The Role of Description and Experience in the Decision Weights of Rare and Customary Events

by

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Abstract

A recent debate has identified a description – experience gap, where the non-linear weighting function identified in prospect theory reverses when probabilities are discovered through experience rather than by description or symbolic representation (i.e. probabilities). While prospect theory predicts that people over emphasize the possibility of rare events, new experimental evidence finds that people ignore the possibility of rare events when the likelihood of an outcome is discovered by experiencing outcomes directly rather than being provided with probabilities.

This thesis will explore the role of experience and probabilities theoretically and empirically. It is argued that both behaviors are compatible on a theoretical basis given a preference for the status quo, but produce opposing decision weights due to different cognitive and motivational factors. Probabilities focus a decision on the potential for rare events creating a preference for certain outcomes and reduced risk taking consistent with loss aversion. Experience overweighs customary outcomes consistent with sensitivity to a reference point or the status quo. Experience in the form of loss, however, moderates the effect of probabilities on risk taking. An experimental game of dice supports this hypothesis, suggesting ambiguity seeking in the face of loss and raising the possibility that the use of probabilities may not be always be maximizing behavior for individual decision making as typically assumed.

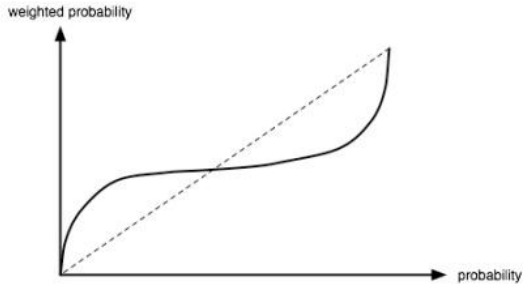
Introduction

Intrigued with the emerging concept of probabilities, Pascal noted in the mid-1600s that people were overly concerned about being hit by lightning given the low probability of this event occurring. People really should consider the likelihood of an event, when in fact they do not, he mused. Four centuries later the role of probabilities in decision making is still not fully understood. The two key inputs into decision making under uncertainty are the value of an outcome and the likelihood of this outcome, with the latter being the focus of this paper. How can we determine the likelihood of an outcome given the inherent uncertainty in a complex and interconnected world? Two sources of information on the likelihood of an outcome are from statistical probabilities and from our personal experiences. How effective are these sources of probabilities in helping us make decisions?

Recently a debate has risen over what has become known as the description – experience gap (Hau, Pleskac, Kiefer, & Hertwig, 2008). An observation has been made that whether people determine the likelihood of an outcome through "description" (i.e. probabilities) or through experiencing the outcome of events directly significantly alters decisions made. Prospect theory, the more established and recognized theory known for its emphasis on losses and gains with respect to a reference point, rather than wealth, as the carrier of utility or subjective preferences, has significantly relied on experimental tests providing descriptive probabilities to assist participants in decision making (Tversky & Kahneman, 1979, 1992). As probabilities are not always available in real life, a group of researchers have attempted to provide more realism to experiments by requiring participants to sample from a distribution of outcomes to discover the likelihood of an event (Barron & Erev, 2003)(Ralph Hertwig, Barron, Weber, & Erev, 2004). They found that probabilities discovered through experience produce the opposite results from experiments which provide statistical probabilities. Prospect theory relies on

experiments using description based probabilities and predicts a non-linear weighting function which under-weighs low probability events and over-weighs high probability events (See Figure 1, Kahneman & Tversky, 1979). This pattern of behavior can be observed when people both buy a lottery ticket and insurance and are afraid of being hit by lightning even though this rarely occurs. Experiments based on experience produce the opposite results, suggesting that people under weigh the likelihood of a rare event occurring. This equally explains why people may ignore pending disaster, such as the economic crash of 2008, until the event occurs and it is too late to take precautions. How can these two sets of findings be reconciled?

Figure 1: Non-linear weighting function described by Prospect Theory



Calls have been made for more than one theory of risky choice (Hertwig et al., 2004). It is proposed that the behavior observed when decisions are informed by experience is incompatible with prospect theory which suggests the opposite behavior when decisions are informed by description. Are these two apparently contradictory phenomena compatible under a single theory of risky choice? What is the respective role of description (probabilities) and experience in decision making and the interaction between the two, Hadar & Fox (2009) challenged participants in the debate. These are the two questions explored theoretically and empirically in this paper. The terms "probabilities" and "description" will be used interchangeably.

This paper will begin by exploring the theoretical foundations of utility theory, presenting a view that a call for a second theory of risky choice is premature without considering the role of a non-linear weighting function within a broader understanding of prospect theory and its theoretical foundations. Rather than searching for an alternative theory that explains the behavior observed in the experience paradigm, an attempt is made to reconcile the two behaviors under a single theory. It will be argued that sensitivity with respect to a reference point, not loss aversion, is the primary underlying principle of decision making under uncertainty which reconciles the apparently contradictory behaviors in the description – experience debate (Gal, 2006) (Samuelson & Zeckhauser, 1988). While consistent with the theoretical foundations of prospect theory, the description – experience debate should be more narrowly focused on the role of description and experience in the formation of decision weights.

The different roles of description and experience will be theoretically developed by identifying two processes which may influence decision weights: decision isolation (Camerer, 2005) and a motivation to overcome the status quo (Gal, 2006). Probabilities and experience not only provide valuable information but they also provide different motivational incentives which influence decision weights. People have a general preference for knowing probabilities in decision making under uncertainty, as observed in the well documented ambiguity aversion phenomenon (Ellsberg, 1961) (see Camerer & Weber, 1992 for review). Probabilities facilitate decision making, provide legitimacy associated with rationality and reduce the potential for regret. However, it is proposed that probabilities focus decision making on the potential for rare events and satisfy the need for cognitive closure, leading to the preference for certain outcomes and reduced risk taking. Experience, on the other hand, anchors decision weights on customary outcomes experienced in the past, forming a powerful preference for the status quo. Experience in the form of a loss, however, provides the neural and affective motivation to shift decision weights to outcomes beyond the status quo, potentially maximizing outcomes.

An experiment using a repeated game of dice rolls with a monetary payoff explored the influence and interaction of probabilities by description and experience on decision making. For all participants, the preference for information as description increased with uncertainty, consistent with ambiguity aversion. An increase in the recall of probabilities over four rounds of dice rolls with progressively higher probabilities of loss was observed. However, probabilities and experience are shown to influence choice in unique ways. Probabilities are shown to decrease risk taking and promote loss aversion, as those who recalled probabilities chose to opt out of the game of dice. However, experience trumps description when a loss is incurred, overcoming the loss aversion caused by probabilities and resulting in an increase in risk taking in the domain of loss. A strategy of moderately increased risk taking is found to be optimal behavior for those who experienced a loss, resulting in a significantly higher payoff than the payoff received by those more risk averse in the final round of dice rolls.

The results of this experiment can contribute to the description – experience debate in two ways. It has been suggested that "ambiguity seeking for losses" would allow for parameters that under-weigh rare events under the two-stage model of prospect theory (Craig Fox in Barron & Ursino, 2013, p. 284). In other words, the opposing weighting functions observed in the description – experience debate could be compatible if the weighting function identified in prospect theory is depressed in the domain of losses. The results of this experiment provide evidence for such a depressed weighting function, as those who experience a loss are equally likely to note probabilities but less likely to respond to these probabilities with reduced risk taking. Finally, the results of this experiment question the assumption in the description – experience debate that objective probabilities optimize behavior. Probabilities may focus attention on the potential for loss, requiring a premium above expected value for uncertain outcomes, and leading to loss aversion which has been shown to result in non-optimal investment

choices (Benartzi & Thaler, 1995). Boundaries for the optimizing use of probabilities in decision making are briefly discussed and recommended for future study.

A Theoretical Context

The origins of utility theory came hand in hand with the newly discovered science of probabilities. It was suggested in a series of letters between Pascal and Fermat in the mid-1600s that people would optimize behavior by maximizing the expected value of an outcome, calculated as the sum of the payoff from each outcome times its probability. In the early 20th century, von Neumann and Morgenstern (1953) revived and defined the modern concept of Expected Utility, identifying axioms of rational behavior, such as independence, transitivity, and completeness. When these axioms are followed, numerical personal utility and probabilities can be used to construct utility functions that have been used in finance to identify indifference curves or the price of an asset. Due to its tractability, classic utility theory is still considered the authoritative framework of optimizing risky choice, in spite of the discovery of the many ways people contradict these axioms in real life (see Camerer & Thaler, 1998 for a review of these anomalies).

While probabilities and the value of outcomes are still central to utility theory, the theory has been adapted over time to reflect how people actually make decisions, providing a descriptive rather than normative theory of decision making. Decisions are now considered to be motivated by subjective preferences or utility (Bernouilli, 1954), rather than absolute payoffs, and subjective rather than objective probabilities – the focus of debate in the description – experience gap (Savage, 1972)(Ramsey, 1978). Utility and weighting functions are inferred or discovered through behavior (Cubitt, Starmer, & Sugden, 2001) rather than being derived from theoretical foundation. Some economists suggest that it

is not necessary for individuals to be aware of preferences, but what is important for predictive power is that they behave "as if" these preferences exist (Friedman, 1953).

As far back as 1948, decision theorists have attempted to explain why people purchase both lottery tickets and insurance (Friedman & Savage, 1948), willing to pay more than their actuarial value to avoid or obtain these risky outcomes. This type of behavior can be explained by decision weights inferred from choices made, that do not necessarily align with the probability of these events occurring or the measure of degree or belief in their occurrence (Kahneman & Tversky, 1979). For example, while correctly judging from a casual glance that the percentage of red to black balls in an urn is approximately 50/50, individuals still prefer to select from an urn where this probability is known. Decision weights can be influenced by factors other than the accurate or inaccurate judgment of probabilities (Heath & Tversky, 1991).

Non-linear weighting preferences were observed by Allais (1953) who noticed that people are more sensitive to the difference between probabilities .99 and 1.0 than to the difference between .10 and .11. In other words, probability changes appear more dramatic near the end points 0 and 1 than near the middle of the probability scale (see Gonzalez & Wu (1999) for a review). These observed behaviors contradict the independence axiom of classic utility theory (von Neumann and Morgenstern, 1953) which states that people should be indifferent between decisions with equal base outcomes that cancel each other out (e.g. eliminating the common base, one should be indifferent between .99/1.0 and .10/.11 probabilities which is a remaining 1% uncertainty). The non-linear weighting function was included in the revised version of prospect theory by incorporating rank-dependent expected utility in which cumulative probabilities are transformed rather than individual probabilities (Kahneman & Tversky, 1992). This modification was considered an improvement to the original prospect theory

(1979) as it avoids the violation of first order stochastic dominance (clear ranking preferences) and extends the theory to uncertain as well as risky outcomes.

The non-linear weighting function was one among many violations of utility theory empirically observed, with the experimental model typically based on prospects or lotteries in which people make a choice between two options using the statistical probabilities provided. However, people do not generally have access to information on probabilities for everyday decisions. In order to provide more realism, a group of researchers introduced a new approach where subjects must discover probabilities acquired from experiencing a series of outcomes (Barron & Erev, 2003, Hertwig, Barron, Weber, Erev, 2004) (Weber, Shafir, & Blais, 2004). This type of experiment was expected to lead to adaptive learning which would move behavior toward expected value maximization (Barron & Erev, 2003).

The primary characteristic of experiments that have contributed to the description – experience debate are experiments in which subjects have an incomplete knowledge of probabilities and this information is derived from a sampling process (Hadar & Fox, 2009). Initial models consisted of two symbolic decks of cards represented by two buttons on a computer screen. The participant could sample from these decks of cards by clicking on each button as often as desired, with replacement, to discover the distribution of outcomes in each deck which have either a high or low expected value. Based on this knowledge, the participant could make a choice between a sure outcome and the outcome from a deck of cards selected. There are three variations to this game (Hertwig & Erev, 2009). In the sampling paradigm, participants can sample the distribution as often as they like and then make a single draw for real. In the full-feedback paradigm, each draw contributes to earnings and feedback is received on each result. The third variation is a partial-feedback model similar to the full feedback model except that people only learn about the obtained payoffs.

The results of these experiments based on experience have consistently identified a marked divergence from prospect theory which suggests that people overweigh low probability events. For example, given the option between a safe choice of a certain payoff of $7 versus a risky choice with a distribution of x=16 (.01) or x= 6.9 (.99), participants who must discover the probability distribution experientially prefer the safe option, while those who are given probabilities prefer the risky option. On the other hand, given the choice of a safe option of $2.20 versus a distribution of x = 3 (.93) and -7.2 otherwise, description based participants will choose the safe option while experience based participants generally choose the risky option. In other words, rare events whether gains or losses tend to have less impact than they deserve according to their objective probabilities.

Under-weighting low probability events has been used to explain why underestimating the likelihood of a housing bubble, in spite of significant evidence pointing to this possibility, led to the worst recession in 2009 since the Great Depression (Hertwig & Erev, 2009). Why then will people both over-weigh the potential of being struck by lighting and also under-weigh the potential of a market crash? This is a question with environmental validity that deserves further investigation. Indeed, Kahneman and Tversky themselves conceded that the weighting function is not well-behaved near the endpoints of 1 or 0 with the result that small probabilities of disaster can be greatly over-weighted or entirely ignored (Kahneman & Tversky, 1979, 1992)

Theoretical Consistency with a Preference for the Status Quo

In order to determine if a second theory of risky choice is required to explain the description – experience anomaly, one must first look more carefully at the primary theory of risky choice in question to determine which part of this theory should be rejected or can be supported. Since the resurgence of utility theory as the rational theory of choice by Neumann & von Morgenstern, the academic landscape

has been littered with anomalies or observations of the many ways that people do not in fact behave according to this theoretical paradigm. Anomalies of expected utility theory show a high degree of convergence to the s shaped utility function described by prospect theory, with risk seeking observed in the domain of losses with respect to a reference point and risk aversion in the domain of gains. This reference point such as a change in wealth or expected wealth is the carrier of utility (preferences) rather than absolute levels of wealth, with diminishing sensitivity as payoffs increase or decrease. Loss aversion, or the tendency for losses to loom larger than gains by a ratio of approximately 2:1, is posited as the explanation of many phenomena such as the endowment effect, preference for the status quo and the certainty effect. Loss aversion has been empirically observed in investor under-investment in stocks (Benartzi & Thaler, 1995), asset prices (Barberis, Huang, & Santos, 2001), animal behavior (Real, 1991), and consumer behavior (Hardie, Johnson, & Fader, 1993)(Paraschiv & L'Haridon, 2008).

Prospect theory has been characterized as a two stage theory wherein options are first evaluated before a decision is made. There are many ways that framing and biases have been shown to influence people's judgment of probabilities or information (Tversky & Kahneman, 1984). Prospect theory recognizes the importance of source dependence, which can be viewed as a specific type of framing depending on whether information regarding the likelihood of an event is provided with probabilities or ambiguous information such as verbal or graphical descriptions. Prospect theory allows for source dependence through a weighting function, but does not specify how source dependence influences this weighting function (Kahneman & Tversky, 1992).

Prospect theory has received broad based acceptance as a descriptive alternative to classical utility theory, garnering its author Daniel Kahneman a Nobel Memorial Prize in Economics in 2002. However, the evaluation stage of prospect theory has diminished its effectiveness as a predictive theory of decision making, and a single tractable theory with predictive accuracy remains elusive (Starmer,

2000). While attempting to provide a tractable and parsimonious theory, the authors concede that the theory falls short of a fully adequate account of complex phenomena, leaving room for refinement of the theory (Kahneman & Tverksy, 1979).

Emphasis on identifying anomalies of the rational EUT paradigm has detracted from the development of a rigorous theoretical foundation of these anomalies. Exploring the psychological foundations of prospect theory, Gal (2006) points out that the literature on prospect theory has been low in theoretical development. "Loss aversion is cited as the explanation for phenomena (the endowment effect, status quo, risky bet premium) and circuitously, the same phenomena are cited as evidence for the existence of loss aversion (p.24)." Gal proposes that a preference for the status quo provides the most parsimonious rationale. A trade-off between the status quo and change is sufficient to explain the phenomenon, making loss aversion superfluous. Likewise, others have suggested that the status quo must be presented as an option in order for loss aversion to be observed (Ert & Erev, 2013)(Samuelson & Zeckheuser, 1988).

The importance of a reference point or the status quo would appear to support, rather than contradict the under weighting of low probability events. Consider the choice of a safe option of $2.20 versus a risky option with a distribution of x = 3 (.93) and -7.2 otherwise. The behaviors of participants in the description and experience paradigms both exhibit a tendency to overweigh the reference point or changes to the reference point, differing only in the type of information provided and the status quo option selected. The person in the experience paradigm will prefer the outcome of 3 which is experienced most often or 93% of the time. This is consistent with the terminology of "customary outcomes" which has been used to describe the reference point (Markowitz, 1951) (Kahneman & Tversky, 1979). Instead of choosing customary outcomes, the person in the description paradigm chooses the certainty option. Choosing not to participate in the gamble can also be considered a

preference for the status quo (Gal, 2006). In a single shot gamble, such as occurs frequently in real life, the customary outcome is the most likely and potentially maximizing outcome while the certain option is chosen at a cost or premium.

While prospect theory asserts that a preference for the status quo is due to loss aversion, this causal relationship is not borne out by the anomaly observed in the description experience debate. Presented with a choice between the status quo and loss aversion by choosing the certain bet, the experience participant prefers the status quo (keeping in mind that the participant has full information of the loss potential). The behaviors observed in the description – experience debate are reconciled by a preference for the status quo, and may also provide evidence that this preference is the underlying phenomenon which makes loss aversion superfluous, as Gal (2006) suggested. The two behavior patterns, loss aversion which overweighs rare events and a preference for the status quo which overweighs events with high probabilities, may be triggered by the type of information provided which focuses the participant's attention on either rare events or customary outcomes.

Decision Isolation: The role of information search places prominently in explanations provided for the description – experience gap, with the observed phenomenon thought to be an artifact of small samples (Fox and Harder 2006). Indeed, the original authors were quick to admit that the degree of sampling by participants was quite modest, with a median of 15 cards per problem with the result that 78% of participants experienced the rare event less frequently than anticipated (Hertwig et al, 2004). Limiting the search for information makes decision making easier, as it increases the contrast between options making it easier to differentiate between options (amplification effect) (Hertwig & Pleskac, 2010).

Given the endless information available in the real world, the selective use of information in decision making is not only a curious behavior but a necessity due to cognitive limitations. The

characteristics of the information used selectively in decision making are critical to the decision made. Consistent with the two stage process identified in prospect theory, this paper proposes that the alternative weighting functions observed in the description – experience debate is due to the framing of rare events which is made salient to the decision maker through the use of probabilities. A similar view is shared by Hogarth and Einhorn (1990) who describe the decision weight model as a two-step process which involves first anchoring on the estimate of a probability and then adjusting this estimate by imagining alternative outcomes.

In his review of anomalies contradicting utility theory, (Camerer, 2005) observed that ***decision isolation*** or focusing on the possibility of a rare outcome was required in order for loss aversion to be observed empirically. In extending the classic weighting function observed in experiments by description to the domain of uncertainty where probabilities are unknown, Fox and Tversky (1998) incorporate a ***possibility effect*** which focuses attention on a previously unidentified or low probability outcome. An event has more impact on choice when it turns an impossibility into a possibility or a possibility into a certainty, rather than if it only makes a possibility more or less likely (Tversky & Wakker, 1995).

The influence of focus is also revealed in studies of myopia loss aversion (Benartzi & Thaler, 1995). Frequent feedback on investment performance over short time horizons has been shown to increase loss aversion and the retreat to safe investment choices, linking loss aversion to the equity premium puzzle or an implausibly high level of risk aversion towards stocks (Mehra & Prescott, 1985) (Benartzi & Thaler, 1995). However, reduced feedback and a longer investment horizon attenuate the focus on feedback, reducing loss aversion. Loss aversion becomes muted when focus is less intense, such as multiple decisions made over the course of a year or a broad temporal view that diminishes the focus on a narrow time frame (Camerer, 2005).

Decision weights, and perhaps even loss aversion itself, are influenced by the informational content made salient to the decision maker. This paper will now explore how probabilities and experience influence decision weights by focusing on different informational content and contributing unique motivational influences.

The Role of Description

Since the emergence of utility theory, the likelihood of an event occurring has played a central role, with the value of potential decisions calculated as the sum of the utility (preference) of the payoff of each possible event times its probability. It was soon pointed out that people based decisions on subjective rather than objective or statistical probabilities and subjective utility theory came to be accepted as a more accurate representation of how decisions are actually made (Savage, 1972). However, the role of objective probabilities has continued to play a prominent role in studies of decision making under uncertainty and in the real world. The distinction between uncertainty with known probability distributions and uncertainty whose parameters are not known was made by Knight (1921) who labeled them "risk" and "uncertainty" respectively. The label stuck and decisions with outcomes that have known probabilities are called decisions under risk.

Ambiguity aversion is a behavior observed when people consistently prefer having information regarding the probability of events over ambiguous situations where probabilities are unknown. The term "ambiguity" was first used by Ellsberg (1961) who characterized ambiguity as varying "quality of information, depending on the amount, type and reliability and unanimity". Information can include probabilities, as in classical ambiguity aversion theory, or information more broadly (Camerer & Weber, 1992). Similar to Knight's distinction between risks characterized by known probabilities and uncertainty where probabilities are unknown, Ellsberg used the term ambiguity aversion to describe the

preference people have for decisions with known probabilities. To illustrate this phenomenon, Ellsberg gave subjects the option of choosing between two games in which selecting a red ball from an urn would produce a winning result. In the first choice, an urn contains red and black balls but the ratio of balls is unknown. In the second urn there are exactly 50 red and 50 black balls. A consistent majority of people prefer to play the second game where the probabilities are known.

Relying on objective rather than subjective probabilities assumes decision optimization and brings social legitimacy. The inability to anticipate utility derived from consequences can potentially lead to regret after an action is taken (Simon, 1997)(Kahneman & Thaler, 2006). Decisions with known probabilities are easier to justify than ambiguous ones and can therefore reduce regret. Subjects are significantly more averse to ambiguity when the gamble is played and the contents of the urn are revealed in front of other subjects. This suggests that decisions based on objective probabilities reinforce the competence of the decision maker and that competence is a key motivation for ambiguity aversion (Heath & Tversky, 1991). Indeed, relying on objective probabilities may appear preferable to relying on subjective probabilities, given that people are poor judges of probabilities and subject to framing effects.

The preference for probabilities over ambiguity may be due to their usefulness as a decision making tool. While probabilities might initially appear to belong to the more effortful, logical and deeper level of processing identified in dual system theories of cognitive processing, it could also be argued that probabilities could be useful as a heuristic. The strength of heuristics are related to the salience of the information to the context, the strength or number of times the rule has been successful in the past, the precision or degree of specification and the social legitimacy of the rule Probabilities would appear to be a very strong heuristic rule, as they are based on average prior experience, are mathematically precise and provide legitimacy as a norm of rationality. As a strong heuristic,

probabilities can create the perception of certainty, resulting in cognitive closure that facilitates decision making (Webster & Kruglanski, 1994).

However, in spite of the preference for and apparent certainty provided by probabilities in decision making, probabilities can reduce uncertainty, but not eliminate it. In his book, "The Foundation of Statistics" Savage (1972) observes that probabilities can only be applied to repetitive events not always experienced in real life, and that probabilities can provide varying degrees of confidence in the truth of proposition, but do not provide certainty. Probabilities assume that the defined set is the set of all relevant information, but in the real world these sets are unknown (Savage, 1972). Even when the defined set of outcomes is known, as in a game of dice, ***outcome uncertainty*** remains when a limited number of games are played (Hogarth & Einhorn, 1990). Unless the gambler plays a large number of games to approach a normal distribution, on the next roll of the dice he may win even if the odds are against him, and may lose even if the odds are in his favor. Like heuristics, probabilities are rules built on prior experience that are usually correct, but can lack predictive power under situations of change.

The Role of Experience

"Experience matters", the proponents for a second theory of choice based on experience claim (Hau et al., 2008). To confirm that it was experience, and not a lack of information due to small sample sizes that produced the conflicting results between probabilities obtained by description and those discovered through experience, the original modeling paradigm was modified to control for sample error (Barron & Ursino, 2013). Participants were required to sample without return from a finite population and allow subjects to keep a tally of sampled results before making their final single choice. In this way they could ensure that low probability events were sampled and known to be a potential outcome. Under-weighting of low probabilities continued to be observed, in contradiction to prospect

theory. These results re-affirm the suggestion that it is the influence of experience, and not incomplete information, which led to the reverse weighting function observed.

Utility theory has been modified over time to reflect the reality that it is not cold, hard probabilities and monetary payoffs that influence our decisions, but rather how these probabilities and payoffs are personally experienced and interpreted through individual preferences and subjective probabilities or weighting functions. Bayesian reasoning suggests that experienced probabilities are more likely to be used (Hau, Pleskac, Hertwig, 2008). Experience plays a significant and real role in decision making.

Experience provides information on the utility previously derived from an outcome or ***experienced utility*** (Kahneman & Thaler, 2006). For this reason, people may continue to select known favorites from a menu, knowing that they have enjoyed this item in the past. However, the informational quality of experience can be subjected to biases. The memory of the enjoyment of an experience may be biased by the emotional state at the time of the event (Stone, Broderick Porter and Kael, 1997). A habitual choice for a particular outcome may be due to fuzzy or unknown preferences and lack of motivation to try something new, rather than a preference for the outcome (Gal, 2006). Under-weighting rare events can occur even in large samples due to a recency effect as participants update their subjective probabilities from recent experience in which rare events are less likely to have occurred (Hogarth & Einhorn, 1992)(Hertwig et al, 2004).

A reference point which takes into consideration the accumulation of prior experience, current status and expectations for future outcomes is the essence of prospect theory and proposed as the carrier of utility (Kahneman & Tversky, 1979). People adapt remarkably quickly to experience, whether good or bad. The grief or joy associated with winning the lottery, becoming a paraplegic (Kahneman, 2000) or receiving or being denied tenure (Gilbert, Pinel, Wilson, Blumberg, & Wheatly, 1998) largely

dissipates within a year of the event (Kahneman, 2000). In contradiction with the rational evaluation suggesting temporal monotonicity the length of time a hand remains in painfully cold water has been shown to decrease the remembered pain associated with this experience (Kahneman, Fredrickson, Schreiber, & Redelmeir, 1993). Adapting to customary outcomes is also consistent with the concept of diminishing sensitivity which has been used to explain loss aversion (Erev, Ert & Yechiam, 2008).

Motivation is required to overcome the effect of the preference for the status quo and influence of a reference point (Gal, 2006). People will tend to remain at the status quo unless they have a clear preference between the status quo and an alternative option. Motivation to alter the status quo can come from a preference for a change in outcomes (Gal, 2006) or aspiration levels associated with the utility of attaining a goal (Kahneman & Tversky, 1991) (Heath, Larrick, & Wu, 1999)(Becker & Siegel, 1962). The value of motivation, whether in the form of incentives, goals or reasons, has long been acknowledged by psychologists and economists alike.

Motivation to overcome the status quo can also come from neural or affective sources. Loss aversion has been attributed to four components including 1) neural, 2) affective, 3) cognitive and 4) conative (Paraschiv & L'Haridon, 2008). Neuroscience has recently turned to studying how the brain processes losses and gains through the use of MRIs. Activation of the amygdala signaling the presence of fear has been linked to loss aversion (Camerer, 2005). Neural reactions such as fear or surprise may also be influential in triggering a search for information. Affect, or the attachment to an outcome, can influence the value or price placed on a product and the information selected and retained. Affect can also be a source of information (Clore, Gasper, & Garvin, 2001).

Motivation to consider alternative options to the status quo can come from external or environmental stimulus. In exploring the boundaries of loss aversion, some have suggested that the status quo must be an option in order for loss aversion to be observed (Gal, 2006)(Ert & Erev, 2013). If

the status quo is no longer an option, one will be forced to search for an alternative outcome. An external source of motivation can also come in the form of increased payoffs which have been shown to increase motivation for search in the description – experience paradigm (Ert & Erev, 2013).

What are the conditions for choosing between probabilities and experience in decision making? When does one information source take precedence over the other, and what effect does the reliance on this type of information source have on risk taking? In the next section, we will look at the results of a dynamic experimental game of dice in which both probabilities and experienced outcomes compete in risky choices to explore the interaction of the two and their effect on risk taking.

Hypotheses

An experimental game of dice with a monetary incentive was conducted to test the effect and interaction of information acquired through description and that acquired through experience on decision making. The following hypotheses will be tested.

Ambiguity aversion suggests that people prefer choices with known probability distributions to choices with ambiguous probabilities (Allais, 1953). A preference for probabilities is also consistent with theories of cognitive closure, which predict a high degree of motivation to search for definite or specific information (Webster & Kruglanski, 1994), a motivational goal in its own right (Pervin, 1989). While the need for cognitive closure can be an individual trait, it can also be triggered by the situational context such as that experienced in a game of dice. When there is a high degree of uncertainty, probabilities facilitate decision making by appearing to provide a clear directive for action. Probabilities are a strong heuristic for decision making as they are precise, structured, historically accurate, and provide legitimacy and the appearance of rationality which reduces the potential for regret (Simon, 1997)(Kahneman & Thaler, 2006). This leads to the prediction that:

H1: Participants will increasingly focus on probabilities (i.e. increased accuracy of probability recall) to assist in decision making as uncertainty (i.e. the probability of loss) increases.

Isolating or narrowly bracketing on the potential for rare events has been proposed as a pre-requisite for loss aversion and the overweighting of rare events, providing the psychological intensity to respond to the event (Camerer, 2005). Similarly, myopic loss aversion, a combination of loss aversion and the focus on a narrow set of statistical outcomes (short investment horizons) due to mental accounting, has been used to explain the equity premium puzzle or the preference for the safety of bonds over the higher but riskier return of stocks (Benartzi, Thaler, 1995). In a follow up experiment, Thaler et al (1997) demonstrated that controlling the amount of feedback information reduced myopic loss aversion and resulted in higher payoffs. By focusing on potentially negative outcomes, the effect of loss aversion is heightened by making the loss more salient to the decision maker and increasing the contrast effect between choices (Ert & Erev, 2013). Due to the association of perceived competency with the use of probabilities identified in ambiguity theory (Curley, Yates, & Abrams, 1986), the disutility of a loss may be magnified, increasing regret if a decision maker should experience a loss having known the probability of its occurrence. On the other hand, people who choose the status quo are less likely to regret decisions than those who choose change (Mannetti, Pierro, Kruglanski, 2007). Salience of loss, perceived competence and regret avoidance may all contribute to reduced risk taking when probabilities are used in decision making.

H2: Attention focused on probabilities (i.e. accurate recall of probabilities) is expected to increase a preference for the status quo (i.e. reduce risk taking).

Negative experience or loss is expected to provide the affective motivation to overcome a preference for the status quo and lead to increased risk taking (Gal, 2006). A loss changes the reference point and aspiration level of the participant. The existence of an option that includes the status quo is

one of the conditions identified for observing loss aversion (Gal, 2006) (Ert & Erev, 2013). When a loss is experienced, the effect of loss aversion is diminished as the status quo is no longer an option. Increased risk taking in the domain of losses is predicted in prospect theory (Markowitz, 1952)(Kahneman & Tversky, 1979). This increased risk taking in the domain of losses has been observed to be accompanied by reduced ambiguity aversion as the probability of loss increases in experiments by Hogarth and Einhorn (1990). While an aversion to ambiguity leads to loss aversion and a preference for the status quo, the experience of a loss reduces this effect.

H3: Experience, in the form of loss, is expected to moderate a preference for the status quo (i.e. reduce risk taking) caused by a focus on probabilities (i.e. accurate recall of probabilities).

The Experiment

An experiment was designed to test the effect of Description and Experience on risk taking. One hundred and two marketing students (n = 102) at the University of Manitoba participated in this game for course credit and nominal compensation (63 male and 39 female). The design was a 2 (Description) x 2 (Experience - manipulated) between subjects design with Risk Taking as the main dependent variable. The experiment consisted of a dynamic series of 20 dice rolls in which participants receive a real monetary payoff to a maximum of $10, and probabilities are provided and change with each round of dice rolls. The game begins with five dice, and after a round of five rolls one dice is removed, leaving two dice in the final and fourth round (i.e. five rounds with five dice, five rounds with 4 dice, five rounds with 3 dice and five rounds with 2 dice). With each round of the dice participants have the choice to participate or opt out of a game of dice rolls. The participant receives 50 cents with each roll of the dice.

However, if all the dice rolled have the same number (i.e. all 6s, all 5s, etc.), the participant loses half of what they earned up to that point. See Appendix A for a Game Sample.

Description was operationalized as the statistical probability of rolling all the same number (resulting in a loss) which was provided to all participants at the beginning of each round. At the end of the game participants were asked to recall the probability of each round of dice and were divided into two groups – Accurate Recall and Inaccurate Recall. As the analysis focus on the final round of dice rolls when two dice are used, accurate recall of two dice (2D) will be used. Ambiguity aversion or the preference for knowing probabilities in decision making leads to the observation of probabilities which focus attention on the potential for loss. The accuracy data lent itself to a dichotomous rather than continuous variable, as there was a sharp divide between those who recalled the probability and those who did not (See Appendix B). While the probabilities of outcomes were provided, the expected value of each decision depended on the score of each participant, as the expected value of a loss depended on the score up to that point. The expected value of each decision was not provided to participants and would have been difficult to recalculate with each roll of the dice.

Experience was operationalized as a Loss and No Loss group. The loss condition was randomly assigned on the 9^{th} roll of the dice, which was approximately halfway through the game, allowing for an adequate comparison of behavior before and after the event. All other rolls of the dice were random. Participants who experienced more than one loss (n = 9) or who experienced a loss naturally were not included in the analysis (n=18). Also excluded were participants who played no rolls of the dice (n=3). Reduced from an initial number of 123, the final number of participants was 51 for the no loss group and 51 for the loss group. Participants were provided with feedback in the form of an updated score after each roll of the dice, which was also the total real monetary payoff received at the end of the game.

Risk taking was measured by the number of rolls played in the final round of dice rolls with two dice (RT4), when the probability of rolling all the same number was 1 in 6. Each game played contributed to one point of a risk taking score. This was a critical decision making round, as the probability of loss had increased significantly and participants had been able to build up a considerable score. A risk taking score of zero would mean that no games were played in the final round, demonstrating a preference for the status quo or satisfaction with the cumulative score up to that point. While framing a choice as a status quo has been identified as a boundary of loss aversion, in no way was the decision framed as a status quo option. The participant was simply asked if they wanted to participate in this round of dice rolls - the same question they had been asked 15 times up to this point.

Control variables for gender and risk appetite (gambling) were also collected. The measure for risk attitude to gambling was modified from the domain specific measure developed by Weber et al (Weber, Blais, & Betz, 2002) (See Appendix A – Game Sample). Subjective probabilities (Savage, 1972) were measured on a scale from 1 to 100 using the response to the question "How confident are you that you will win the next roll of the dice?" Measures were also taken to explore cognitive processes related to information processing. Participants were asked why they opted out of playing a game of dice, and the number of rationales was counted. The time taken to respond to the confidence question was also recorded as a measure of cognitive processing. As regulatory focus or goal orientation influences the use of information, promotion and prevention scores were measured using a modification of Lockwood, Jordan & Kunda (2001) (See Appendix B for scale used).

Care was taken to use neutral, non-deterministic wording that did not suggest gain or loss or refer to the maximum game payoff (although individuals may have figured this out on their own) to avoid a framing effect thereby inducing risk taking or risk aversion. While people have been said to be poor judges of probability outcomes (Tversky & Kahneman, 1973), some have suggested that probabilistic

reasoning is improved when probabilities are presented as frequencies, such as the number of times that an event will occur (Fiedler, 1988). Taking into account all of these factors, the information provided for each set of dice rolls was as follows:

> "*When five dice are thrown, the probability of throwing dice that are all the same is 1 out of 1,296 for each roll of the dice. However, please remember that this probability may not reflect the likelihood of occurrence in a limited number of dice rolls.*"

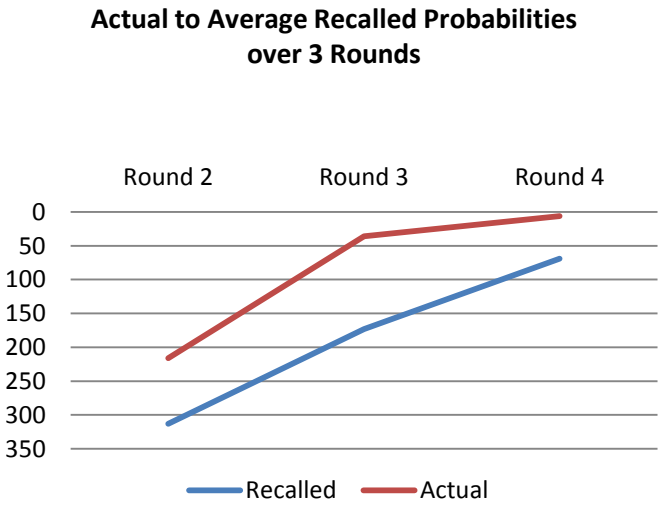
The design attempted to provide realism with decision makers facing a real-world choice between risk, return and status quo. Participants could take the risk of a loss in order to obtain a payoff, or choose to "satisfice" (Simon, 1955) and maintain the status quo. Multiple decisions or rolls of the dice provide participants with a learning opportunity, ensuring that they understood how the game works. Real money was used to provide economic incentive to ensure sufficient motivation. This design satisfies the recommendation for a single repeated task and adequate incentives (Cubitt et al., 2001). Realism was provided while maintaining a lab controlled experimental design and using variables that are compatible with utility theory and can be mathematically manipulated. New to the description – experience body of literature, this experiment provided the dynamic of change with an increasing probability of loss introduced with each round of dice rolls.

Results

A majority of participants (71 out of 102) participants observed and accurately recalled probabilities in round 4 of the game, demonstrating ambiguity aversion or a preference for knowing probabilities in decision making. The probabilities of loss were 1/1,296 when five dice were rolled, 1/216 when four dice were rolled, 1/36 when three dice were rolled and 1/6 when two dice were rolled. Accuracy increased as uncertainty or the probability of loss in the game increased. Using a mixed

ANOVA, there is a significant main effect of time across rounds of dice rolls on accuracy (Wilk's Lambda = .526, F(1,99)= 44.674, p = .000, See Figure 2). The average accuracy at each round of dice, measured as the variance from the actual probability, was significantly different from the accuracy of all the other rounds at *p*=.05 (M R2= 94.24, M R3=136.6, M R4=58.77).

Figure 2: The Change in Accuracy of Recall of Probabilities over 3 Rounds



Response to the question "The probability of rolling equal numbers when four (three, two) dice were rolled was 1 chance in how many?"

Hypothesis 2 predicted that a focus on probabilities would promote a preference for the status quo or reduced risk taking. There is evidence of a general effect of accuracy on risk taking. A Pearson correlation between accuracy of information recall with two dice and risk taking in round 4 was negative and significant (B = - .170 p=.041) suggesting that accurate recall of information varied inversely with risk taking. However, as we will soon see with the results for Hypothesis 3, the impact of probabilities on risk taking is much stronger for the no loss group than for the loss group.

Hypothesis 3 predicted that the experience of loss would moderate the reduced risk taking caused by the focus on probabilities. This hypothesis was supported, with a significant difference in risk

taking between the two control groups who accurately recalled probabilities. The no loss group who accurately recalled probabilities reduced their risk taking, as predicted by Hypothesis 2. However the loss group did not significantly reduce their risk taking. Reduced risk taking can be seen by a preference for the status quo in Round 4, demonstrated by playing no games in the final round. The status quo was chosen more frequently by the no loss group (14 out of 51) than by the loss group (5 out of 51) (See Table 1). Those who experienced a forced loss on Roll 9 were 3 times more likely to play Roll 16 (but not Rolls 17-20) (B=1.13, Wald X^2 7.611, p=.006, Odds Ratio 3.122).

The difference in risk taking between the loss and the no loss group which is predicted by Hypothesis 3 can also be seen in a 2x2 ANOVA of loss and accuracy on risk taking after the loss on roll 9, which revealed a main effect of accuracy (F (1,96) = 9.226, p =.003) but not for loss (F=1.890, p=.172). After roll 9, the accurate group played fewer games of dice rolls (M = 7.57) than the non-accurate group (M=8.97), supporting Hypothesis 2 which predicts reduced risk taking when participants focus on probabilities. A preference for the status quo among the no loss group was robust to the fact that participants did not receive an endowment payment at the beginning of the game and therefore had nothing to lose. Although a "house money" effect can be seen to occur equally among the loss and no loss group who played all five rolls in round 4 (No Loss = 16, Loss = 14) this does not dilute the significance of the results.

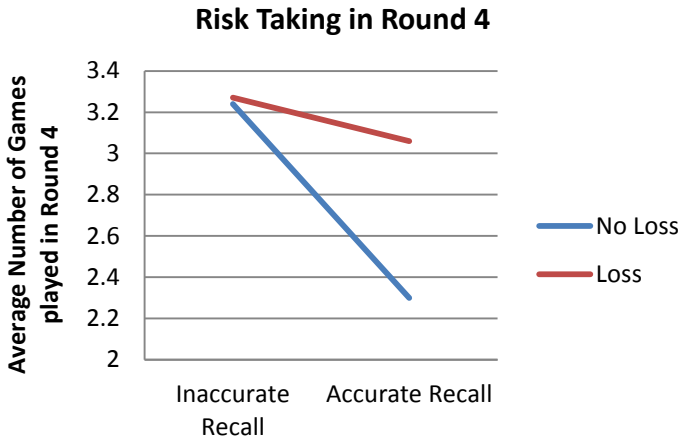
Table 1: Round 4 Statistics

Number of Dice Played in Round 4	Average Score ($) in Round 4	# Players No Loss	# Players Loss	Average Accuracy *
0	0	14	5	39.6
1	.23	5	7	32.17
2	.17	7	5	64.65
3	.40	1	8	55.67
4	-.37	8	12	77.75
5	-1.06	16	14	67.75
TOTAL		51	51	

* *The probability of loss in Round 4 is 1 in 6 rolls of the dice. Accuracy is a continuous variable calculated as the difference between 6 and the probability recalled. All recalls were higher than 6*.

While the interaction between loss and accuracy on risk taking is no longer significant in round 4 (F(1,96)=.855*, p*=.358), the hypothesis is predicting a significant difference only for those who accurately recalled probabilities. Simple effect tests among those who did not experience a loss (no loss) showed that an accurate recall of information led to marginally decreased risk taking (*F*(1,96) = 3.058, p=.084) shown by the difference of means between the average number of games played by the loss (M=3.15) and the no loss (M=2.36) group who accurately recalled probabilities. In the loss group, however, accuracy did not significantly change risk taking (*F* (1,96) = .016, *p* = .900). A slight, but not statistically significant, decrease in risk taking of the accurate recall group (M for RT4 = 3.055) is not significantly different from the risk taking of the inaccurate recall group (M for RT4 = 3.26). While this effect is marginal, the relationship becomes significant when those who experienced a loss randomly are included with those who experienced a forced loss on Roll 9 (*F* (1,110) = 3.805, p = .054).

Figure 3: A 2x2 ANOVA Interaction: Accuracy vs Loss/No Loss on Risk Taking



A 2x2 ANOVA, DV: Risk Taking in Round 4
IV-1: One Loss vs No Loss
IV-2: Accuracy of Information Recall with 2 Dice

Table 2: Descriptive Statistics – DV Risk Taking in Round 4, IV Loss & Accuracy

Loss 9	Accuracy	Mean	Standard Deviation	N
0	**0**	3.250	1.9494	16
	1	2.343	2.1136	35
	Total	2.627	2.0877	51
1	**0**	3.267	1.7099	15
	1	3.056	1.7299	36
	Total	3.118	1.7047	51
Total	**0**	3.258	1.8068	31
	1	2.704	1.9449	71
	Total	2.873	1.9123	102

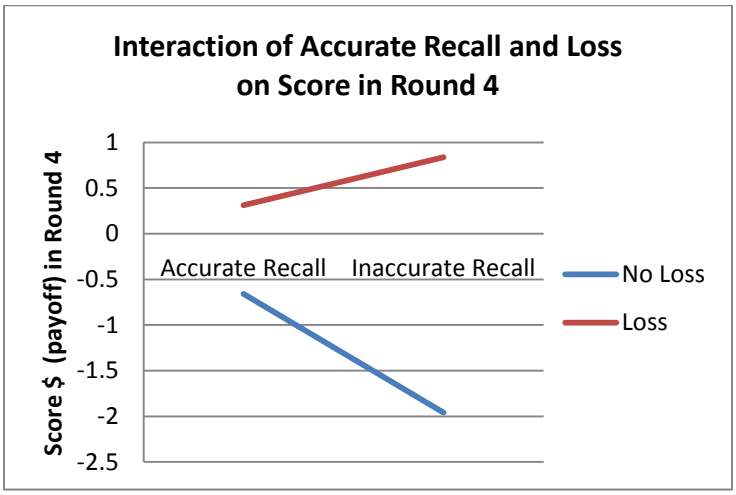
Discussion

In this paper an argument has been made that focusing on probabilities can result in decreased risk taking or a preference for the status quo as the awareness of loss has been heightened. Decreased risk taking by the group who accurately recalled probabilities was supported by a main effect of accuracy on risk taking after the loss on roll 9. The no loss group was also more likely to exhibit loss aversion by playing no dice rolls in round 4. Is reduced risk taking in response to probabilities optimal

behavior? Written from a learning perspective, the assumption frequently made in the description – experience debate is that people should be trained to behave according to objective probabilities. However, if probabilities decrease risk taking, this may not always be optimizing behavior. Ert & Erev (2013) propose that a condition of loss aversion is that the choice predicted by loss aversion maximizes the probability of expected positive outcomes, suggesting that loss aversion is always rationale behavior. However, by virtue of the risky bet premium, loss aversion is not optimizing as it requires a premium above expected value. Likewise, studies on myopic loss aversion have been shown to result in non-optimizing investment decisions (Benartzi & Thaler, 2001).

In the experiment above, there is evidence that reduced risk taking is not always optimizing behavior. For the no loss group, reduced risk taking in Round 4 was optimizing behavior, as they entered this round with a higher score and more to lose, resulting in a negative expected value. However, reduced risk taking was not optimal for the loss group who had positive expected value. Accurate recall of probabilities and reduced risk taking resulted in lower scores among the loss group. There is an interaction between loss and accurate recall of probabilities on score (F (1,96) = 5.522, p = .021). The loss group who ***inaccurately*** recalled probabilities had a significantly higher score than those who did not recall probabilities (M Accurate = .313, M Inaccurate = .838, F (1,98) = 5.205, p=.025). However, the no loss group who ***accurately*** recalled probabilities had a significantly higher score than those who did not accurately recall probabilities (See Figure 4) (M Accurate = -.664, M Inaccurate = -1.965, F (1,98) = 18.689, p = .000).

Figure 4: 2X2 ANOVA: DV Score in Round 4, IV: Accurate Recall 2D and Loss



Future Research

A decrease in ambiguity aversion, or ***ambiguity seeking***, in the domain of losses is a behavior hypothesized and observed in experiments by Hogarth & Einhorn (1990). In this experiment there was no significant relationship between loss and accuracy, suggesting that those experiencing a loss were not less likely to recall probabilities. Loss did not vary together with the accurate recall of probabilities (Pearson correlation between loss and accuracy = -.035 p=.365). However, for those who accurately recalled probabilities, a loss did significantly moderate the ***response*** to this information as illustrated above. In this experiment, ambiguity seeking among the loss group exhibited itself not as a deficiency in noting information as probabilities but in the motivation to act on this information. Future research on ambiguity aversion should make this distinction between the processing of information processing and its motivational or conative impact on behavior.

When comparing the different cognitive and motivation impact of probabilities and experience, it was argued that probabilities isolate and heighten the probability of rare events, particularly the probability of loss. While probabilities may be a particularly effective method of creating decision

isolation, experience can also focus attention on the possibility of rare events. Novelty associated with a new experience focuses attention on the utility derived from the experience. Peoples' perception is more attuned to changes in our environment, such as brightness, noise level or temperature (Helson, 1964). For all these reasons, people's behavior is more erratic when probabilities are close to 1 or 0 such as observed by the overweighting or underweighting of rare or certain events. The impact of surprise on decision weights is a concept explored by the economist Shackle (1990), who explains that the "inner range of experience" from which decisions are made may exclude relevant information, resulting in surprise when an event occurs. Surprise was measured in the experiment conducted in this paper, but no significant impact on risk taking was observed. Opportunities to explore the impact of surprise on decision weights are a recommended area for future study.

Ambiguity aversion observes that people prefer choices which provide probabilities over ambiguous choices. The causal nature of this preference was explored and thought to be due to a heightened sense of uncertainty, which was made salient in the experiment through the removal of dice with each round of the game. Those who believe loss aversion is the underlying principle driving behavior may question this causal relationship, believing that it is loss aversion which drives the preference for choices with probabilities. This paper proposes that in a real world context, where probabilities have to be sought rather than provided in an experimental one-shot gamble, the preference for the status quo may outweigh the preference for seeking out probabilities that may be caused by loss aversion. To further test this causal relationship, this game could be repeated but altered by making uncertainty less salient and not removing dice with each round. As this is a repeated game, the status quo or reference point becomes the customary outcomes experienced. The percentage of people who accurately recall probabilities may be compared with the percentage of people in the game already conducted to see if people are less likely to seek probabilities when uncertainty is less salient.

While ambiguity seeking or inattention to probabilities in the experiment conducted resulted in a higher score for the loss group, this may not always be the case. It is also quite possible that loss aversion is not always non-optimizing as proposed in this paper. The boundary conditions for optimization remain to be explored. In round 4 of this game, those who played no rolls of the dice received no score while those who played 5 rolls of the dice lost on average -1.06 dollars as the probability of winning five dice in a row is lower than winning a single roll (See Table 1). Those who chose to play all or no games received the lowest scores in round 4, while playing 3 games resulted in the highest score of .40 cents. Hogarth and Einhorn (1990) describe a decision model where decision weights first anchor on the probabilities most readily available, and then a process of mental stimulation considers alternative outcomes. They propose that ambiguity stimulates this mental process. In the experiment described in this paper, expected value was ambiguous (not provided and difficult to calculate) and probabilities were presented in an ambiguous manner (i.e. "*Please remember that this probability may not reflect the likelihood of occurrence in a limited number* of *dice rolls.").* Ambiguity may have encouraged the consideration of options other than all or nothing. A second condition for ambiguity seeking resulting in higher outcomes may be small sample outcomes. As the number of outcomes approaches a normal distribution, the expected value would align with probabilities, and the participant would be better off behaving according to expected values. In real life, small sample outcomes are most often experienced and probabilities are less relevant for an individual. Alternative conditions when ignoring probabilities may be beneficial could be explored.

Conclusion

This paper has theoretically explored the influence of probabilities and experience on decision weights. It is proposed that both the over weighting and the under weighting of rare events demonstrate sensitivity with respect to a reference point, a key element of prospect theory. Experience

overweighs the reference point itself, or the customary outcomes that are have occurred in the past and are expected to occur in the future. On the other hand, the overweighting of rare events typically observed in prospect theory can be explained by probabilities drawing attention to potential extreme changes with respect to the reference point. Decision isolation is consistent with the evaluation phase in the two step process described in prospect theory. Probabilities and experience alter decision weights by focusing attention on changes to the reference point, or the reference point itself.

To explore the role and interaction of description and experience, an experimental game of dice was conducted with significant results. Consistent with ambiguity aversion, a focus on probabilities was observed, with participants' increasing the accuracy of recall with each round of the dice as uncertainty in the game increased. Accuracy of probability recall was found to be closely correlated with reduced risk taking. However, this reduced risk taking was more pronounced among those who had not experienced any losses. Ambiguity ***seeking*** was observed by the group who had experienced a loss. While those who experienced a loss were no less likely to accurately recall probabilities, they were less motivated to respond to these probabilities by reducing their risk taking. Ambiguity seeking was found to result in higher scores among the loss group. This experiment sheds new light on the role of risk seeking in the domain of losses, a fundamental attribute of prospect theory (Markowitz, 1954; Kahneman & Tversky). While usually presented as a descriptive rather than normative theory of behavior, this experiment suggests that risk seeking in the domain of losses can be optimizing behavior when it reduces the negative influence of loss aversion on risk taking.

Irving Fisher, a prominent American economist early in the 20th century, famously prefaced the Wall Street crash of 1929 with the comment that the stock market had reached a "permanently high plateau". Similar attitudes can be seen in the events leading up to the 2008 financial crisis. This behavior is consistent with observations in the description – experience debate, where the behavioral

response to experience is to overweigh customary outcomes by adapting expectations to recent outcomes experienced. Prospect theory has been considered by economists to be an inadequate tool for predicting economic behavior due to the vagaries of the evaluation step in decision making. Experience or recent outcomes, however, are a powerful evaluation filter which is externally observable, providing a path dependent prediction of future behavior. For example, prospect theory was found to predict choice when using the outcomes experienced by the participant rather than probabilities (Fox & Hadar, 2006). The description – experience debate has raised the importance of experience on decision weights in decision making, opening the door for further understanding of the relationship between well- known concepts in prospect theory such as the importance of a reference point, a preference for the status quo and loss aversion.

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APPENDIX A – GAME SAMPLE

Note: Not every round of the dice is included. These are sample screen shots of a representative of each type of screen, with exact screens viewed conditional on choices selected and results of dice rolled.

INSTRUCTIONS - Please read carefully

This game will consist of a series of 20 rounds of dice rolling. At the beginning of each round you will be asked if you want to participate. If you agree, you may win or lose money with each roll of the dice. You will win 50 cents if the dice are not all the same (all 1s, all 2s, etc). However, if the dice are all the same, you will lose half of all that you have earned up to this point. If you do not choose to participate in the round, the dice will be rolled, but you will not earn or lose money.

Example 1: If your score is currently $6 and you roll:

Dice1: 2
Dice2: 5
Dice3: 1

Then 50 cents will be added to your score and you will have a total score of $6.50.

Example 2: If your score is currently $6 and you roll:

Dice1: 3
Dice2: 3
Dice3: 3

Your score of $6 will be halved, and your new total score will be $3.
You can't lose more than you've earned, so your balance will never be less than zero.
Your score will be rounded to the nearest 25 cents.

Example 3: If your score is currently $6 and you decline to roll,
your score will remain $6 and you will proceed to the next roll.

We will now begin. For the first set of dice rolls we will use five dice.

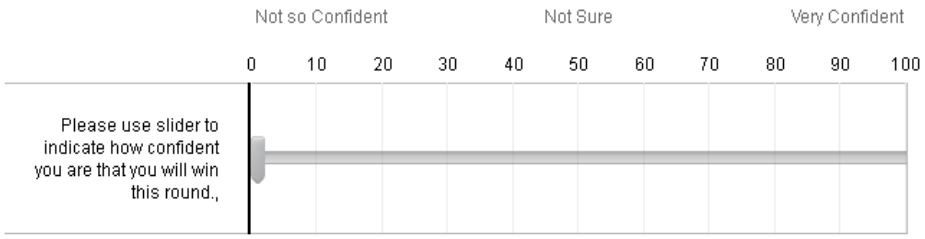
NOTE:

When five dice are thrown, the probability of throwing dice that are all the same is 1 out of 1,296. However, please remember that this probability may not reflect the likelihood of occurrence in a limited number of dice rolls.

>>

Let's begin with the first dice roll with five dice.

How confident are you that you will win this roll of the dice?



Would you like to participate in this roll?

- Yes
- No

>>

Congratulations! You have earned 50 cents.

Your total score is now 0.5

>>

You have declined to participate in Roll #3. Your score will remain unchanged. Let's go on to the next round of dice rolling.

>>

Unfortunately, the numbers of the dice you rolled are all the same. You lose half of what you've earned so far.

Your score is now 0.5

>>

Your final score is:

0.75

>>

You will receive instructions shortly on how to receive payment for your final score.

However, before we give these instructions, please carefully consider the following questions and record your response.

Please select an answer from the following multiple choice.

I am:

- ○ Male
- ○ Female

My age is:

For each of the following statements, please consider the likelihood of engaging in each activity or behavior. Provide a rating using the following scale.

	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely
Bet a day's income on an online poker game.	○	○	○	○	○	○	○
Spend a day's income on lottery tickets.	○	○	○	○	○	○	○
Bet a day's income on a sports event.	○	○	○	○	○	○	○
Gamble a week's income at the casino.	○	○	○	○	○	○	○

>>

Using the scale below, please select the response that most closely matches a description of you.

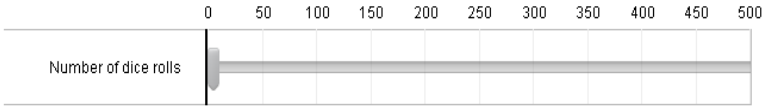
	Not at all like me	Not like me	Not much like me	Neutral	Somewhat like me	Like me	Very true of me
In general, I am focused on preventing negative events in my life.	○	○	○	○	○	○	○
I frequently imagine how I will achieve my financial hopes and aspirations.	○	○	○	○	○	○	○
I often worry that I will fail to accomplish my financial goals.	○	○	○	○	○	○	○
I often think about how I will achieve financial success.	○	○	○	○	○	○	○
I often imagine myself experiencing financial hardship I fear may happen to me.	○	○	○	○	○	○	○
I am more oriented toward preventing losses than I am toward achieving gains.	○	○	○	○	○	○	○
My major financial goal in school is to create opportunity for future financial success.	○	○	○	○	○	○	○
My major financial goal in school is to minimize student debt.	○	○	○	○	○	○	○
I see myself as someone who is primarily striving to reach my ideal self - to fulfill my hopes and aspirations	○	○	○	○	○	○	○
I see myself as someone who is primarily striving to become the self I "ought" to be - to fulfill my duties and responsibilities	○	○	○	○	○	○	○
In general, I am focused on achieving positive outcomes in my life.	○	○	○	○	○	○	○
Overall, I am more oriented toward achieving success than preventing failure.	○	○	○	○	○	○	○

>>

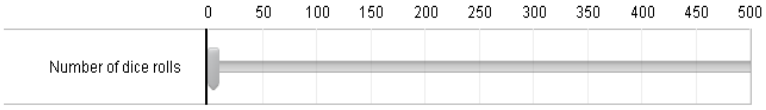
The probability of rolling equal numbers when five dice were rolled was 1 chance in 1,296 rolls of the dice.

To the best of your memory, please use the slider to answer the following question.

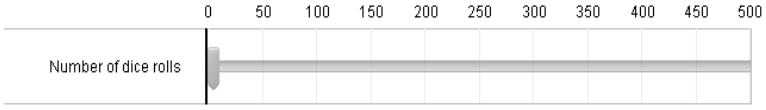
The probability of rolling all equal numbers when 4 dice are rolled was 1 chance in how many dice rolls?



The probability of rolling all equal numbers when 3 three dice were rolled was 1 in how many rolls of the dice?



The probability of rolling all equal numbers when 2 two dice were rolled was 1 chance in how many dice rolls?



If you declined any dice rolls, could you tell us why you chose to decline?

Please raise your hand, and a lab assistant will come and record your score on the piece of paper provided.

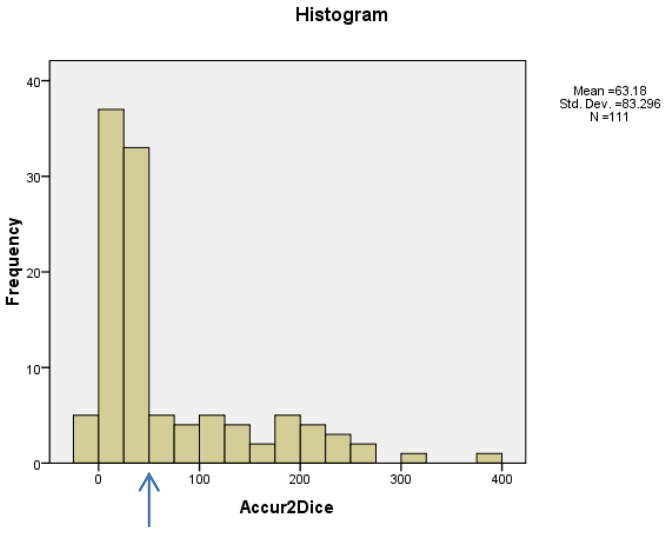
Your score will be rounded to the nearest twenty five cents. Please note that payoffs will vary widely across participants as results are random.

MY FINAL SCORE IS: 0.75

Once you have completed all surveys in this time period, proceed immediately to the Cashier with the signed score sheet where you will receive payment.

Thank you for your participation in this survey! Please advance page to record your survey.

APPENDIX B – Normality of Information Recall



Cut Off