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Comparison of Risky Decision Making Processes in Dyads and Individuals

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Abstract

The thesis compared the likelihood of taking risks in dyads and individuals in varying situations. Patterns of risky decision making were examined in the standard risky choice task and a novel risk management task. The relative successes of two theories of risky decision making were assessed: Prospect Theory emphasizes perceptual and psychophysical processes, whereas Security-Potential/Aspiration Level Theory emphasizes dispositional and motivational processes. The thesis also examined dyads' decision behavior in light of competing social influence perspectives regarding risky versus cautious shifts and group polarization.

Participants, as individuals or as part of a dyad, made decisions in 23 trials about hypothetical two-outcome monetary gambles in one of two different tasks. Risky choice involved making choices between two given 50-50 lotteries which varied in riskiness (i.e., outcome variability), whereas risk management required actively manipulating an existing 50-50 risk by changing outcome values. The 23 trials were equivalent across tasks. Dyad participants communicated via an instant messenger program, while viewing the same lotteries on different computers. Data on risk preferences across gain and loss domains were analyzed using a mixed factorial ANOVA design.

Consistent with Prospect Theory value function predictions, the risky choice task led to risk averse preferences for gains and risk seeking preferences for losses, though risk seeking was weak. Consistent with SP/A theory predictions, the risk management task led to overall risk averse preferences, with movement toward risk taking for gains.

In addition, there was some evidence of social influences in that dyads tended to be more conservative than individuals in their decision behavior when dealing with undesirable outcomes. Thus, a cautious shift was observed, but only for lotteries involving guaranteed losses. This could not be explained by group polarization.

Each of the theories received some support, but none of them could explain all of the findings. Recommendations were made to give greater attention to defining and measuring risk attitudes and dispositions, and to continue exploring differences in decision situations and social settings to obtain a more comprehensive understanding of risky decision making processes. Findings here suggest the need for an overarching theory that can account for a wide variety of influences. A dual processes approach was recommended as one promising avenue. Social and situational influences may prove an essential part of understanding risky decision making in real life contexts.

Introduction

In real life decision making, individuals often make decisions with another person. Be it a spouse, a parent, a sibling, a friend, a colleague, dyad decision making is common. Much attention has been devoted to studying dyadic interactions and behavior in a variety of contexts. The game theory framework provides insight into human cooperative and competitive tendencies in any of a variety of strategic situations with well-defined rules (e.g., Camerer, 2003). The medical decision making literature addresses issues of shared decision making typically between a patient and his or her physician or health care provider, especially when facing risky alternatives for dealing with serious or life threatening diseases (e.g., Charles, Gafni, & Whelan, 1997; Frosch & Kaplan, 1999; Légaré et al., 2008; Towle & Godolphin, 1999). There is also an extensive literature exploring dyads through the study of intimate relationships, much of which is relevant to decision making. For instance, studies often explore how variables such as length and perceived quality of relationship influence relationship-related outcomes, which presumably are the result of decisions made within the relationship (e.g., Aron, Norman, Aron, McKenna & Heyman, 2000; Laurenceau, Barrett, & Pietromonaco, 1998). Studies of parents as dyads, or "decision units," have also been examined, particularly with respect to decisions about their children (Becker, 1974; Bostrom, Hoffmann, Krupnick, Adamowicz, Goldman, McWilliams & Varner, 2005).

Each of these areas advances our knowledge of dyad decision making within a specific set of circumstances (e.g., life-threatening illness) and concerning a particular

type of dyad (e.g., father/mother). However, less attention has been given to more generic cases, particularly with respect to day-to-day encounters with risky choice. This is somewhat surprising given the quantity of research focused on risky choice by individuals. Hundreds of studies designed to test hypotheses derived from expected utility-type theories have produced a wealth of data on patterns of risky choice, typically in the context of two-outcome gambles (see Mellers, Schwartz, & Cooke, 1998, for a review). In the present study, I enlist this classic risky choice paradigm to compare patterns of choice between individuals and dyads. I also move beyond the traditional risky choice paradigm by comparing it to a newly introduced paradigm in which individuals or dyads actively engage in management of an existing risk. In what follows, I provide a brief overview of studies of individual risky choice, followed by a look at related studies among dyads and small groups. I then introduce some general hypotheses derived from theories dealing with motivation and social processes.

Psychophysical Influences on Risky Choices

Hundreds of studies have been done exploring human risky choice behavior (For review, see Levin, Schneider, & Gaeth, 1998; Kuhberger, 1998; Mellers, Schwartz, & Cooke, 1998). Much of the impetus arose from attempts to test Expected Utility Theory and later Prospect Theory. Bernoulli's (1738, 1954) Expected Utility Theory focused attention on probabilities and outcomes in describing risky choices. The theory suggests that subjective values (known as utilities) differ from objective values (monetary outcomes) in that the utility of gains increases at a slower rate as values move away from zero. When utilities are graphed as a function of objective values, one would expect a straight line if the two were equal to one another. However, the undervaluing of larger

amounts results in a concave curve, or one that exhibits decreasing marginal utility. This marginally decreasing utility function predicts that a guaranteed win (e.g., 100% probability of winning $50) would be preferred over an equal probability of winning $0 or $100, even though the expected values of the two alternatives are the same. According to the function, the difference between receiving $0 and $50 would be experienced as larger than the difference between receiving $50 and $100, so that it would not be worth giving up the $50 for sure to take a risk on possibly gaining $100. Hence, the concave utility function can explain the commonly observed pattern that people tend to be risk averse, avoiding risky alternatives in favor of safer (high probability) ones.

Essentially, Bernoulli's explanation of risk averse behavior relied on the psychophysics of values. Because the experienced or subjective magnitudes of options systematically differ from the physical magnitudes, risks are routinely experienced as less valuable than their mathematical expected values. Like other psychophysical principles, this relationship has been confirmed so often that it has come to be known as the law of diminishing marginal utility (e.g., Savage, 1954).

Over the years, scholars have suggested variations from the original expected utility theory. The first variation, which drew immense attention among economists in the 1940s and 1950s, was introduced by Von Neumann and Morgenstern (1944, 1947). This version included a canonical mathematical system, via which a rational decision maker would be able to assure coherent and consistent risky choices, provided he or she was willing to endorse a set of required axioms. Although von Neumann and Morgenstern did not make any explicit claims about the inherent value of the axioms, many scholars entered the debate about the status of these decision rules (most notably, Savage, 1954).

Over time, these axioms were widely embraced as requirements for rationality, bestowing the von Neumann and Morgenstern version of expected utility theory with a normative status against which actual decision making could be evaluated.

A second variation to Bernoulli's original theory was descriptive in nature. Savage (1954) introduced the concept of subjective probability in Subjective Expected Utility Theory. Savage's preferred term was 'personal probability' (as originally introduced by Thornton C. Fry), however, with time, the term 'subjective probability' gained acceptance among scholars. The basic premise of subjective probability is that, like values, subjective assessment of probability does not always match the objective probability associated with the outcome in question. Savage's characterization does not make it clear whether subjective probabilities can best be understood as resulting from psychophysical processes or from individual differences in beliefs about likelihood.

The third variation to expected utility theory came in the form of Prospect Theory (Kahneman & Tversky, 1979). Like the original expected utility theory, prospect theory starts with the assumption that risky choice behavior is primarily driven by psychophysical processes; in particular, it retains the idea of marginally decreasing sensitivity. Instead of utility, Kahneman and Tversky introduce a subjective value function. For gains, the function is concave like the standard utility function. However, Kahneman and Tversky also explicitly include losses in their subjective value function. Oddly enough, by maintaining *marginally decreasing sensitivity* in the negative domain, the function becomes convex, leading to the somewhat surprising prediction of a tendency to be risk seeking (preferring the gamble over the sure thing) for losses. Considering a risk of losing $50 for sure versus a 50% risk of losing $0 or $100, the

difference between losing $0 and $50 would be experienced as larger (i.e., worse) than the difference between losing $50 and $100, so that it would not be worth taking a loss of $50 for sure to avoid a possibly larger loss of $100 (marginally decreasing sensitivity still at work). This is likely to lead one to go for the risky alternative.

Together, this gives the prospect theory value function curve an S-like shape, which is concave in the positive domain and convex in the negative domain. The introduction of a specified origin in the value function is also significant. Kahneman and Tversky suggest that perceptual processes are highly sensitive to changes and that the subjective value function serves as a measure of change from some default asset position. The origin represents this default position and serves as the reference point for choice. This reference point is subject to change with each new decision, usually as a function of changes in one's status quo. Tversky and Kahneman (1991) call this *reference dependence*, which implies that the perception of gains and losses is tied to the reference point adopted for the decision. They hypothesize that minor to moderate changes in reference point are not likely to substantially influence preferences.

Although Bernoulli briefly touched upon the issue of losses (Bernoulli, 1954, pp. 26-27), it was the prospect theory value function that clearly showed how choice tendencies are likely to reflect a risk seeking attitude when dealing with perceived losses. Kahneman and Tversky (1979) also argue that perceived losses are experienced more strongly than perceived gains, which is visible in a steeper curve in the negative domain of the value function. They call this *loss aversion*, and argue that, all else equal, "losses loom larger than gains" (Kahneman & Tversky, 1979, pp. 279). For example, people are reluctant to take an even bet that would result in either winning or losing some amount,

say, $5. Most people would find this bet unattractive, because the perceived impact of the negative consequence (losing $5) would seem stronger than the potential impact of the equivalent positive consequence (winning $5).

Prospect theory also introduces the idea of decision weights. The decision weight function retains the basic idea of subjective probability. Kahneman and Tversky (1979) go beyond Savage's characterization by describing decision weights not as simple degrees of belief but as measures of a somewhat more complex construct of "the impact of events on the desirability of prospects" (Kahneman & Tversky, 1979, pp. 280). They argue that probabilities are subject to a decision weighting function, and the values of possible outcomes are multiplied by these decision weights. Kahneman and Tversky (1979) theorize that large probabilities tend to be underweighted and small probabilities tend to be overweighted. So people will tend to feel less sure of highly likely outcomes than is warranted and more sure of unlikely outcomes.

Prospect theory also incorporates a cognitive element with the introduction of an "editing phase" in the decision making process. Kahneman and Tversky propose that people usually engage in a "preliminary analysis" to simplify outcomes and probabilities, prior to entering the evaluation phase. Although Kahneman and Tversky (1979) provide some examples of how editing might occur, there is little systematic agreement about these processes. Many studies use simple ("post-editing") stimuli in order to test the primary predictions of prospect theory and rule out editing processes as a possible alternative explanation of results.

The next section provides a brief review of some of the findings on risky choice. The focus is on the prospect theory prediction that is most often put to the test (See, e.g.,

Hershey & Schoemaker, 1980; Kuhberger, 1998; Levin, Schneider, & Gaeth, 1998; Weber, 1999). The prediction involves a preference reversal pattern in which preferences are risk averse for gains but are risk seeking for losses.

Soon after the original prospect theory was published, Hershey and Schoemaker (1980) critically evaluated the generalizability of the preference reversal prediction by studying decision making under risk both between and within subjects. They presented participants with a series of choices between a sure gain/loss and a probabilistic gain/loss, with matched expected values. Hershey and Schoemaker found little support for Kahneman and Tversky's predictions of risk averse for gains and risk seeking for losses, when making comparisons across subjects. When they did find a reversal (7-25% of choices), it typically involved a sure thing with a high value or a gamble with high variance. Given this weak support for Prospect Theory predictions regarding preference reversals, perceptual influences on choice behavior may not be sufficient to describe and/or explain risky choice behavior.

Kuhberger (1998) also completed a review of Prospect Theory's preference reversal prediction, but his focus was on framing effects and monetary gambles. Framing effects occur when descriptions of the same set of alternatives in terms of gains versus losses produce preference reversals. A typical example of a framing manipulation in decision making research is the Asian Disease problem. This problem involves choice options framed either in terms of possible lives saved (positive frame) or in terms of possible lives lost (negative frame). In his review, Kuhberger found a low to moderate impact of framing across studies, resulting in preference differences from positive to negative domains. Kuhberger (1998) also reports preference reversals to be more

common in the typical case of riskless choice (choices with certain outcomes or sure things) and risky choice (probability of outcomes vary), in comparison to risky-risky choice cases. Thus, while partial support of preference reversals was observed, the question remains how generalizable these patterns are.

Levin, Schneider and Gaeth (1998) conducted a more refined review of framing effect studies. After removing examples of framing that did not necessarily involve risky choice, they were able to isolate cases in which risk preferences changed for positively versus negatively framed outcomes. The majority of studies showed some effect of framing, though few were clear preference reversals as Prospect Theory would predict. In most cases, preferences appeared to differ across valence, but not by much. Clear preference reversals were generally found only for studies in which the task domain was similar to the Asian Disease Problem used by Tversky and Kahneman (1981) to introduce framing effects. Several studies did not find significant differences in preferences for gain and loss frames across different scenarios. This again points out the limited generalizability of Prospect Theory predictions regarding preference reversals from risky gains to losses.

Another vein of research focused on different definitions of risk, and showed how different interpretations of risk could influence preferences. Weber (1999) distinguishes perceived risk attitudes from traditional economic definitions of risk as variance. For economists, risk aversion is associated with low variance outcomes and risk seeking with high variance outcomes. Perceived risk attitude emphasizes the individual's perception of some alternative as more or less risky. Weber and colleagues found that the average individual's perception of risk may not be exclusively dependent on variance. The same

alternative (for example, the low variance outcome alternative) could be perceived by the decision maker as less risky in one domain and more risky in the other.

Using gamble pairs, Mellers, Schwartz, and Weber (1997) found economically-defined risk attitudes to be reversed from gain to loss domains for the majority of subjects (61%), which is consistent with Prospect Theory predictions (though somewhat weak). However, they observed that perceived risk attitudes did not change in the same way. Most participants (60%) were consistent across domains in their perceived risk attitude, with 44% of all participants reporting that they were risk averters. This points out that traditionally defined concepts of risk may not always fit with what people experience as risk. These findings also raise a question about Prospect Theory's ability to explain risky choice in terms of perceptual or psychophysical processes. Logically, the Prospect Theory implications regarding willingness to take risks and the perceived risk attitudes studied by Weber and colleagues should match up. However, participants' responses indicated that their (and perhaps the lay person's) interpretation of risk does not necessarily equal the economic definition of risk assumed in Prospect Theory. This casts some doubt on the classification of Prospect Theory as a perceptual theory of risky choice.

Weber and Milliman (1997) studied perceived risk attitude and risk preference in paradigms of commuter train times and financial investments (with hypothetically endowed amounts). They also found that participants tended to be consistent in their risk preferences based on their assessment of perceived riskiness of alternatives. Over 75% of the participants exhibited consistent perceived-risk attitudes across gain and loss domains, and more than 65% consistently chose the less risky alternative across domains

in both the commuter train times and financial investments studies. They observed risk seeking preferences in the gain domain, when participants expressed their preferences for commuter train times. Thus, results were not consistent with preference reversal predictions of Prospect Theory. Additionally, here too, the concept of perceived risk attitude, as reported by participants, did not match with the standard economic interpretation of risk as variance.

Weber and colleagues' work provides weak support for the kinds of preference reversals predicted by Prospect Theory, especially in cases involving sure things and high risk situations. At the same time, their work also highlights problems with the basis for Prospect Theory predictions. Prospect Theory may not adequately capture people's experience of riskiness, thus the perceptual underpinnings of the theory may be in question.

In summary, there is mixed support for Prospect Theory preference reversal predictions. The prediction is most likely to hold for choices involving a risky option compared to a sure thing. The lack of generalizability points out that there may be additional influencing factors on risky choice than those proposed in Prospect Theory. Most people tend to have a strong reaction when they are exposed to risk, which may be reflected in their perceived attitude toward risk. As we have seen, this experience is not reflected in the economic view of risk. One aspect of perceived risk that is ignored in both economic theory and Prospect Theory views of risky choice is an affective or motivational component which intuitively is an integral part of risky situations. People routinely describe the experience of hope and fear associated with taking risks. In addition, pre-existing orientations, or personality characteristics, may also play a role in

determining how people react to risk in general. Therefore, looking into dispositional and motivational factors may give us another perspective on people's dealings with risk. The next section reviews briefly approaches exploring this possibility.

Motivational and Dispositional Influences on Risky Choices

Another approach to risky decision making explains the process as arising from dispositional and motivational sources, rather than psychophysical ones. Lopes introduced the SP/A (Security Potential/Aspiration) theory, which brings in affective influences that are more in line with traditional approach-avoidance paradigms (Lopes, 1984, 1987; Schneider & Lopes, 1986). Lopes does not deny the relevance of the marginally decreasing utility function. She rather draws attention to the differences in the theoretical approaches to describing decision behavior. Lopes (1984, 1987) suggests that there are two dispositional inclinations towards risk that differ according to appetitive versus avoidant reactions to risk. Those with a *security* focus are dispositionally inclined to avoid the negative consequences associated with risk taking and those with a *potential* focus are dispositionally inclined toward approaching the positive consequences associated with risk taking. Lopes suggests that most people are security oriented, and are thus typically risk averse in their behavior.

SP/A theory also suggests that situational factors introduce another approach-avoidance variable, in particular, with respect to aspiration levels. High aspiration levels typically require that some risk must be tolerated in order to reach a goal, whereas lower aspiration levels may be reached without having to take risks. SP/A theory implies that risk preferences will be strong when dispositional tendencies match situational needs, but

will be weaker and more conflicted when dispositional tendencies are at odds with situational needs.

According to Lopes, most people are likely to exhibit risk averse decision patterns most of the time, because most people are hypothesized to have security-prone dispositions. There are two occasions, however, when even security-minded people may engage in risk-seeking behavior. First, when they feel safe (i.e., when no element of threat to their sense of security exists), they may feel comfortable taking risk. So, for instance, security-minded people might be willing to take a risk when all outcomes involve something positive. The second occasion is on the other extreme, when security-minded people are under great threat. In such threatening situations, no safe alternative is available, and any hope of getting out of the situation may require taking a risk. In these cases, the disposition to "play it safe" is in conflict with the aspiration to avoid acceptance of a bad outcome.

Instead of using two-outcome gambles, Schneider and Lopes (1986) used a more complex set of multi-outcome lotteries to study decision preferences of individuals who were pre-screened as dispositionally risk averse or risk seeking. They found 70% of their prescreened participants to be dispositionally risk averse (risk averse participants). Schneider and Lopes (1986) observed complex patterns of risk preferences, which emphasized that, factors other than perception must also be at work. They found weak support for reversal of preferences from risk averse to risk seeking in gain to loss domains predicted by Kahneman and Tversky (1979). With the exception of lotteries with a better-than-zero (risk less lottery) worst outcome, the typical risk averse participant was strongly risk averse for gains. Hence, the sure thing was strongly

preferred in most cases. Lotteries that guaranteed more than zero were also quite popular, and sometimes preferred to the sure thing. Lotteries with minimum outcomes greater than zero pose no threat to the sense of security, since there is nothing to lose with these gambles. This may have allowed the participants to raise their aspiration level higher than the sure thing. The riskless lotteries offer the opportunity for winning an amount higher than the sure amount, possibly closer to the raised aspiration level.

However, in the loss domain, the possibility of losing at least some amount posed a serious threat to the participant's sense of safety. Therefore, for loss lotteries, the typically risk averse participant exhibited a mixed pattern of preferences. For losses, participants appeared to dislike the lotteries at both extremes; the safest (including sure thing) probably because it does not meet their aspiration levels, and the riskiest, probably because the threat to security is too high, and they wanted to minimize the chance of the worst loss.

Higgins' Self Discrepancy Theory (1987) and later the Regulatory Focus Theory/Principle (1997) also share a focus on motivational and dispositional factors influencing human experience and behavior. Higgins' early work centered on explaining personality differences in terms of dispositional tendencies to focus on discrepancies in self-concept relative to an "ideal" self or relative to an "ought" self. Higgins found that those who focus on self-concept discrepancies with the "ideal" self are more apt to regularly experience emotions such as joy and dejection, whereas those who focus on discrepancies with the "ought" self are more likely to experience feelings of relief and anxiety. These findings eventually led to Higgins' concept of regulatory focus, which highlights motivational influences in personality. In particular, Higgins hypothesizes that

some people tend to focus on promoting the positive, whereas others prioritize preventing the negative (Higgins, 1998; Shah & Higgins, 1997). Higgins connects an individual's ideal self discrepancy concerns with promotion focused strategic inclinations, where one seeks matches with positive outcomes, such as hopes and aspirations. Higgins connects the individual's ought self discrepancy concerns with prevention focused strategic inclinations, where one seeks prevention of mismatches with negative outcomes often associated with duties and obligations, (Higgins, 1996; Higgins, Roney, Crowe, & Hymes, 1994). The prevention-promotion distinction in regulatory focus is conceptually similar to Lopes's security-potential dichotomy. Both emphasize the importance of approach-avoidance motivation as a guide in behavior.

Crowe and Higgins (1997) studied the impact of regulatory focus on strategic inclinations in decision making, using a signal detection paradigm. Crowe and Higgins (1997) associated a risky response bias with promotion-focused individuals and a conservative response bias with prevention-focused individuals. They found that promotion-focused individuals were more likely to take risks (be more prone to getting 'hits' and 'false alarms'), and prevention-focused individuals were more likely to play it safe, and generally be risk averse (be more prone to avoiding 'misses' and getting 'correct rejections'). This finding may be mapped on to Lopes (and colleagues') work connecting potential-oriented persons with risk seeking and security-oriented people with risk aversion (Lopes, 1984, 1987; Schneider & Lopes, 1986).

Weber and Milliman (1997) also drew the connection between dispositional and situational factors in their explanation for risk preferences and perceived risk attitudes. In choices between possible commuter train times, they observed risk seeking (i.e., higher

variance) preferences for 61% of the participants in the gain domain. This does not match what would be predicted by the Prospect Theory value function. Weber and Milliman (1997) cite aspiration level as the possible influencing factor behind people's preferences for the higher variance train times in the gain domain. When all options were faster than average, people could rely on some savings either way, so that none of the options would have a downside or—in SP/A terms—be a threat to security or the status quo. Thus, aspiration levels could be raised without any worry, so that the possibility of saving the maximum time could now be considered the more attractive alternative. Risk perceptions were also apparently sensitive to this lack of a downside. Greater unpredictability, when there was no downside, was associated with the possibility of the greatest savings, and so was seen by some (34%) as less risky.

In the loss domain, where trains were running slower than current average commute time, however, concern for avoiding the maximum time loss frequently led participants to make risk averse choices in traditional terms. In this case, greater unpredictability had a downside, or an element of threat (e.g., being late for work or class), which was seen by the overwhelming majority as more dangerous or risky. Weber and Milliman (1997), therefore, emphasized that what people considered as "risky" changed from one domain to the other. These observations also point out that real life contingencies may be a determining factor behind assessments of riskiness.

Dispositional and motivational theories have thus informed researchers of the possibility of pre-existing tendencies and situational characteristics together influencing people's behavior. They remind us that people's initial (gut-level) reaction towards risk

may set the tone for the decision making process; but the complete process may involve impact of situational demands as well.

From a review of the existing literature on risky decision making, Prospect Theory has done fairly well in describing standard risky choice behavior, particularly when sure things or extreme outcomes have been involved. Nevertheless, it is not clear that Prospect Theory's reliance on psychophysics gets to the heart of the experience of risk, and thus, may be inadequate or incomplete as a theory of risky choice. Motivational and dispositional explanations, including the SP/A Theory, potentially may expand the ability to understand risky choice across a larger variety of risky decision situations.

With the objective of exploring these different influences on risky decision making, the present study includes two different tasks. I hypothesize that the simpler psychophysical explanation is more likely to be plausible in situations that are more superficial and less actively engaging. In contrast, motivational and dispositional influences are more likely to be seen when the decision situation demands a more active level of engagement on the part of the decision maker. The first task is the standard passive risky choice task, which is a paradigm expected to favor the perceptual perspective. The second task is a novel active managing risk task (Schneider, Hudspeth & Decker, manuscript in preparation), which may be more likely to engage dispositional and motivational processes.

Additionally, the author explores decision making in dyads, which provides the opportunity to examine whether the introduction of another person into the decision making environment may bring in yet another set of factors: social influences. Findings related to possible social influences on risky choice will be discussed next.

Social Influences on Decision Making in Groups and Dyads

While group phenomena have been studied extensively in various sub-areas of psychology throughout the last century, studies of decision making under conditions of risk comparing groups and individuals became popular starting in the early sixties. Hunt and Rowe (1960), Stoner (1961) and Wallach, Kogan and Bem (1962) are a few names among researchers who studied risky decision making in individuals and groups in the early sixties.

Wallach et al., (1962) found groups to be more inclined to prefer risky alternatives over cautious ones following group discussions, as compared to individuals in the absence of discussion. In Wallach et al.'s, (1962) study, group members were previously unacquainted and had the same status (no identifiable influential characteristics) when group members began interacting. Participants considered several scenarios, and in each they provided their recommendation regarding the lowest probability of success that the character in the scenario should require before selecting the riskier of two options. In questions afterward, some individual members of the group reported that individuals who were more risky tended to be more influential in the group than those who were more cautious.

Wallach et al., (1962) offer two possible explanations for the observed risky shift phenomenon. First, Wallach et al., (1962) consider 'diffusion of responsibility' among group members as a possible reason for the shift towards riskier decisions following group discussion. Diffusion of responsibility occurs when being part of a larger group reduces individual member's sense of personal accountability or responsibility for the outcomes of decisions. Wallach, Kogan and Bem (1964) speculate that this phenomenon

may be related to decreased anxiety from emotional bonds created in the group setting, where risk is perceived as shared. Second, Wallach et al., (1962) consider the possibility that risk takers tend to be more influential in groups and that this could play a role in the observed shift towards riskier decisions following group discussion. They propose that these individuals might be more inclined to take initiative in mediating the group discussion. Such initiative could lead to greater acceptance of risk in the decision making, compared to average pre-discussion individual preferences.

With respect to the present thesis, the question is whether we shall observe similar decision patterns in dyads. Previous work suggests that the presence of many people in a group provides the possibility that a given individual's sense of accountability may be diminished. However, when only two people are present, as in a dyad, both are at least partly responsible for the decision outcomes. Therefore, for dyads, it is questionable whether diffusion of responsibility would occur. Also, with two people, the hypothesis that risk takers might be more influential seems less likely given that both people are required to interact to make the decision.

Using a similar design as the one used by Wallach et al., (1962), Stoner (1961) compared risky decisions in groups and individuals. He observed a risky shift in majority of his participants. However, not all group members were consistently more risky across all items following discussion. Nordhøy (1962) revisited Stoner (1961) and Wallach et al.'s (1962) work. He observed that, for at least some of their choice items, several group members exhibited a cautious shift following group discussion.

Stoner (1961, 1968) explains this with reference to the general value hypotheses of Nordhøy (1962) and Brown (1965). According to this hypothesis, group decision shifts

would be to riskier or safer (more cautious) alternatives depending on how they match with widely held values within the culture, which will be reflected in the individual's original inclinations. For example, if decisions concern a choice such as marriage, the culturally approved value may rest on the side of caution rather than risk; in such cases, group discussion is likely to lead to more cautious decisions, compared to individuals making decisions by themselves.

The risky and cautious shift observations were later described as variations of a single phenomenon called group (attitude) polarization (Moscovici & Zavalloni, 1969). A wide range of theoretical and research work has been carried out in the area of group polarization, from the pioneering work of Moscovici and Zavalloni (1969), to Myers and Lamm (1976) to more recent work by Stasser and Titus (2006), and Luhan, Kocher and Sutter (2009). Group polarization occurs when discussion among the group members creates the sense of a single decision making unit, working towards a shared goal. This often causes individual preferences to align with that of the group majority. Inclination of the majority of the individual members in a group is strengthened when the group behaves as a decision making unit. Research with groups has shown that groups make significantly "more extreme" choices than individuals (For review, see Isenberg, 1986; Myers & Lamm, 1976). Notably, decisions tend to be made in the same directions as majority of the individuals.

Research has shown that individuals who made moderately risky decisions prior to group interaction made even riskier choices following group discussion, whereas individuals who made initially cautious preferences showed a heightened tendency to choose safer alternatives following group discussion (e.g., Deets & Hoyt, 1970;

McCauley, Stitt, Woods & Lipton, 1974; Zaleska, 1974, 1976). Thus, the polarization effect produces the same pattern of pre-discussion preferences, only more pronounced. Notice that the risky or cautious shift is sometimes consistent with polarization processes, but not always. If group discussion shifts decisions in a direction opposite to the one originally favored by many individuals (e.g., risky shift in which risk averse individuals gravitate to more risky choices after discussion), this would be inconsistent with a polarization explanation.

For the present thesis, the relevant question is concerned with how dyads' decision preferences may be affected by group—or in this case, partner-discussion. If polarization takes place in dyads, dyad members will make more extreme decisions together compared to individuals. So, if individuals are typically risk averse, dyads would be expected to be even more risk averse. If individuals are risk seeking, dyads will be even more so. If risky or cautious shifts occur, dyads will tend to take more of less risks, respectively, than individuals, independent of individual predispositions.

There are few studies that allow a comparison of risky/cautious shift versus group polarization hypotheses in the context of dyads. In one of the rare exceptions, Keller, Sarin and Sounderpandian (2002, 2007) compared individual and dyad preferences for monetary gambles involving risk (i.e., stated probabilities) or uncertainty (i.e., unknown probabilities). In all conditions, they found that cautious shifts predominated. Both individual and dyad tended to be risk averse. Most dyads (typically around 60%) became more risk averse (i.e., cautious) than individuals when facing risky and ambiguous monetary choice situations. However, there was also a sizable minority that became less risk averse (i.e., risky shift, typically around 25-30%). Although the majority results are

consistent with a group polarization explanation, the subset of dyads that moved in a riskier direction suggest that other social influences were also present.

In a more recent study, Hardisty and Sanitioso (2007) studied three-person groups using various communication media to make hypothetical decisions about taking business risks. Hardisty and Sanitioso found that face-to-face discussion as well as video conferencing led to more extreme group decisions compared to individual ones. The pattern of results was consistent with Prospect Theory predictions of risk aversion for gains and risk seeking for losses, though more extreme for groups than individuals. However, they did not find this effect of polarization for instant messaging (IM). For the IM condition, participants showed an opposite effect, expressing risk aversion for losses, and moving toward risk seeking for gains (though in both conditions, they were generally in favor of the sure option). Again, there is partial support for the role of group polarization but only for two of the three media.

Work on peer influences may also provide some insight into social influences in dyad decision making. Gardner and Steinberg (2005) studied the impact of peer influence on risk preference, risk taking, and risky decision making by comparing individuals and three person groups in adolescents (13-16 year olds), youths (18-22 year olds), and adults (24 years and older). The authors tested risk-taking using a video game about driving called 'Chicken.' In the video game, participants were required to make decisions about stopping or continuing to drive after a traffic light turns yellow. While continuing could earn more points for the participant, crashing if the light turned red before the car stopped would lead to losing all points. Gardner and Steinberg found in all three age groups that individuals engaged in more risk taking when in presence of two

other same-age individuals volunteering advice than when alone. They observed the overall impact of peer influence (enhancing risky inclinations) to be most prominent in adolescents and young adults compared to older adults. The individuals in peer groups thus exhibited a risky shift, especially among adolescents. Because our dyad participants are mostly in the youth (young adult) age range, we are likely to observe some effect of peer influence on risk preferences. Although it was not possible in Gardner and Steinberg's study to assess whether the shift in preferences was consistent with polarization of risk attitudes, the present work will provide the opportunity to observe whether polarization versus risky shift patterns occur in dyads.

In addition to peer influences, the literature on persuasion may also provide insight into social influences in decision making. Wood's (2000) review of the persuasion and social influences in social interactions revealed that motivations about the self, the other and the situation may all bring about changes in attitude. One way that social influence may occur is through learning new arguments in favor or against an alternative. According to the classic Persuasive Arguments Theory (Burnstein & Vinokur, 1977; Vinokur & Burnstein, 1974, 1978; Vinokur, Trope & Burnstein, 1975), for instance, each member of a group is only aware of a few of the existing arguments in favor of a choice. Group interaction offers the opportunity for exposure to a greater number of arguments compared to deciding alone. If discussion leads to a greater number of arguments favoring riskier over safer alternatives, the Persuasive Arguments Theory would suggest a riskier choice, and vice versa (Vinokur, Trope & Burnstein, 1975). In the context of the present study, dyads may potentially come up with more arguments in favor of the riskier (or safer) alternatives and therefore make decisions towards (or away from) risk

depending on cognitive availability of arguments. According to SP/A theory, since most people are likely to be more concerned with security, they may also be more likely to think up arguments in support of caution rather than risk, leading to an increase in risk averse decisions.

Finally, one of the other factors that could be a possible social influence on the dyad decision process is norms. According to Fehr and Fischbacher (2004), from food sharing to mating practices to religious traditions, and cooperative as well as defense activities, social norms have a large role in influencing human behavior. Clark (1984), Elster (1989), Fiske (1992) and Heyman and Ariely (2004) observed the application of different sets of norms by people when dealing with different sets of scenarios. Out of these, two major categories have been noted: social and economic (market) norms. Compared to the economic market, which usually involves a clear exchange of equivalent benefits (e.g., a person expects to pay a certain amount of money to receive a good of a given value), the social context is more complex. The social context involves different types of interactions, and different types of norm relations (e.g., a person may not expect to pay for a good given to them by a parent). Additionally, there are varying circumstances, in which the same relations can take on different considerations (e.g., a friend becomes one's work supervisor), requiring reassessment of norms to be applied. Therefore, in social interactions, the norms may be harder to determine and apply a priori. Kerr, Garst, Lewandowski and Harris (1997) studied the influence of human tendency to behave according to established group norms compared to inclination to act following internalized personal norms. They found that personal convictions were not the only predictor of how people behaved, but that group norms, which were defined and

established via group discussion, also contributed to behavior. In working with dyads, we might also expect that social norms may become a part of the decision process. Because the dyads will be working cooperatively toward a common outcome, we expect that social norms would be likely to enhance collaborative efforts.

In the context of the present research, we imagine that dyad partners will be motivated both to persuade their task partner towards their own way of thinking, but also to work cooperatively toward a common goal. If security is a more common motivation as predicted by SP/A Theory, the dyads may be able to accomplish both goals by tending toward risk averse choices. The next section describes in details the general and specific hypotheses.

Hypotheses and Predictions

The thesis presents the opportunity to explore whether individuals and dyads respond similarly when dealing with risk in different situations. For each research question, competing hypotheses supported by each relevant theoretical perspective are delineated.

Research question 1. Does risky decision making differ across situational contexts?

Competing hypothesis 1. If Prospect Theory value function predictions hold across multiple situations, then for both risky choice and risk management tasks, participants would exhibit a risk averse pattern of preferences for gains and a risk seeking pattern for losses.

Competing hypothesis 2. If SP/A theory predictions hold across multiple situations, then for both risky choice and risk management tasks, participants would

exhibit a general risk averse pattern of preferences. Some risk taking may be observed, particularly for choices involving assured gains, and posing no threat to security.

Competing hypothesis 3. If risky decision making differs due to the nature of the situation, then the two theories may apply differentially based on the psychological processes most likely to be activated. The Risky Choice task seems more passive, static, and reactive whereas Risk Management was designed to be more active, dynamic, and situated. Therefore prospect theory may be better able to predict risky choice preferences whereas SP/A theory may be better able to predict risk management preferences.

Prospect Theory is a theory of choice (with the characteristics listed above); so Prospect Theory should do a good job of predicting results for the choice task, risk seeking for losses and risk averse for gains. Since stimuli are in effect equivalent across tasks, Prospect Theory should do just as well at predicting the management task *unless* the process of actively changing one's current situation is fundamentally different from passively responding to given alternatives. Active decision making may engage motivational processes more, which could change the pattern of decision making.

SP/A theory is a theory about how dispositions and situational motivations affect risk preferences. Ideally, the theory should be applicable to both choice and risk management tasks. However, the decision making literature shows risky choice behavior to be fairly consistent with prospect theory predictions, but these are all for standard (passive) risky choice situations, and usually situations involving a sure thing versus a two-outcome risk where one outcome is zero. SP/A may do better for other gain and loss lotteries (ones that may not involve a sure thing or zero outcome).

Risk management, by definition, is a more active, dynamic undertaking that is likely to initiate motivational processes that are more typical of daily-life decision making. In particular, because management involves dealing with a situation over time, it might better reflect the combination of dispositional, motivational, and situational influences hypothesized in SP/A theory. Tendencies toward ensuring security or seeking potential might be exaggerated due to the active manipulation of worse and better outcomes in risk management. Aspiration levels might be more salient in the management task than the choice task because participants may set a level as part of their management strategy. Thus, overall, SP/A theory predictions may be more predictive in active risk management tasks compared to passive risky choice tasks.

Schneider and colleagues (Schneider, Hudspeth and Decker, manuscript in preparation) showed that, in individuals, tasks focused on newly introduced risk (as in standard risky choice) yielded remarkably different patterns from an analogous situation that was presented as a problem of managing existing risk. In the first (risky choice) study, they found a weak pattern of results roughly consistent with prospect theory with risk seeking in negative and risk aversion in the positive domain. However, in the risk management study, they observed a distinctly risk averse approach on behalf of the individuals when approaching risk overall. In a sense, in the risk management study, the individual (or the dyad in the present study) is endowed with this (existing) risk and has to manage it. This active aspect of risk management is likely to be influenced by motivational factors, more so perhaps than the passive risky choice task. In the present work, the opportunity was available to extend these findings to decision making in dyads.

Research question 2. How might risk taking differ from individuals to dyads?

The social psychological literature offers at least two relevant perspectives regarding influences of social factors on risky decision making. According to the risky/cautious shift perspective, groups (in the present work, dyads) would engage in greater/lesser risk taking following group discussion. This shift would be irrespective of the original attitude of majority of the individual participants. According to the group polarization perspective, on the other hand, dyads would make more extreme decisions in the same direction as the majority of individuals. Because both SP/A and Prospect Theory posit different risk preference patterns as a function of outcome valence, the prediction for group polarization assumes that individuals' attitudes toward risk may vary for gains and losses. Therefore, preferences of individuals at various outcome levels were used as the indicator of majority individual attitudes for gains versus losses.

Competing hypothesis 1. According to the risky shift literature of group decision making, groups tend to take more risks than individuals. In contrast, the cautious hypothesis suggests that groups avoid risk more than individuals.

If risky or cautious shift and Prospect Theory (PT) were both to be correct in predicting individuals' and dyads' risk preferences, results would show a pattern illustrated in Figure 1. So, for PT and risky shift predictions to be correct, dyads would tend in all cases to make riskier decisions compared to individuals as shown in the dotted line above the individual data. On the other hand, if PT and cautious shift predictions were correct, dyads would consistently make safer choices than individuals as indicated by the more risk averse preferences in the dotted line below the individual data.

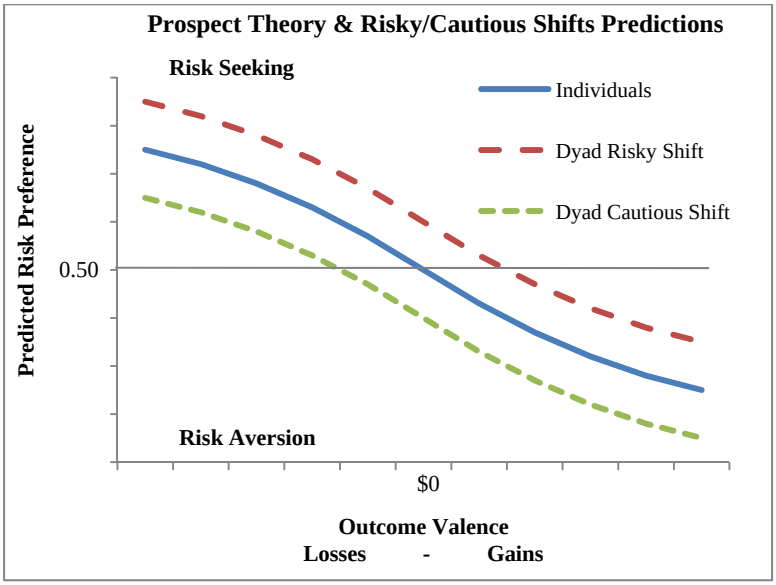

Figure 1. Predictions for Risk Preferences according to Prospect Theory and Risky and Cautious Shift Perspectives

Competing hypothesis 2. Assuming that individual majority preferences are indicative of typical risk attitudes, the group polarization hypothesis would suggest that dyad discussion would strengthen those initial attitudes and exaggerate patterns of risk behavior. However, this shift could be either in the direction of risk or caution, depending on dyad partners' original predispositions. If Prospect Theory and group polarization perspectives were both correctly predicting risk preferences, decision behavior patterns would be likely to resemble the dotted preference curve in Figure 2.

Overall, dyads would continue the same pattern of preferences of risk seeking for losses and risk aversion for gains, as predicted for individuals in PT. If group polarization took place, the only notable change would be an emphasized pattern for the dyads in each domain. Therefore, dyads would tend to be more risk seeking for losses and more risk averse for gains compared to individuals.

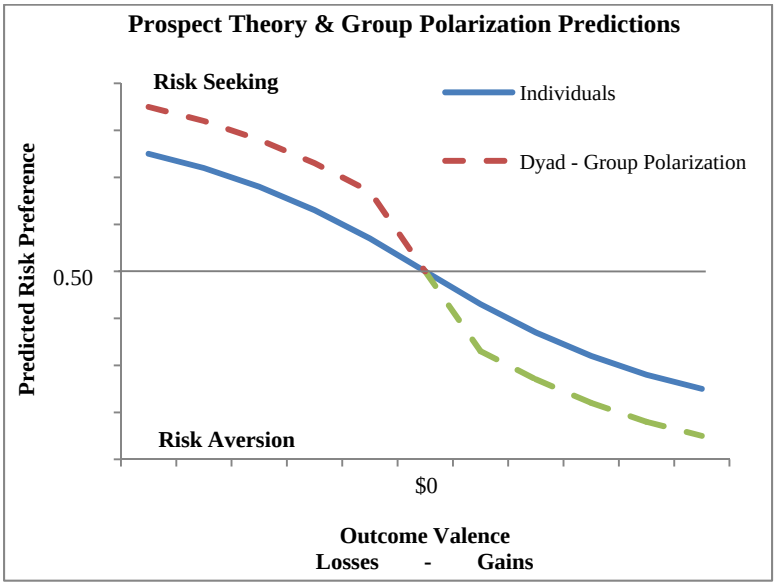

Figure 2. Predictions for Risk Preferences according to Prospect Theory and Group Polarization Perspectives

Competing hypothesis 3. If risky or cautious shift and SP/A Theory were both to be correct in predicting individuals' and dyads' risk preferences, results would show a pattern illustrated in Figure 3. For SP/A and risky shift predictions to be correct, dyads would make riskier decisions compared to individuals as shown in the dotted line above the individual data. On the other hand, if SP/A and cautious shift predictions were correct, dyads would consistently make more risk averse choices than individuals as indicated by the dotted line below the individual data. If group polarization were coupled with SP/A theory predictions, dyad preferences would resemble the same pattern as for cautious shift because majority preferences under SP/A theory are expected to be predominantly risk averse across most if not all outcome values.

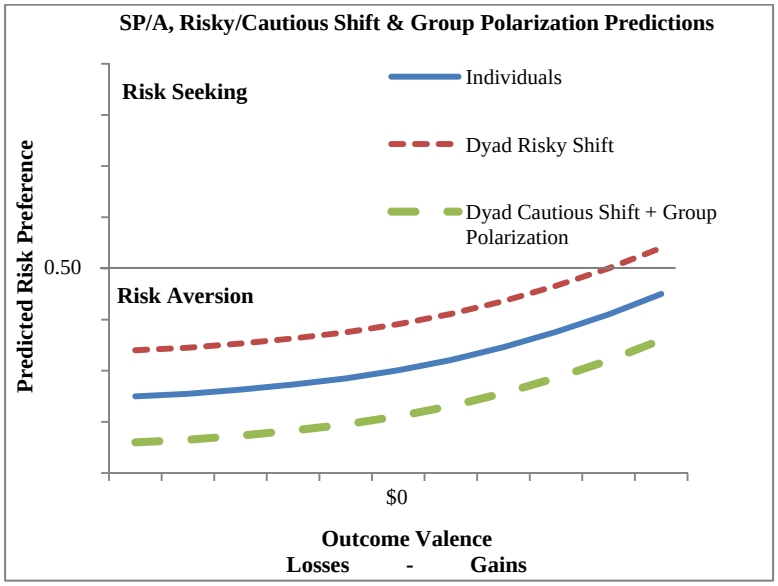

Figure 3. Predictions for Risk Preferences according to SP/A Theory and Risky versus Cautious Shift and Group Polarization Perspectives

Few studies have explored group versus individual preferences across outcome valences. One exception, Marquis and Reitz (1969) observed that groups would take more risks than individuals for positive expected values, but were less likely to take risks for negative expected values, with no discernable change for zero expected value. This was consistent with the original individual preference patterns suggesting that group polarization processes provided a better explanation than either a general risky shift or a cautious shift. These results also provide support for the idea that social influences may affect risk taking differently as a function of outcome valence (and in this case were generally supportive of the pattern anticipated in SP/A theory rather than PT).

Research question 3: How might risk taking differ for valence (negative, mixed, and positive lotteries)?

Competing hypothesis 1. According to Prospect Theory, for positive lotteries which would result in gains, risk averse preferences are expected. For negative lotteries

representing losses, a general inclination towards risk taking would be observed. For mixed lotteries (wherein outcomes include losses, gains, and/or zero), preference patterns are likely to be exaggerated because the value function implies that sensitivity to changing values should be greatest for values closest to zero. For negative expected values, an intensified risk seeking pattern of preferences would be expected, and for positive expected values, a stronger risk averse pattern would be expected.

Competing hypothesis 2. According to SP/A theory, an overall risk averse pattern is predicted. Loss lotteries present a more tangible threat to people's sense of security, supporting risk aversion. For gain lotteries, no tangible threat to security is present. Therefore, if aspiration level is set (moderately) high, the individual may engage in some risk taking. For mixed lotteries, concern for security would push decision makers away from outcomes with losses. For lotteries with negative expected values, this would typically lead to risk aversion in order to avoid the worst possible loss, but occasionally might support risk seeking if the riskier option is the only one that involves the chance to lose nothing. For lotteries with positive expected values, security-seeking would lead to strong risk aversion when the riskier option involves a possible loss, and weaker risk aversion when the riskier option's worst outcome is zero.

Method

This thesis brings together findings from four different studies, comparing risky decision making in dyads and individuals in two different tasks. One task is the standard passive risky choice task, which requires participants to react to pre-determined risky alternatives. The other is a novel managing risk task, which requires participants to actively modify a risk that they are currently facing. Only data for dyads were collected as part of the thesis. Data for individuals were collected by Schneider, Hudspeth and Decker (manuscript in preparation) earlier. Each set of data was collected in a different semester, from virtually the same participant pool of undergraduate students enrolled in Psychology courses, with a high consistency of demographic characteristics across semesters.

Participants

Data were collected following university IRB requirements from students enrolled in undergraduate Psychology courses for course credit. After an introduction to the lotteries, a quiz was administered to ensure that participants understood the task. The quiz assessed basic understanding of probabilities and how probabilities relate to outcomes in lotteries. It also tested whether participants comprehended the computerized representations used to display the lotteries. Data for participants who failed the quiz were not included in analyses. For dyads, both participants had to pass the quiz for their combined data to be included in analysis.

For individuals, 47 out of 63 participants passed the quiz in the risky choice task and 69 out of 79 participants passed the quiz in the risk management task. For dyads, both members passed the quiz in 26 out of 44 dyads in the Risky Choice task and 42 out of 56 dyads in the Risk Management task. Although there was considerable variation in pass rates, this was not unusual given extensive data on semester-by-semester variability in similar studies.

Materials

The same twenty-three pairs of monetary lotteries were used (in different ways) as stimuli in each of the risky decision making tasks. Each lottery in a pair could result in one of two equally probable outcomes, i.e., every lottery was composed of two outcomes, each with a 50% chance of occurring. One lottery in each pair was riskier than the other. The riskier lottery had tickets that were farther apart in value, representing more extreme potential outcomes. The less risky lottery had tickets that were more similar in outcome value, offering the participants a better functional sense of where they might end up. Table 1 shows the complete set of lottery pairs that were used.

The pairs of lotteries covered a wide range of outcome values from -$300 to +$300, and were classified in terms of outcome valences as all negative (NN; loss lottery pairs), mixed negative (MN), mixed positive (MP) and all positive (PP; gain lottery pairs). Each outcome valence condition was made up of six lotteries that were factorially determined using a 3 x 2 Variance x Relative Expected Value (RelEV) design. Variance conditions were defined according to three degrees of ticket separation. For the high variance lottery pairs, the outcomes of the riskier lottery were separated by $200 and the outcomes of the less risky lottery were separated by $100. For the medium variance

lottery pairs, the outcomes in the riskier and less risky lotteries were separated by $150 and $50 respectively. For the low variance lottery pairs, the outcomes in the riskier and less risky lotteries were separated by $100 and $0 (zero) respectively. Relative expected value was defined by relative outcome distance from zero. The outcome that is farther from zero would count as high relative EV while the outcome closer to zero would count as low relative EV.

The 3x2 factorial construction of the lottery pairs in each outcome valence set was adopted to systematically ensure a comprehensive range of stimuli. Although Variance and Relative Expected Value have been analyzed elsewhere (Schneider, Hudspeth & Decker, manuscript in preparation), a detailed exploration of these influences on decision making are beyond the scope of the thesis.

Design

The study used a 2 x 2 x 4 (Decision Maker [individual, dyad] x Task [risky choice, risk management] x Outcome Valence [all negative, mixed negative, mixed positive, all positive]) Repeated Measures Factorial design. Decision Maker was a between-subjects variable representing whether the decisions were being made by an *individual* or a *dyad*. The data for dyads were collected as part of the Master's thesis, and compared to existing data for individuals (which were collected previously by Schneider, Hudspeth, & Decker, manuscript in preparation). Task was also a between-subjects variable; some of the subjects completed the *Risky Choice* task and the remainder completed the *Risk Management* task. Outcome Valence was a within-subjects variable with 4 *levels: all negative (NN, losses), mixed negative (MN), mixed positive (MP) and*

Table 1. Lottery Stimuli broken down by Expected Values and Variability

					Risk Seeking		Risk Averse	
Lottery (by Trial)	Valence	Expected Values	Rel EV	Variance	Low Ticket	High Ticket	Low Ticket	High Ticket
B	NN	-200	High	High	-300	-100	-250	-150
C	NN	-175	High	Medium	-250	-100	-200	-150
D	NN	-150	High	Low	-200	-100	-150	-150
E	NN	-150	Low	High	-250	-50	-200	-100
F	NN	-125	Low	Medium	-200	-50	-150	-100
G	NN	-100	Low	Low	-150	-50	-100	-100
H	MN	-100	High	High	-200	0	-150	-50
I	MN	-75	High	Medium	-150	0	-100	-50
J	MN	-50	High	Low	-100	0	-50	-50
K	MN	-50	Low	High	-150	50	-100	0
L	MN	-25	Low	Medium	-100	50	-50	0
M	*MN*	*0*	*Low*	*Low*	*-50*	*50*	*0*	*0*
M	*MP*	*0*	*Low*	*Low*	*-50*	*50*	*0*	*0*
P	MP	25	Low	Medium	-50	100	0	50
Q	MP	50	Low	High	-50	150	0	100
R	MP	50	High	Low	0	100	50	50
S	MP	75	High	Medium	0	150	50	100
T	MP	100	High	High	0	200	50	150
U	PP	100	Low	Low	50	150	100	100
V	PP	125	Low	Medium	50	200	100	150
W	PP	150	Low	High	50	250	100	200
X	PP	150	High	Low	100	200	150	150
Y	PP	175	High	Medium	100	250	150	200
Z	PP	200	High	High	100	300	150	250

In each experiment, Trial M was presented to participants only once. However, for all analyses, the data for Trial M, which has an expected value of Zero, were included twice, once to represent the Mixed Negative set and once to represent the Mixed Positive set.

all positive (PP, gains). These levels are described in more detail in the *Materials* section.

The dependent variable was Risk Preference, which was measured as number of times out of 6 that the riskier option was selected. These 6 opportunities correspond to the six lottery pair trials within each Outcome Valence condition.

To minimize potential order effects, eight different stimulus orders were used. These orders were systematically manipulated to ensure that each lottery pair would appear at the beginning, middle or end of the stimulus sequence for at least some participants. Also, the orders were checked to be sure that similar stimuli did not co-occur too often, and that the four outcome valence conditions were represented roughly evenly throughout the sequence of trials.

Procedure

Stimuli presentation and data collection were done via a computer program. Twelve computers in the laboratory were set up so that two of those computers would run the same order of the lottery at any given time. Participants choosing to sit at those matched computers were therefore assigned to work as partners in a dyad. Previously unacquainted participants were assigned to dyads in this way to reduce the likelihood that relationship dynamics could influence responses. Matched computers were arranged such that the partners in a dyad would not face each other. Thus, care was taken to avoid the influence of nonverbal communication. A minimum of four participants (two dyads) were run in each session to maintain anonymity of partners.

On entering the lab, participants were instructed to take a seat at any of several computers with a lit screen. Instructions regarding the basic task followed, including

three practice lotteries which participants completed as individuals. Then participants were informed that they would complete the next segment of the study with an experimenter-assigned partner as part of a dyad. Each participant would be able to communicate with their assigned partner by "chatting" (i.e., sharing of text messages) via an Instant Messenger (IM) window on their screen.

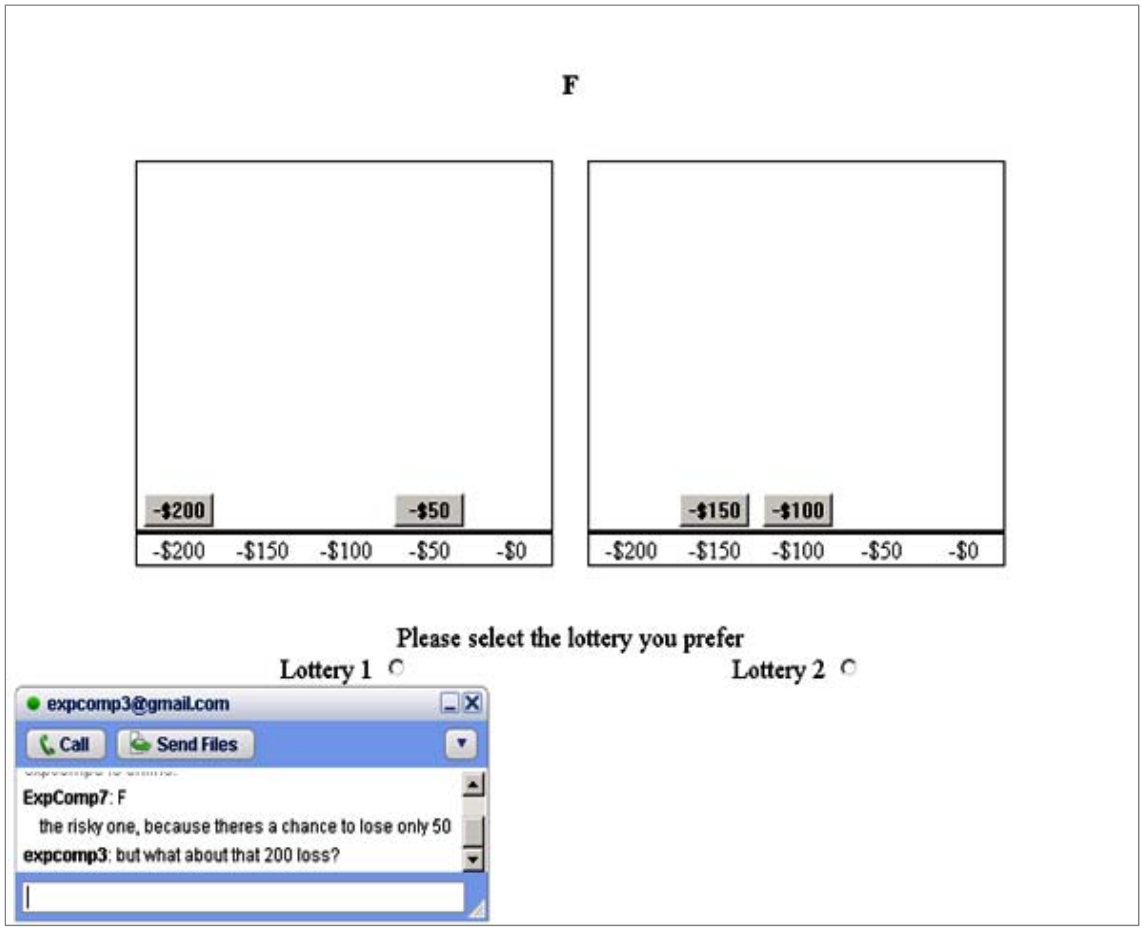

Figure 4. Sample Screen Shot of a Trial in the Risky Choice Task. Dyads communicated through an Instant Messenger window (lower left), which remained on screen throughout the experiment. Here, Lottery 1 has two tickets -$200 and -$50, each of which has a 50% chance of being randomly drawn, resulting in a monetary loss. Similarly Lottery 2 has two tickets, -$150 and -$100, each of which has a 50% chance of being the outcome in a random draw of this loss lottery.

Dyads were instructed to use generic names (e.g., “ExpComp6”) pre-assigned by the experimenter to maintain anonymity. Dyads were encouraged to discuss their thoughts and reasons behind their impressions of one or the other lottery, and to “explain in details why you think a particular lottery is better than the other.” Dyads were also told that they must reach an agreement prior to choosing a lottery on the computer. In reality though each participant could select whichever lottery they preferred. (In practice, there was only one occasion in which a participant failed to select the lottery that the dyad had agreed to choose.)

Both the Risky Choice and the Risk Management task involved 23 decision trials. Figures 4 and 5 show sample screenshots for lottery presentations in the risky choice task and risk management tasks respectively.

Risky choice task. On each trial in the risky choice task, a pair of lotteries was presented on the screen. Each dyad then shared their impressions back and forth via IM about which lottery to choose until an agreement was reached. Then each individual responded by clicking on the button beneath the preferred lottery consistent with that agreement. Then the next lottery pair appeared, signaling the next trial.

Risk management task. In the risk management task, only one lottery was presented on the screen in each trial. Participants’ task was to improve the outcome value of one of the two lottery tickets by $50. Dyad partners shared their impressions with one another via IM regarding which ticket to improve until an agreement was reached. Then each individual clicked on the agreed-upon ticket, which increased the face value of that potential outcome by $50 (and moved the ticket one column to the right on the lottery display). If the dyad selected the lower ticket to improve, the resulting lottery

corresponded to the low risk lottery (i.e., risk averse choice) from the comparable trial in the risky choice task. If the dyad selected the higher ticket to improve, the result corresponded to the high risk lottery (i.e., risk seeking choice).

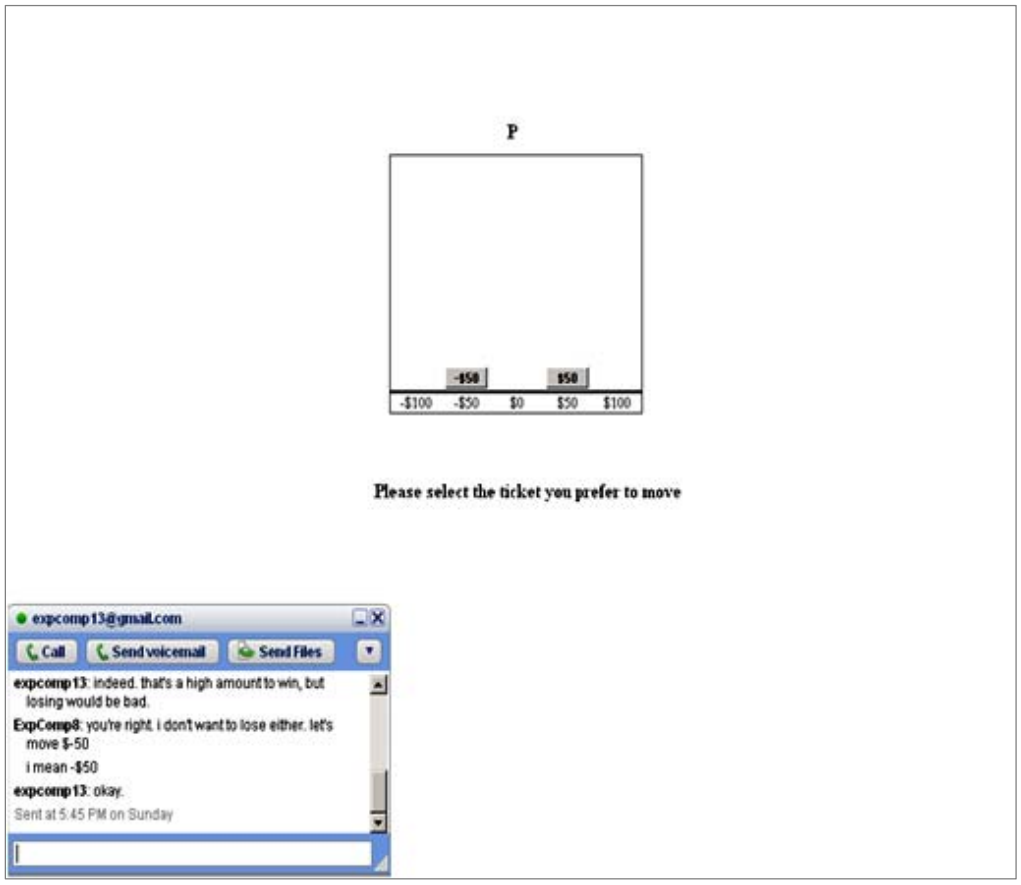

Figure 5. Sample Screen Shot of a Trial in the Risk Management Task. Dyads communicated through an Instant Messenger window (lower left), which remained on screen throughout the experiment. The lottery has two tickets -$50 and $50, Each ticket has a 50% chance of being randomly drawn. In this task, one of the two tickets can be moved to the next higher value on the number line. Moving the low ticket results in a less risky lottery with outcomes of $0 and $50, whereas moving the high ticket results in a riskier lottery with outcomes -$50 and $100.

After completing the 23 trials of the decision making task, each participant independently answered a set of five open-ended questions presented on their computer.

These questions were designed to explore their thoughts and feelings regarding the nature of the task and experience of working with another person.

Results

Data from the four studies were combined and analyzed using Repeated Measures Analysis of Variance feature of SPSS (PASW – Version 18) in a 2x2x4 (Decision Maker [individual, dyad] x Task [risky choice, risk management] x Outcome Valence [all negative, mixed negative, mixed positive, all positive]) factorial design. Decision Maker was a between-subjects variable representing whether the decisions were being made by an *individual* or a *dyad*. As mentioned before, the data for dyads were collected as part of the Master's thesis, and compared to existing data for individuals (which were collected previously by Schneider, Hudspeth, & Decker, manuscript in preparation). Task was also a between-subjects variable; some of the participants completed the *Risky Choice* task and the remainder completed the *Risk Management* task. Outcome Valence was a within-subjects variable with 4 *levels: all negative (NN,* losses*), mixed negative (MN), mixed positive (MP) and all positive (PP,* gains*).* The dependent variable measure of Risk Preference was defined as the number of times out of six that the riskier option was selected over the safer one.

Analysis revealed a significant main effect of outcome valence (See Figure 6) on risk preference, $F(3, 540)=55.07$, $p<0.05$. The pattern of preferences does not clearly follow either PT or SP/A theory, though it has aspects of both. Consistent with prospect theory, there seems to be slightly more risk taking on average for loss lotteries than gain lotteries, especially in the mixed conditions. However, consistent with SP/A theory, risk

preferences were generally on the cautious side; a risk seeking majority was not observed in any condition.

Neither the main effect of Task or Decision Maker was significant. Decision preferences for both the risky choice (*M*=2.53, *SD*=1.91) and the risk management (*M*=2.27, *SD*=1.96) tasks were neutral or slightly on the cautious side,*F*(1, 180)=1.32, *n.s.* Similarly, overall, individuals (*M*=2.49, *SD*=1.91) and dyads (*M*=2.17, *SD*=1.98)

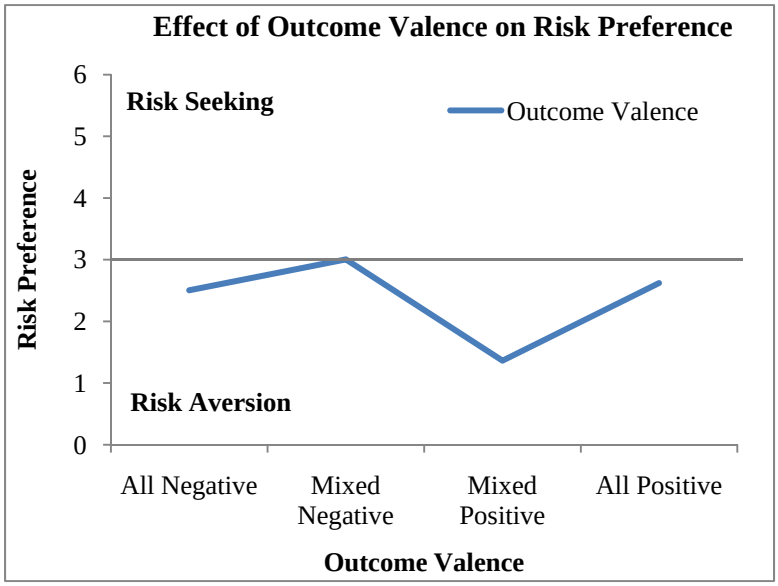

Figure 6. Effect of Outcome Valence on Risk Preference

engaged in similar levels of risk taking, *F*(1, 180)= 2.69, *n.s.* Although the main effects were not significant, the impact of these variables was evident in interactions.

The Outcome Valence x Task interaction was significant, *F*(3, 540)=49.7, p<0.05. (See Figure 7). As expected, there was a cross-over interaction. In the risky choice task, preferences were risk averse for gains, whereas preferences were slightly risk seeking for losses. The decision preference pattern in risky choice was consistent with Prospect

Theory's Value Function. Notably though, degree of risk seeking in the negative domain was at best modest. For risk management, the picture was consistent with SP/A theory predictions. Preferences tended to be risk averse for all outcome conditions except for

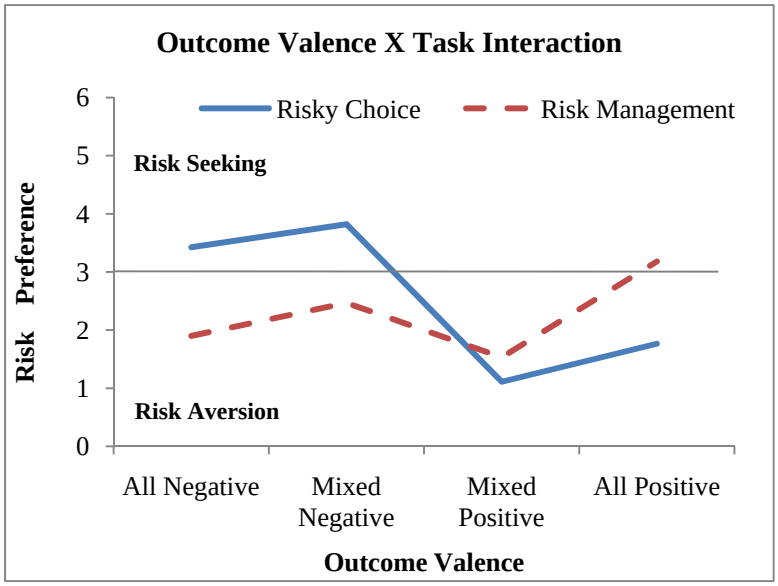

Figure 7. Effect of Outcome Valence and Task on Risk Preference

lotteries that guarantee some gain. There, participants were more willing to take a risk, though still not clearly on the side of majority risk taking. Follow up tests demonstrated that differences in risk preferences for the two tasks were statistically significant at every level of outcome valence.

The Outcome Valence x Decision Maker interaction was also significant, $F(3, 540)=3.33$, $p<0.05$. As can be seen in Figure 8, the overall pattern of risk preferences was similar at most outcome valences for individuals and dyads. The one exception was for the all negative lotteries, which imply loss of some amount for sure. When faced with this situation, dyads tended to take fewer risks than individuals, and pairwise comparison revealed that this difference was statistically reliable, $F(1, 182)=8.31$, $p<0.05$. For the

other three outcome valence conditions, risk preferences between dyads and individuals were not significantly different. Thus, overall, it appears that dyads' are more cautious than individuals in conditions in which losses are guaranteed, but there was little evidence of systematic differences elsewhere.

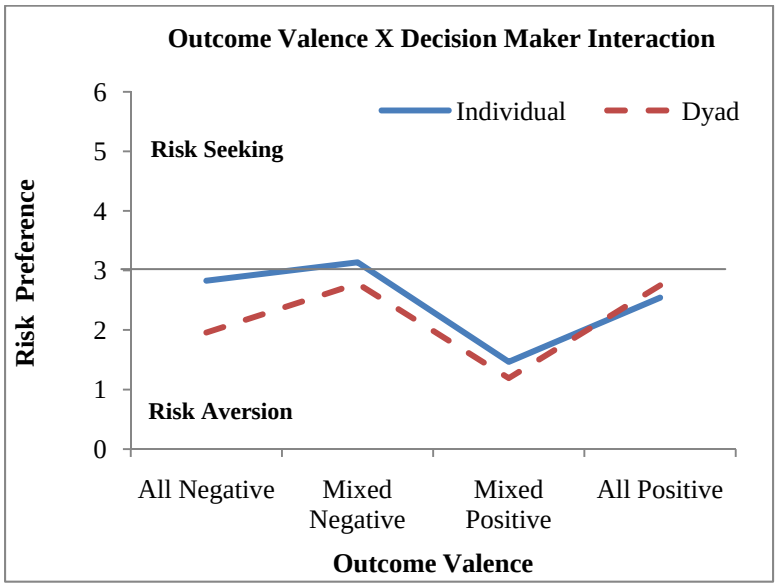

Figure 8. Effect of Outcome Valence and Decision Maker on Risk Preference

There was no Task x Decision Maker interaction, $F(1,180)=0.13$, *n.s.*; nor was there a three-way interaction of valence, decision maker, and task, $F(3, 540)=0.94$, *n.s.*. As can be seen in Figure 9, patterns confirm the two-way interactions observed for outcome valence x task and outcome valence x decision maker. Risk preference patterns appear roughly consistent with Prospect Theory predictions for risky choice (Figure 9a) and roughly consistent with SP/A Theory predictions for risk management (Figure 9b). Dyads and individuals made similar decisions except for guaranteed losses in both tasks, when dyads were less willing to take risks.

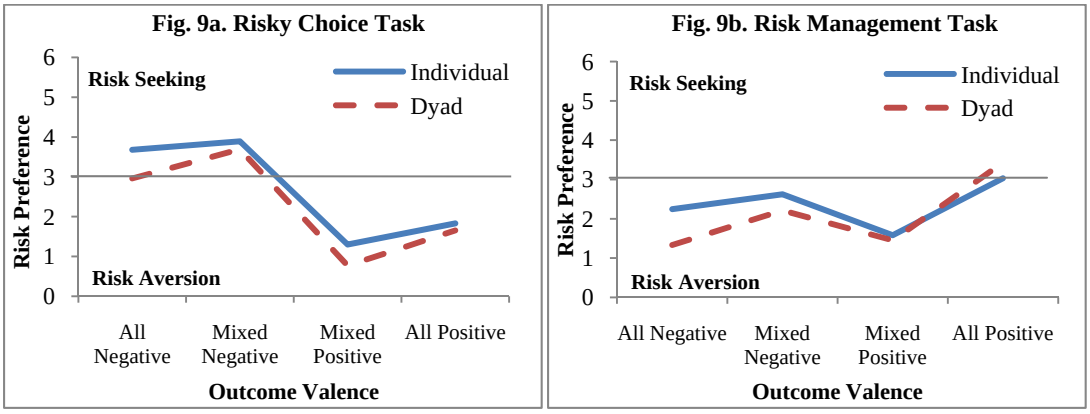

Figure 9. Effect of Outcome Valence, Task and Decision Maker on Risk Preference

Thus, the overall pattern of results suggests some support for Prospect Theory, particularly for the risky choice task, and some support for the SP/A Theory, particularly for the risk management task. There was also some evidence that making decisions with a partner influences willingness to take risk, but only when losses were involved.

Discussion

The present work explored the processes of risky decision making in individuals and dyads to see whether dyad decision might be subject to social or situational influences. Evidence was examined for the possibility of risky versus cautious shifts, or for group polarization effects. Two different tasks were used in order to see whether changes in the decision context would produce different risk-taking strategies. The standard passive risky choice task was expected to engage shallower, psychophysical processes, whereas the active risk management task was expected to enlist more self-relevant motivational and dispositional processes.

As predicted, the risky choice task led to preferences consistent with prospect theory, and the risk management task led to preferences consistent with SP/A theory. Thus neither perspective could predict overall preference patterns, but each of the two theoretical perspectives was successful in a different task setting. There was also some evidence of the role of social influences in that dyads tended to be more conservative than individuals in their decision behavior when dealing with undesirable outcomes. So a cautious shift was observed, but only for lotteries involving losses. Theoretical implications of these findings are discussed next.

Psychophysical Influences on Risky Decision Making

Prospect Theory Value Function (Kahneman and Tversky, 1979) predicts a risk preference pattern of risk aversion for gains and risk seeking for losses. Additionally losses are likely to be experienced as stronger compared to gains of comparable values.

Also for both outcome valence domains, marginally decreasing sensitivity would be expected. Overall, in the present work, Prospect Theory predicted results for Risky Choice for both individuals and dyads. However, Prospect Theory's psychophysical explanations could not successfully account for risk decision preferences exhibited by individuals and dyads in the risk management task.

It appears that for the passive risky choice task, the psychophysical and perceptual aspects of Prospect Theory are sufficient to predict behavior patterns. Change of reference from gains to losses appeared to influence participants in the Prospect Theory predicted direction such that they were generally risk averse for gains and risk seeking for losses, though not as risk seeking as might be expected.

Further evidence of psychophysical influences can be found in subtleties of the risky choice preference pattern across outcome valences. Decreasing marginal sensitivity predicts that reactions should get smaller as outcome value differences move away from zero. Careful review of Figure 7 shows that participants exhibited higher degrees of risk aversion and risk seeking respectively when responding to mixed lotteries for gains and losses compared to sure gains and sure losses. Because the outcomes in the all negative and all positive conditions were further away from zero, this decrease in sensitivity to outcome differences may have weakened risk propensities.

Thus, it seems that a relatively peripheral level of processing may be adequate to make passive choices between given alternatives. However, preference patterns for the risk management task were markedly different, and could not be understood based on Prospect Theory's psychophysical predictions. This could be because the nature of the

risk management task required a greater engagement of mental processes bringing into focus motivational and dispositional considerations.

Dispositional and Motivational Influences on Risky Decision Making

The Security-Potential/Aspiration Level Theory (Lopes, 1987) predicts an overall risk averse behavior pattern for most individuals. Dispositionally, most people are expected to be more inclined towards security (valuing safety more) though some may be more inclined toward potential (valuing opportunities more; Schneider and Lopes, 1986). According to Lopes, when that sense of security is threatened, most people would avoid risk.

SP/A Theory also considers the impact of a situational factor, aspiration level, on risky decision behavior. On occasions in which no threat to security is experienced, aspiration levels might be raised, and the individual could potentially aim for something better than the sure thing, or the comparable outcomes, choosing in favor of the riskier alternative. In situations of loss, risks will typically be avoided, with a few exceptions involving cases in which specific aspirations encourage consideration of the riskier alternative. In situations in which losses could potentially be avoided (mixed negative), occasional risk taking may occur in an effort to maintain the possibility of breaking even. Also, in cases of desperation, people may take risks as the only means of potential survival. In these cases, Weber and Milliman (1997) have found evidence that people re-interpret the technically riskier option as safer one in these kinds of cases.

This pattern of generally risk-averse preferences was observed for both individuals and dyads in the risk management task. For positive (gain) lotteries, where no possibility for loss existed, security was not threatened, and people could potentially

have placed more weight on raising their aspiration levels, and meeting those levels. Therefore, compared to other outcome valence conditions, some risk taking was noticeable for the all positive lotteries. We hypothesized that this task, relative to risky choice, would be more likely to engage subjects, and thus, to involve motivational and dispositional processes in addition to psychophysical ones.

Indirect evidence for higher engagement in the risk management task comes from a preliminary coding analysis of the Instant Messenger conversations between dyad partners. About one-third of the participants in the risk management task expressed some concern with financial responsibility (about 60% of which focused on losses). Statements typically concerned "saving money" or "lowering owed money." The issue of financial responsibility was never brought up in the conversations between dyad partners in the risky choice task. This is probably another indication that the risk management task, though identical to the risky choice task in terms of stimulus materials, may have brought into focus motivational factors having to do with action and personal accountability. The opportunity for manipulating outcome values may potentially have made participants more aware of their roles in the decision making process, enhancing motivation and a sense of responsibility for possible consequences.

Social Influences on Risky Decision Making

The risky and cautious shift perspectives predict a shift in group's (in the present study, dyad's) responses in the risky or cautious direction respectively when compared to individual's decision preferences. Group polarization concepts on the other hand, suggest that dyads are likely to exhibit similar patterns of behavior as majority of individuals; only, for groups, these patterns are likely to be more extreme. This means

that if majority of individuals were risk seekers to begin with, dyads would engage in even more risk taking, whereas if individuals were risk averse initially, dyads would exhibit more pronounced risk aversion tendencies.

Results do not show reliable differences between individual and dyad preferences in all cases. Only for sure losses, dyads seem to have engaged in significantly less risk taking compared to individuals. This raises the possibility that when the direct threat to security was greatest, it became powerful enough in a social context to discourage risk taking. In terms of cautious shift versus group polarization, we can examine the results to see which is more likely to have occurred. If security motivation is what is important, then a cautious shift explanation would be supported.

Given that the preference patterns for risky choice and risk management were opposite for the all negative condition, where individual-dyad differences were found, we can readily assess which explanation is most fitting. Individuals exhibited a risk seeking majority in risky choice, but a risk averse majority in risk management. Group polarization would predict that the dyads would engage in even greater risk seeking in risky choice and greater risk aversion for risk management. A cautious shift explanation would predict that dyads would be more risk averse than individuals in both tasks. The cautious shift explanation was supported because, as Figure 9 shows, the dyads were less willing to take risks in the all-negative condition for both tasks. This is consistent with the possibility that security motivation tended to be stronger in interacting dyads than it was for individuals. Nevertheless, this cannot explain why dyads were not more risk averse overall.

Marquis and Reitz back in 1969 obtained similar findings in a study the effects of uncertainty and group discussion on individuals' willingness to take risks. Marquis and Reitz (1969) found cautious shifts, but only for negative expected values (comparable to losses. However, they also found a risky shift for positive expected values (comparable to gains). Both of these findings are consistent with an SP/A explanation. Perhaps with more power, this type of pattern would also have been observed in the current study.

The conversational data are also somewhat supportive of a security-based description of dyad-individual differences. A preliminary coding analysis of the Instant Messenger conversations showed that dyad participants, in general, tended to talk more about losses than anything else. They also exhibited much concern with worse outcomes, and this was particularly evident in the risk management task. All negative lotteries presented decision situations where participants experienced a combined impact of both undesirable outcomes. Therefore, it is possible that dyads felt most vulnerable in these situations involving all negative lotteries, and wanted to reduce the unpleasant experience of threat by avoiding risk, as best as they could, given the circumstances.

One interesting point made by some participants came at the end of the study, when all participants were asked to respond to several questions regarding their experiences about working in dyads. In response to a question about whether the individual participant would have made decisions differently had they been working alone (as compared to working as part of a dyad), some of them brought up the point of experiencing some concern for the partner's welfare. One sample comment was: "… since I had a partner, I tried to think of him/her so he/she wouldn't lose money and act[ed] more conservatively". Thus, when working in a dyad context, participants

expressed discomfort with risking the loss of other people's money. This could be one reason why many participants when working as a dyad tended to err on the side of caution rather than risk in the negative domain.

Limitations and Future Directions

This thesis provides an initial exploration into situational and social influences on decision making. In the future, these variables might be combined into one larger formal experiment with random assignment of participants in order to replicate these findings with greater control of extraneous variables. In addition, recruiting larger samples of participants would afford additional statistical power to reliably document effects of moderate size, especially given the necessity to exclude participants who do not show a basic understanding of probabilities or lotteries.

Future studies might benefit from including *a priori* measures of risk attitude or dispositions. However, the current findings suggest that this may not be as straightforward as some might imagine. We found that risky decision making patterns differ with situations, suggesting that an individual may not have a single overarching risk attitude or disposition that transcends situations. For example, an individual may have conservative views towards financial investments and yet be an adventure sports enthusiast, indicating that risk dispositions may vary with respect to different domains or situations in real life. In addition, even the interpretation of riskiness may not always be a point of agreement across individuals, or between researchers and participants.

Future research comparisons might also go beyond individual versus dyad to include other comparisons that could bring in teams and/or groups of different types and

sizes. Exploring different types of social interactions as well as different settings for those interactions may be key to understanding real world decision making.

Finally, the present work suggests the need for an overarching theory to connect the gap between psychophysical, motivational, dispositional and social (not to mention cognitive) processes to successfully predict general patterns of risky decision behavior across decision situations and social settings. One promising direction has been taken in dual process perspectives of decision making. It has been increasingly accepted by decision theorists and researchers that risky decision making processes may involve two different systems of processing of information (Damasio, 1994; Epstein, 1994; Evans, 2010; Finucane, Peters, & Slovic, 2003; Hogarth, 2001; Kahneman, 2003; Lieberman, 2000; Reyna, 2004; Stanovich & West, 2000). One system is hypothesized to involve relatively superficial processes, which are heuristic-based and involve easy or automatic rules for quickly responding to familiar situations. The other system involves deeper conscious processes, which are analytical in nature and involve a systematic evaluation of the decision situation. The nature of task situations may play a role in determining how these systems interact, and therefore influence both the decision process and resulting behavior.

The risky choice task, for example, may be one situation in which heuristic approaches may be sufficient to make risk-related decisions, whereas the risk management task may be a situation in which a different heuristic or a more analytical approach is needed. There may be many different default heuristics depending on the type of decision situation, assuming that the situation feels familiar. For unfamiliar situations, a more analytic approach may be needed (e.g., Stanovich & West, 2000).

Social situations may place additional constrains on decision strategies. In real life, there are many different kinds of decision situations that are likely to be more or less familiar. Determining how the tradeoff between these two systems occurs may help us resolve when these different theories may come into play. Advances in neuroscience are likely to be particularly informative in making progress along these lines.

Decision researchers may sometimes seem to forget that in real life, we often make decisions with different people in different sets of circumstances and that these characteristics define decision situations. A comprehensive understanding of human decision making processes requires sensitivity to the many different kinds of social and contextual influences that may be at work in different decision situations.

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