking	More highly differentiated
More crudely integrated. Dissociative, emotional complexes; context-specific processing	More highly integrated: cross-context processing
Experienced passively and preconsciously: we are seized by our emotions	Experienced actively and consciously: we are in control of our thoughts
Self-evidently valid: “Experiencing is believing”	Requires justification via logic and evidence

Source: Epstein (1994, p. 711), first suggested in Epstein and Curtis (1991)

Kahneman (2011) adopts the terms proposed by Stanovich and West (2000) and describes “system 1” and “system 2” in the following manner:

System 1 operates automatically and quickly, with little or no effort and no sense of voluntary control. System 2 allocates attention to the effortful mental activities that demand it, including complex computations. The operations of system 2 are often

associated with the subjective experience of capacity, choice and concentration. (pp. 20-21)

Of special relevance to this thesis, Kahneman (2011) further describes some of the differences in system 1 and system 2. System 2 is the only one that follows rules, compares objects in terms of several attributes, and makes deliberate choices between options. System 1 detects simple relations (e.g. likeness or difference in height) and excels at integrating information about one thing, but does not deal with multiple distinct topics at once. According to Kahneman (2011), people who are “cognitively busy” in system 2, i.e. conduct cognitively difficult tasks, e.g. try to memorize long sequels of numbers, “are more likely to make selfish choices, use sexist language, and make superficial judgments in social situations” (pp. 41). Here, system 2 is effortful, and system 1 influences behavior somewhat unconsciously.

Kahneman (2011) further states: “One of the main functions of system 2 is to monitor and control thoughts and actions “suggested” by system 1, allowing some to be expressed directly in behavior and suppressing and modifying others” (p. 44). Sometimes, too many of the “suggestions” from system 1 are let through, negatively influencing rational thinking and logics. Kahneman (2011) uses the following example in his book:

All roses are flowers.

Some flowers fade quickly.

Therefore some roses fade quickly. (p. 45)

He explains that a large majority of college students find this argument valid. Unfortunately, the argument is wrong, because it is possible that there are no roses among the flowers that fade quickly. Kahneman (2011) argues that *the plausible answer* comes to mind immediately, and overriding this immediate judgment requires hard work. Therefore, the perceived and insistent “true” idea makes it difficult to second-guess, and most people do not make the effort to think through the problem (Kahneman, 2011). Kahneman (2011) uses the “fading flower” argument as an example of why many people are overconfident, and sometimes place too much faith in their intuition. He suggests that people find cognitive effort somewhat unpleasant and therefore try to avoid it as much as possible.

Gilbert and Wilson (2009) illustrate how the two systems interact with each other, through “previews” – mental stimulations, “promotions” – affective reactions, and “predictions” – forecast about the future event’s emotional consequences. They state:

System 2 generates simulations of dentists and doughnuts and system 1 generates emotional reactions to those simulations. Because system 2 does not have direct access to the information that system 1 uses to generate these emotional reactions, it tells system 1 a fairy tale—sometimes enthralling, sometimes frightening—and then listens closely to its response. System 2 uses system 1 as a test audience and assumes that if system 1 reacts with pleasure to a simulated event, then it will react with pleasure to the event itself. In essence, system 2 determines how system 1 will react in the future by tricking it into reacting in the present. (p. 1340)

In summary, the literature suggests that information in decision-making is processed by different systems or different modes of thinking, often one deliberative and one affective-experiential, which to some degree interact with each other (according to. e.g. James, 1890; Zajonc, 1980; Chaiken, 1980; Sloman, 1996; Epstein, 1994; Kahneman, 2011).

2.4 Expectations, experiences and explanations, and influencing factors

2.4.1 Expectations (of outcome)

As presented in the introduction, a choice of decision in a monetary game is based on “expected value theory”: calculating the value of each possible outcome, and weighing these results using the probability of occurrence. This chapter will highlight that expectations may also be influenced by preferences, cognitive available memory, experience from earlier decisions, and the context in which choices are presented. Weiner’s (1985) and Weinstein’s (1989) studies on what motivates people not to engage in a certain activity are relevant here because they suggest that e.g. experience forms expectations and influence perceived controllability of the situation/event. For example, the suggestion that perceived low controllability in a situation gives a sense of vulnerability is of special relevance for the core theme.

Weiner (1985) states that people have affective responses to perceived potential consequences of external or internal cause, which subsequently influence a person's own perceptions or attributions which in turn determine the amount of effort the person will invest in activities in the future. Further, Weiner (1985) argues that perceived causes of success and failure share three common properties: locus, stability, and controllability. Further, Weiner (1985) argues:

The perceived stability influences and changes anticipation of success, and all three dimensions of causality affect a variety of common emotional experiences, such as anger, gratitude, guilt, hopelessness, pity, pride, and shame. Expectancy and affect, in turn, are presumed to guide motivated behavior. (p. 548)

Weinstein (1989) argues that personal experience of unpleasant consequences might cause subsequent precautionary or self-protective behavior that subsequently affects the decision-making process. Weinstein holds that personal experience can modify people's emotional reactions to risky situations in complex ways, situation- or domain-specific, like increased feelings of worry, resulting in an increase in self-protective behavior in some domains but also, and more commonly, decreasing feelings of controllability in specific situations. According to Weinstein (1989) sense of vulnerability appears to be limited to situations very similar to the ones in which a certain treatment has happened before, but he argues that there is no clear evidence of the extent of this generalization. As a consequence, people might take the precautions that they believe are appropriate on the basis of specific risky/unpleasant experiences encountered in the past. These past experiences lead people to think about the risk more often, and add clarity and greater perceived higher frequency than is actually merited (Weinstein, 1989). The consequence might result in increased interest in prevention. The tendency in complex decision-making, however, is slightly different; people are often unable to weigh the evidence accurately for and against taking precautions. As a consequence, recommendations by “experts” that enable them to bypass the decision process are found preferable (Weinstein, 1989).

Heuristics and biases

A number of phenomena influence judgments, directly or indirectly, and selection of such phenomena is presented within this section.

Tversky and Kahneman (1973) found indications of a judgment shortcut, namely the availability heuristic. This heuristic uses the strength of memory associations to judge the frequency or likelihood of an event. Availability can be influenced by factors such as the immediacy, familiarity and vividness of events (Tversky & Kahneman, 1973). Further research conducted by Tversky and Kahneman (1983) shows that people often confuse judgment of probability with judgment of similarity, known as the representativeness heuristic. This phenomenon might lead a judgment away from what probability theory would

predict, and can especially enhance misperceptions of random sequences that involve an assessment of probability (Tversky & Kahneman, 1983).

Gambler's fallacy (Tversky & Kahneman, 1971) is a cognitive bias produced by the representativeness heuristic. Gambler's fallacy is described as the tendency to expect the opposite outcome in future trials when there has been a deviation from the expected outcome in repeated independent trials. A player influenced by gambler's fallacy will implicitly assign a higher chance of occurrence to a special event ("the law of small numbers"), even though from the randomness perspective all outcomes are equally probable. Also, the reverse behavior is a fallacy, that is, a player choosing to believe that an already repeated outcome is more likely to occur again (Tversky & Kahneman, 1971). Lehrer (2009) gives an example of gambler's fallacy that happened in a Monte Carlo casino in the summer of 1913, when the ball fell on black 26 times in a row, an extremely uncommon occurrence, and gamblers lost millions betting against black in the black streak. Gamblers reasoned that the streak was an "imbalance" in the randomness of the wheel, and that it had to be followed by a long streak of red (Lehrer, 2009).

The true believer in the law of small numbers commits his multitude of sins against the logic of statistical inference in good faith. The representation hypothesis describes a cognitive and perceptual bias; which operates regardless of motivational factors. (Tversky & Kahneman, 1971, p. 110)

"The belief in the hot hand" (Gilovich, Vallone, & Tversky, 1985) is a misperception of random sequences in "streak shooting," observed in basketball. The study shows that outcomes of previous shots influenced basketball-player's predictions of performance, but not their actual performance. Gilovich et al. (1985) argue that "the 'detection' of streaks in random sequences is attributed to a general misconception of chance" (p. 295), and even a short random sequence is thought to be valid for generalization an outcome. A field study by Croson and Sundali (2005) supports the "hot hand" hypothesis, and sees the results as an argument for: "intuitive ideas of randomness [which] depart systematically from the laws of chance" (p. 195).

The "sunk cost" effect is a tendency to continue the effort once an investment of money, time or effort is made (Arkes & Blumer, 1985). According to Arkes and Blumer (1985), the psychological rationalization for this behavior is that people do not want to appear wasteful. Two overall characterizations of the "sunk cost" effect suggest that people are

overly optimistic about the probability of success in their investment, and that they feel that they have a personal responsibility for being consistent, even when the investment is viewed as a failure (Arkes & Blumer, 1985).

According to Fischhoff (1975), hindsight bias is the inclination to evaluate past events as more predictable than they in fact are. He found that individuals tend to remember their predictions of future events as having been more accurate than they actually were, especially in those cases where their predictions turned out correct; this is called “creeping determinism” by Fischhoff.

When we attempt to understand past events, we implicitly test the hypotheses or rules we use to both interpret and anticipate the world around us. If, in hindsight, we systematically underestimate the surprise, which the past held and holds for us, we are subjecting those hypotheses to inordinately weak tests and, presumably, finding little reason to change them. Thus, the very out-come knowledge which gives us the feeling that we understand what the past was all about, may prevent us from learning anything from it. (Fischhoff, 1975, p. 298)

Mark Pezzo (2003) proposes a sense-making model, which suggests that an unexpected outcome requires a sense-making process, which in turn is associated with “hindsight bias.” Even though it is possible that an outcome was (to some extent) expected, Pezzo (2003) associates the sense-making process with “hindsight bias.” If an outcome can be understood in the light of one's expectations, then hindsight bias should occur. According to Pezzo (2003), the expected outcome will also produce little hindsight bias, because the outcome invokes relatively little sense-making in the first place. Pezzo (2003) argues that feelings of surprise arising from sense-making should inversely be related to hindsight bias.

In relation to heuristics and biases, Slovic (2000) points out that people usually find it challenging to obey the principles of probability theory when they are forced to make a choice in uncertain events. Instead they replace the laws of probability with intuitive heuristics. These estimates might be good estimates, but usually they result in systematic biases (Slovic, 2000).

2.4.2 Experiences

This section concentrates on how people appraise risk and act on unpleasant experience. Also, the affect heuristic is here presented as a relevant explanation of how we

react emotionally to threat. The section also considers intuition from the experience and from the cognitive perspectives. A study of confidence in intuition is also presented.

According to Alhakami and Slovic (1994), judgments of risk and judgments of benefit might be related to a person's general affective evaluation of activity or outcome. As a consequence, "pleasant" activities that are judged low in terms of risk tend to be judged high in terms of benefit. Certain outcomes can be high in both risk and benefit, and vice versa, e.g. playing a game of poker. Breakwell (2007) argues that the perceived inverse relationship between risk and benefit is linked to how affect influences judgments (p. 112). Slovic, Finucane, Peters and MacGregor (2005) explain this by what they call a "faint whisperer of emotion," namely affect. The description of affect by Slovic et al. (2005) is a specific quality of pleasantness or unpleasantness, both conscious and unconscious, determined by the positive/negative quality of an experienced stimulus. Slovic et al. (2005) suggest that risk is perceived and acted on in two different ways. "Risk as feelings refers to individuals' fast, instinctive, and intuitive reactions to danger. Risk as analysis brings logic, reason, and scientific deliberation to bear on risk management. Reliance on risk as feelings is described with 'the affect heuristic'" (p. 35). Finucane, Alhakami, Slovic and Johnson (2000) suggest the "affect heuristic" as an attempt to explain the commonly observed inverse relationship between perceived risk and perceived benefit (p. 1). The affect heuristic is described as rapid and automatic affective responses, and the reliance on these, where both judgments and decisions can be incoherent, not only because the affective components are involved but also because these are subjected to innate biases of the experiential system (Finucane et al., 2000). In their, the assumptions are made that people base their judgments of an activity not only on what they process of information but also on their feelings toward the activity. If feelings toward an activity are favorable, the risks are judged as low and the benefits as high; if feelings toward the activity are unfavorable, the risk is judged as high and the benefit as low (Finucane et al., 2000).

As exemplified by Slovic, Finucane, Peters and Macgregor (2004), "...the affective system seems designed to sensitize us to small changes in our environment (e.g., the difference between 0 and 1 death) at the cost of making us less able to appreciate and respond appropriately to larger changes further away from zero (e.g., the difference between 500 and 600 deaths)" (p.9). Slovic et al. (2004) suggest that perception and integration of affective feelings, within the experiential system, form a psychological basis of utility. Therefore, the affect heuristic enables us to be rational actors in many important situations, but unfortunately

not in all: “It works beautifully when our experience enables us to anticipate accurately how we will like the consequences of our decisions. It fails miserably when the consequences turn out to be much different in character than we anticipated” (Slovic et al., 2004, p. 11).

According to Loewenstein, Weber, Hsee and Welch (2001), people react to the expectation of risk at two levels: they estimate the risk cognitively and they react to it through emotions. These two processes influence each other, even though they have different determinants. Loewenstein et al. (2001) argue that cognitive evaluations of risk are sensitive to normative decision-making analysis like probabilities and outcome valences. Emotions respond to cognitive evaluations, but they might also appear in minimal cognitive processing. For example, a fear reaction can be experienced without even knowing what to be afraid of, and might be more influenced by factors like association and proximity. Loewenstein et al. (2001) point out that because of these possibilities, people often experience an inconsistency between the fear they experience in connection with a particular threat and their cognitive evaluation of the threat posed by that (actual) risk. Loewenstein et al. (2001) state:

One's mental image of what it would be like to win the state lottery, for example, is likely to be about the same, whether there is a 1 in 10,000,000 chance of winning or a 1 in 10,000 chance of winning. The mental image of winning \$10,000,000 or \$10,000, on the other hand, is likely to be very different. This is not to say that fear responses are completely unaffected by probabilities, but they are largely unaffected by orders-of-magnitude differences at the extreme (e.g., between a 1 in 100,000,000 chance of winning the lottery and a 1 in 100,000 chance). (p. 267)

They further note that responses to a situation with low probability of success appear to be largely insensitive to the probability of negative consequences and more sensitive to the *perceived possibility* of positive consequences. This causes the tendency of very small probabilities to carry great weight in decision-making processes, as long as the perceived consequences are positive (Loewenstein et al., 2001).

Intuition-based decisions

Klein (2008) describes the naturalistic decision-making (NDM) framework that contrasts with Kahneman and Tversky's heuristics and biases tradition, and experimentally demonstrates that people do not obey the principles of optimal performance (the laws of probability, the principles of expected utility theory, and Bayesian statistics). The NDM

framework was designed to study how people actually make decisions and perform cognitively complex tasks in demanding situations (Klein, 2008).

Klein, Orasanu, Calderwood and Zsombok (1993) define NDM as “the way people use their experience to make decisions in field settings” (p. 19). Kahneman and Klein (2009) state that the NDM and heuristics and biases (HB) approaches share the assumption that intuitive judgments and preferences have the characteristics of “System 1” activity: “They are automatic, arise effortlessly, and often come to mind without immediate justification” (p. 519). The difference between the approaches is that the NDM framework focuses on intuition based on experience and skill, whereas HB are mainly concerned with intuition from simplified heuristics (Kahneman & Klein, 2009). Kahneman and Klein (2009) claim that intuitive judgments from simplified heuristics might be less accurate and more prone to systematic biases. They reach the conclusion that intuitive judgments can arise from both genuine skill (NDM approach), and from application of the heuristic processes. Further, other “failures to disagree”¹ between Kahneman and Klein involve given examples such as “skilled judges are often unaware of the cues that guide them, and individuals whose intuitions are not skilled are even less likely to know where their judgments come from” (p. 524). Kahneman and Klein (2009) claim that true experts “know when they don’t know” (p. 524). Moreover, non-experts (whether or not they think they are novices) do not even know when they do not know. Therefore subjective confidence is an unreliable indicator of the validity of intuitive judgments and decisions (Kahneman & Klein, 2009, p. 524). Other relevant arguments by Kahneman and Klein (2009) follow:

1. The determination of whether intuitive judgments can be trusted requires an examination of the environment in which the judgment is made and of the opportunity that the judge has had to learn the regularities of that environment.
2. Validity and uncertainty are not incompatible. Some environments are both highly valid and substantially uncertain. Poker and warfare are examples. The best moves in such situations reliably increase the potential for success. (p. 524)

Kahneman and Klein (2009) seem to argue for the possibility of developing a “skilled intuition,” although an environment of high validity and sufficient opportunities for learning in that environment (prolonged practice and feedback that is both rapid and explicit) are needed in the process. Highly valid and responsive environments will eventually develop skill

¹ This is the title of the 2009 article.

and expert intuition in individuals of sufficient talent. Further, Kahneman and Klein (2009) state that, “true skill cannot develop in irregular or unpredictable environments. Individuals might sometimes make judgments and decisions that are successful by chance” (p. 524). These individuals will be more likely to be vulnerable to an illusion of skill and to overconfidence in their intuition (Kahneman & Klein, 2009).

Overconfidence and persuasive intuition

With regard to skilled judges, Larrick, Burson and Soll (2007) demonstrate that in some cases being overconfident might also result in a perception of better-than-average nature. They argue that domain-specific feelings of competence account best for the relationship between overconfidence and better-than-average judgments. Simmons and Nelson (2006) suggest that having confidence in intuition makes people choose intuitive options more frequently than similar valid (or even more valid) non-intuitive alternatives. In other words, people often choose their favorites over reason-calculated choices. This intuitive bias is not a simple product of people’s failure to process limited information in the environment; people still persist in using intuition, even when other people recognize such explicit and quantifiable limitations within their intuitions. Some people, even though they have set the limits of their choices themselves, trust more in their intuition than logical thinking. Research conducted by Simmons and Nelson (2006) suggests that intuitive biases are mostly pervasive, occurring even when all information relevant to the immediate decision context is processed and understood and renders a different decision.

Mental accounting and loss sensitivity

Finally, it is of relevance in this context to look at experiences related to prior gains and, especially, losses.

“The loss-sensitivity principle” was suggested by Romanus, Hassing and Gärling (1996) after a series of risky decision experiments with Swedish psychology students. They found that their subjects integrated the knowledge (i.e. loss) of a prior outcome in gambles with noticeable expected losses, like horse racing. The “integration of loss” was observed to have stronger impact in high stakes than low stakes. Moreover, students in a positive mood had a greater integration of prior outcome than students in a neutral mood. Students who did not know the outcome of a previous choice of gamble were more likely to accept the current gamble. According to Romanus et al. (1996) their results support the loss-sensitivity principle,

suggesting that when subjects evaluate possible outcome of a current choice, they integrate the prior outcome with an expected loss. Rather than attempting to maximize happiness (Thaler, 1985), (novice) students appeared to attain affective control by minimizing negative impacts.

Thaler and Johnson (1990) suggest that people might cognitively separate or integrate gains and losses in the process of maximizing their happiness. As a “mental accounting” strategy, the “hedonic editing hypothesis” is suggested. According to Thaler and Johnson (1990, p. 647) it contains four principles (first proposed by Thaler, 1985) of hedonic framing, based on the shape of the value function in prospect theory:

1. Segregation of gains (concave value function)
2. Integration of losses (overall steeper convex value function for loss than gain)
3. Integration of smaller losses with larger gains
4. Segregation of small gains from larger losses (because the gain function is steepest at the origin, and the utility of a small gain can exceed the utility of slightly reducing a large loss)

Thaler and Johnson (1990) ask how risk-taking behavior is affected by prior gains and losses. They state that prior gains and losses can evoke intuition in a novice decision-maker, and dramatically influence subsequent choices. They found empirical support for two hedonic editing effects. First, the supported effect, i.e. “house money effect,” which states that increased risk-seeking behavior is observed in the presence of a prior gain. Second, the “break even effect” (see Kahneman & Tversky, 1979) suggests that a decision-maker seeks an outcome that offers a chance to break even, as long as it does not include the risk of losing significantly more money.

2.4.3 Explanations

This section will present relevant theories that help explain why a person may conduct risk-seeking or risk-averse behavior after an unexpected negative outcome. These theories involve perspectives from framing models, and the well-known “attribution theory.” In attribution, the section presents views on the “need” for control and explanations from motivational psychology, cognitive ability and personality traits, more specifically the “need for cognition” and the “numeracy” factors.

Kahneman, Knetsch and Thaler (1986) found that judgments of fairness are vulnerable to framing effects, especially in consumer and labor markets. They found that raising prices or cutting wages is seen as unfair, even if the market is changing. Kahneman et al. (1986) exemplify this phenomenon by citing how 82 percent of respondents (N = 107) found it unfair that a hardware store raised prices on snow shovels after a large snowstorm.

Fritz Heider according to Teigen (2004), was inspired by Spinoza in the development of attribution theory. Heider (1958) argues that an unfair advantage judged by objective standards might create annoyance, resentment and envy. This unfair advantage is a violation of the “ought force,” a psychological balance that suggests that similar people should have similar outcomes. The envious person feels a sense of injustice because the envied person’s advantage violates what “ought” to be (Heider, 1958). The feeling of injustice, i.e. the violation of what “ought to be,” leads to constrained hostility. Heider (1958) also argued that people have a tendency to attribute an event or action either to the characteristics of a person (internal attribution) or to the situation where this event/action was conducted (external attribution). This theory can be compared to Rotter’s (1966) theory of locus of control, which specifies that people with internal (high) locus of control see themselves as responsible for events happening to them, whereas a person with external (low) locus of control explains that an external force is responsible for personal events and behavior (Rotter, 1966).

An example of illusion of control in games follows. Dice games like “Yatzy” are popular games. A probable reason for this popularity might be an innate need for control over randomness, and to show that it is possible to achieve success despite bad odds. Langer (1975) found implications of an interaction of illusion of control and competition, familiarity, choice and involvement. A person might experience greater confidence in their own predictive ability, or in a favorable outcome, when they have a higher degree of personal involvement, even when their involvement is not actually relevant. In a situation of competition, people were found to be more confident (betting more money) when playing a non-confident opponent than a confident opponent (Langer, 1975). She also suggests that the individual’s perceived control over an outcome leads to a flawed individual probability of success. A later article by Fenton-O’Creevy, Nicholson, Soane and Willman (2003) argues that “illusions of control may cause insensitivity to feedback, impede learning and predispose toward greater objective risk taking (since subjective risk will be reduced by illusion of control)”(p. 55).

Cohen, Stotland and Wolfe (1955), in their work on individual differences in cognitive motivation, identified a "need for cognition" which they defined as "the individual's need to organize his experience meaningfully," "the need to structure relevant situations in meaningful, integrated ways," and the "need to understand and make reasonable the experiential world" (p. 291). Petty, Briñol, Loersch and McCaslin (2009) discuss several findings relevant to "need for cognition" and argue that people low in "need for cognition" are more prone to process information through the experiential system than the rational system, and vice versa. These people might rely more on heuristic biases than people high in need for cognition (Petty et al., 2009).

Numeracy or "number sense" is the ability to reason and to apply simple numerical concepts, e.g. addition, subtraction, multiplication and division. It is mentioned here since it is of relevance to the thesis. Peters, Västfjäll, Slovic, Martz, Mazzocco and Dickert (2006) examined the roles of numeracy and affect in decision-making. They studied to what extent numerical ability serves as a mediator of decision performance (helping performance in some situations and hurting performance in others) (p. 414). The results show that highly numerate individuals are more likely to retrieve and use numerical principles, and are less impacted by framing effects, compared with less numerate people. Further, highly numerate individuals draw a more precise and affective meaning from numbers and numerical comparisons –which might result in both a more accurate decision and a worse decision. Peters et al. (2006) argue that the research demonstrates that individuals may differ regarding the type of assistance they need in making decisions. Those low in numerical ability may need different decision aids than those high in numerical ability. In the current context "numeracy" could be assumed to impact ability and success in terms of playing poker as well as help explain reactions to unexpected negative outcomes.

2.4.4 Learning, memory and recall

Schwarz and Clore (1996) wrote, "a large amount of recent social psychological research into affective influences on human cognition and behavior has been guided by the assumption that our feelings influence the content of our thought" (p. 435). They held that research in the area was dominated by a focus on "recall-mediated processes," in line with the general focus of information processing models. In social psychology, the focus was on research into encoding, organization, storage, and retrieval of information (e.g. about others) (Schwarz & Clore, 1996). Moreover, Schwarz and Clore (1996) observed that researchers in

social cognition started to pay attention to the impact of affective states on social judgments, and observed that evaluative judgments are usually more positive under euphoric than under depressed moods. These researchers in this field have assumed that moods' effect on evaluative judgments and behavioral decisions are mediated by emotional influences on the retrieval of information from memory (e.g. Isen, Shalke, Clark, & Karp, 1978). Swartz and Clore (1996) suggest several key predictors for emotional influence on information from memory. The most relevant predictors for this thesis are found in the associative network model, state-dependent learning and recall and the mood congruency hypothesis. Bower (1981) proposed an associative network model, introducing the term "emotion nodes" as a representation of emotion. The model describes how emotions function as central nodes in an associative network which links related information of corresponding valence.² When new items or pieces of information are learned or stored, they are associated with the nodes that are active at the time of learning. Bower (1981) states: "Activation of this emotion unit aids retrieval of events associated with it; it also primes emotional themata for use in free association, fantasies, and perceptual categorization" (p. 129).

Further, state-dependent learning and recall predicts that material learned in one specific affective state or environment is more likely to be recalled in the same state or condition than in another (Schwarz & Clore, 1996). The mood-congruent hypothesis predicts that positively valenced material is more likely to be recalled in a positive mood, and vice versa. Schwarz and Clore (1996) suggest that the congruency effect of mood on recall of material is independent of the influence of mood on encoding material, and therefore is distinct from the state dependence effects. Given that moods affect recall of valenced material, Swartz and Clore (1996) argue that moods are also likely to affect both the encoding of new material and judgments formed at the time of encoding (mood-congruent encoding). Schwarz and Clore (1996) suggest that the suggested predictors can also be used to predict affective influence on type of information processes. For example, if a given affective state brings a large amount of corresponding information into consciousness, it may limit the cognitive resources required for working on a task to which this material is irrelevant, resulting in diminished cognitive performance (Schwarz & Clore, 1996). Ellis and Ashbrook (1988) suggest that both positive and negative affective states are likely to impair the attention and cognitive capacity allocated to a given task. Intruding thoughts and ruminations might

² Valence is described by Frijda (1986), as the intrinsic attractiveness or aversiveness of events, objects and situations (p. 207); e.g. the intrinsic aversive situation "threat" is negatively valenced.

result in negative states that reduce capacity of encoding and recall of other relevant information (Ellis & Ashbrook, 1988).

Forgas (1995) proposes the affect infusion model (AIM) as a comprehensive explanation for the role of affective states in social judgments. The AIM identifies four alternative judgmental strategies, two low-affect infusion strategies and two high-affect infusion strategies: (1) direct access: repeating or reproducing a stored reaction or a response given before in a similar situation, (2) the motivated process: specific and targeted search strategies with a direct informational goal, (3) the heuristic process: assumes that affective or emotional processing occurs outside our awareness and judges require a degree of constructive processing, (4) substantive processing that requires a systematic processing strategy to compute an outcome. Forgas (1995) suggests that the extent of affect infusion into judgments varies along a processing continuum, i.e. judgments requiring heuristic or substantive processing are more likely to be infused by affect than direct access or motivated judgments. The AIM assumes that the nature and extent of mood effects on judgments largely depend on what kind of processing strategies are adopted by a judge.³ Furthermore, the model assumes that judges are effort-minimizing information processors inclined to adopt the simplest and least effortful processing strategy as long as a minimum of contextual requirements is satisfied (Forgas, 1995). According to Forgas (1995), mood also affects risk behavior; individuals in a good mood are more prone to take risk than individuals in a sad mood. Judges in a sad mood have decreased cognitive capacity, and when forced to make a judgment in demanding conditions (atypical, unusual, or complex) are most likely to adopt the substantive process strategy –resulting in a mood-congruent recall from memory.

Schwarz and Clore (1996) state that affective states inform the individual about the nature of his/her current environment. They further suggest that: “positive affective states can inform the individual that a situation is safe, and does not threaten the person’s current goals. Negative affective states, on the other hand, can inform the individual that the current situation is problematic, that [it]is characterized by a lack of positive outcomes or by a threat of negative ones” (Schwarz & Clore, 1996, p. 437). This assumption might provide some explanation of the influence of affect on information-processing strategies. Further, Schwarz and Clore’s (1991) review of theories suggests that positive moods foster heuristic

³ Forgas (1995) calls a person who adopts a judgment strategy a “judge” (p. 39).

information processing, whereas negative moods foster more effortful, systematic processing (cf. Chaiken, 1980).

Bell (1985) suggests that including psychological satisfaction in decision analysis might affect short-term financial efficiency. The tendency of spending money to avoid disappointment is a type of risk aversion that is not reflected by a utility function, however and Bell (1985) suggests that the psychological impacts of a decision are generated by the same thought processes that are used in decision-making processes. Here, value of an outcome is weighed against various reference points like status quo, foregone assets, and prior expectations. It was also observed by Bell (1985) that decision-makers usually agree with logical decision analysis, e.g. considering expected utility, but feel uncomfortable about it on an intuitive level. Even though it is challenging, Bell (1985) argues that formal analysis might be what is needed to prevent decision-makers' intuition from forcing them to make economically inefficient decisions.

Schwarz and Clore (1996) state that theories on memory are mostly about organization of content, and how thinking by using one domain of memory content makes recall of other content more likely. Here, the role of structuring subjective experiences in memory is of utmost importance.

Further, Schwarz and Clore (1996) argue that feelings of familiarity towards a certain stimulus make a person conduct a memory search in order to find a memory content that “fits” the stimuli. Feelings of familiarity might vary in different contexts, previously encountered objects may feel familiar, and new ones or rearrangements of previously encountered objects may feel unfamiliar (Schwarz & Clore, 1996). Schwarz and Clore (1996) further argue that feelings play similar roles in information processing, regardless of their source. Feelings of familiarity might be affective feelings, feelings associated with cognitive states of surprise, or bodily feelings of pain. Schwarz and Clore (1996) argue that the feeling “alerts” the person, making him or her focus conscious attention and processing capacity on the search for the cause of the feeling. For example, an irritated person focuses on the irritating stimulus and a way to eliminate it. A surprised person will engage in the surprising aspect of the situation and try to find ways to adjust the conception of the situation to incorporate the new feature (Schwarz & Clore, 1996).

Schwarz and Clore (1996) thus suggest that when something seems familiar, people focus on a search for the source of the feeling. Familiarity involves a memory search, in an

attempt to recall the original situation. The authors also remark that feelings of familiarity activate information about prior exposure to a familiar-seeming stimulus, which already exists in memory. In this context, it is generally worth recalling the information rather than trying to recompute it on the basis of new experience. Feelings of familiarity might keep people from constantly discovering what they already know (Schwarz & Clore, 1996).

3.0 The poker game as a special case

3.1 Tilt after a bad beat

Hayano (1982) describes a *bad beat* as when an opponent player makes a statistically improbable draw. As an illustration, he refers to these draws as “Gardena miracles” and the players who make them, as “miracle workers”. Repeated *bad beats* make even the steady (experienced) player *tilt*, and change his/her normal style of play. Rosecrance (1986) defines *bad beat* as a significant monetary loss resulting from a seemingly inexplicable turn of events, not necessarily pinned to an opponent player. He further divides the observed reaction to a *bad beat* into three phases: manic reaction, realization, regaining inner control. According to Rosecrance (1986) a manic reaction occurs when a player’s sense of rationality is temporarily displaced. Players who are typical amateurs remain in the phase of manic reaction and can stay there for a long time. Other more experienced players may proceed to the next phases much earlier, and finally regain control.

Hayano (1982) describes being on tilt as a vivid and durable losing period, involving monetary loss relative to a player’s total stake. This situation is accompanied by expressed anger, hostility, depression, or anxiety and the player goes from a stable emotional state to an unstable emotional state. Consequently, running on tilt threatens the present and further quality of the playing ability, making the player conduct “wild plays” (Hayano, 1982).

Browne (1989) describes tilt as a term used by poker players to describe behavior resulting in a huge loss of money or loss of control. He also suggests that the term represents a deviation from the norm where a player’s playing ability and emotional state are set as the base line. He holds that tilt illustrates a player’s playing ability changing for the worse owing to loss of control. Some players play “wildly,” but the majority do not express their tilt to that extent. Rather, their play gets weaker as they struggle to regain control. Browne (1989) argues that players in a bad mood might employ a "minimize your losses" strategy: playing their normal game, but using a less aggressive version.

A period of intense internal emotion struggle is often visible after a bad beat. Browne (1989) divides the phenomena of a tilt into three phases: first, encountering a tilt-inducing situation, second, an internal emotional struggle to retain control, and third, the deterioration of the player’s game when he or she does not regain control.

According to Rosecrance (1986), a large or unexpected loss sometimes makes players

fall into this chain of events and leads to problematic gambling. Retaining inner control (breaking out of the chain) is a way to rationalize the loss; the player sees past the belief in external forces, and does not blame bad luck or unpleasant fate (Rosecrance, 1986). Players who stay in the phase of manic reaction often go from playing low-limit to higher-limit poker, which effectively reduces their bankroll and the possibility of bankruptcy increases. This development puts more pressure on the player, and he or she experiences a stronger demand to play perfectly. Further, the smaller bankroll the player has, the greater the likelihood of reacting to a *bad beat* (Browne, 1989). Consistent losers on a losing streak think that they are *due*; and that the cards are against them and the luck has run out. According to Browne (1989), this usually results in a more aggressive betting behavior, e.g. frequent playing y more initially weak hands.

Rosecrance (1986) claims that typical tilt behavior is observed in the manic reaction phase of a bad beat. Hayano (1982) suggests that all it takes for a player to tilt is to have a strong hand “cracked,” and players often refer to this as a sudden incident when their good fortune changes, because of unforeseeable circumstances. Browne (1989) argues that bad beats are common incidents, and it is the player’s ability to cope with this phenomenon that is a crucial condition for success in poker.

Rosenthal’s (1995) version of Rosecrance’s (1986) "manic reaction" stage is presented as four defensive responses, which can occur in combination or alone. First, a denial of the *bad beat* itself. Second, personalization and anger arise in the player (“Why is this happening to me?”). Third, external attribution and increased erroneous beliefs arise. Finally, an undoing of the outcome is decided, explained as the need to deny what has happened, by trying to will one's money back. Rosenthal (1995) argues that a player’s response to a *bad beat* usually involves the impression of being cheated, and he further claims that this is an important aspect of why it is unacceptable for the player. According to Rosenthal (1995) *bad beats* is an insult to one's sense of "how things should be,”⁴ He writes:

There is a sense of injustice, of loyalty betrayed. The gambler feels: I have done my part, and played by the rules, and someone has cheated me. Chasing is directed not only at recouping losses, but at denying helplessness, shame or humiliation, by erasing

⁴ Note that Rosenthal's reasoning is very similar to Heider’s (1958) “ought force” but Rosenthal (1995) does not cite this reference in his article.

the experience which provoked such feelings. They chase, not simply to get back their money, but also their "fair chance."(Rosenthal, 1995, p.168)

3.2 Rules of the game

Poker is a family of card games which usually have the same betting rules and hand rankings, but differ in the handling of cards. All variants consist of opponent players, betting monetary value of hidden and shown cards, who try to increase the monetary value of their personal cards. The poker variant "no-limit: texas-hold'em" has at least two players. The objective of the game is to win rounds by either ending up with the best card combination at the end of the game or by being the only active player left. Poker has multiple betting rounds where the players are allowed to invest money. Players can remain active in the round, by at least matching the largest investment made by any of the other players, or they can choose to fold (excluding them from the ongoing round). If all the players choose to fold except one, the remaining player wins all the chips invested by the opponents. In the poker variant No-Limit Texas Hold'em (hereafter "texas hold'em) there are four betting rounds: these are called the "pre-flop," "flop," "turn" and "river." In the "pre-flop" round, every player is dealt two private cards (also called "start hand"). The flop is three community cards on the table for everyone to see, then one community card for the respective next rounds. The combination of the private cards gives an indication of how strong or how weak the start hand is. Two aces are the initial strongest hand, and a combination seven and three is an initial weak hand (Skalinsky & Malmuth, 1999).

To ensure that there is always a minimum investment in the round, two players are obliged to invest a small amount in the first round (called small blind and big blind); this investment increases after a predefined time interval. In addition to this, a minimum investment is made by all players, which is called the "ante" and increases in the same phase as the blinds but is usually just one-tenth of their value.

When the basic investments are made, the players can decide if they want to participate or not, depending on how strong their start hand is. If a player decides to participate, s/he must invest at least the same amount as the minimum investment, or the current bet (calling), or s/he can invest more in the round (raising). The latter is often done if a player feels that his/her hand is strong, and wants to exclude the minimum betters from the pot, giving him/her a better starting point before the next phase. The round enters the next phase when every player has either called all the opponents or folded their hand. During the

remaining three betting phases, the same procedure is followed. In every phase, community cards appear on the table (three in the flop phase, and one in the other phases). These cards appear to all the players and are used to determine the card combinations (e.g. a pair or three-of-a-kind may be formed from the player's private cards and the community cards). In a showdown, the remaining players must show their hand, and the player with the best card combination wins the round and all the money in the pot.

Poker can be played as both a tournament and a cash game. In tournaments, every player is given the same number of chips (plastic coins representing money/value), and players must leave their seat when their chips are spent. The one player who remains with all the chips wins the tournament. In the cash game players do not exit the game if their chips are out, unless they want to, or go broke. The cash game allows the players to bring infinite money to the game, unless they agree on a limit. Whereas the chips in tournaments represent a one-off entry fee, and cannot be exchanged for money, the chips in cash games represent the actual value of money, and may be exchanged if the player decides to leave in the middle of a game session.

3.3 Skill versus chance in poker

What are the similarities to pathological gambling and tilt?

According to the American Psychiatric Association (1994), pathological gambling is defined as persistent and recurrent maladaptive gambling behavior characterized by an inability to control gambling, leading to significant deleterious psychosocial consequences: personal, familial, financial, professional and legal.

It might be argued that tilt behavior is a warning sign of pathological gambling, or a trigger mechanism of pathological gambling. This thesis suggests that both hot and cold tilts are temporarily negative emotional and cognitive experiences and reactions after the interruption of an appraised outcome. Pathological gambling is arguably related to maladaptive gambling behavior before an outcome (American Psychiatric Association, 1994), whereas tilt is the reaction to the negative actual outcome.

Moreover, pathological gambling is characterized as a persistent and recurrent maladaptive behavior, not present in the majority of a population. Research conducted by Bakken, Gøtestam, Gråwe, Wenzel, and Øren (2009) shows that less than 2 percent of a study population (N= 3,482) were problematic gamblers. The monetary games included in the

questionnaire were mostly games of chance like lotto and “poker over the internet”. Tilt behavior, on the other hand, is observed at almost all poker tables, and is here argued to be a phenomenon most players show in various degrees. Poker, and especially the variant “Texas hold’em,” is arguably a game of skill, and requires a certain understanding of probability calculation, dedication and patience. These characteristics might not attract pathological gamblers and the probability of a bad-beat encounter is therefore low.

According to Yampolskiy (2007), games can be classified as games of skill, games of chance, or mixed games. For a game to be considered a game of skill, skill needs to predominate over the element of chance. The player proposes a game skill measurement, and utilizes it to calculate the skill component in texas hold’em. S/he suggests that all games with a skill measurement over 50 percent should be treated as a game of skill in the long run. Yampolskiy (2007) concludes that texas hold’em has a game skill measurement of 75 percent and thus counts as a game of skill. Still, the possibility of losing is always present, even for a professional player.

3.4 Complexity of poker

Siler (2010) conducted a study that analyzed 27 million hands played online in small-stake, medium-stake and high-stake poker games. The study judged the types of strategies utilized by players at each of these levels and examined the various payoffs associated with different strategies at varying levels of play. Siler’s (2010) results indicate that competition is harder as one moves up the levels and that “tight-aggressive (plays few hands, but high bets) strategies,” which tend to be the most financially rewarding, also become more common. The findings also show that payoffs for different combinations of cards vary between levels and illustrate how strategic payoffs are derived from competitive interactions (Siler, 2010). Smaller-stake players especially have more difficulty properly weighting incentive structures with frequent small gains and occasional large losses. This often results in a negative relationship between winning a large proportion of hands and making a profit (success) in poker. Siler (2010) argues that the challenge of the cognitive burdens in poker, like adopting risk-neutrality (i.e. making risky decisions with initial low payout, as long as they are outweighed by relative rare positive events) to maximize expected value, aggression and proper mental accounting, emphasizes the rational work of the player and consequently reconfigures personal preferences and goals into more competitive ones, thus maximizing the winning and profit chances.

Smith, Levere and Kurtzman (2009) conducted a study to find out if experienced poker players change their style of play after a big loss or a big win. They suggest that bad mood, “house money effect” (Thaler & Johnson, 1990), and hot/cold streaks (Gilovich et al., 1985) argue more cautious play after a big loss. Prospect theory (Kahneman & Tversky, 1979) and “gamblers' fallacy” (Kahneman & Tversky, 1971) argues for less cautious play after a big loss (Smith et al., 2009). The latter researchers' findings suggest that experienced players are less cautious after a big loss, evidently hoping for lucky cards that will erase their loss (Smith et al., 2009). The explanation of this seems to be that players remember big losses and are eager to return to their previous chip level, trying to break even by hitting a long-shot flop with a weak hand (Smith et al., 2009).

According to Skalinsky and Malmuth (1999), Texas hold'em is a game best described by implied odds, i.e. playing speculative and uncertain (initial weak) hands is sometimes profitable, but the chances of success are small. These hands might have enormous payoffs, and can therefore be extremely valuable to play (Skalinsky & Malmuth, 1999). On the other hand, initially strong hands suffer from reverse implied odds, because they have fewer options for improvement as the community cards are dealt. According to Siler (2010), implied odds offer the possibility of large losses in the future and small losses in the present. On the other hand, reversed implied odds have the prospect of small gains in the present against potentially large losses in the future. Siler (2010) argues however that stronger and more certain hands provide a payoff structure that is more favorable than frequent small/medium wins and occasional large losses.

4.0 Conclusion

The main research question was whether the decision-maker becomes risk-averse or risk-taking following the negative outcome of a rationally justified prior decision.

Relevant theories in the area have been presented, and expectation of “justice” and the degree of violation of expected outcome seem to account for some of the risk behavior. Further, two systems of information processing have been described to be related to individual differences and (gambling) situations. Also, the influence of intuition (e.g. degree of confidence, heuristic, biases) on decision-making, the dealing with unpleasant experience, and mental accounting preferences were noted in this paper. Emotional and mood influence on learning and memory also offer a broader understanding of the phenomena. The results from the theoretical outline are summarized in the following features:

- (1) Degree of violation of expected outcome: the appraised probability of negative outcome.
- (2) Significance of bet: amount of invested monetary or utility value.
- (3) Personal traits: ability to process information in a rational manner.

These features correlate in various degrees, and a decision-maker's action(s) taken against the background of the relationship define whether a decision-maker is a novice or a professional. The definition is here argued to predict the decision-maker's risk behavior following the negative outcome of a rationally justified prior decision. A novice decision-maker will show risk-averse behavior and a professional decision-maker will show risk-taking behavior. The main question seems a little more complicated than hypothesized. As in the poker example, a player does not necessarily become more risk-taking following a negative outcome of a rationally justified prior decision, but can show more risk-averse behavior than what it is expected based on logical thinking. This paradox will be discussed.

5. Discussion

The probability of winning a round in poker, every time, is small. It is advisable to make an investment, however, since a predefined weak hand might still be the best hand, especially in a game with few players. Winning a round involves having the best, not necessarily a strong, hand. The hand ought, however, to be evaluated by its strength according to a given standard of ranking groups of strong hands, and not in relation to the frequency of hands played. The distinction of a strong/weak hand would ideally be based on the probability of having the best hand, but in a normal poker game this is unknown to a player. Moreover, this is too complex a calculation to utilize as decision support for every hand, and it is therefore assumed that poker players utilize some heuristics in their decision-making process. For example, there is a large number of books on poker strategies on the market (e.g. *Hold'em Poker For Advances Players* by Skalinsky and Malmuth, 1999), each claiming to provide the best strategy for success in poker.

As described earlier, a decision-maker in poker might show two types of risk behavior after a bad beat. The poker player is expected to be either risk-averse or risk-taking. This behavior might be observed in two different actions. First, playing a hand when the right decision is to fold (risky), and, second, folding when the right decision is to play (aversive). Here, playing a weak hand is defined as risk-seeking behavior, whereas not playing a strong hand is defined as risk-averse behavior.

A player's emotional reaction to a bad beat is, according to Rosecrance (1986), a neglected area of research. He points out that because of this psychological disorientation, learned coping skills are not sufficient in dealing with these events. Browne (1989) holds that bad beats are also seen in everyday life, and asks why some gamblers still continue to gamble to the point of losing their jobs, their families and even their lives.

Hayano (1982) contributes with an old story about what he regards as the most notorious example of "tilt" behavior: "A story told by many regulars and now part of local folklore – took place on January 12, 1965, when a losing small-stakes lowball player fired a shotgun into three card rooms. He killed one player and wounded twenty-seven more in his mad attack. Witnesses who had played with him blamed his violence on his losses" (p. 53).

As argued by Hayano (1982), Browne (1989), Rosecrance (1986), Rosenthal (1995), and Smith et al. (2009), bad beat and tilt are ever-present phenomena in poker, and are

probably related to each other. In an attempt to present a relation between observed tilt behavior and bad beat, three phases are presented below from the poker literature. First, a bad beat is a tilt-inducing situation that influences the stability of playing ability and emotional state (Browne, 1989). The player is entering a *tilt*-inducing situation (e.g. goes all in with a strong hand), then the outcome of a game is revealed as a *bad beat* (significant investment of money/chips losses for an initially weaker hand, “the entry of a miracle worker”). The three phases after a bad beat develop as follows:

1. Emotional reaction of tilt (Rosecrance, 1986), Rosenthal’s (1995) four defensive responses and loss of control (internal emotional struggle) (Browne, 1989; Hayano, 1982). This loss of emotional control decreases emotional stability and the player experiences an emotional reaction involving the initiation of defensive responses, denial of the bad beat, personalization and anger (i.e. feelings of injustice), erroneous beliefs, followed by an attempt to win money back (aggressive betting behavior, “wild plays”). Playing weak hands is regarded as risk-taking behavior because of bad strategy (i.e. weak hands have low initial strength, probability of success is low), the player stays a certain time in tilt, meaning low emotional stability (negative expressed mood and internal struggle) and bad playing ability (making more wild plays, losing more money). In contrast, risk-averse players experience low satisfaction, and are likely to fall into a negative mood, tending to try to minimize the losses by folding strong hands.
2. Realization (Rosecrance, 1986). The tilt continues until realization occurs, when the player accepts the reality of a random outcome in the game and understands why the bad beat happened. Players who are characterized as typical amateurs (novices) remain longer in the tilt phase of manic reaction, and can stay there for a long time. Other, more experienced, players may proceed to the next phase of realization much earlier, and finally regain control.
3. Retaining inner control (Rosecrance, 1986) involves establishing stability of playing ability and emotional state. A successful realization restores emotional stability and playing ability (going out of tilt), but not the economic status. An unsuccessful realization either leaves the player in tilt or the player re-establishes emotional stability by accepting and encoding this improbable experience (bad beat), which again might

influence decisions in future similar situations (e.g. recalling a bad beat might influence playing ability).

5.1 Handling tilt

Ekman and Friesen's (1969) and Izard's (1977, 1979) studies of universal expressions of emotions suggest that certain basic emotions have a biological heritage, and are arguably to be found in humans all over the world. This research might contribute to a better understanding of why tilt behavior following a bad beat is allegedly common at the poker table worldwide (Browne, 1989). The present thesis suggests that there could be a universal reaction to a bad beat, and also that perceived unfair treatment (by randomness) might be the origin of negative emotions in poker. This is interesting, because randomness itself has no relationship with fairness and justice. It is the human mind that gives a random outcome a meaning, and tries to reason, or wants random outcomes to "behave" predictably. In poker, it appears that an appraisal of the situation is necessary to make an optimal decision. By conducting an affect-free appraisal, it could be argued that "system 2" (Kahneman, 2011) kicks in and probably provides a logical solution. If a player only uses sensation, or feels the situation, "system 1" instead leads the poker player to make intuition-based decisions. Playing with what is perceived to be the strongest hand is seen as a rational decision. The problem arises when a player blindly assumes that the strongest hand is a guaranteed success, which could be a big mistake. In poker, the expectation of outcome should include consideration of unlikely exceptions, and not be based on exclusions of alternative outcome.

5.2 Hot and cold tilt behavior

The results seem to indicate that whether a person becomes risk-averse or a risk-taker depends on several features, as concluded previously. In an attempt to predict better which reaction (risk aversion/risk-taking) will occur, it is here suggested that there may be two types of tilt, i.e. hot tilt and cold tilt (cf. "hot" and "cold" cognition in Abelson, 1963). The literature on emotion and affect suggests that human reaction to a threat is fight, flight or freeze (James, 1890). In terms of poker, the fight reaction is the basis for risk-taking behavior. Flight is seen as risk-averse behavior. Freeze is not a valid choice here because "no action" will be the same action as "fold"; risk aversiveness. Type of expressed behavior is, as already concluded, influenced by the significance of loss (value/utility), (appraised) degree of interruption of expectations, and some personal traits of the player. The suggested terms of hot and cold tilt are in this thesis made in reference to Kahneman and Klein (2009) who assert that a decision

made by intuition is so much more than cognitive limitation. The mentioned categorization also helps in defining the suggested concepts hot tilt and cold tilt in relation to poker behavior.

Hot tilt is defined as:

- Risk-taking; not folding weak hands.
- “Wild plays.”
- Trying to win back money with weak hands.
- Emotional reaction: expressed aggression, hostility and depression (Rosecrance, 1986).

Cold tilt is defined as:

- Risk aversion: folding strong hands.
- Minimizing of loss/maximizing happiness (Romanus et al., 1996; Thaler, 1985).
- Trying to break even, without risking more value.
- Negative mood, expressed depression.

The phenomena of hot and cold tilts are distinguished with respect to expectations, emotions and experience. Expectations are linked to the knowledge a person has prior to an outcome. Here, it is argued that there are two types of expectations related to experience, that of a professional player and that of a novice player. It is argued that professional gambling experience increases self-confidence and therefore a higher emotional investment relative to the outcome (bad beat) renders hot tilt and risk-taking behavior more likely. The less experienced novice, however, could be expected to be more loss-sensitive due to less confidence in own expectation, which would more often result in a cold tilt. In the former case emotions are more likely to be “externalized,” e.g. expressed by anger and action, whereas in the latter case emotions would be “internalized,” e.g. expressed by regret, negative mood and non-action. The suggested explanations of why a professional would probably display risk-taking behavior after a bad beat (prospect theory) and why a novice would probably adopt risk-aversive behavior (loss sensitivity) are discussed below.

5.3 Conditions for risk-taking behavior - hot tilt

- (1) Degree of violation of expected outcome: the appraised probability of negative outcome

In this condition, the unpleasant outcome itself must have a perceived low probability of occurrence, and the lower the appraised probability of occurrence, the higher the violation of expectation (cf. “the ought force” of Heider, 1958). If a decision-maker takes, over and over again, the right actions with the intention of maximizing value, the successful outcomes are likely to provide a high illusion of control, attributing the success to the own ability and to

feelings of confidence in own judgments and decision-making strategy. This strategy will be encoded in memory and will strengthen certain memory nodes, facilitating “intuition,” which will be decoded and used again when the decision-maker perceives certain similar situations. The decision-maker is defined as a professional, because of the repeated exposure to risky choice. Unfortunately, confidence in intuition in some uncertain and highly valid environments (Kahneman & Klein 2009) is tricky, because random or lucky decisions might have been appraised as good decisions, resulting in false learning. In these circumstances, an “unexpected” negative outcome is more likely to occur. In the light of the “gambler's fallacy” (Tversky & Kahneman, 1971), a professional decision-maker builds up their expectation of the chance of achieving a successful outcome, and when this chance arrives, the decision-maker “feels” that it is time to win (cf. Heider’s ought force), because it represents his fair chance (Rosenthal, 1995). When a decision-maker instead experiences a bad beat, s/he clearly feels an injustice due to “the ought force” (Heider, 1958). This perceived injustice creates *arousal*. A decision-maker who acts on arousal linked with negative emotions and the perceived cause of injustice might “activate” the “affect heuristic” and be involved in risk-seeking behavior. With respect to emotional reactions, the experiential system (Epstein, 1994) is involved in rapid decisions and is driven by emotions. Feelings of injustice and anger over the outcome might trigger immediate affective decisions, because the player now wants the injustice to be balanced. This “balance” might be restored by risk-taking behavior in the very next action (or after a similar bad beat situation in future round(s)/games(s)).

(2) Significance of bet: amount of invested monetary or utility value

For a professional decision-maker, the investment is a key feature related to risk behavior. The most common loss is of monetary value; still, the professional decision-maker also invests his or her reputation for skill. In addition, according to Arkes and Brumer (1985), people do not want to appear wasteful. The professional decision-maker must make a significantly big enough investment in relation to his/hers capital in order to produce arousal after a bad beat. This “failed gambling” produces physical arousal, and combined with (negative) feelings of injustice provides a base for both emotional and physical reaction. In this state, however, the decision-maker does not behave according to the rules to maximize expected value, and instead adopts a risk-taking strategy, as described by e.g. Kahneman and Tversky’s (1979) prospect theory, that is, trying to win back the loss. A decision-maker in this situation seems less sensitive to the probability of negative consequences and more sensitive to the *perceived possibility* of positive consequences. The explanation is supported by

Kahneman and Tversky's (1979) steeper value function for losses than for gains in prospect theory, showing risk-seeking behavior after loss.

(3) Personal traits and ability to process information in a rational manner

Some personal traits and abilities are predictors for risk-taking behavior. For example, numeracy, being good at handling numerical concepts and calculations, makes people less influenced by framing effects; however, numeracy might make people "calculate too much" in an attempt to rationalize a bad beat. A need for understanding the bad beat or to organize experience meaningfully might be present in risk-taking behavior. People high in "need for cognition" more often make use of a more effortful and unpleasant information process (system 2). The literature suggests physical reactions, and in some instances violent attacks (Hayano, 1982) on other players/surroundings. The likelihood of such reactions must certainly be explored by involving various personality traits. The ability to accept the unexpected negative outcome as a rational occurrence and to understand that randomness is uncontrollable are important aspects of risk behavior. If a decision-maker appraises the outcome as unacceptable and irrational, he or she will probably show aggressive risk-taking behavior. The decision-maker who shows risk-taking behavior after a bad beat is most likely to be an experienced person rather confident about his or her cognitive processing abilities, the expert who becomes emotionally displeased when experiencing a (significant) loss in a low-risk situation. The action-direction of a hot tilt by an experienced person could be explained by the literature that argues that intuition-based actions (from system 1) sometimes are conducted in the wrong situations, and because of the overconfidence in them (Simmons & Nelson, 2006) it is difficult to take actions complying with logical thinking (system 2). In addition, if a player tries to learn from such actions in hindsight (Fischhoff, 1975) it is assumed that a successful realization (Rosecrance, 1986) will be very demanding, and if a successful realization is not achieved, it will result in an enduring degree of risk-taking behavior. This explanation provides substance to the notion of why a professional decision-maker would make a higher-risk investment to justify the loss. A poker player who acts on arousal of negative emotions and a feeling of injustice will show risk-seeking behavior, i.e. hot tilt. The player will play according to intuition, and succumb to system 1 (emotionally) when reacting.

5.4 Conditions for risk aversive behavior - cold tilt

- (1) Degree of violation of expected outcome: the appraised probability of negative outcome

In this case, the interruption of expected outcome is a surprise (in terms of “not knowing”) rather than a cause of anger. The probability of the negative outcome might have been rated as very low or negligible. The decision-maker knows the rules and limitations, but lacks experience overall, especially of “extreme” unexpected negative outcomes. Further, the decision-maker has not adopted a strategy of action yet, has a low illusion of control, and applies different strategies to learn more. A negative surprising event is likely to produce *low arousal*; therefore the novice player is likely to have a milder negative emotional response. In this case the interruption is of information processing in system 1 (not necessarily a well thought-through strategy), and system 2 is engaged to rationalize the unexpected loss. Since we find effortful thinking unpleasant (Kahneman, 2011), a transference between these systems might contribute to an irrational influence on logical thinking. It is therefore assumed that a *plausible* outcome (the bad beat) is appraised by the player as a somewhat probable outcome. It is fair to assume that the player conducts a low-affect infusion strategy, “motivated processing” (Forgas, 1995), as a targeted search strategy to find out the reason for the loss, as the minimum effort of information processing. This could be because the outcome is appraised as less complex, i.e. not an appraised injustice (“I *should* have known it all along,” p. 438 in Pezzo, 2003).

- (2) Significance of bet: amount of invested monetary or utility value

For a novice decision-maker, the investments are mainly of monetary value, because he or she has no reputation to invest. Further, s/he has little experience and training, the novice decision-maker is not expected to take highly skilled actions. The monetary loss must still be significant and big enough to produce disappointment in the outcome. Unpleasant consequences of a decision might make people engage in a self-protective strategy in order to avoid experiencing such unpleasantness again. One strategy is to take precautions in situations similar to the unpleasant consequence (outcome) experienced in the past (Weinstein, 1989). In complex decision-making processes, those involved might feel more indecisive about when and how to use precautions, and rely more on “experts,” e.g. strategies described in poker books. This explanation could be helpful for predicting risk-averse behavior when an unpleasant loss of monetary value is experienced. The decision-maker is prone to be loss-sensitive, and would try to break even, rather than be risk-seeking to win back the loss. This

might also be seen as a strategy for maximizing happiness (Thaler, 1985) rather than monetary value.

(3) Personal traits: ability to process information in a rational manner

Some personal traits are predictors for risk-averse behavior. Decision-makers who experience a disagreement between the experienced emotional fear of a threat (losing) and the cognitive evaluation of the actual risk are expected to show risk-averse behavior. Decision-makers low in ability to utilize numerical concepts and calculation might find it difficult to understand probability and fail in their attempt to maximize expected value. Also, a low need for cognition makes the decision-maker more prone to use a more pleasant and less effortful information-processing approach (system 1). Here, “suggestions” from the automatic and quick system 1 influence rational thinking and logics, and the decision-maker will find the improbable outcome more probable than it actually is. Also, the proneness to accept the unexpected negative outcome as a possible occurrence and to accept that randomness is uncontrollable seem to be promising predictors for risk behavior. A decision-maker who appraises the outcome as acceptable and rational will in the next similar situation experience a disagreement between the experienced emotional fear of a threat (losing), and the cognitive evaluation of the actual risk. The decision-maker will probably show risk-averse behavior to avoid the appraised threat.

The novice decision-maker will (wrongly) learn that in a specific case of low risk/high gamble, the outcome is unpleasant. Therefore, the novice decision-maker will try to avoid the unpleasant consequences by being risk-averse in similar situations. It is assumed that a novice player would be more surprised than angered by a negative outcome than a professional player, due to a lesser degree of interrupted expectation and personal investment. The surprise produces “hindsight bias” (Pezzo, 2003), and results in a realization within system 2: “It makes sense, I should have foreseen this.” A negative but surprising event is likely to produce *low arousal* compared with feelings of anger and injustice and therefore the novice player is likely to have a milder negative emotional response, triggering caution rather than aggressive behavior. In a cold tilt, a person does not behave according to the rules for maximizing expected value, and will end up with a risk-averse strategy, e.g. “the loss sensitivity principle” as described by Romanus and Gärling (1996), and try to maximize happiness by reducing loss. It is also assumed that the player develops an aversion to similar (unpleasant) situations, and that this aversion is stored in memory and acts on intuition. As discussed

earlier, overconfidence (in intuition) and “illusion of control” support a risk-averse strategy after a bad beat.

5.5 Generalizability: reflections on results and conclusion

Are the conclusions valid? This thesis has provided explanations and predictors for events following an unexpected negative outcome by providing theoretical and empirical bases from research on emotion and cognition. The problem of which approach to expect, i.e. risk-taking or risk aversion, after an unexpected negative outcome seems to originate in ancient times as a struggle between emotion and logic, the heart and the head. Often, following the heart is easier and more pleasant, even though the head may argue for another, more thought-through, solution. This struggle is described as a conflict, or teamwork, between two independent information-processing systems. The interaction of these systems predicts a decision-maker's experiences and behavior based on their emotional, psychical and cognitive reactions to a stimulus. Taking risks is here discussed as an outcome of a basically physical response, the “fight” reaction. Hence, avoiding risks is discussed in terms similar to the “flight” reaction. These basic reactions seem to provide different frameworks for the interaction between emotion and cognition. Why do people not do what they should in order to succeed in games or in everyday life? It seems of the utmost importance to differentiate between decisions made in normal circumstances and decisions made in extreme situations, like accidents. “Normal” circumstances involve familiarity and the high predictability of outcomes. Extreme situations are neither familiar nor predictable. They occur in uncertain environments and often have unexpected negative consequences. These extreme situations seem to demand qualitatively different decisions for achieving success than those in everyday life, and acting in everyday learned and intuition-based ways (either risk-taking or risk-averse) appears to be an unsuccessful strategy. The three suggested features, and the interactions between these, are factors that are suggested to predict a decision-maker's action in an extreme situation, and whether a decision-maker will have an initial hot tilt or a cold tilt reaction.

A bad beat might be defined as an accident in poker. Here, human emotional reactions and mental limitations contribute to influencing the next action(s). Individuals' reactions to accidents in real life might follow similar patterns of processes and behavior. Further research on tilt reactions in everyday life might contribute to a better understanding of how people react in certain unexpected situations where there has been a significant loss of utility because of a surprising, unfair, or negative outcome. Of special interest for future research would be to

investigate the role and significance of the random outcome for subsequent behavior. Violated expectations are here argued to be a part of everyday life, and they add complexity to understanding the perception of risk and prediction of behavior in unexpected negative events. Further, people usually put more faith and confidence in intuition (stemming from previous experiences with pleasant consequence) than in reasoned choices. Personal involvement and perceived control (over an outcome) in a decision-making process create higher confidence in the own ability, i.e. illusion of control. Tilt reactions indicate the importance of (correct) training in decision-making in extreme situations. Training in normal circumstances will not prepare the decision-maker for responding adequately to an extreme situation. Naturalistic decision-making (Klein et al., 1993) provides some principles for training that give a basis for more optimal decisions in extreme situations. Experiencing a loss of significant value should not be surprising to the decision-maker; still, this loss is often observed to be disappointing or unsettling. The example used in this paper is the tilt phenomenon from poker games. In relation to “fight and flight,” it appears that some poker players try to fight off the threat (bad beat) by acting aggressively and taking risks. Other players seem to avoid risking more money by fleeing from the threat (bad beat). Both the hot and the cold seem to provide a suboptimal strategy for success in poker, which it could be argued exemplifies reactions to unexpected negative events in other life situations. Given the results in this thesis it would be very interesting to pinpoint the “border” between hot and cold tilt reactions and thus help to promote rational behavior in life-threatening circumstances, i.e. to contradict over- and under-reactions to threats. The poker example certainly has some limitations with respect to generalization to other populations. Poker is a game of rules and logic, and demands a basic ability to calculate and understand numbers. This is not necessarily the case in everyday life. Nonetheless, the strength of the poker example is its simple and explicit format, i.e. trying to win the most money possible by clever use of strategy and the dealt hand. The tilt in this setting is argued to be similar to the reaction in other significant and expected negative circumstances, but the chosen case setting presents a more standardized rule-based situation. Furthermore, the similarity to empirical experiments like e.g. decision experiments on professionals and others from the 1970s onwards, which are still used to generalize human behavior in given situations, provides some support for the assumption that human reactions to threats are essentially similar in different situations.

What happens in the decision-making process after we make a rational choice that results in an unexpected negative consequence? The answer depends on the involved

decision-maker's talent to withstand the urge to fight or flee a perceived threat. The reaction, which is influenced by appraisal of the threat, perceived injustice (violation of expectation), amount of lost value, and the ability to process information in a rational manner, requires the gift of emotional control in the face of disaster.

6. References

- Abelson, R. P. (1963). Computer simulation of “hot cognition”. In S. S. Tomkins & S. Messic (Eds.), *Computer simulation of personality* (pp. 277–302). New York, NY: Wiley.
- Alhakami, A., & Slovic, P. (1994). Psychological study of the inverse relationship between perceived risk and perceived benefit. *Risk Analysis*, *14*(6), 1085–1096.
doi:10.1111/j.1539-6924.1994.tb00080.x
- American Psychiatric Association. (1994). Book review diagnostic and statistical manual of mental disorders. *New England Journal of Medicine* (4th ed., Vol. 331). Washington, DC: American Psychiatric Press.
- Arkes, H. R., & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Processes*, *35*(1), 124–140. doi:10.1016/0749-5978(85)90049-4
- Bakken, I. J., Gøtestam, K. G., Gråwe, R. W., Wenzel, H. G., & Øren, A. (2009). Gambling behavior and gambling problems in Norway 2007. *Scandinavian Journal of Psychology*, *50*(4), 333–339. doi:10.1111/j.1467-9450.2009.00713.x
- Bell, D. E. (1985). Disappointment in decision-making under uncertainty. *Operations Research*, *33*(1), 1–27. doi:10.1287/opre.33.1.1
- Bower, G. H. (1981). Mood and memory. *American Psychologist*, *36*(2), 48–129. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/3322254>
- Breakwell, G. M. (2007). *The psychology of risk*. New York, NY: Cambridge University Press.
- Browne, B. R. (1989). Going on tilt: Frequent poker players and control. *Journal of Gambling Behavior*, *5*(1), 3–21. doi:10.1007/BF01022134
- Cannon, W. B. (1915). *Bodily Changes in Pain, Hunger, Fear and Rage: An Account of Recent Researches into the Function of Emotional Excitement*. New York, NY: Appleton Century Crofts

- Cannon, W. B. (1927). The James–Lange theory of emotions: a critical examination and an alternative theory. *American Journal of Psychology*, *39*, 106–124.
- Chaiken, S. (1980). Heuristic versus systematic information processing and the use of source versus message cues in persuasion. *Journal of Personality and Social Psychology*, *39*(5), 752–766. doi:10.1037/0022-3514.39.5.752
- Cohen, A. R., Stotland, E., & Wolfe, D. M. (1955). An experimental investigation of need for cognition. *Journal of Abnormal and Social Psychology*, *51*(2), 291–294.
doi:10.1037/h0042761
- Croson, R., & Sundali, J. (2005). The gambler’s fallacy and the hot hand: Empirical data from casinos. *Journal of Risk and Uncertainty*, *30*(3), 195–209. doi: 10.1007/s11166-005-1153-2
- Damasio, A. (1994). *Descartes' error*. London: Papermac, Macmillan.
- Ekman, P. (1999). Basic emotions. In M. Power & T. Dalgleish (Eds.), *Handbook of cognition and emotion* (pp. 45–60). Sussex, UK: John Wiley.
doi:0.1002/0470013494.ch3
- Ekman, P., & Friesen, W. (1969). The repertoire of nonverbal behavior: Categories, origins, usage, and coding. *Semiotica*, *1*(1), 49–98.
- Ellis H.C., & Ashbrook, P. W. (1988). Resource allocation model of the effects of depressed mood states on memory. In K. Fielder & J. Forgas (Eds.), *Affect, cognition and social behavior* (pp. 25–43). Toronto: Hogrefe & Huber.
- Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, *49*(8), 709–724. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/8092614>

- Epstein, S., & Curtis, R. (1991). Cognitive-experiential self-theory: An integrated theory of personality. In R. Curtis (Ed.), *The relational self: Theoretical convergences in psychoanalysis and social psychology* (pp. 111–136). New York, NY: Guilford Press.
- Fenton-O’Creevy, M., Nicholson, N., Soane, E., & Willman, P. (2003). Trading on illusions: Unrealistic perceptions of control and trading performance. *Journal of Occupational and Organizational Psychology*, 76(1), 53–68. doi:10.1348/096317903321208880
- Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.
- Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision-making*, 13(1), 1–17. doi:10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S
- Fischhoff, B. (1975). Hindsight ≠ foresight: The effect of outcome knowledge on judgment under uncertainty. *Journal of Experimental Psychology: Human Perception and Performance*, 1(3), 288–299. doi:10.1136/qhc.12.4.304
- Fiske, S. T., & Taylor, S. E. (1991). Affect and cognition. In S.T. Fiske & S.E. Taylor (Eds), *Social cognition* (pp. 409–461). Singapore: McGraw-Hill.
- Forgas, J. P. (1995). Mood and judgment: the affect infusion model (AIM). *Psychological Bulletin*, 117(1), 39–66. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/7870863>
- Frijda, N. H. (1986). *The emotions*. New York, NY: Cambridge University Press.
- Gilbert, D. T., & Wilson, T. D. (2009). Why the brain talks to itself: sources of error in emotional prediction. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, 364(1521), 1335–1341. doi:10.1098/rstb.2008.0305
- Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive Psychology*, 17(3), 295–314. doi:10.1016/0010-0285(85)90010-6

- Hardman, D. (2009). *Judgment and decision-making*. West Sussex, UK: Blackwell.
- Hayano, D. M. (1982). *Poker faces: The life and work of professional card players*. Berkeley, CA: University of California Press.
- Heider, F. (1958). *The psychology of interpersonal relations*. Hoboken, NJ: John Wiley.
- Isen, A. M., Shalcker, T. E., Clark, M., & Karp, L. (1978). Affect, accessibility of material in memory, and behavior: A cognitive loop? *Journal of Personality and Social Psychology*, 36(1), 1–12. doi:10.1037/0022-3514.36.1.1
- Izard, C. E. (1977). *Human emotions*. New York, NY: Plenum.
- Izard, C. E. (1979). *The maximally discriminative facial movement coding system (Max)*. Newark, DE: University of Delaware Instructional Resources Center.
- James, W. (1884). What is an emotion? *Mind*, 9(34), 188–205.
- James, W. (1890). *The principles of psychology* (vol. 1). New York, NY: Holt
- Kahneman, D. (2011). *Thinking, fast and slow* (p. 499). New York, NY: Farrar, Straus and Giroux.
- Kahneman, D., & Klein, G. (2009). Conditions for intuitive expertise: a failure to disagree. *American Psychologist*, 64(6), 515–26. doi:10.1037/a0016755
- Kahneman, D., Knetsch, J. L., & Thaler, R. (1986). Fairness as a constraint on profit seeking : Entitlements in the market. *American Economic Review*, 76(4), 728–741. Retrieved from <http://www.jstor.org/discover/10.2307/1806070>
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 263–291. doi:10.2307/1914185
- Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. *American Psychologist*, 39(4), 341–350. doi:10.1037/0003-066X.39.4.341
- Klein, G. (2008). Naturalistic decision-making. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 50(3), 456–460. doi:10.1518/001872008X288385

- Klein, G., Orasanu, J., Calderwood, R., & Zsombok, C. (1993). *Decision-making in action: Models and methods*. Norwood, NJ: Ablex.
- Kolstrand, H. (Ed.). (2006). *Platon -Samlede verker* [Platon – collected works]. Oslo: Vidarforlaget A/S.
- Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology*, 32(2), 311–328. doi:10.1037/0022-3514.32.2.311
- Larrick, R. P., Burson, K. A., & Soll, J. B. (2007). Social comparison and confidence: When thinking you're better than average predicts overconfidence (and when it does not). *Organizational Behavior and Human Decision Processes*, 102(1), 76–94. doi:10.1016/j.obhdp.2006.10.002
- Lazarus, R. S. (1966). *Psychological stress and the coping process*. New York, NY: McGraw-Hill.
- Lewin, K. (1927). Untersuchungen zur Handlungs- und Affektpsychologie [Studies on Action and Emotional Psychology]. *Psychologische Forschung*, 9(1), 1–85. doi:10.1007/BF02409755
- Lehrer, J. (2009). *How We Decide*. New York: Houghton Mifflin Harcourt Publishing Company.
- Lichtenstein, S., & Slovic, P. (1971). Reversals of preference between bids and choices in gambling decisions. *Journal of Experimental Psychology*, 89(1), 46–55. doi:10.1037/h0031207
- Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, 127(2), 267–286. doi:10.1037/0033-2909.127.2.267
- Mandler, G., & Cowan, P. A. (1962). Learning of simple structures. *Journal of Experimental Psychology*, 64(2), 177–183. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/14469216>

- Peters, E., Västfjäll, D., Slovic, P., Mertz, C. K., Mazzocco, K., & Dickert, S. (2006). Numeracy and decision-making. *Psychological Science, 17*(5), 407–13.
doi:10.1111/j.1467-9280.2006.01720.x
- Petty, R., & Cacioppo, J. (1986). The elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology, 19*, 123–205. doi:10.1016/S0065-2601(08)60214-2
- Petty, R. E., Briñol, P., Loersch, C., & McCaslin, M. J. (2009). The need for cognition. In M. R. Leary & R. H. Hoyle (Eds.), *Handbook of individual differences in social behavior* (pp. 318–329). New York, NY/London: Guilford Press.
- Pezzo, M. (2003). Surprise, defence, or making sense: What removes hindsight bias? *Memory, 11*(4), 421–441. doi:10.1080/09658210244000603
- Romanus, J., Hassing, L., & Gärling, T. (1996). A loss-sensitivity explanation of integration of prior outcomes in risky decisions. *Acta Psychologica, 93*(1-3), 173–183.
doi:10.1016/0001-6918(96)00007-8
- Rosecrance, J. (1986). Attributions and the origins of problem gambling. *Sociological Quarterly, 27*(4), 463–477. doi:10.1111/j.1533-8525.1986.tb00272.x
- Rosenthal, R. J. (1995). The Phenomenology of 'Bad Beats': Some Clinical Observations. *Journal of Gambling Studies, 11*(4), 367–372. doi:10.1007/BF02108615
- Rotter, J. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monograph, 80*(1), 1–28. doi:10.1037/h0092976
- Schachter, S., & Singer, J. E. (1962). Cognitive, social, and psychological determinants of emotional state. *Psychological Review, 69*(5), 379–399. doi:10.1037/h0046234
- Schwarz, N., & Clore, G. L. (1996). Feelings and phenomenal experiences. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 433–465). New York, NY: Guilford Press.

- Siler, K. (2010). Social and psychological challenges of poker. *Journal of Gambling Studies*, 26(3), 401–420. doi:10.1007/s10899-009-9168-2
- Simmons, J. P., & Nelson, L. D. (2006). Intuitive confidence: choosing between intuitive and nonintuitive alternatives. *Journal of Experimental Psychology. General*, 135(3), 409–428. doi:10.1037/0096-3445.135.3.409
- Skalinsky, B. D., & Malmuth, M. (1999). *Hold 'em poker for advanced players*. Henderson, NV: Two Plus Two.
- Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin*, 119(1), 3–22. doi:10.1037/0033-2909.119.1.3
- Slovic, P. (2000). *The perception of risk*. London: Earthscan.
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: some thoughts about affect, reason, risk, and rationality. *Risk Analysis*, 24(2), 311–322. doi:10.1111/j.0272-4332.2004.00433.x
- Slovic, P., & Peters, E. (2006). Risk perception and affect. *Current Directions in Psychological Science*, 15(6), 322–325. doi:10.1111/j.1467-8721.2006.00461.x
- Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2005). Affect, risk, and decision-making. *Health Psychology*, 24(4), 35–40. doi:10.1037/0278-6133.24.4.S35
- Smith, G., Levere, M., & Kurtzman, R. (2009). Poker player behavior after big wins and big losses. *Management Science*, 55(9), 1547–1555. doi:10.1287/mnsc.1090.1044
- Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: implications for the rationality debate? *The Behavioral and Brain Sciences*, 23(5), 645–726. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11301544>
- Teigen, K. H. (2004). *En psykologihistorie*. Bergen: Fagbokforlaget Vigmostad & Bjørke AS.
- Thaler, R. H. (1985). Mental accounting and consumer choice. *Marketing Science*, 4(3), 199–214. doi:10.1287/mksc.4.3.199

- Thaler, R.H., & Johnson, E. J. (1990). Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. *Management Science*, *36*(6), 643–660. doi:10.1287/mnsc.36.6.643
- Tomkins, S. S. (1962). *The positive affects*. New York, NY: Springer.
- Troland, L. (1928). *The fundamentals of human motivation*. New York, NY: Van Nostrand.
- Tversky, A., & Kahneman, D. (1971). Belief in the law of small numbers. *Psychological Bulletin*, *76*(2), 105–110. doi:10.1037/h0031322
- Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207–232. doi:10.1016/0010-0285(73)90033-9
- Tversky, A., & Kahneman, D. (1983). Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological Review*, *90*(4), 293–315. doi:10.1037/0033-295X.90.4.293
- Von Neumann, J., & Morgenstern, O. (1944/2004). *Theory of games and economic behavior* (6th ed.). New Jersey: Princeton University Press.
- Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, *92*(4), 548–573. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/3903815>
- Weinstein, N. D. (1989). Effects of personal experience on self-protective behavior. *Psychological Bulletin*, *105*(1), 31–50. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/2648439>
- Yampolskiy, R. V. (2007). Game skill measure for mixed games. *Proceedings of World Academy of Science, Engineering and Technology*, *27*, 308–312.
- Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist*, *35*(2), 151–175. doi:10.1037//0003-066X.35.2.151

Zajonc, R. B., Adelman, P. K., Murphy, S. T., & Niedenthal, P. M. (1987). Convergence in the physical appearance of spouses. *Motivation and Emotion, 11*(4), 335–346.

doi:10.1007/BF00992848

Zillmann, D. (1983). Transfer of excitation in emotional behavior. In J. T. Cacioppo & R. E. Petty (Eds.), *Social psychophysiology: A sourcebook* (pp. 215–240). New York, NY: Guilford Press.