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Choice, Management, & Modification: Situational Context in Risky Choice

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by

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Abstract

We sought to examine the potential differences between different types of risky decisions. While some decisions are easily represented as choices between future alternatives, other decisions may be better represented as the management of a personally owned situation. Schneider (2003) created the risk management task, which manifested these situated improvement decisions, and identified a unique pattern of risk preferences when compared to the standard gambling paradigm. To determine what cognitive processes might be differentially activated for each type of decisions so as to yield these risk preference differences, we incrementally manipulated the gambling paradigm to parse potentially influential elements of situational context from both risky choice and risk management. The elements of context found to be influential were (a) making an improvement of your situation rather than a choice within your situation, (b) integrating information into a more compact display, and (c) limiting the visual salience of consequence information. The implications of these results as they relate to current formal models of decision making and subsequent investigations of decision context are addressed. Future directions using a similar appreciation of individual perceptual and cognitive processes when studying decision making are also discussed.

Choice, Management, and Modification: Situational Context in Risky Choice

Understanding and predicting how people deal with risks when making decisions has been a primary component of numerous scientific disciplines, including economics, psychology, anthropology, and cognitive science. Risky choice is one of the most common approaches currently used in risky decision making research (Goldstein & Hogarth, 1997). The primary methodological tool used when investigating risky choice is the "gambling paradigm," which involves a comparison and choice between alternative risky lotteries or gambles.

In most cases, examples of the gambling paradigm involve a forced choice between two outcome/probability pairs. An example of the gambling paradigm is provided in Figure 1. Participants are offered a choice between these two options. Option A offers a 50/50 chance of winning $50 or $250 while option B offers a 50/50 chance of winning $100 or $200. Risk preferences are established by the experimenter based on participant's responses. All else equal, higher variance lotteries (Option A in this case) are considered riskier because the available outcomes are further from the mean ($150 in this case).

Please select one of the two available options --

Option A

50% chance of $50 with 50% chance of $250

or Option B

50% chance of $100 with 50% chance of $200

Figure 1. An example of the gambling paradigm.

Decisions in the gambling paradigm format have served as foundations in popular normative models of decision making related to expected utility theory, like Von Neumann and Morgenstern's (1944) axiomatic treatment of expected utility and Savage's (1954) subjective expected utility (SEU) theory. Additionally, the gambling paradigm has been a popular tool in the measurement of risk preferences for subsequent descriptive models of risky choice, such as prospect theory (Kahneman & Tversky, 1979).

There are a variety of benefits in using the gambling paradigm as a methodological tool in current and future research endeavors. First, as with all paradigms that reach some measure of popularity, the gambling paradigm is highly tractable. New findings can easily be tied into the existing body of research using this paradigm and its exemplars. Another benefit of the gambling paradigm is its simplicity (Hastie & Dawes, 2001). Risks are represented as separate situations that can be contrasted with one another, and "risk preference" can be inferred when one risky alternative is preferred to another, all else equal.

However, a major contribution of behavioral research in decision making in the last 50 years has been robust demonstrations that the way information is presented has a profound influence on behavior. Not all decisions in life are gambles; to the extent that a type of decision is incongruent with the gambling paradigm, the predictions and conclusions in that domain are suspect. As a result, identifying the types of decisions or aspects of real world decision environments that are incongruent with the gambling paradigm is a compelling research endeavor.

The progenitor of this approach is arguably Herbert Simon (1955, 1956), who suggested that the study of decision making should focus on different methodologies and models to investigate a diverse set of environments. This is because the cognitive processes used to evaluate decisions may differ across decision contexts. Simon provides a metaphor for decision making where "behavior is shaped by scissors whose two blades are the structure of task environments and the computational capabilities of the decision maker" (p. 7, 1986).

Lopes (1981) also criticized rational choice theory's use of the gambling paradigm as being too rigid in its expectations for people's use of probability information for separate outcomes in isolated choice examples. Lopes instead suggested that situational motivations including goals and aspirations are influential in how people experience and respond to risks (Lopes & Oden, 1999).

Klein and colleagues (Klein & Calderwood, 1991; Rasmussen et al., 1993; Zsambok & Klein, 1997) challenged the focus on analytical processing common to risky choice research. They instead emphasize the relationship between proficient decision making and recognition-based processes, or cognitive processes that generate potential actions from within a situated decision environment. This desire for added realism is not well represented in traditional investigations of risky choice, which posit that decision makers use analytical processes to consolidate and compare available information about future events or consequences. In models of risky choice, high quality decision making requires substantial reduction of real world contingencies into discrete choices using computational formats that can be combined algebraically.

An alternative viewpoint posits a focus on the influence of a decision environment on behavior. Decisions in the laboratory are provided as discrete choices with complete information and may not generalize across different decision formats or content domains. In many cases, decision makers find themselves in less circumscribed, less complete situations and may be required to use recognition-based and possibly other processes to decide how to move forward.

There are a variety of possible contextual elements present in real world situations that are unexplored by popular theories which rely exclusively on the gambling paradigm. These atypical real world situations have been investigated to some extent by naturalistic decision making (Klein, 2008). This research primarily focuses on the constrained, situated, and personally-relevant contexts found in decisions made about specific content domains such as medicine (Elstein et al., 1978), aviation (Simpson, 2001), or law (Pennington & Hastie, 1988). However, this approach is limited by a difficulty in operationalizing concepts like risk across domains (Lipshitz et al., 2001) and difficulty in allowing for quantitative comparisons with existing research that uses the standard gambling paradigm (Connolly & Koput, 2002).

From a methodological perspective, it would be ideal if it were possible to test various contextual elements like those explored in naturalistic decision making via systematic changes to the gambling paradigm. While a laboratory decision task may never completely capture a real world situation, a subset of situational context from the real world can be represented as comparisons between laboratory manipulations to the standard gambling paradigm. This systematic approach would provide for new insights in understanding the unique contributions of potential real-world contextual elements while simultaneously retaining enough similarity with the gambling paradigm to allow for quantitative comparisons to existing literature in risky choice.

The purpose of this dissertation is to explore some fundamental features that are likely to vary across decision contexts, but to incorporate them into tasks that are sufficiently similar to the gambling paradigm to allow comparisons with mainstream findings popular in both economic and psychological theories of risky decision making. This will be accomplished through a series of systematic variations to the gambling paradigm meant to capture four basic features of decision environments that are likely to differ across various real-world decision contexts. These features include: (a) the visual or perceptual separation or integration of decision options, (b) whether consequence information is available either explicitly or implicitly, (c) how the decision relates to the current status quo, specifically whether the current status quo already includes the risky prospect (i.e., whether the risky prospect is endowed), and (d) whether evaluation focuses on pre-existing options or potential actions.

Background: The Risk Management Task

The approach for the dissertation follows from the recent introduction of the risk management task by Schneider (2003). Schneider was concerned that while many decisions in the real world are made as choices between available options, other decisions are made within an ongoing and situated context. She posited that in certain situations, people may be more apt to see themselves as managing risks rather than selecting between risky prospects. Schneider introduced the risk management task, which incorporated a situated decision that can be improved by increasing or decreasing risk.

In the risk management task, participants are given a single gamble, but they are provided with an opportunity to improve one of the two possible outcomes in the gamble before playing it. Thus, the decision is characterized as managing an existing risk by changing the situation for the better in one of two possible ways.

Methodologically, the risk management task is especially attractive because the two possible improvements in the risk management task can alternatively be characterized as two possible choice alternatives from a gambling paradigm task. In this way, one can make direct comparisons between the risk management and risky choice tasks for each pair of potential options.

Figure 2 presents the version of the risky choice task used by Schneider (2003) to represent the gambling paradigm. In the risky choice task, participants are asked to select between two, two-outcome gambles of equal expected value that differ in riskiness of each gamble. Each gamble is posed as a lottery, and each lottery is provided in a separate display. The outcomes from each gamble appear as tickets along a number line in each box. Participants are told that the outcomes in a given lottery are equiprobable. Participants indicate which lottery they would prefer to play by selecting the “Lottery 1” or “Lottery 2” radial button located below the respective lottery. Participants are also informed that the hypothetical lottery would be resolved by placing the two tickets from the chosen lottery into a hat and randomly drawing one of the two tickets and receiving the amount indicated.

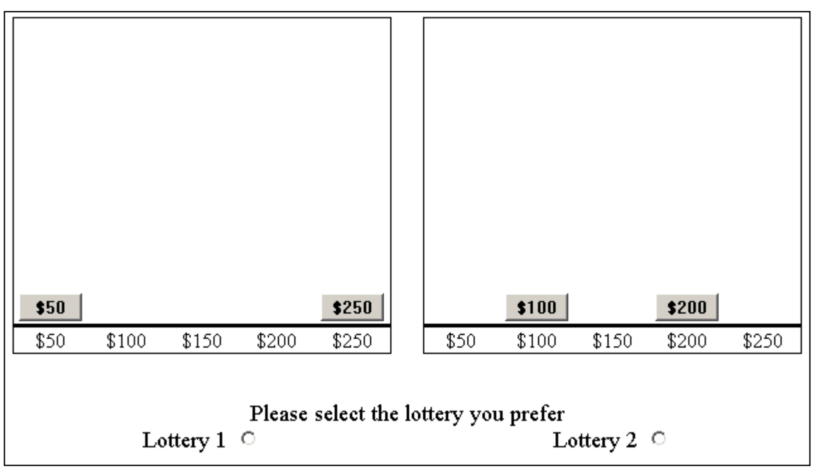


Figure 2. An example of a decision stimulus from the risky choice task in Schneider (2003). Participants are asked to select which of the two lotteries they prefer by selecting the radial button located below that lottery.

By contrast, the risk management task proposed by Schneider (2003) conceptualizes risky decisions as a situation in which participants manage their exposure to risk. Figure 3 provides an example of the risk management task that corresponds to the risky choice example above. Participants are told they are about to play the given lottery. However, they are then given an opportunity to improve one of the possible outcomes in that lottery before it is played. Participants can improve one of the two outcomes by clicking on a ticket to move it to the next best position on the number line.

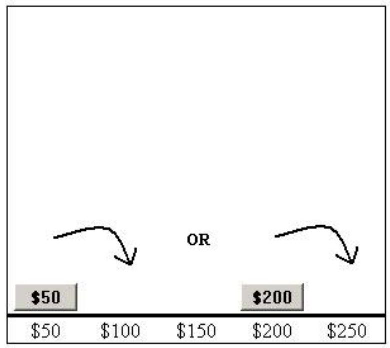


Figure 3. An example of a decision stimulus from the risk management task (Schneider, 2003). The arrows are included here to illustrate the possible ticket moves, and were not actually presented to participants.

For instance, a participant could choose to improve the $50 ticket by clicking on it so that it moves to the $100 position and then takes on the $100 value. So by clicking on the lowest ticket, the participant would create a lottery with $100 and $200 tickets, or clicking on the higher ticket, the participant would create a lottery with $50 and $250 tickets. In this way, the improvement of a ticket yields one of two possible lottery scenarios.

Both the risky choice and risk management tasks from Schneider (2003) used different procedural mechanism to address what is otherwise the same simple forced-choice decision; two alternatives, with differing amounts of risk, were contrasted with one another. Figure 4 demonstrates how stimuli from these two tasks use the same economic information. In the risky choice task, the decision is organized into two alternatives as their own separate probabilistic events. In the risk management task, the decision is organized into a single probabilistic event that can be actively improved into one of the same two events presented separately in the risky choice task.

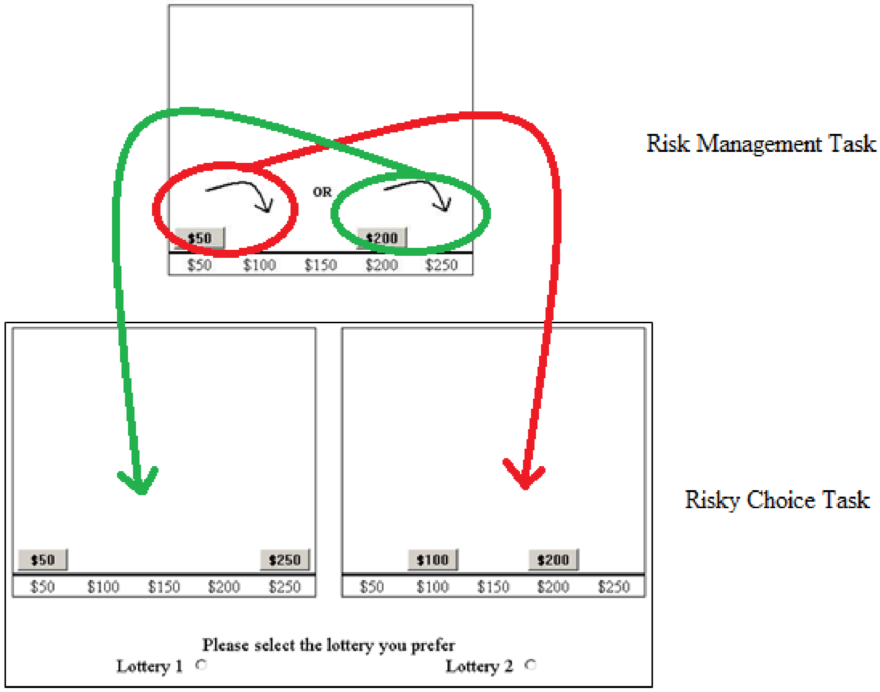


Figure 4. A demonstration of the way in which the two possible improvements in the risk management task correspond to the two possible choices in the risky choice task.

Decisions made in the context of an active improvement in the risk management task elicit a substantially different pattern of preferences than decisions made in the context of a choice between risky alternatives in the risky choice task. In early studies of the risk management task, Schneider and colleagues (2003; 2004; 2006) examined monetary lotteries across a range of positive and negative expected values and across lotteries that differed in risk level as defined by outcome variance. Figure 5 provides an illustration pooled across multiple studies.

For the risky choice task, risk preferences largely conformed to patterns predicted by the S-shaped value function of prospect theory (Kahneman & Tversky, 1979). Participants were more likely to choose the riskier option when lottery outcomes were negative and were more likely to choose the safer option when lottery outcomes were positive. This pattern is highly reliable and has been demonstrated across hundreds of studies of risky choice (Kuhberger, 1998; Levin, Schneider, & Gaeth, 1998).

However, for the risk management task, risk preferences tended to switch for positive and negative valences. When the lottery outcomes were negative, participants tended to be especially cautious, decreasing the amount of risk by routinely improving the worse ticket thereby reducing risk. When outcomes involved gains, participants were more open to taking risks when facing situations with increasingly large outcomes. This was demonstrated by a tendency to improve the better ticket thereby increasing the riskiness of the lottery. In some instances there was a difference in risk preferences between the two tasks of as much as 30% -- just based on a relatively subtle change in how decisions were presented.

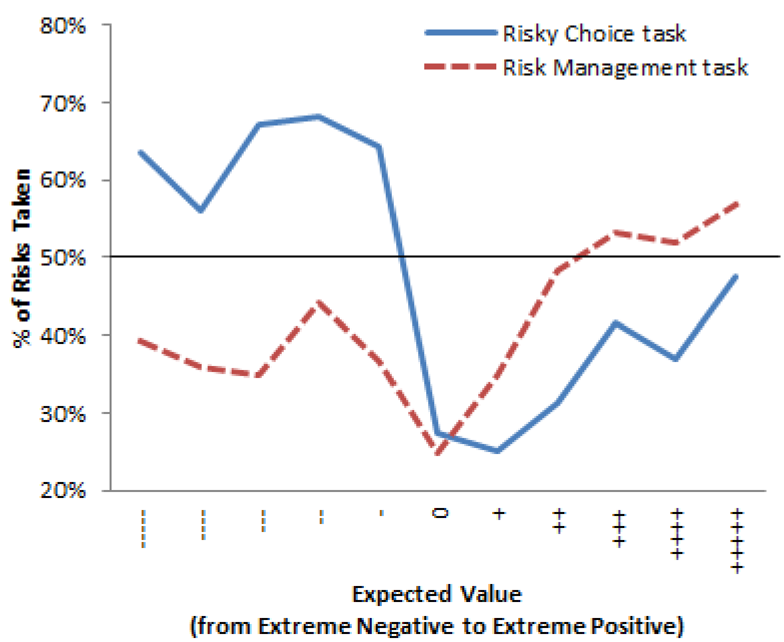


Figure 5. Risk preferences for the risky choice task and the risk management task for lotteries with a positive or negative valence at a range of expected values (indicated by the number of “-“s and “+”s).

The striking task-related differences in preferences that have been observed between the two paradigms are highly reliable. The same task-related risk preference patterns were found when participants were given actual payouts (Schneider, Hudspeth, Decker, & Gagnon, 2006). In addition, the same pattern of responding was exhibited by dyads who worked together to establish preferences (Mukherjee & Schneider, 2007). Moreover, Schneider and Hudspeth (2005) have replicated the pattern of risk preferences in the content domain of health outcomes. Given this reliability, these task-related differences illustrate how a theoretically-important change in decision presentation can produce vastly different patterns of risk preferences. Schneider and colleagues argue that the risk management task allows participants to think about risks using the current state as a reference point. This contrasts with the presentation of decisions as a selection from passive and isolated choice alternatives. While the risky choice task and risk management task both extract out essential elements of real decisions, the risk management task extracts out different elements than the risky choice task. Some decisions in the real world may be more easily interpreted as choices between available options, such as choosing between brands in a department store, while there are certainly many other examples of decisions in the real world that map more closely onto personal-situation/improvement decisions represented by the risk management task, such as investment decisions (Lopes & Oden, 1999) or the content domains from naturalistic decision making mentioned earlier.

From the Risk Management Task to Principles of Risky Decision Making

The risk management task is a compelling example of behavioral changes that can be revealed by altering the traditional decision paradigm to include situational context consistent with a focus on the situated improvement of a given situation, rather than the choice comparison between alternative scenarios. Although the change in how decisions were presented may seem relatively subtle, this manipulation reflects a theoretically-meaningful concern for task environments yielding reliable differences in risk preferences. Because our primary focus is on understanding how elements of situational context combine to influence risky decision behavior, we plan to explore several possible reasons for the difference between preferences in the risky choice and risk management tasks.

Specifically, four features were selected as promising candidates for being elements with a primary influence on risk preferences: display integration, consequence salience, personal ownership and behavioral focus. The primary goal is to explore how these elements influence risk preferences. In what follows, each of the four selected elements of situational context will be explained, followed by a theoretical argument for why it may be responsible for the differences in behavior between the risky choice and risk management tasks.

Choice display format and integration. One of the simplest characteristics that might potentially influence preferences is the way information is presented in a display. In particular, one might be concerned about the visual ease or difficulty in identifying possible decision criteria or deciphering the relationship between the possible choice options. The issue of integration within choice displays deals specifically with the visual *consolidation* of information about available options.

The risk management task (Schneider, 2003) uses a single visual display to communicate the information about available options, so one might argue that it has a more consolidated presentation format. This differs from the risky choice task (Schneider, 2003) and most other instantiations of the gambling paradigm, which provide possible alternatives either as separate lotteries in separate displays or as descriptions of distinctly separate “Plans” or “Alternatives” (Kuhberger, 1998). So, a gamble with two options would use two different displays, one for each option. Thus, the risk management task may lead to different preferences than the risky choice task because the decision takes up less perceptual space.

It may be possible to better equate the presentation effects between the risky choice and risk management tasks by combining the information from the two choice options in the risky choice task into a single visual display. . There are two possible rationales for how integrating choice information into a single display might influence risk preferences. They will be discussed in turn.

Ease of processing information from integrated displays. First, some researchers suggest that information integrated into a single display is simply easier to evaluate. Cognitive models of learning and problem solving are designed to address the benefits of different types of display formats. One of the avenues of this research is focused on the potential benefits of integrated displays over separate displays of similar information (Sweller, Ayres, & Kalyuga, 2011).

Tarmizi and Sweller (1988) investigated how well students could learn information about geometry when information was displayed with text shown separately from a visual diagram compared to when information was displayed with text as an overlay in the diagram. They found that students presented with text and diagrams simultaneously in a single display outperformed students who were presented with two separate sources of information. Similar results were observed in a number of experimental studies (Chandler & Sweller, 1992; Bobis, et al., 1993; Sweller et al., 1998).

They argued that the physical integration of information reduced the need for mental integration and reduced extraneous cognitive load (Cierniak, Scheiter, & Gerjets, 2009; Sweller, Ayres, & Kalyuga, 2011). This aspect of physical integration may generalize to risky decision making stimuli. As a result, information about risky decisions may be made easier to cognitively evaluate when the information is presented in an integrated single display, rather than separate displays of each option in the choice set.

Different decision strategies for different display formats. Second, some decision researchers have noted that aspects of the display promote qualitatively different information processing strategies. One of the major distinctions among strategies is whether processing focuses on evaluating alternatives or comparing choice attributes (Payne & Bettman, 2004). The differences in these strategies may be influenced by whether displays present information in an integrated or separated format.

In alternative-based decision strategies, probability and outcome information is combined to yield a summary evaluation (e.g., utility) for each alternative, and then the summary values are compared across alternatives to select the better option. Alternative-based decision strategies are predicted by utility theories popular in risky choice research (Payne, Bettman, & Johnson, 1993), such as expected utility theory (Von Neumann & Morgenstern, 1944) and prospect theory (Kahneman & Tversky, 1979). In attribute-based decision strategies, the decision process starts with a comparison across each of the attributes that are shared by alternatives. The option that has a preponderance of better values on what are judged to be the most important attributes is then selected. Attribute-based decision strategies are usually focused on the effects of one or more attributes over others, such as elimination-by-aspects (Tversky, 1972) and the priority heuristic (Brandstätter et al., 2006).

Research contrasting alternative-based strategies and attribute-based strategies has examined the effects of different presentation formats on strategy selection. Bettman and Kakkar (1977) investigated whether organizing information in different ways encourages the use of a particular alternative- or attribute-based decision strategy. They found people predominately selected a strategy that corresponded to the organization of information. Alternative-based comparisons were encouraged by displays that provided information about each choice alternative separately. Attribute-based comparisons were encouraged by displays that provided information about each attribute separately. They found a wider range of strategy selection when information about alternatives and attributes were combined into a matrix display.

These results were extended by Jarvenpaa (1989, 1990) to the realm of graphical display formats in decision support systems. Displays that provide an overt contrast between alternatives or between attributes overwhelmingly show strategic behavior consistent with the display format. This may be related to Wickens and Carswell's (1995) proximity compatibility principle, which suggests that display design facilitates cognitive processing to the extent that the decision criteria that need to be compared are physically close to one another.

Furthermore, the constructivist viewpoint in decision research (Fischhoff et al., 1988; Payne et al., 1992; Slovic, 1995) provides 30 years of research demonstrating that decision representations are a primary influence in the construction of preferences. It is typically assumed that different contextual factors support the adoption of different decision strategies, which in turn lead to the observed differences in preferences.

In terms of risk preferences, however, there is little or no evidence regarding the link between alternative- versus attribute-based strategies and risk preferences (Payne, 1982). The research has typically been focused on decision accuracy, showing that people are more apt to choose dominated alternatives when attribute-based strategies are adopted. It is not clear how preferences might differ when gambles of equal expected value are presented.

Based on this literature, it seems that the standard risky choice task, which presents alternatives separately, may encourage the use of alternative-based processing strategies. Indeed, prospect theory, like other expectancy-based theories, posits that choice processing involves an alternative-based strategy of combining an option's probability and subjective value characteristics into a summary evaluation. In practice, however, Payne and Braunstein (1978) found a wide variety of individual differences in strategy selection, even among simple binary (i.e., two-option) risky choices. Sometimes, decision makers were apt to engage in attribute-based processing, comparing the attributes of "amount to win", "amount to lose", "probability to win", or "probability to lose" across alternatives. Other types of hybrid strategies were also commonly employed.

Manipulation to address display integration. In this study, we modified the risky choice task to integrate information from two gambles into a single combined display. This will be done to address the potential differences in cognitive difficulty and strategy selection given the integrated display format used in the risk management task. This entails displaying outcomes from the two possible choice alternatives on the same number line, thus making their attributes (i.e., better/worse values) easier to visually compare across alternatives. This will make the risky choice task visually similar to the risk management task *without* fundamentally changing the underlying behavioral requirements of the risky choice task.

If the separate displays used for the risky choice task are a driving factor in the formation of risk preferences, then the risk preferences for the *integrated* risky choice task should become more similar to risk preferences for the original risk management task. In addition, choice reaction times will be examined to determine whether combining information into an integrated display will enhance information processing speed relative to the original risky choice task.

Additionally, the aforementioned learning behavior research suggests integrated tasks require substantially less effort for students to learn and manipulate information. As a result, risk preferences may be influenced by the differences in effort necessary to evaluate the decision. To test the relative amount of effort required to make a decision, time used to evaluate a decision will be used as a proxy for the effort needed by participants to make a decision. We hypothesized that a task using separated displays would require more effort than tasks using an integrated display, and so the task which maintains a separated display (the original risky choice task) should take significantly longer than tasks which maintain an integrated display (the other four tasks). This was assessed as a manipulation check.

Consequence-related information in risky decision making. Consequence information is the knowledge about the potential final outcomes of a decision. In the standard conception of a gambling paradigm, complete information about all outcomes and probabilities is provided to a participant when eliciting a risk preference (Hastie & Dawes, 2001). The risky choice task provides this complete information in a similar fashion to the gambling paradigm. However, the risk management task does not provide *explicit* consequence information about at the outset of the decision (Schneider, 2003). Instead, participants are provided with a single situation with two outcomes whereby only one of their two outcomes can be improved. The gamble a participant will play is only made visually available after improving the value of one of the outcomes. This effectively requires participants to make a decision before they can directly observe their possible final outcomes for the risk management task.

The risk management task is meant to represent situations where visible consequence information is not necessarily available before making a decision. Situations without explicit consequences pose a significant problem for popular models of decision making (Sen, 1994). This is because some form of explicit consequence information is required to form utilities in expected utility theory (Von Neumann & Morgenstern, 1944) and other expectancy-based theories that rely on drawing a quantitative distinction between decision alternatives, such as prospect theory (Kahneman & Tversky, 1979). While it may seem trivial when consequence information can be easily inferred in the risk management task, a number of behavioral decision models, including prospect theory, argue that the underlying process for making decisions is psychophysical. If explicit consequence information is required for this process, and no explicit consequence information exists, then the underlying psychophysical process requires either (a) additional steps to impute this missing information or (b) an altogether different method of information processing. The issue of "consequence salience" focuses on the availability (or lack thereof) of explicit consequence information to a decision maker *before* making a decision.

To decipher the potential effect of consequence salience in the risk management task, we will include explicit consequence information about the impending choice as a manipulation of the risk management task. If the presence of *explicit* consequence information is fundamentally important for determining risky decision behavior, then risk preferences will be similar for the explicit-consequences manipulation of risk management task and the risky choice task. Three possible reasons why consequence salience might influence the formation of risk preferences will be discussed.

Imagined or hypothetical consequences. One reason why consequence salience might influence risk preferences is the potential difference in the quality of information from imagined or hypothetical outcomes when compared to explicitly-provided outcomes. It may be the case that evaluating decisions with imagined consequences would require more cognitive effort, hence making the decision more cognitively taxing. In addition, imputed data may carry the burden of the potential that it less precise than explicit consequence information, which may in turn influence risk preference formation.

The limitations of working memory were addressed earlier in the discussion of Cognitive Load theory (Sweller, 1994). A decision maker would require working memory to glean complete choice options from the incomplete decision scenario. Because of this, additional cognitive faculties would be required to process decisions where consequence information is incomplete. To that end, differences in the effort of evaluation for different gambles have been shown to influence patterns of risk preference behavior (Garabarino & Edell, 1997). This may provide an explanation for the differences in risk preferences between the risk management and risky choice tasks.

It may also be the case that decision makers may de-emphasize or overlook information about a decision that needs to be imagined. Slovic (1972) posits the "concreteness principle," whereby decision makers will tend to use only information that is explicitly available and will typically use it only in the form in which it is displayed. He goes on to argue that "information that has to be stored in memory, inferred from the explicit display, or transformed tends to be discounted or ignored" (p. 9). To justify this, he points out several studies where underlying probability distributions seem to have little influence over behavior when participants are provided easily comparable payoff information (Slovic & Lichtenstein, 1968; Payne and Braunstein, 1971). The implication from the concreteness principle is that decision makers in the risk management task may not focus on specific consequences when making decisions because consequence information was not explicitly provided. These decision makers would instead presumably focus on comparisons between the available information about their current situation.

Adaptive decision making: operating without consequences. Realistically, people are not always presented with information about their future consequences. As a result, tasks that display explicit consequence information may not reflect risky choice information in a way that decision makers are used to. However, tasks which represent consequence information without certitude may reflect more accurate representations of real world decisions, and hence provide a more generalizable task to examine risk preferences.

The adaptive decision making approach (Payne, Bettman, & Johnson, 1993; Gigerenzer et al., 2001) suggests that there are cognitive mechanisms that draw out the useful information from an environment to help guide the decision process (Todd & Gigerenzer, 2001), even under novel circumstances and without relying on a decision calculus on information about future consequences. When placed in a real-world risky situation, there may be some difficulty in figuring out what is possible, what actions can be taken, and what the consequences of each action might be.

The underlying assumption of adaptive decision making is that a decision can be made from a course of action formed based on one’s understanding of the rules and constraints of an environment (like a mental model) without necessarily deriving all the possible consequences. These mechanisms are defined as explicitly adaptive because (a) the uncertainty in novel environments often makes direct derivations of consequences impossible and (b) real-world decision environments are often changing, which further limits the ostensive usefulness of a direct derivation of utilities (Todd & Gigerenzer, 2007).

One example of research that addresses a lack of consequence information when making decisions is the gap in risk preferences between “decisions from experience” and “decisions from description” (Hertwig & Erev, 2009). The impetus of this research is that, in many real world situations, it doesn’t make sense to provide consequence information. This research focuses on how decisions made by gleaning probabilities from actually-experienced samples of outcomes differ strategically from decisions made when probability-outcome pairs are provided as description choice options (Hertwig et al., 2004). For the sake of this investigation, we will only provide outcome information in a descriptive format and will seek to always include consequence information, so as not to confuse the issue of consequence salience with outcome/probability salience.

Naturalistic decision making: deriving one’s own consequences. Naturalistic decision making research suggests that individuals need to derive their own consequences when making decisions in real-world. Naturalistic decision making researchers have investigated situations which require decision makers to figure out their own choice options from a provided scenario, and have concluded that providing explicit consequence information will necessarily bias a decision maker’s behavior. This approach argues that the decision making process is artificial for tasks that provide explicitly-stated consequences because these tasks do not include option generation, which they view as an essential psychological component of making decisions.

Real world decisions often lack clearly delineated choice options. For example, devising a plan to balance the national budget constitutes a decision situation that has a variety of possible avenues for solutions, but as a situation it lacks *a priori* choice options. Choice alternatives must be formulated by the policy maker before the risks can be assessed and a final decision can be made. The wide variety of real world contexts where explicit consequence information is not provided prompted naturalistic decision making researchers to investigate for the potential biasing factor associated with giving decision makers their options up front.

Naturalistic decision research has demonstrated that people have cognitive strategies they can use to identify choice consequence information from their situation (Klein, 2008). Research in this field has also shown that preferences are different for decisions in instances where these strategies are activated to formulate choice alternatives (Bouffard, 2002; Johnson & Raab, 2003; Gettys et al., 1987; Klein et al., 1995).

Following this argument, the presence of explicit consequences would encourage the selection of existing choice alternatives similar to processes operating in the standard risky choice context. Additionally, because the risk management task does not provide explicit consequence information, decisions may activate a cognitive process responsible for the formation of choice alternatives consistent with reports in naturalistic decision research. With a difference in cognitive processing, there may also be comparable differences in preferences.

Manipulation to address consequence salience. This study includes a manipulation of the risk management task that provides explicit information about future consequences. If consequence salience influences the decision process, then the risk preferences for the risk management task with explicit consequence information should appear different from the risk preferences found using the original risk management task without explicit consequences. If explicit consequences prime the same cognitive processes used to make risky choices, then preferences will look similar to those for the risky choice task.

Construal of situations as personally owned when making decisions. Personal ownership is meant to represent the conditions provided to participants in the risk management task that may engender a sense of ownership over the persistent situation that requires improvement and the outcomes in said situation. As mentioned earlier, the gambling paradigm provides risky decisions as a comparison of two alternatives that vary in their overall riskiness. By contrast, alternatives to the gambling paradigm, such as naturalistic decision making, generally provide tasks that require decision makers to formulate their own possible actions from a situated and malleable situation (Brehmer, 1992; Klein, 2008). Like the standard gambling paradigm, the risky choice task provides separate, fixed and isolated scenarios. Similarly to the paradigms found in naturalistic and complex decision making, the risk management task provides a single malleable situation that is described as the participants' "current state." We hope to discern the influence of personal ownership or situated decision making on risk preferences.

Endowment and a sense of personal ownership. An avenue of research to consider when addressing the influence of personal ownership on risky decision making behavior is endowment (Kahneman, Knetsch, & Thaler, 1991). Endowment is a psychological phenomenon that deals with the propensity for individuals to overvalue outcomes after 'ownership' is transferred to the individual. When asked to attribute values to outcomes, decision makers assign a larger value to objects that they have been given than equivalent objects that they do not own. Furthermore, risk preferences formed about gambles with endowed outcomes have been shown to differ drastically from risk preferences formed about gambles without a manipulation of endowment (Kuhberger, 1998). A variety of investigations of framing effects have demonstrated that endowment may influence people's evaluations of gains and losses (Thaler, 1980), people's evaluation of losing owned items over gaining equivalent items (Tversky & Kahneman, 1991), and people's willingness to sustain losses in lieu of forgoing an equivalent gain (Johnson et al., 1993).

The risk management task provides instruction to participants that the provided gamble and its outcomes are already in their possession. Participants are then instructed that they are afforded an opportunity to improve the gamble. Endowment becomes an issue of importance when the first instruction is considered to provoke a sense of ownership over the *outcomes* within that given situation. An interpretation using endowment would then posit that the subsequent improvement is made to "*one of their outcomes*". By contrast, the risky choice task, which instructs participants to select one of two possible situations, would potentially not provoke the same sense of ownership over the outcomes within the decision environment, and would not hence involve issues dealing with endowment.

Alternative interpretations of personal ownership. Popular opinion among rational choice theorists contends that endowment is a bias inherent in human judgment (Horowitz & McConnell, 2002, for a review). This interpretation of endowment suggests that information about the owned nature of outcomes should be removed from manipulations of risky choice, as it is considered an extraneous variable when studying the larger behavioral processes involved in risky decision-making.

However, it seems plausible that endowment manipulations show unique effects because decision makers are being asked to evaluate a more personally meaningful situation. Almost all decisions made in the real world share encompass a situated and meaningful personal attachment. It therefore seems unacceptable to dismiss endowment as a bias of human judgment without first investigating decision environments which differ from the standard choice paradigm using tasks that represent real world situations where personal ownership over outcomes might be anticipated.

Situated gambles, while providing a sense of personal ownership, also put a gamble into the context of having a current and future state. This information may provide additional tacit information about the context of a decision. Research on reference points suggests that people's evaluations of objects are sensitive to the current and future states of those objects.

For example, McKenzie and Nelson (2003) found that people tended to describe a cup as "half full" if the cup was being filled and "half empty" if the cup was being emptied. Moreover, people were more apt to infer the previous state of "empty" or "full" based on the description of the current state. This suggests decision makers are sensitive to the historical information about outcomes when evaluating situated decisions.

In this study, information that stems from the situated nature of a decision in the risk management task may be influencing risky decision behavior. Tacit information about the gamble "as it is" may provide insight into the relationship between choice alternatives by providing information about the previous relative position of outcomes prior to eliciting a preference. The outcomes are not provided as a singular, current situation in the risky choice task context and, as a result, may not reflect the historical information about a decision that is present in the risk management task.

Manipulation of personal ownership. A new task is required to incorporate the ownership of a situation and its outcomes into a risky choice context. This task consists of a gamble with four outcomes in pairs similar to the risky choice task. Participants are afforded an opportunity to make a *modification* to the gamble by selecting which of the two pairs of outcomes they want to remain in the gamble before it would be played. This *risk modification task* characterizes the decision as choice within an owned situation with owned outcomes. This is done to evoke the personally relevant nature of the outcomes in a situated context. Participants will then exert control of the risk in their situation by modifying the outcome set by selecting a pair of the outcomes to “keep”. This is done to evoke a sense of manipulating an owned scenario. The pairs of outcomes that a decision maker can select to keep are the same as the two possible alternatives that will be presented in the risky choice task. This is done to make risks directly comparable across the manipulation of personal ownership.

The risk modification task is meant to represent the procedural behavior of selecting between alternatives exhibited during the risky choice task and other previous instantiations of the gambling paradigm by asking participants to actively select one of two possible probability/outcome pairs. However, the risk modification task also encourages the interpretation of outcomes as endowed by asking decision makers to change a single, personally-relevant situation. By establishing a personally-owned situation, the risk modification task may provide participants with an additional reference point with which to evaluate further choices. This would mean that risk preferences for the risk modification task would be different from the risky choice task.

Alternatively, when outcomes are owned, they are considered of a higher value than when they are passively presented. As a result, people may act more conservatively with outcomes that are given to them in a scenario rather than outcomes which are passively presented to them as available choice options. Hence we might expect that to the extent that personal ownership is responsible for the differences between the risky choice and risk management task, people should take fewer risks in the risk modification task.

The behavioral focus on improvement over selection. Not all risky decisions require individuals to make selections from sets of alternatives. Different kinds of decision environments may require people to manipulate risk and denote preferences in different ways. One alternative approach denotes risky decision behavior as actions or series' of actions occurring within a complex environment (Klein, 2008). Naturalistic decision making experiments often establish multiple goals or objectives for decision makers to accomplish within a content domain (Todd & Gigerenzer, 2007; Gonzalez et al., 2005; Keeney, 1988; 1996). Whereas the gambling paradigm involves a selection from a set of alternatives, task environments from this alternative approach require decision makers to improve their current situation through motivated action, as opposed to passive selection (Klein, 2008). Actions taken as a result of these motivations are purported to be a fundamentally different psychological process than deliberating between choice alternatives (Vera & Simon, 1993; Adams, Tenney, & Pew, 1995). Behavioral focus examines these task-induced motivations and their impact on risk preferences.

So, if behavioral focus were to influence risk preferences, then tasks which provide decisions as passive selection behavior would differ from tasks that require decision makers to improve their situation. There are several approaches to decision making that demonstrate potential reasons why behavioral focus may influence risk preferences. Each of these approaches will be discussed.

Adaptive decision making: heuristics and goal-directed behavior. The adaptive toolbox approach (Todd & Gigerenzer, 2001) identifies a series of heuristics which decision makers use to devise strategies for evaluating decisions. The presence of environmental cues is posited to be the determining factor in the formation of these heuristics for particular contexts. For example, people use satisficing strategies when making decisions in environments where it is difficult to return to previous observed experiences (Gigerenzer et al., 1996), whereas people use incremental or decremental strategies when making decisions about where to search in environments with limited resources (Todd & Gigerenzer, 2007).

Selection and improvement are two environmentally-determined decision characteristics. It may be the case that improvement-focused and selection-focused environments may constitute distinct environmental structures supposed by the adaptive toolbox approach to activate different heuristics. This would explain the differences between the risk management and risky choice tasks, as the decision strategy chosen for the task with an improvement focus would be qualitatively different from the decision strategy chosen for the task with a selection focus.

Naturalistic decision making and situation improvement. Task manipulations from the naturalistic decision making tradition are often thought to be limited by the difficulty in operationalizing theoretical constructs across different content domains (Todd & Gigerenzer, 2007). However, the thread that seems to narrate the behavioral aspects of these tasks is the goal to improve the current situation. Examples from naturalistic decision making have included fire-fighting (Brehmer, 1990; Brehmer & Dorner, 1993), aviation (Simpson, 2001), criminal trials (Pennington & Hastie, 1988), and medical diagnosis (Elstein et al., 1978). All of these content domains simulate a deficient situation (i.e., forest fire, airplane malfunction, unresolved trial, or unknown illness) that must be resolved via some intervention that ultimately makes an improvement.

Situated action research uses task structures that start participants within a complex environment and ask them to make a series of decisions to improve their situation. The added benefits of the approach from Schneider (2003) over situated action research is in type of behavior being measured; Schneider devised a way of constraining responses while simultaneously keeping the environment situated and focused on improvement, whereas situated action research employs free response and process tracing methodologies to understand what strategies people exhibit in different content domains.

Selection tasks do not maintain an act of improvement to a situation found in many real world contexts studied by naturalistic decision making. That is, a choice between alternatives does not ask decision makers to initiate some action to improve an ongoing active situation. Therefore selection tasks that examine risky decisions that are missing some element of improvement may be limited in their generalizability to those types of situations.

Dual process theory: two specific physiological mechanisms for making decisions. Dual process (Stanovich & West, 2000) is a class of theories used to describe a wide array of cognitive and neuropsychological findings. Dual process theory posits two separate cognitive and/or physiological mechanisms operating during the decision process; one is an intuitive feed-forward mental-modeling mechanism (system 1) while the other is deliberative mechanism that operates on decisions similarly as is presumed by mainstream risky choice research in economics (system 2) (Loewenstein et al., 2008). According to the theory, differential activation of these systems has been shown to yield differences in risk preferences (Stanovich and West, 2000).

It may be the case that selection as a behavioral focus may engage the dual process systems in a different way than when people are trying to make an improvement. Improvement tasks maintain a salience of motivational goals which is posited to apply in the context of the intuitive system (Evans, 2003). As a result, one might expect improvement tasks to engage the intuitive system to manage this motivation. Selection tasks, like the risky choice and risk modification task, would more appropriately be evaluated more using the deliberative mechanism because they are focused on differentiating economic alternatives, which is characteristic of system 2 processing (Evans, 2003).

However, the specific task-relevant characteristics that activate one system over another in dual process theory are still largely unknown. Because this study consists of two different kinds of task environments, it is reasonable to believe that differential activation of the dual systems may be a factor in the different behaviors found in the risky choice and risk management tasks.

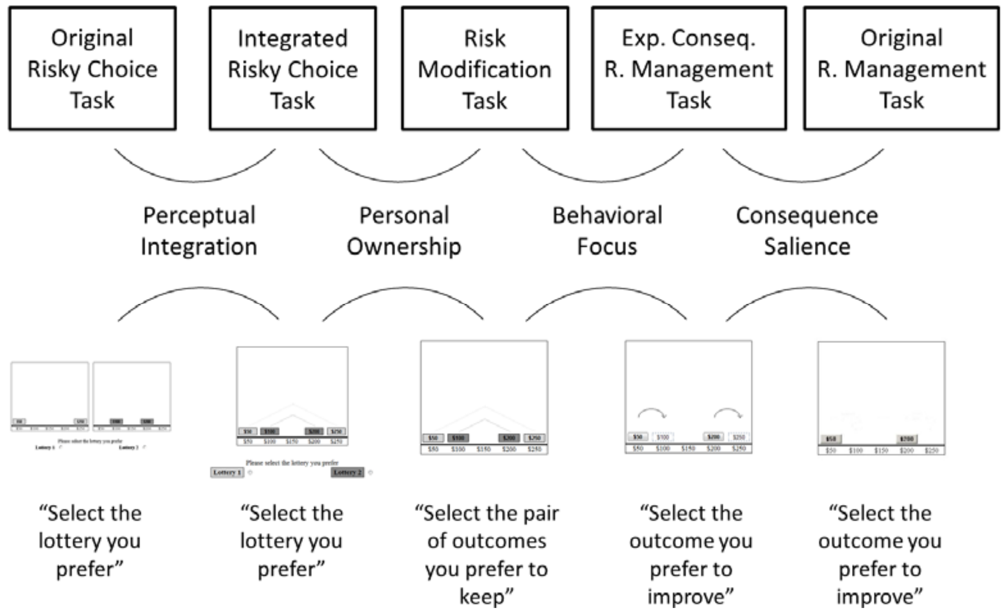
Manipulation of behavioral focus. For manipulating behavioral focus, we can compare the already-devised risk modification task (from the previous section) to the explicit consequence risk management task. The risk modification task incorporates a choice focus while preserving the integrated display and endowed aspects of the risk management task. The explicit consequences risk management task retains the same visible outcomes, but provides task instructions that describe the decision task as improving an existing situation.

Naturalistic decision making has suggested that people can establish different goals depending on the requirements of the decision environment (Keeney, 1988, 1996). Different behavioral foci would then presumably lead to developing different strategies for making decisions and thus different patterns of risk preferences. Also, Schneider (2006) also addressed the motivational aspects of improving versus selecting good and bad situations. A focus on improvement establishes a different motivation for what do to about a situation that is already considered good or bad. Improvement focus may activate motivational goals associated with making bad situations less hazardous and increasing the potential of good situations. As a result, differences in risk preferences as a function of valence are expected.

Summary and Hypotheses

The purpose of this dissertation is to explore four contextual elements that serve to illustrate ways that real-world decision environments may differ from one another. Similar to the technique used by Schneider and colleagues (2003, 2004, 2006), this study is comprised of a set of systematic task variations meant to incorporate aspects of real world contingencies while preserving tractability to allow comparisons with mainstream findings that have come to dominate both economic and psychological theories of risky decision making.

A summary table of the manipulations of situational context present in each task is provided in figure 6. The structure of the task manipulations fit together such that the classic risky choice task is incrementally transformed into the risk management task by adding contextual elements piece by piece to each new task. The differences in risk preferences between these tasks will be investigated, progressing one-by-one through manipulations of display integration, consequence salience, personal ownership, and behavioral focus.



Task Manipulation	Original Risky Choice Task	Integrated Risky Choice Task	Risk Modification	Explicit Consequence Risk Management Task	Original Risk Management Task
Display Integration	Separated	Integrated	Integrated	Integrated	Integrated
Consequence Salience	Explicit	Explicit	Explicit	Explicit	Implicit
Personal Ownership	Passive Choice	Passive Choice	Owned Situation	Owned Situation	Owned Situation
Behavioral Focus	Selection-focused	Selection-focused	Selection-focused	Improvement-focused	Improvement-focused

Figure 6. Each task broken down by its component aspects of situational context.

For display integration, information about alternatives were provided in either separate displays (one for each of two alternatives) or combined into a single display. We expected risk preferences for tasks with an integrated display to be different from the original risky choice task because of the additional contrasts available when information is integrated. In learning theory, information is suggested to be evaluated more easily for integrated displays. Therefore, people may change their preference patterns when using integrated displays because these task environments provide a simpler contrast between the available options. Differential contrast may also lead to an overall tendency to take fewer risks because integrated displays illustrate the shared characteristics of both gambles, including the risks shared by both options.

For consequence salience, information about potential outcomes is provided visually. We expect risk preferences for tasks with consequence information provided visually to be different from the original risk management task because of the reliance on information that can easily be extracted from a situation. Slovic (1972) suggests that decision makers are more apt to use information that is available, rather than information that must be intuited, calculated, and/or derived. As a result, the lack of consequences provided in the risk management task, while applicable in many real world situations, would change the pattern of risk preferences. The reliance on this information may also lead to an overall tendency to task more risks because one of the consequences being made salient is the largest possible value, which may increase the overall attractiveness of the riskier gamble over the safer gamble.

For personal ownership, the decision maker makes a contrast between options within a gamble that is given to them (and thus a part of their personal situation), rather than making a contrast between choice options which are outside the immediate personal involvement of the decision maker. We expect risk preferences for tasks with personally-owned situations to be different from the original risky choice task because of the impact of situated behavior on valuing outcomes in a decision environment. Research on endowment has demonstrated that people valuate personally-owned outcomes differently from non-owned outcomes (Tversky & Kahneman, 1991). Valuing outcomes differently for endowed gambles may change the way risks are calculated in different contexts, resulting in different patterns of risk preferences for endowed and non-endowed decision scenarios. It is unclear exactly how the valuation of personally owned outcomes might influence the calculation of risk; however, endowed outcomes are suggested to have a larger subjective value (Kahneman, Knetsch, & Thaler, 1991). This suggests people may be more attached to personally-owned situations and therefore less willing to take risks, yielding an increase in risk aversion for gambles with personally owned outcomes.

For behavioral focus, the decision maker is asked to indicate their preference by one of two processes; either via choosing between two possible alternative options or via improving a single situation by increasing or decreasing risk. Different behavioral foci may operate using separate motivational processes; choice involves a contrast between separate and distinct options, whereas improvement involves making a situation better through guided action.

Because behavioral foci may involve different motivational goals, risk preference behavior may exhibit different patterns. For the vast majority of studies on risky choice, the prevailing pattern of risk preferences is largely consistent with prospect theory (Kahneman & Tversky, 1979), which suggests a pattern of risk seeking for losses and risk aversion for gains. We expect to replicate this pattern.

In a risk management context, Schneider (2003) predicted that improving a good or bad situation would yield a more intuitive pattern of risk preferences, wherein people would be wary of taking risks when in a dangerous situation and would only be willing to consider risks when in a safe situation. This means we might expect risk aversion throughout, and only occasional risk seeking behavior in the gain domain for improvement-focused tasks.

To better characterize the influence of situational context on risk preferences, we will include systematic manipulations of gamble characteristics, including valence and variance. Previous investigations of valence suggest that people have different risk preferences for gambles with positive outcomes and negative outcomes. More specifically, prospect theory suggests that people more often exhibit risk-seeking behavior for losses and risk-averse behavior for gains (Kahneman and Tversky, 1979). However, further analyses with expanded sets of lotteries have demonstrated that lotteries with a zero outcome are treated differently, and that patterns across positive and negative are not as clear as previously thought (Hershey and Shoemaker, 1985). We expect to replicate the pattern roughly consistent with prospect theory for the risky choice task, but we predict that preferences will become farther and farther from that predicted pattern as the context moves away from the standard gambling paradigm.

Variance serves to manipulate growing uncertainty in achieving an expectation. Savage (1967) suggested that when given a choice between a gamble and a sure thing, people will avoid the sure thing (and thus are willing to choose a risky option), but that when people are given a choice between two gambles, they tend to choose the less risky gamble. This can be illustrated by people's willingness to buy lottery tickets (instead of saving that money) coupled with their desire to make safer financial investments. We predict that situations where sure-thing options are compared with gambles will result in more risk seeking than situations where two gambles are being compared. There may also be some task-related differences as a function of variance because some of the tasks elucidate the shared variance between gambles better than others. For example, when gambles are integrated onto the same number line, the relationship between those gambles is more readily apparent. The risky choice task does a poor job of illustrating shared variance, and so differences as a function of variance between the risky choice task and the other four integrated task manipulations is expected.

Because the body of research on risky choice research is already vast, investigations of risky choice have commonly focused on the gambling paradigm. Although alternative approaches to studying risky decision making behavior exist in the field of naturalistic and adaptive decision making, they are not easily relatable to the methodologies common in risky choice. In the present experiment, we try to bring these two aims together by investigating differences in risk preferences due to commonly ignored but potentially important aspects of situational context using systematic variations of the gambling paradigm.

Method

Participants

Two hundred and eighty seven undergraduate students participated in the experiment in exchange for extra credit towards a psychology course. Experimental sessions were conducted in groups of 4-12 participants. To ensure that respondents adequately understood how to interpret the probabilistic stimuli, eighty participants were excluded from the analysis for failing an eight-question quiz, leaving data from a total of 207 participants divided roughly evenly across five tasks. Participants who failed the quiz were excluded because of potential biases or increased variability in risk preference behavior resulting from a lack of complete understanding of the task rules. However, to determine if these results generalize to a broader population, a robustness analysis is provided to ensure that the general patterns of risk preferences for these participants did not differ substantially from participants who passed the quiz.

Stimuli and Materials

Gamble Pairs. Stimuli consisted of 54 gamble pairs. The gambles within each pair had the same expected value and each gamble consisted of two equiprobable monetary outcomes. One of the two gambles was riskier because its outcomes were (symmetrically) farther apart from the mean. The set of gamble pairs were structured according to a factorial manipulation of valence (3), variance (3), and expected value (6).

Valence represents whether a gamble pair had all positive, all negative, or mixed (some positive and some negative) outcomes. Instances of zero-valued outcomes also appeared for some gambles in all valence conditions.

Variance was manipulated by increasing the spread of the outcomes by a fixed amount for both gambles in a pair. In the low variance condition, the lower risk option was a sure-thing (100% probability; 0 spread) whereas the higher risk option had outcomes that differed from the expectation by ±$50. In the moderate variance condition, low risk option outcomes differed from expectation by ±$25 and high risk outcomes differed from expectation by ±$75. In the higher variance condition, outcomes differed from one another by deviations of ±$50 or ±$100.

Expected values were manipulated by six $25 increments for each valence. Expected values varied between $75 and $200 for the positive valence, -$75 and -$200 for the negative valence, and between -$50 and $50 for the mixed valence (with dual presentation of $0 expected value).

Task Manipulations. Five tasks were included in the study to systematically manipulate differences in situational context. These are summarized in Table 1. Two of the conditions were replications of the original risky choice and risk management manipulations of Schneider (2003), while the other three were systematic manipulations of these two tasks. The first two manipulations are largely perceptual: the display integration manipulation compares an integrated display to the separated display of the original risky choice task with all else equal; the consequence salience manipulation adds explicit consequences to the original risk management task with all else equal. The final variation is an amalgam of characteristics from both of the original tasks to serve as a manipulation of personal ownership when compared to the integrated display variation of the risky choice task and behavioral focus when compared to the consequence salience variation of the risk management task.

Original risky choice task. Following Schneider (2003), the risky choice task elicited choice between pairs of two-outcome gambles. Each gamble was presented in a separate display on the left and right of a single computer screen. The proposed replication of the risky choice task was altered slightly to include similar visual cues found in the updated computer version; in particular, each of the two gambles had outcomes of a unique color (either light gray or dark gray). An example of this task is presented in figure 7a.

Integrated risky choice task. This task is a variation of the original risky choice task which presents a choice between two gambles in a single display instead of separate displays. An example of this task is presented in figure 7b. Each gamble was represented by a pairs of tickets in a single display with different colors for each gamble (one light gray pair, one dark gray pair).

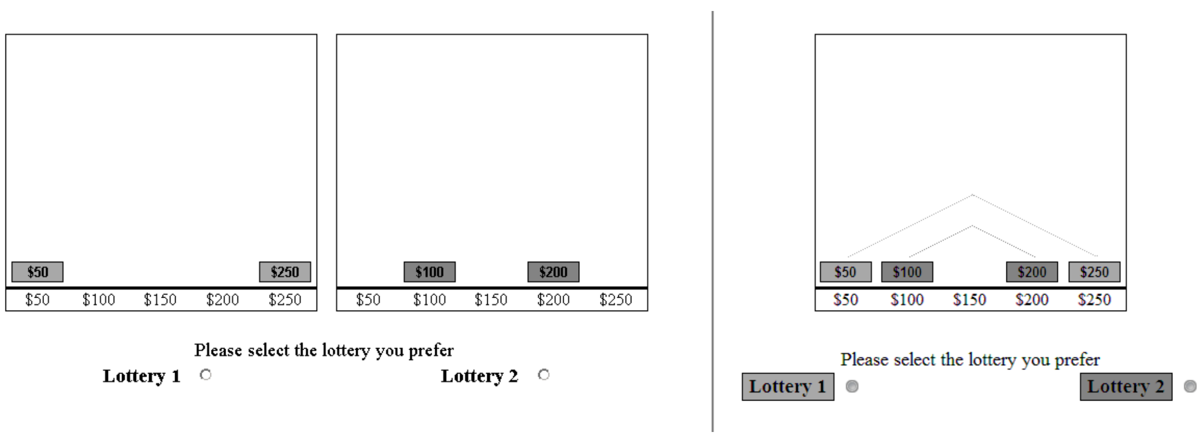


Figure 7. The image on the left (7a) portrays the original risky choice task, while the image on the right (7b) portrays the integrated risky choice task. For the integrated risky choice task, a gamble is still selected using radial buttons at the bottom, however, the different gambles appear on the same number line and in the same display.

Original risk management task. Following Schneider (2003), the risk management task elicits an improvement of one outcome from a single two-outcome gamble scenario. An example of this task is presented in figure 8a. The two possible-resulting gambles after an improvement correspond to the two gambles presented in the choice tasks.

Figure 8. The image on the left (8a) portrays the original risk management task, while the image on the right (8b) portrays explicit-consequence risk management task. For the explicit-consequence risk management task, information about the consequence of each improvement is provided as a visual cue.

Explicit consequences risk management task. This task is a variation of the original risk management task that provides visual cues about the consequences of each improvement. The outcome that each ticket can be improved to yield was provided as a ticket outlined with hyphens. An example of this task is shown in figure 8b.

Risk modification task. This is an intermediate task between the integrated risky choice task and explicit consequence risk management task used to address two elements of situational context simultaneously. Comparing the risk modification and integrated risky choice tasks serves as a manipulation of personal ownership while comparing the risk modification and explicit consequence risk management tasks serves as a manipulation of behavioral focus. Two pairs of tickets (one light gray pair, one dark gray pair) are combined into a single four-outcome gamble scenario. An example is shown in figure 9. For each four-outcome gamble, risk preferences were elicited by selecting of one pairs of tickets to keep, while the other pair of tickets is removed. These two pairs of tickets correspond to the gambles from the risky choice task and the two possible gambles after an improvement in the risk management task.

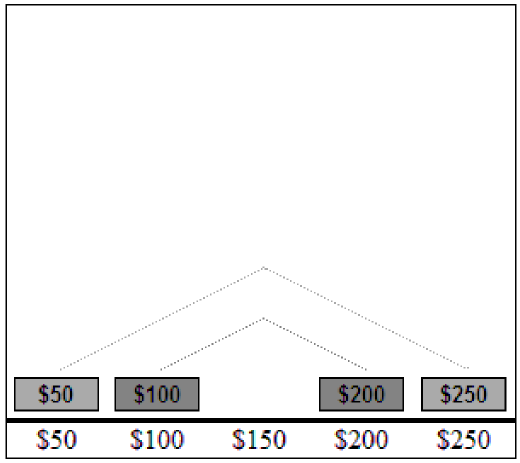


Figure 9. Example from the risk modification task. Participants start with all four tickets described as one gamble. By clicking on an outcome, the pair of outcomes of a similar color would remain, while the outcomes of the alternate color would be removed from the gamble. Electing to keep the pair of outcomes with less variance (shown in dark gray) indicates risk aversion while electing to keep the pair of outcomes with greater variance (shown in light gray) indicates risk seeking.

Design

The experimental design was a 5 x 3 x 3 mixed factorial design. Each participant saw a series of 54 gamble pairs represented in one of the five possible tasks. As described previously, three levels of valence and three levels of variance were manipulated within the series of gamble pairs. The dependent variable was the chosen number of riskier gambles out of five within each valence x variance condition.[1] Four partially counterbalanced orders were used for the series of 54 gamble pairs to control for potential order effects. To control for the potential effects of time of day and task sequencing

[1] Data were collected for 6 levels of expected value. However, one expected value was removed from the positive and negative valences to remove instances of zero-valued outcomes, and one expected value was removed from the mixed valence to remove the second (duplicate) presentation of the zero expected value pair. Hence, the dependent variable for each condition is the number of riskier gambles selected out of a possible 5 gambles systematically varying in expected values in increments of $25 for an overall range of $100.

effects, each of the five task conditions were run exactly once each day for ten days. The task orders were determined using a pair of 5x5 Latin squares balanced to make sure each task was preceded and followed by every other task exactly twice. These procedures were done to balance for order and other nuisance variables in order to increase the likelihood that the groups were equivalent. The colors of the tickets in the gambles for the original risky choice, integrated risky choice, and risk modification tasks were also switched halfway through the data collection process as a counterbalancing measure to control for the possible influence of color perception/preference on behavior.

Procedure

Laboratory sessions lasted approximately 45 minutes and involved oral instructions on how to complete the computerized task, the eight-question quiz to judge an understanding of basic gamble characteristics, the series of 54 trials in one of four orders, and four open-ended questions about individual's strategies for making decisions. The assigned task was explained during these instructions. As instructions were read to the participants, four practice examples of gambles were completed by participants along with the proctor. Participants then completed an eight-question quiz designed to test their understanding of the basic distributional elements of gambles represented as tickets on a number line [see attached quiz]. Participants were then presented with the series of 54 gamble pairs about which they made a decision. The risk preferences for each gamble pair was recorded by the computer, along with the amount of time in seconds used to evaluate the decision before making a choice. Finally, participants responded to four open-ended questions about their strategy for making decisions.

Empirical Results

The analysis explores the influence of display integration, consequence salience, personal ownership, and behavioral focus on risky decision making behavior. First, manipulation checks were conducted to verify that the control manipulations were successful. Next, an overall analysis of task-related differences is provided. A set of sub-analyses are then used to test the predictions of each aspect of situational context made previously. These sub-analyses allow us to investigate the individual influence of each contextual element on risk preferences, with particular emphasis on interactions between situational context, valence, and variance.

Finally, an analysis of individual differences is used to further our understanding of how different tasks may encourage different individuals to respond in different ways. Each participant's responses are compared to a variety of strategy predictions made using various theoretical approaches to risky decision behavior. These individual analyses allow us to see if different tasks encourage the selection of strategies consistent with one or more of these predicted strategies.

Manipulation Checks

A series of manipulation checks were performed to verify that the control manipulations were successful. First, ease of processing information in the task displays was inferred by looking at the amount of time people used when evaluating a decision across the five task manipulations. Next, participants' likelihood to pass the quiz was investigated to see if it was unduly influenced by the type of task being completed.

Finally, an omnibus analysis was run including passing/failing the quiz as an independent analysis to verify that there were no systematic differences in risk preferences due to an incomplete understanding of the task requirements.

The amount of time necessary to evaluate a decision was investigated to infer whether any of the task environments were easier to evaluate. If the integration of information into a simpler display makes information easier to process, there should be differences in the amount of time necessary to evaluate a decision. A decrease in the amount of effort was expected for integrated displays, as predicted by cognitive load theory (Chandler & Sweller, 1992).

A one-way ANOVA was performed to assess the average amount of time needed to evaluate decisions as a function of the five tasks. There was a significant main effect of task on decision time, $F(4,202) = 236.61$, $p < .001$. The main effect was clearly driven by the differences between the original risky choice task, which had separate displays, (M = 8.8 seconds) and the other four tasks, which had integrated displays (with M ranging from 2.0 seconds to 2.3 seconds). This confirms our suspicions that integrated displays take less time to evaluate than separate displays, and may therefore require less effort.

To ensure that there was no undue influence of task type on the participants' ability to pass the quiz, the ratios of participants failing the quiz were compared across the five tasks. To assess whether there were differential fail rates for different tasks, the two tasks with the largest disparity in pass/fail percentage were compared using a 2 x 2 chi-square test of independence. The integrated risky choice task had the highest fail rate (43 passing, 20 failing) while the risk modification task had the lowest fail rate (41 passing, 12 failing). The fail rates for these two tasks were not significantly different, $\chi^2(1, N = 116) = 1.19$, $p = .27$. As these two tasks had the greatest disparity, and sample sizes were relatively consistent across tasks, all differences in fail rates were not significant.

To assess whether participants who failed the quiz had different risk preference behavior than participants who passed, a 5 x 2 x 3 x 3 Task x Quiz x Valence x Variance Mixed ANOVA was performed. There was no significant main effect of passing/failing the quiz, $F < 1$. None of the interactions were significant; all F's < 1 (or all p's > largest test value).

Both quiz-related control manipulations indicated that there were no differences in either ratio of participants who failed as a function of task, nor was there a strong impact on risk preferences as a function of having failed the quiz. Nevertheless, to remove any potential biases or noise due to inadequate knowledge of the task requirements, participants who failed the quiz were excluded from all subsequent analyses..

Overall Analysis of Task-related Differences

A 5 x 3 x 3 Task x Valence x Variance Mixed ANOVA was performed to assess influences on risk preferences, operationalized as the number of riskier gambles selected across five trials representing similar expected values.

As expected, there was a main effect of task, $F(4,202) = 3.89$, $p < .01$. Participants in the original risky choice task ($M = 2.43$, $SE = 1.67$) took more risks overall than participants in the original risk management task ($M = 1.48$, $SE = 0.17$) and the other three tasks fell somewhere in-between. This is consistent with expectations and the overall pattern observed in previous studies (Schneider, 2003).

There was also a main effect of valence, $F(2,404) = 21.27$, $p < .01$, however it may perhaps come as a surprise that risk preferences for gambles with positive outcomes

($M = 2.18$, $SE = 0.11$) were similar overall to risk preferences for gambles with negative outcomes, ($M = 2.10$, $SE = .07$). In contrast, people were more risk averse overall for mixed valence gambles ($M = 1.56$, $SE = 0.11$) than either positive or negative gambles, which is likely responsible for this effect.

The main effect of variance was also significant, $F(2,404) = 31.78$, $p < .01$. As expected, people took more risks in gamble pairs with a sure thing option ($M = 2.21$, $SE = 0.08$) than gamble pairs where both options had less predictable outcomes ($M = 1.84$, $SE = 0.08$ & $M = 1.79$ $SE = 0.08$ respectively).

As expected, there was a significant interaction of valence and task type, $F(8,404) = 7.71$, $p < .01$, the results of which are displayed in figure 10. First, the pattern of preferences for the original risky choice task is roughly consistent with the predictions of prospect theory. When investigating the simple effect of valence for the risky choice task, participants are significantly more risk seeking for negative valence gambles than for positive and mixed valence gambles, $F(2,42) = 13.78$, $p < .01$. Additionally, the pattern of preferences for the original risk management task is consistent with prior evidence. When investigating the simple effect of valence for the risk management task, participants are significantly more risk seeking for positive valence gambles than for negative and mixed valence gambles, $F(2,39) = 6.38$, $p < .01$.

The simple effects of valence for the three intermediate task manipulations maintain one of these two possible patterns. The integrated risky choice and risk modification tasks share a similar pattern across valence as the original risky choice task; $F(2,42) = 8.92$, $p < .01$ and $F(2,40) = 13.26$, $p < .01$ respectively. The explicit consequence risk management task shares a similar pattern across valence as the original risk management task, $F(2,39) = 20.42$, $p < .01$.

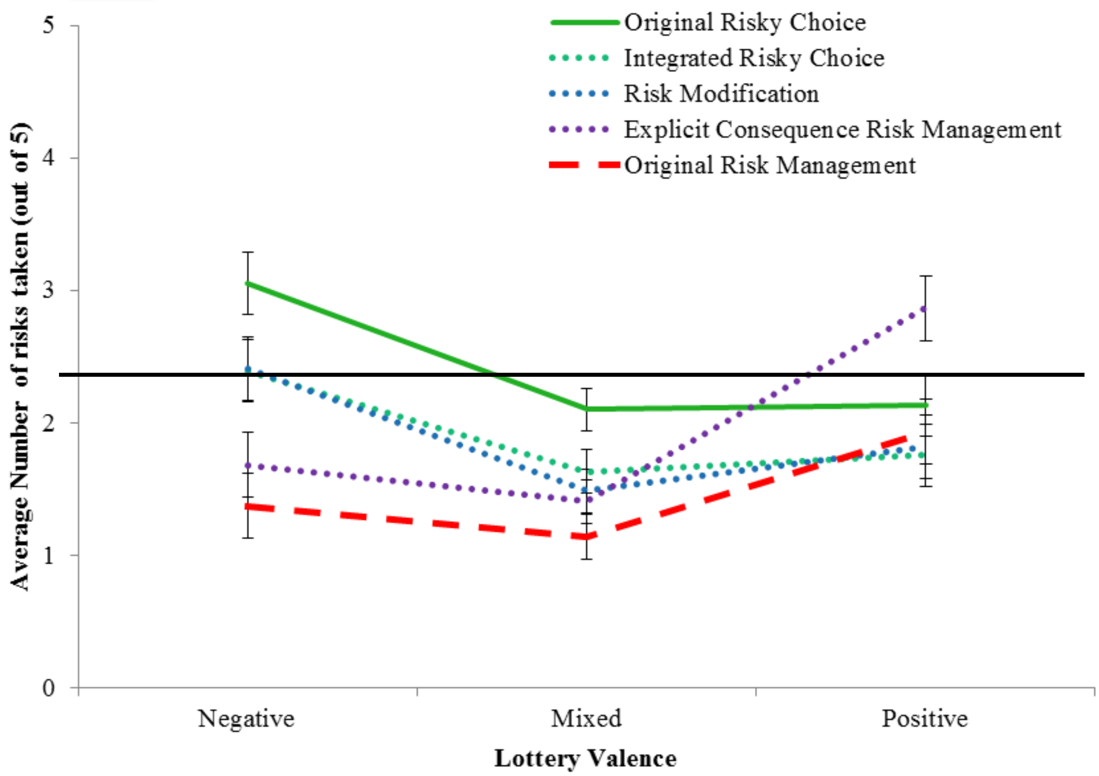


Figure 10. Risk preferences as a function of Task Type x Valence. Error bars are standard error.

There was a significant interaction of variance and task type, $F(8,404) = 2.98$, $p < .01$. The graph in figure 11 demonstrates that the previously discussed pattern of risk seeking for low variance gambles and risk aversion for moderate and higher variance gambles is more prominent for the original risk management task, with the other four tasks showing very little change in behavior as a function of variance.

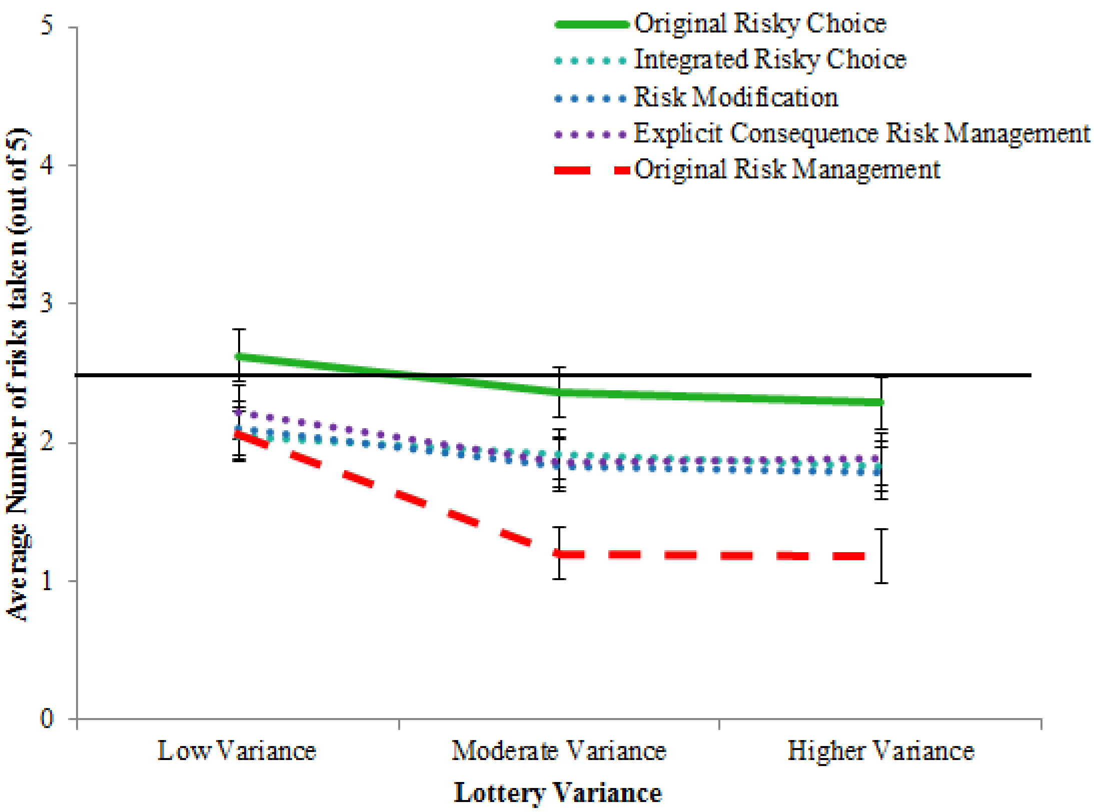


Figure 11. Risk Preferences as a Function of Task Type x Variance. Error bars are standard error.

There was also a significant interaction of valence and variance, $F(4,808) = 11.92$, $p < .01$. Participants tended to be more risk seeking for low variance gambles and more risk averse for moderate and higher variance gambles, but this pattern is more pronounced for negative and mixed valence gambles than for positive valence gambles. The pattern was especially pronounced for the original risk management condition.

Additionally, the three-way Valence x Variance x Task interaction was significant, $F(16,808) = 1.8$, $p < .05$. In the low variance conditions, the pattern of risk preferences for the original and explicit consequences risk management tasks are more risk seeking than the other three tasks for the positive valence but more risk averse for the negative and mixed valence conditions. However, in the moderate and higher variance conditions, only the explicit consequence risk management task is more risk seeking than the other (now four) tasks for the positive valence gambles. This suggests that some of the differences in valence normally found in the risk management task occur primarily for lower variance gambles, while the presence of consequence information enhances risk seeking for positive valence gambles throughout. The three choice tasks (original risky choice, integrated risky choice, and risk modification) all have relatively stable patterns of risk preferences across valences and variances.

Separate Analyses of Contextual Differences

To measure the influence of individual contextual manipulations, effect coding was used to conduct follow-up regression analyses. The relationship between tasks and their corresponding effect code is available in figure 6. Even though these individual analyses are admittedly additional tests and are a non-orthogonal set of planned comparisons, we did not adjust familywise alpha as this work is exploratory. Although there is a higher likelihood of making one or more type 1 errors, we were more concerned that we not miss potential effects. Nevertheless, this decision reinforces the need to demonstrate the reliability of our findings through replication.

Display Integration. The difference in the pattern of risk preferences from the original risky choice task and the other four tasks in combination served to demonstrate the size and direction of the influence of integrating the displays. Results from the effect-coded analysis for display integration showed a main effect, $F(1,202) = 4.43$, $p = .04$. As was expected, participants were more risk seeking for the original risky choice task (M = 2.2), where options were presented in separate displays, than the combination of the other four tasks (M = 1.71), which all used integrated displays. No other interactions with display integration approached significance.

These results suggest that risk preferences are influenced by the type of contrast provided in a decision. Combined with the manipulation check looking at decision times, these results suggest that simpler contrasts between choice alternatives are easier to process and may yield an overall increase in risk aversion. .

Consequence salience. The difference in the pattern of risk preferences between the original risk management task and the other four tasks served to demonstrate the influence of providing consequence information visually. Results from the effect-coded analysis for consequence salience showed a main effect, $F(1, 202) = 4.23$, $p = .04$. As expected, we found an overall tendency to take more risks when consequence information is visually provided ($M = 2.21$ across four tasks) compared to the original risk management task ($M = 1.7$).

There was also a significant interaction of consequence salience and variance, $F(1.76, 256.07) = 5.39$, $p = .007$[2]. This interaction can be observed in figure 11 above. Participants in the original risk management task were more risk averse for moderate and higher variance gambles, whereas the other four tasks did not have noticeably different risk preferences as a function of variance. No other interactions that included consequence salience were significant.

These results suggest that risk preferences are influenced by the presence of visual cues that convey explicit consequence information. The presence of these visual cues seems to increase the overall tendency to take risks. This may be due to an increase in the attractiveness of the riskier gamble now that the best possible outcome is visible (and always belongs to the riskier gamble).

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[2] Greenhouse-Geisser correction was used to account for potential heterogeneity of variance given a significant Mauchly's Test of Sphericity.

Personal Ownership. Personal ownership serves to differentiate tasks with two potential gambles not belonging to the decision maker from tasks with a single gamble that is described as being owned by the decision maker. The risk modification, explicit consequence risk management, and original risk management tasks all fall under the single owned gamble case, while the original and integrated risky choice tasks both fall under the two gamble choice case.

We expected to see different patterns of risk preferences for tasks with a single owned gamble versus tasks with two non-owned gambles. Results from the effect-coded analysis for personal ownership did not show a main effect on risk preferences, $F(1, 202) = 0.009$, $p = .925$. Additionally, no interactions involving personal ownership approached significance (all $p > 0.7$). These results suggest the manipulation of personal ownership did not affect risk preferences.

Behavioral Focus. Behavioral focus serves to differentiate tasks which require a choice between options from tasks which require an improvement of a given situation. The risk modification, original risky choice, and integrated risky choice tasks are all choice-focused, while the original and explicit consequence risk management tasks are both improvement-focused.

Different patterns of risk preferences were expected for the different behavioral foci. Specifically, choice-focused tasks were expected to look similar to the predictions of prospect theory (Kahneman and Tversky, 1979), while improvement-focused tasks were expected to yield a predominance of risk aversion, with a tendency to take more risks only when gambles are positive. Results from the effect-coded analysis for behavioral focus showed no main effect, $F(1, 202) = .104$, $p = .75$. However, there was a significant interaction of behavioral focus and valence, $F(1.61, 325.72) = 14.37$, $p < .001$.

The pattern of results is shown in figure 12. The pattern of risk preferences for choice-focused tasks conforms roughly to the predictions of Prospect Theory (Kahneman & Tversky, 1979), namely an increased tendency towards risk seeking for negative valence gambles and risk aversion for positive valence gambles. However, the patterns of risk preference for improvement-focused tasks are the opposite, with risk aversion for the negative valence and a tendency toward risk seeking for the positive valence. Notice that risk seeking tendencies are weak at best across all conditions. Preferences for mixed lotteries are nearly identical for the two behavioral foci.

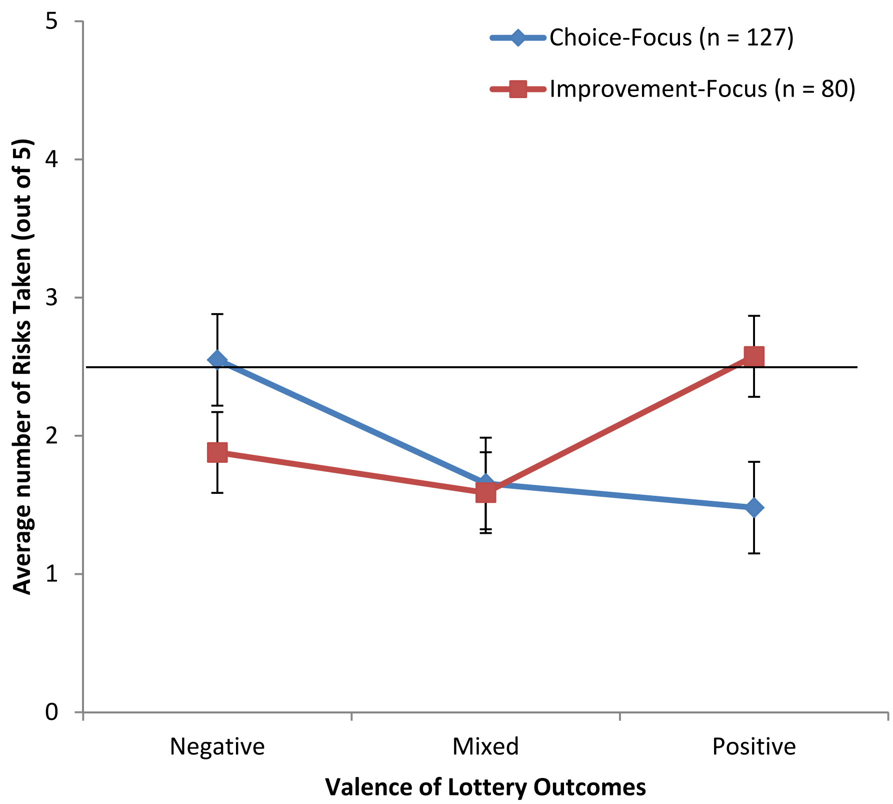

Figure 12. Risk Preferences as a Function of Behavioral Focus and Valence. Error bars are standard error.

In sum, the sub-analyses suggest that (a) display integration reduces risk taking and, as observed previously, also reduces the amount of time used to evaluate options; (b) consequence salience increases risk taking on its own and interacts with variance; (c) personal ownership does not seem to influence risk preferences at all; and (d) behavioral focus influences the overall pattern of risk preferences as a function of valence.

Individual Differences Analyses

The purpose of the individual differences analysis is to understand human behavior at the level of the decision maker, not simply looking for patterns across averages. So, to better understand each individual's behavior, we compared individual responses with the predictions from a number of generally recognized 'strategies' that participants might use to form their preferences. If there are different strategies being selected for different tasks, then the contextual elements that separate those tasks are presumably contributing to strategy selection. First we will outline the strategies we used to predict individual behavior. Then we will show the predictive capacity of these strategies within each task.

Types of Strategies. Three commonly recognized strategies were the focus of this analysis. Two first two strategies result from a contrast in predictions as a function of valence. The prospect theory strategy predicts behavior according to the prospect theory value function, whereby decision makers are risk seeking for negative valence gambles and risk averse for positive and mixed valence gambles (Kahneman & Tversky, 1979). The risk-as-threat strategy predicts a pattern generally consistent with the security/potential component of SP/A theory (Lopes & Oden, 1999), whereby people avoid risks when facing negative or threatening situations, but become more apt to take risks in situations as they move into safer territory and can garner more positive opportunities. For the risk-as-threat strategy, zero outcomes are treated as a contrasting value, so that zero seems positive when among only negative outcomes and is treated as negative when among only positive outcomes.

Finally, one strategy is sensitive to the variance in gamble pairs. The modest variance strategy predicts that individuals will be more apt to take risks when facing a low variance gamble and avoid risks when facing a moderate or higher variance gamble. This pattern is consistent with the predictions made by Savage (1967) and our overall analysis.

Strategy Prediction Analysis. Binomial z was used to identify risk preference strategies that best predicted individual behavior on significantly more than half of the 54 trials. Strategies needed to predict at least 35 trials to be considered predictive of actual behavior, otherwise no strategy was indicated. If more than one strategy reached this threshold, the one that could account for the most selections was deemed the best predictor. The number of people best predicted by each strategy for each task is provided in Figure 13.

	Original Risky Choice	Integrated Risky Choice	Risk Modification	Explicit-Consequence Risk Management	Original Risk Management
PT	18	15	16	2	6
RAT	6	11	12	21	21
MV	3	4	1	3	11
ns	16	13	12	14	2

Figure 13. Number of participants best predicted by each of three strategies for each task.

The strategy prediction results coincide with the omnibus analysis and demonstrate that behavioral focus has the prevailing influence over which strategy is selected. For the original risky choice, integrated risky choice, risk modification tasks, more people are behaving in a manner consistent with the prospect theory strategy or a basic risk strategy. For the original and explicit consequence risk management tasks, more people are behaving in a manner consistent with the risk-as-threat strategy. Additionally, the differences between the original and explicit consequence risk management tasks are an increased prevalence of the modest variance strategy in the original risk management task. Also, the lack of non-significant predictions for the original risk management task may be due to the prevalence of modest variance strategies. The absence of consequence salience may encourage people to use a strategy that operates using variance.

Summary of Results

The primary findings is that behavioral focus has the strongest impact on risk preferences; choice-focused tasks are more risk seeking for negative gambles than positive gambles while improvement focused tasks are more risk seeking for positive gambles than negative gambles. The effects of behavioral focus were also confirmed through individual strategy prediction. There were also effects of display integration and consequence salience on risk preferences, whereby preferences shifted to be more risk averse in conditions where participants were (a) given an integrated display and (b) not given explicit consequence information, especially for moderate and higher variance gambles.

Discussion

The goal of this dissertation was to understand how several elements of situational context might influence risky decision making behavior. This evolved from the motivation to understand what aspects of a situation might be responsible for the differences in risk preferences between the risky choice and risk management tasks from Schneider (2003). Four distinct elements of situational context were identified and manipulated using the gambling paradigm.

Figure 14 summarizes the Task x Valence relationship between these four contextual aspects. Behavioral focus had the greatest influence on risk preferences. For choice-focused tasks, risk preferences were consistent with the prospect theory value function (risk aversion for gains and risk seeking for losses). For improvement-focused tasks, risk preferences were consistent with the risk-as-threat pattern (risk seeking for gains and risk aversion for losses).

Both display integration and consequence salience were also responsible for preference differences between the risky choice and risk management task. When gambles are combined in an integrating display, people on average take fewer risks. In contrast, when consequence information is more salient, people tend to take more risks. Personal ownership did not seem to have any effect on risk preferences.

We have identified 3 potentially important influences on risky decision making behavior using features of decisions not well represented by the classic gambling paradigm. By incorporating systematic variations in the gambling paradigm, these results take us beyond the standard paradigm while at the same time providing a means to relate our findings directly to existing research in risky choice. To communicate how these results fit into existing theory, a brief summary of the implications of results for each element of situational context will be provided, followed by an analysis of the predictive capacity of models such as cumulative prospect theory and security potential/aspiration (SP/A) theory. Finally, the future directions of this approach to studying risky decisions using situational context will be discussed.

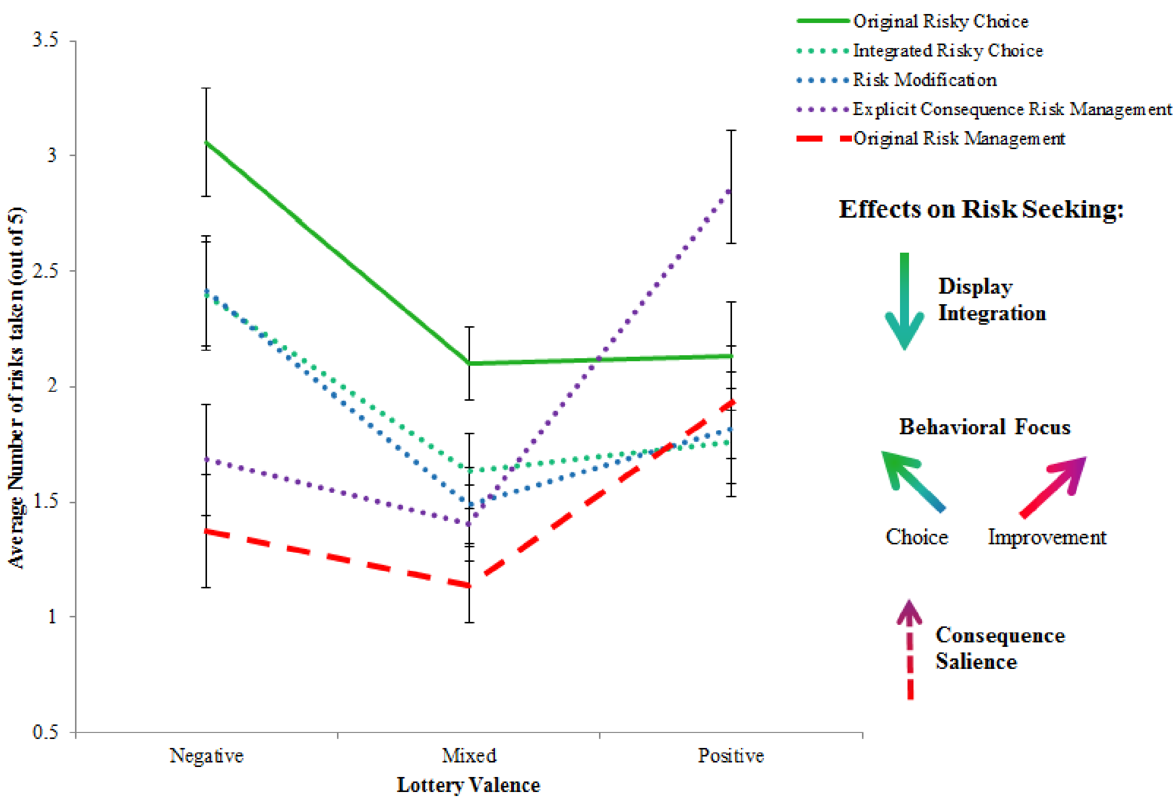

Figure 14. Task x Valence results and the effects of elements of situational context on willingness to take risks.

Behavioral Focus and Current versus Future States

A pattern of results consistent with the prospect theory value function was confirmed for selection tasks up to and including risk modification, but the opposite pattern with respect to positive and negative outcomes was found for improvement-focused tasks. The gambling paradigm represents all decisions as choices, and as was pointed out in the introduction, there are other domains where decisions may be better represented as an improvement of a situation (Gigerenzer, 2007; Gonzalez et al., 2005; Keeney, 1988; 1996).

Because there has been little crossover between these two behavioral foci, the field of decision making currently lacks an established interpretation of why decisions represented as choices differ from decisions represented as improvements. One possible explanation is that improvement environments provide a single, simple assessment of what to expect, whereas choice environments require more information to be combined before a total assessment of the situation can be made. The influence of expectations about a decision on behavior has been referred to as aspirations (Siegel, 1955; Payne et al., 1980), The risk-as-threat strategy presents an interpretation of what might happen when evaluating a decision using aspirations; when people perceive themselves to be in a threatening or negative space, they avoid adding additional risk, whereas when people perceive themselves to be in a positive or potentially lucrative space, may add risk to maximize their potential gains. This would not occur in the risky choice task because there is no easy way to discern how the available choice alternatives relate to one another. A more easily discernible assessment of one's situation for improvement-focused tasks might strengthen the influence of aspirations on risky decision behavior, thus making risk preferences appear similar to the risk-as-threat strategy.

An alternative interpretation of the differences between improvement and choice situations is that the act of making an improvement instantiates a positive trajectory of the situation necessarily getting better, whereas choice situations contain no such trajectory or information about past states. People in the improvement task may get the sense that they are moving through time in a decision, whereas the choice task has no such information about the past and so no sense of a timeline exists. This is akin to moving forward along a simple one-directional Markov decision process (Markov, 1971), where improvement-focused tasks provide additional information about the previous state of a decision that choice-focused tasks do not provide. It is not yet clear exactly how this trajectory might then influence risk preferences; trajectories could potentially change how people value outcomes, what kinds of goals or aspirations people set, etc.

Consequence Salience and Inferences

Exact visual representations of consequences are common in the gambling paradigm. However, in many instances people may lack explicit information about the consequences of their intended behavior. Instead, people make and use predictions or inferences about future consequences. The risk management task provides a consistent rule for how to infer the value of future consequences without providing exact visual information. Because we found decreased risk seeking behavior for implicit presentations of consequence information, decision processes must somehow be affected by gaining consequence information explicitly.

The gambling paradigm nearly always provides complete information, so there is little research which can specifically address the effects of consequence salience. One possible interpretation is that when exact information is present, people may maintain more confidence in their decisions. Confidence has been shown to correlate with increased risk taking behavior (Darke & Freedman, 1997). Increased risk taking for explicit consequence information suggests that the gambling paradigm might be overestimating the amount of risk taking behavior that occurs in risky decision making more generally.

Display Integration and an Effort-versus-Preference Distinction

There are two distinguishing characteristics of display integration; (a) slightly more risk seeking for separated than integrated displays and (b) substantially more time required to make a decision for separated than integrated displays. Taken together, these results suggest that while information in the integrated display is easier to understand and process, risk preferences are only mildly affected by the added benefits that come from the greater ease of processing.

Slightly more risk seeking for separated displays than integrated displays demonstrates a potential effect of format presentation on risk preferences. As hypothesized earlier, it may be that separated displays encourage an alternative-based strategy and tasks with integrated displays encourage an attribute-based strategy. The results suggest a need to further explore whether attribute-based representations are more likely in situations similar to risk management, and whether attribute-based representations encourage more risk averse tendencies.

As a dependent variable, time was intended as a rough estimate of evaluative effort. Our results cast doubt on claims that differences in effort should have corresponding differences in risk preferences because we found a large difference in processing time with small differences in risk preferences, as well as small differences in processing time with large differences in risk preferences. Time differences may persist when information can be evaluated more easily, but it is unclear precisely why the ease of information processing would translate into risk preferences.

In the literature, a popular approach to understanding effort versus risk preference relationships is a class of theories that suggest risky decision behavior uses two differentially-effortful processes, commonly referred to as dual process theory (e.g., Slovic et al., 2004; Stanovich and West, 2000). Dual process theories describe two systems used to guide behavior. The two processes are the slow and effortful deliberative system and the fast and automatic intuitive system.

Our results may present a problem for dual process theory, as we observed large time differences with relatively small risk preference differences as well as small time differences with relatively large risk preference differences. It is not clear how a dual process theory approach might reconcile this result. Speculatively, the decreased time necessary to analyze the information in an integrated display may suggest that relying more heavily on intuitive processing could decrease the tendency to take risks.

Personal Ownership

The manipulation of personal ownership was intended to represent situations in which someone is given something before making a decision about it. The strength and prevalence of endowment effects made personal ownership a likely candidate to differentiate the original risky choice and risk management tasks, because gambles were owned in the original risk management task and were not owned in the original risky choice task. However, there were no observed differences in risk preferences as a function of providing a situation with a personally-owned gamble. While research on the endowment effect has suggested that endowment may increase risk aversion (Kachelmeier & Shehata, 1992), we did not find evidence of this.

One possibility is that our manipulation of personal ownership may not have been sufficiently salient. There are multiple characteristics of an endowment effect manipulation, of which personal ownership is only one. Other elements from endowment manipulations that might increase the likelihood of observing an effect include the motivation to sell rather than to buy (Kahneman, Knetsch, & Thaler, 1990), physical objects being exchanged rather than an abstract representation of monetary information (Thaler, 1980), and single objects or outcomes being evaluated rather than multiple, usually risky objects in a selection task.

Capacity of Existing Model Predictions

As discussed in the introduction, one benefit of using the gambling paradigm is its relationship to existing models of risky choice. This section will provide an analysis of the predictive capacity of popular models to account for the results of our contextual manipulations. The analysis will focus on the model structures of cumulative prospect theory (CPT) and security/potential aspiration (SP/A) theory.

Cumulative Prospect Theory Model. Cumulative Prospect theory (CPT) incorporates three psychological components into the value function of a descriptive theory of decision making: marginally decreasing sensitivity, reference points, and loss aversion (Kahneman & Tversky, 1979). These three psychological phenomena are reflected in how model parameters are incorporated and bounded into an otherwise simple formal model. In combination with a probability weighting function, the CPT model aims to provide a descriptive account of risky decision behavior.

The following are the formulas which constitute the CPT model:

$$\mathrm{WV}(X) = V(x_1)\pi(p_1) + V(x_2)\pi(p_2)$$

$$V(x_i) = \begin{cases} x_i^{\alpha} & \text{if} \quad x_i \geq 0 \\ -\lambda|x_i|^{\beta} & \text{if} \quad x_i < 0 \end{cases}$$

$$\pi(p_i) = \begin{cases} \dfrac{p_i^{\gamma}}{(p_i^{\gamma} + (1-p_i)^{\gamma})^{1/\gamma}} & \text{if} \quad x_i \geq 0 \\ \dfrac{p_i^{\delta}}{(p_i^{\delta} + (1-p_i)^{\delta})^{1/\delta}} & \text{if} \quad x_i < 0 \end{cases}$$

WV(X) is the weighted value of gamble X which is determined by combining evaluations of each of the possible gamble outcomes and their associated probabilities, $V(x_i)$ is the subjective value for outcome x_i, $\pi(p_i)$ is the (cognitively) weighted probability of p_i. The parameters represented here are: (a) alpha (α), which is the weight applied to positive or zero outcomes ($x_i \geq 0$); (b) beta (β), which is the weight applied to negative outcomes; (c) lambda (λ), which represents the extent to which losses are weighted more heavily than gains; and (d) gamma and delta (γ & δ), which are probability weights for positive/zero and negative values respectively.[3]

Additionally, parameters are bounded; that is, prospect theory stipulates the range of possible values for each parameter in the prospect theory model. In the CPT model

$$0 < \alpha < 1,\ 0 < \beta < 1, \text{ and } \lambda > 1$$

By bounding alpha and beta between zero and one, the value function is concave for positive values of X and convex for negative values. As the values get further from the reference point, the difference in values is weighted as less. For example, the difference between \$400 and \$420 is weighted as less than the difference between \$20 and \$40 because

$$|420^{.5} – 400^{.5}| < |40^{.5} – 20^{.5}|$$

Bounding lambda to always be greater than 1 means losses will always be more heavily weighted than equivalent gains (loss aversion). For example, the difference between gain \$10 or \$20 is weighted as less than the difference between losing \$10 or \$20 because

$$|20^{.5} – 10^{.5}| < |\ {-\lambda}*20^{.5} – (-\lambda*10^{.5})| \text{ if } \lambda > 1$$

[3] Since we were using equal probabilities for outcomes in both gambles, the probability parameters are extraneous. For our case, this also means that the predictions of CPT are equivalent to those of the original formulation of prospect theory.

Because parameters are bounded, prospect theory will always predict risk aversion for gains. Where $V(x_i) > 0$, the smaller the difference in the values of x_i, the greater the value WV(X) will be given equal expected values. For example, imagine a choice between gamble R, a 50/50 chance of \$1 or \$3, or gamble S, a sure thing of \$2.

$$\mathrm{WV(R)} = 1^{.5} * .5 + 3^{.5} * .5 = .5 + 1.73 * .5 = 1.365$$

$$\mathrm{WV}(S) = 2^{.5} * 1 = 1.41$$

$$\mathrm{WV(S)} > \mathrm{WV(R)} \text{ while } |V_s(X_1) - V_s(X_2)| > |V_r(X_1) - V_r(X_2)|$$

Risk seeking is predicted for negative gambles because

$$\mathrm{WV(R)} > \mathrm{WV(S)}$$

$$\text{while } [-\lambda|X_{r1}|^{\beta} - (-\lambda|X_{r2}|^{\beta})] > [-\lambda|X_{s1}|^{\beta} - (-\lambda|X_{s2}|^{\beta})]$$

$$\text{and all } x_i > 0$$

Also, as α and/or β → 1, WV(A) ≈ WV(B) leading to a weaker prediction of risk preference behavior until the decision maker becomes indifferent between choosing the more versus less risky option when $\alpha = \beta = 1$.

To demonstrate how well CPT model can predict our empirical results, the region of possible predictions is provided in figure 15 along with the average risk preferences at each expected value for the five tasks from the current investigation. The regions of possible prediction for the CPT model are provided as the shaded area.

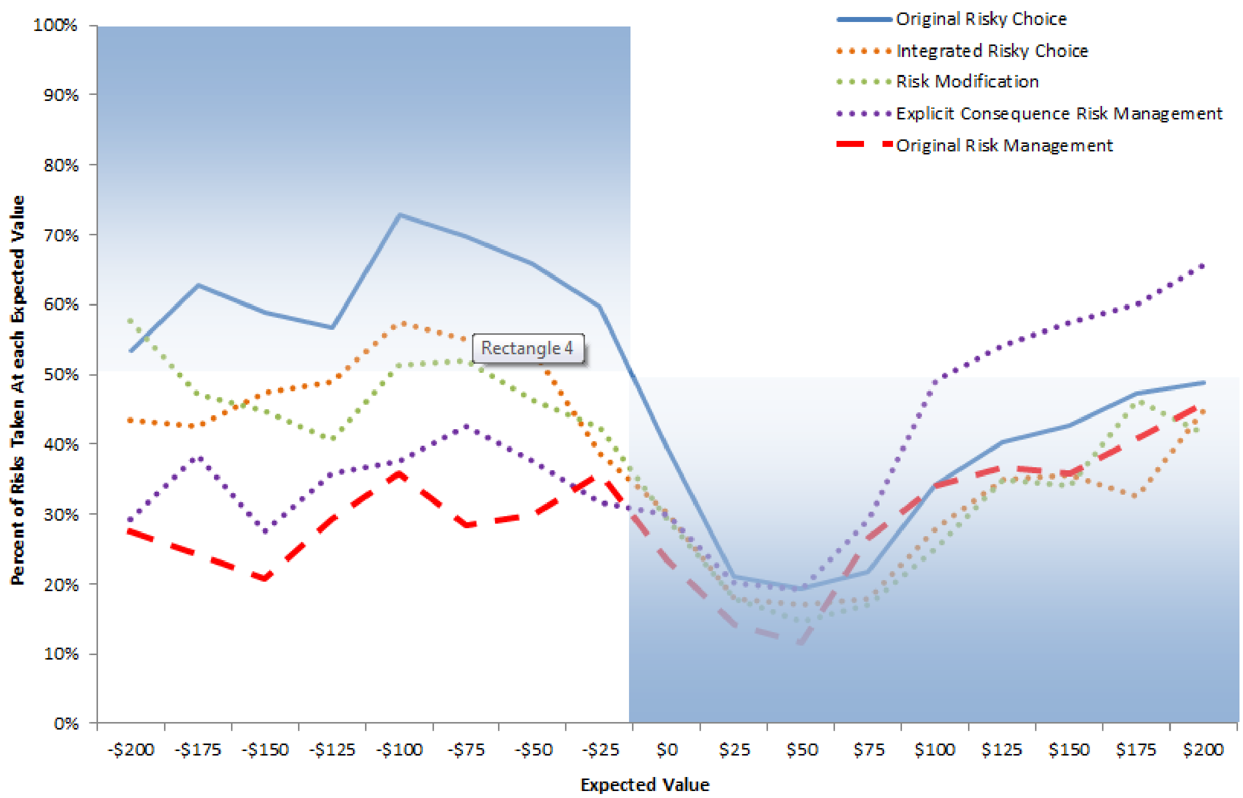

Figure 15. Average risk preferences at each expected value with added region of possible prediction for CPT. Due to loss aversion, predictions are risk averse at the $0 expected value.

The original risky choice task barely fit within the regions of prediction for the CPT model, meaning the parameters of the CPT model could be adjusted to account for its results. However, the remaining four tasks fall *outside the possibility of being predicted* by the CPT model for several expected values, especially in the negative domain. There is no way the parameters of the CPT model can be adjusted to fit these data. In addition, the CPT model is incapable of predicting risk seeking for increasingly large positive expected values in the explicit consequence risk management task.

The limitations on how CPT model parameters can be defined are what establish the above regions of prediction. In summary, predictions from the prospect theory model are rigid in their interpretation of decision making because the value function has been defined as necessarily S-shaped. While the parameters used to establish the value function represent relevant psychological phenomena, the manipulations of situational context transform preference patterns in ways that the CPT model cannot predict.

SP/A theory model. Security Potential/Aspiration (SP/A) theory was developed as an alternative to explain risky decision behavior using a dispositional motivation and goal-oriented perspective. The security-potential (SP) tradeoff in SP/A theory applies approach/avoidance motivations to deal with risky situations; people's feelings about risk lie on a spectrum from seeking security and avoiding risks to seeking potential and taking risks. The aspiration (A) in SP/A theory represents a potential threshold for what a participant expects out of a current situation that causes people to exhibit behavior that can satisfy this threshold. These two components can generate preferences which are sometimes in concert but sometimes conflict.

Whereas CPT must predict different risk preferences for gains and losses, SP/A theory allows for asymmetric predictions in value functions for gains and losses. Specifically, SP/A theory was devised in part to account for observed behavior that is largely consistent with our findings; strongly risk averse for gains, but varied for losses (Lopes & Oden, 1999). SP/A accounts for this pattern by suggesting that most people (a) are security-minded, (b) set modest aspirations for positive gambles, and (c) set high aspiration levels for negative gambles, thereby leading to conflict for negative gambles (Lopes, 1995).Additionally, SP/A theory makes individual level predictions to allow for flexibility when observing domain specific risky decision behavior.

Given this added predictive capacity, the SP/A theory model could feasibly describe all of the risk preference patterns exhibited across the manipulated aspects of situational context. However, the general approach of SP/A theory was as a model of individual behavior, with flexibility to increase the number of parameters given additional complexity in the specific content domain (Lopes & Oden, 1999).

It would be unwise to use the formal SP/A theory model to make specific predictions about our data because parameters in the SP/A theory model are designed to capture individual differences. The strategy-prediction analysis confirms that there were individual differences both within and across situational contexts. A within-subject design would be necessary to distinguish between (a) changes in SP/A theory model parameters to best fit each situational context and (b) the predictive capacity of SP/A theory model parameters to account for individual differences across situational contexts.

While the CPT model cannot predict our context manipulation results that deviate from the risky choice task, the SP/A theory model can predict some aspects of situational context, but only in-so-far as each aspect of context influences how people form aspirations. Because we have found 3 different situational context variables that each influence risk taking in different ways, it may be premature to think that context effects can currently be incorporated into formal models at this point. Additional studies similar this one may be helpful in identifying a small set of situational context variables that exert a predictable influence on risk preferences.

Conclusions and Future Directions

Model Predictions. Overall, the popular formal models we considered lack the capacity to account for elements of situational context. Both models lack a means to directly address how systematically manipulated situational context might influence risk preferences. There are, however, viable alternatives to using a formal model. The adaptive toolbox approach can provide a descriptive account for the influence of aspects of situational context. This approach suggests that people uses available cues from their decision environment to build a heuristic to navigate decisions in similar environments. It is unclear whether this approach can be modified into a predictive model of risk preferences, given its reliance on adaptive constructs like learning and experience (Todd & Gigerenzer, 2001).

Alternatively, a computational model of decision making like decision field theory (Busemeyer & Townsend, 1993) gives a greater level of detail at predicting and modeling individual responses by introducing psychophysiological techniques like eye-tracking and neuroimaging to the prediction of decision behavior. However, these models are generally considered by many to be too complex (Busemeyer & Johnson, 2008), focus on aspects of context which are too narrow, too often focus on specific domains (Brehmer, 1992), and are again intended for primarily descriptive purposes. However, by identifying elements of context shared across domains and injecting them into the gambling paradigm, we have identified perceptual and cognitive constructs that could be included into a computational model or otherwise process-level explanation of risk preferences across domains. The primary challenge is one of parsimony in capturing those aspects of situational context that provide the clearest and most reliable effects on risk preferences.

Alternative Explanations of Behavioral Focus. Behavioral focus is a complex construct which maintains multiple possible interpretations. One the one hand, choices are comparative between alternatives that cannot be altered, whereas improvements are made to situations which can be altered by the decision maker. This may well instantiate a feeling of perceived personal control over decisions in improvement-focused tasks not present in choice-focused tasks. Alternatively, choices are made between two possible scenarios which will happen sometime in the future, whereas improvement situations are made about a current situation that must be fixed or improved in the present. Finally, choices in this experiment involve picking between two innocuous situations, whereas improvement-focus task necessary takes a bad situation and makes it better. The implications of each of these possible interpretations will be discussed in turn.

Perceived Control. Some might argue that choice-focused and improvement-focused task environments engender a differential sense of personal responsibility over the scenario (Klein, 1989). In the original and integrated risky choice tasks, people were asked to observe and select one of two isolated alternatives with no say in how those alternatives will look. In the improvement-focused tasks, people were given an opportunity to change an existing gamble in a manner of their choosing. However, the risk modification task, which represented a choice as the alteration of a situated gamble, presumably shared a similar sense of control over a given situation. The risk modification task showed no noticeable differences in risk preferences compared to the standard choice task. As a result, it is difficult to make the claim that behavioral focus occurred entirely due to a different sense of control over the situation or its outcomes.

Knowledge about Current and Future Situations. Decisions made along a timeline, whether they are from experience (Erev et al., 2010), under time pressure

(Svenson, 1993; Ordonez & Benson, 1997), or occurring with feedback in an adaptive environment (Brehmer, 1992; Jessup, Bishara, & Busemeyer, 2008) are of particular interest due to their practical applications. Our reality is bounded by time. Even so, ‘information about the future’ and ‘information from the past’ have not been given equal treatment in the study of risky decision making. Economics has almost exclusively concerned itself with understanding risky decision making from the point of view of *future* states to formulate predictions about behavior. Economic models are then built as additive linear calculations to compress any and all information from a decision into future prospects to be compared or judged.

Behavioral focus may influence risk preferences because of the differential focus on present vs. future states. All three choice-focused tasks provide information about future states as separate entities; separate gamble displays in the original risky choice task, and separate pairs of gamble outcomes in the integrated risky choice and risk modification tasks. Both improvement focused tasks provide information about the current state, and only provide tacit information about the future; dotted lines with arrows in the explicit consequence risk management task and as a task rule in the original risk management task. Motivationally, you might expect differences in risk preferences given a person’s association of what they are currently looking at into what they might expect to happen in the future.

The Effect of Making a Situation Better. It may also be that the improvement focus anchors participants to a not-as-good situation before eliciting any action. When providing a situation that requires improvement, the decision maker is exposed to an anchor that might influence the evaluation of possible future actions. For improvement-focus tasks, this anchor was always worse than both of the possible future states. To determine whether the direction of the anchor (going from bad to good) was at least partially responsible for the effects of behavioral focus, a future investigation might provide participants with a superior situation that would need to be made worse (going from good to bad). Mitigating a situation that will become worse via curtailing outcome values would constitute an unexplored behavioral focus; one focused on the mitigation of an impending negative change in the situation.

Further Systematic Manipulations of Context. It should be clear that not all decisions are choices, and not all choices are the same. Additional characteristics of context from naturalistic decision making and other sources of field research should be included into research in risky decision making. It will be especially valuable if critical real-world variables can be extracted and mapped onto tasks that can be studied in controlled settings. The gambling paradigm only captures a limited set of contextual elements from decisions in the real world; choices between pre-existing alternatives with explicit consequences. Research in risky decision making is missing out on capturing a great deal of context necessary to understand what people are doing when decisions aren't represented as choices between well-defined alternatives.

It is one thing to say that not all gamble are choices, but yet another to identify the specific ways in which other kinds of decisions differ from choices. By systematically adding context from naturalistic decision making, and other realms of psychology like learning, into systematic manipulations of highly controlled paradigms, it may be possible to directly observe the effects on preference from many different elements of context. This has wide ranging potentially transformative implications for risky decision research, which historically has been limited to only using a handful of tasks to study risk preferences.

By using several cognitive process-level explanations as the basis for developing intermediate task conditions, a researcher can determine if effects are due to a perceptual characteristic of stimuli, a motivational component of human behavior, etc. Further experimentation using similar paradigmatic manipulations of context are necessary to understand the impact of real-world context that are not adequately represented by the gambling paradigm.

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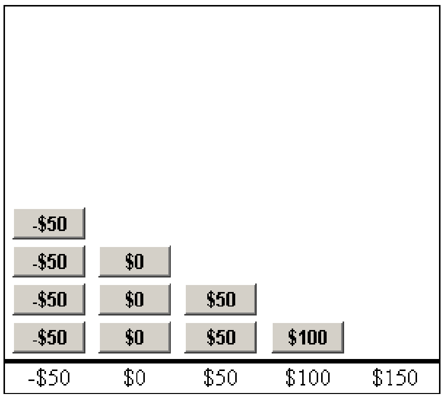
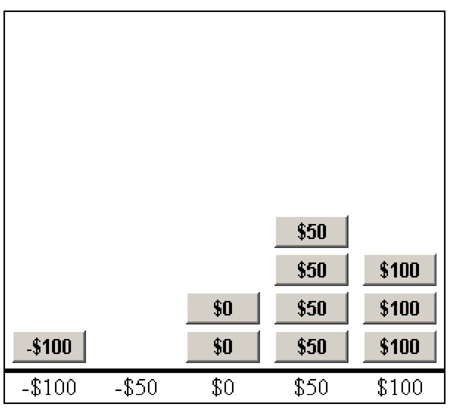
Appendix

Eight Question Quiz



1. Do you have a better chance of drawing a ticket worth $50 or $100?
2. If you were to draw randomly from this lottery over and over, what ticket value would you be expected to draw an average of only 3 out of every 20 times?
3. If you were given the chance to randomly draw a ticket from this lottery, which value would you be **least likely** to draw?
4. In this lottery, do you have a better chance of drawing a positive ticket, a zero, or a negative ticket?



5. Of the values in this lottery with at least one ticket, what value is the **least likely** outcome?
6. In a single draw from this lottery, do you have a better chance of drawing a $0 ticket or a $100 ticket?
7. What is the best value that you can draw from this lottery?
8. How many tickets result in you not losing money?