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The Role of Attentional Control and Social Influence in Risky Decision Making

Samantha Salernitano

Abstract

People often are required to make decisions in a collaborative environment, including decisions that deal with risky or uncertain outcomes. The present thesis investigated the role of both social influence and individual cognitive factors (attentional control) in risky decision making. Two measures of attentional control (a Stroop task and a Go/No-go task) were completed by participants. Risky choice was then measured through a hypothetical monetary gambling task where participants made choices between a smaller-guaranteed reward or a larger-risky reward. Three blocks of the risky-choice task were completed. Participants in the individual condition completed all three blocks of trials individually. For participants in the dyad condition, two participants would collaborate together during the second block and make all choices as a pair. This study design afforded the ability to measure changes in risky choice preferences from pre-collaboration (block 1) to post-collaboration (block 3). Data collection for the present study is currently ongoing with a target sample size of 200 participants. As a result, all findings are reported as tentative until the full sample size is achieved. The current thesis sample size includes 65 participants. The preliminary results suggest a social influence effect on risky choice preferences for participants in the dyad condition, with participants' risk preferences significantly more similar post-collaboratively compared to pre-collaboratively. Attention did not significantly correlate with risky choice, but the preliminary results suggest a possible trend such that members in a dyad with higher attentional control may have had more of an impact on decisions made by the dyad during collaboration. The overall findings serve to suggest the possibility of a complex interaction between cognitive mechanisms and risk preferences in a collaborative environment.

Keywords: risky choice; risk preferences; social influence; group decision making; attentio

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The Role of Attentional Control and Social Influence in Risky Decision Making

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Introduction

Overview of Topic

Many consequential decisions in life involve a determination of risk, including financial, health, and hazard domains. Thus, understanding how individuals make decisions under risk and uncertainty is a topic of interest in psychological and economic research. Due to the risky decision-making process involving the weighing of likelihoods of possible outcomes, prior research has investigated the role of cognitive functions such as attentional mechanisms in shaping risk preferences. Additionally, many risky decisions are made in social contexts, yet there is far less research that has focused on the risk decision-making process in small group environments. As a result, the current thesis sought to bring together multiple lines of research by exploring how individual difference factors (e.g., attentional control) relate to risky choices in both an individual and social laboratory setting. Below, prior research is first summarized on risky decision making, the relationship between executive functioning and risk preferences, and risky decision making in social environments. An overview of the current thesis is then provided.

Risky Decision Making

Risk is known to produce vast amounts of uncertainty in the decision-making process, with relevant research noting that it is almost impossible to perfectly anticipate risk outcomes due to the influential nature of decision making (Krewski et al., 2022). However, the ability to engage in decision making is a foundational concept that utilizes a certain level of logic, problem analysis, and intuition, while incorporating individual values and experiences to help consider circumstances and determine the best course of action (Schmitz, 2021). With this in mind, decision making is a subjective and individualized psychological process that is multidimensional and malleable. Despite the different approaches and theories relevant to risky decision-making (e.g., expected utility theory, prospect theory), all principles have a foundational understanding that any risky decision requires problem formulation (Krewski et al., 2022). According to de-Juan-Ripoll et al. (2021), our best understanding of risky decision making is based on the following three elements: decision features, situational factors, and individual differences. All three elements have provided promising results as influences on decision outcomes, but interpreting the interrelated nature of these factors is still not yet fully understood (de-Juan-Ripoll et al., 2021). With respect to the current thesis, cognitive and social processes are both situational and individual factors that present the potential to influence the way a risky decision is perceived.

Expectation models have been heavily utilized in experimental settings to measure risky decisions (Batteux et al., 2017; Eckel & Grossman, 2002; Holt & Laury, 2002; Pachur et al., 2013; Pollak et al., 2019,), with a focus on the balance of potential loss to potential gain when given a decision to make. This quantitative approach utilizes economic probabilistic models to evaluate risk options with respect to one's ability to engage in probability computation and has been found to be a relevant and popular framework in examining influences of decisions made under risk. The concept that individuals evaluate risky decisions based on their expectation for potential gain/loss has been discussed in both normative and descriptive theories of risky choice and has been successfully applied in accounting for an individual’s overt choices (Pachur et al., 2013).

Risky decision making is often measured in laboratory settings by presenting participants a series of choices between rewards that differ both in magnitude and probability of occurrence. These tasks usually consist of monetary rewards, such as a choice between a guaranteed $40 or a 50% chance of $80 (with a 50% of $0). A general preference for the guaranteed or safer option is indicative of risk aversion, whereas preference for the risky options demonstrates risk tolerance. This approach is a broadly accepted application of measuring risky decision making in experimental settings and has been utilized extensively at the individual level (Barberis, 2013). For example, Holt and Laury (2002) measured risk aversion utilizing a lottery decision-making paradigm. In this study they asked participants to choose between lottery A and lottery B, each with different probabilities of gaining a monetary reward. They addressed previously believed limitations that stated economic tasks in the past presented low laboratory incentives that could result in unrealistic results that were not able to measure attitudes about real-world risks. They addressed this by deriving a choice task that had high hypothetical payoffs that would more accurately be able to estimate a degree of risk aversion that was applicable in predicting real life risk behavior. Similarly, Eckel and Grossman (2002) presented participants with gambling choices that exhibited different substantial financial stakes differing in their return and likelihood. Though often hypothetical in nature, preferences in these monetary gambling tasks have been shown to relate to a variety of consequential behavioral outcomes. Anderson and Mellor (2008) found that responses on a monetary gambling task utilizing a college aged sample was associated with health and hazardous risky behaviors (e.g., smoking, heavy drinking, and seat belt use). Finally, Barsky et al. (1997) reported that participants with larger parameter values of risk tolerance were more likely to smoke, drink, and not own health insurance. Taken together, these findings demonstrate that risk preferences can be measured in the laboratory in a domain-general fashion, yet these preferences tend to be associated with risk-taking behavior across a variety of risk domains.

Executive Functioning and Risky Decision Making

Prior research has discussed the nature of the relationship between cognitive ability and risk preferences (e.g., Kusev, 2017). Yet, despite numerous studies depicting an association between cognition and risky decision making, the results remain inconsistent. Dohmen et al. (2018) discussed risk preference as being conceptualized under the assumption that all other factors are controlled for, and the trade-offs in an economic choice task are perceived with the assumption that the individual understands the probabilities being offered to them. With this in mind, choices made on probability risk tasks require mental deliberation, a process that requires cognitive ability. Charness et al. (2018) suggested that the highly complex nature of many experimental risk measures can cause noisy estimates due to uncontrolled covariates. Ultimately, risk preferences being dependent on probability computation assumes that an individual possesses the ability to accurately and effectively compute probability or expected value (i.e., reward magnitude multiplied by its probability). This ability is heavily reliant on underlying cognitive mechanisms discussed further by Amador-Hidalgo et al. (2021), who found that those with lower cognitive ability may be driven to make riskier decisions simply because of error or a lack of understanding that is rooted in their cognitive ability rather than their actual perception of risk. For example, they found that cognitive ability was negatively associated with making noisy or inconsistent choices (Amador-Hidalgo et al., 2021). These findings suggest that a lack of understanding in the decision-making task at hand likely contributed to prior significant correlations between cognitive ability and risk preference. However, these results still further suggest that underlying cognitive mechanisms determine problem-solving and formulation in ambiguous circumstances and serve as influential components in risky choice.

To further investigate the relationship between executive functioning and risky decision making, Xu et al. (2020) found that improving executive functioning, specifically focusing on response inhibition, showed significant improvement in reducing overly conservative behavior in risky decision-making tasks that resulted in the participants to gain more money. This study utilized a Go/NoGo and stop-signal task paradigm to teach and develop response inhibition ability in college students, while measuring risk assessment at a pre- and post-test level. These results demonstrate that response inhibition, a vital component of executive functioning, plays a role in the risky decision-making process. Furthermore, Pollak et al. (2019) found that individuals with attention deficit/hyperactivity disorder (ADHD) exhibited higher amounts of risk-taking behavior across several domains such as reckless driving, substance use, and unprotected sex when utilizing a probabilistic reward task. This pattern of results suggests that both the cognitive and social deficits associated with ADHD may affect an individual's ability to assess or manage risk.

Lilleholt (2019) conducted a meta-analysis consisting of 97 studies that revealed a significant relationship between cognitive ability and risk aversion in the gain domain. This finding suggests that executive mechanisms may play prominent roles in the risky decision-making process, but most studies fail to acknowledge that cognitive ability is multidimensional. As a result, it is important for studies to identify particular mechanisms that relate to decision outcomes. The current thesis focused on attentional processes. This is due to the fact that effective risky decision making often requires the inhibition of a prepotent response to monetary gambles (e.g., solely being attracted to the larger reward magnitude of a risky gamble) while integrating and weighing all decisional outcomes.

Decision Making in a Social Context

Brooks and Sokol-Hessner (2020) suggest that the computations underlying risky decision making are fundamentally dynamic and are able to be influenced by outside factors relative to the environment. With the understanding that risky choices are relative to contextual factors, this is suggestive to the potential influence a group environment may have on participants who have been asked to evaluate risky monetary choices. Real-life scenarios require important decisions to be made by groups. A board of directors, committees, classroom environments, and even personal friend and family matters will require decisions to be made by more than a single individual (Masclet et al., 2009). This raises many questions: What influence can group environments have on the risky decision-making process? How and to what extent do small groups make risky decisions differently than individuals? How do these social pressures and influences affect the subsequent decisions of individuals? Despite that many important decisions are made at the dyad or small-group level, research in both the psychological and economic literatures have largely focused on decision making in individuals.

Yet, over the past decade, there has been a trend in more studies beginning to explore how risky decision making is affected by social contexts. Brunette et al. (2015) had participants make a series of lottery-style gambles either by themselves or in small groups. Their general findings were that the participants were less risk averse when making decisions in the group condition. Moreover, interacting with others and observing their preferences have been shown to subsequently influence an individual's own risk preferences. According to Reiter et al. (2019), this idea of risk contagion has been found to be positively associated with real-life social integration, and this has been found to occur especially when participants observe other peers engage in risk-seeking behavior. But this relationship has the ability to be bidirectional in nature. Chung et al. (2015) found that risk attitudes at the individual level are expressed differently alone than in the presence of others through one's susceptibility to social influence. Interestingly, this study found that participants were more likely to choose a safer gamble when observing other participants that chose a safe gamble, but were more likely to choose a riskier gamble when observing other participants that chose a riskier gamble. These results demonstrate the possible bidirectional influence that social exposure may have on risky decision making.

Batteux et al. (2017) analyzed surrogate decision making, which is when individuals are tasked with making decisions that would have consequences for others. They found that when utilizing a probability monetary task, participants made riskier decisions when deciding for themselves but were more risk averse when making decisions on behalf of their friend or even an unknown participant. This suggests that even the consideration of a social component can cause a measurable change in decision making that is not dependent solely on individual risk preferences. The way that individuals interact in a group setting, and the consequences of this social exposure on subsequent decisions, has the possibility of altering behavior.

Prior Research in the MSU Cognition, Decision Making, and Behavior Lab

The current thesis built off of prior research and study methodologies utilized in the Cognition, Decision Making, and Behavior lab. For instance, a recently completed thesis by another MA student (Kesha Patel) also investigated social influence on risky choice. In the experiment, participants first made a series of choices between a smaller, certain reward, and a larger, risky reward (the pre-exposure block). Participants then made a series of similar choices, but were exposed to the choices of who they believed was another participant (the exposure block). In actuality, the choices of the social other were experimentally manipulated to be the preferences of either a risk-averse individual or a risk-tolerant individual. Finally, participants once again made a series of choices without any social information (the post-exposure block). Though no baseline differences between the two conditions were observed during the pre-exposure block (as would be expected due to random assignment), participants in the risk-tolerant social other condition chose the risky reward option significantly more during the post-exposure block than participants in the risk-averse social other condition. That is, being exposed to the choice preferences of another individual led participants to significantly adjust their own preferences to align with this social other. Furthermore, results demonstrated that those who expressed more decisional uncertainty following the pre-exposure block were more likely to adjust their choice preferences from pre- to post-exposure blocks. These latter results show how individual difference factors can interact with the social environment during the risky decision-making process.

The above thesis study involved social exposure but did not involve actual social interaction. However, other prior research by Dr. Bixter has investigated decision making in dyads and small groups (e.g., Bixter & Luhmann, 2020, 2021; Bixter & Rogers, 2019; Bixter, Trimber, & Luhmann, 2017). In these studies, participants first completed a decision-making task individually (the pre-collaboration block), then participants completed a similar task with a partner or group (the collaboration block), and then the task was once again completed individually (the post-collaboration block). This study design allows the ability to measure how groups of participants make decisions together during collaboration, and also how this prior collaboration goes on to impact individual decision making post-collaboratively. The results of these prior studies demonstrated that groups would tend to average together the preferences of the individual group members when making decisions together, and the preferences of the individual group members would often converge towards this average post-collaboratively. Though these studies usually focused on decisions in another domain (delay/time and not risk), this collaborative decision-making design was utilized in the current thesis.

Overview of Current Study

The aim of the current thesis was to measure individual differences in executive functioning (attention) and explore its relationship to risky choices in a collaborative decision-making design. The study was carried out in a laboratory setting. All participants completed two measures of attentional control (a Stroop task, a Go/No-go task). Moreover, all participants completed three blocks of a hypothetical monetary risky choice task (see Methods below for details). However, in the second block of the risky choice task, participants were randomly assigned to either complete the trials individually or together with a partner (dyad condition). For the risky choice task, this produced a 2 (individual vs. dyad condition) x 3 (block 1, block 2, block 3) study design.

A series of hypotheses and research questions were formulated based on the prior research summarized above. The first set of hypotheses focused on replicating patterns of findings in decisions involving delay in the risk domain. Specifically:

Hypothesis 1: For those in the dyad condition, risk preferences exhibited as a dyad during the second block will be related to the average of the two members' baseline risk preferences during the first block (an averaging effect).

Hypothesis 2: For those in the dyad condition, risk preferences during the post collaborative third block of trials will be significantly more similar within the dyad compared to risk preferences during the first block (a convergence effect).

Hypothesis 3: Participants in the dyad condition will adjust their risk preferences from the first block to the third block significantly more than participants in the individual condition.

The next set of research questions focused on the relationship between attentional control and the above decision-making effects. Due to these being the more novel aspect of the current study, they were designated research questions instead of hypotheses.

RQ 1: What is the relationship between performance on the attention measures and risk preferences exhibited during the first block of risky choice trials for all participants?

RQ 2: For participants in the dyad condition, will members with higher (or lower) attentional control affect the dyad decision-making process more during the second block of the risky choice trials?

RQ 3: For participants in the dyad condition, how will attention relate to the extent participants adjust their risk preferences following collaboration with their partner during the second block?

Method

Participants

Data collection for this study is ongoing with a target sample size of 200 participants. The data and results presented below represent data collection up until April 13th, 2023. As a result, all reported results must be considered tentative until the full target sample size is achieved. This thesis sample size was 65 participants (*M* age = 19.26 years, *SD* = 3.42). The sample consisted of 41 females (63.1%), 22 males (33.8%), and 2 non-binary individuals (3.1%). For ethnicity, 31 participants were Hispanic (47.7%), and 34 participants were non-Hispanic (52.3%). As it relates to race, 29 participants were White (44.6%), 19 were Black or African American (29.2%), 7 were Asian American or Pacific Islander (10.8%), 3 were multi-racial (4.6%), 1 was American Indian or Alaskan Native (1.5%), and 6 reported their race as not listed above (9.2%).

Participants were MSU students enrolled in courses that require SONA research credits. This sample of 65 participants were randomly assigned to two experimental conditions. Specifically, 37 participants were assigned to the individual condition and 28 participants were assigned to the dyad condition (14 dyads). The target sample size is based off of prior research completed within the lab summarized above, that often had 25-50 dyad/groups per condition.

Materials

Risky Choice Task. A hypothetical monetary choice task developed by Byrne et al. (2021) was used to measure risk preferences. The task consists of 36 choices between a certain reward and a larger risky reward. These 36 choices consist of 3 types of trials: risky advantageous, risky equal, and risky disadvantageous. This classification is based on the expected value for the risky option compared to the certain reward. As an example, a 50% chance of $250 has an expected value of $125 ($250 x .50). If this expected value is higher (lower) than the certain reward, the trial would be designated a risky advantageous (disadvantageous) trial. If the expected value of the risky option equals the certain reward, it is classified as a risky equal trial.

Stroop Task. On each trial a word was presented in the center of the screen. The word was either ‘blue’, ‘green’, ‘yellow’, or ‘red’. A color word was also presented to the left and to the right of the target color word in the center of the screen. The word in the center of the computer screen also used a colored font. Participants' task was to choose which of the two flanker color words matched the color font of the target word in the center. A total of 96 test trials were included in the Stroop task. In half of the trials, the color font of the target word matched the text color (the congruent trials). In the other half of the trials, the color font of the target word did not match the text color (the incongruent trials). Participants used the ‘x’ and ‘m’ keys on the computer keyboard to select the left and right flanker words, respectively, as their choice on each trial. Both the accuracy of the response and the response time (RT) were logged on each trial. Participants first completed six practice trials and received feedback (correct vs. incorrect) on each of their choices. No feedback was received on the 96 test trials of the Stroop task. Participants were not under a time constraint to provide a response on the trials.

Go/No-go Task. On each trial, either a blue circle or an orange circle were presented at the center of the computer screen (with a gray background). Participants were instructed to press the “space bar” if a blue circle was presented, and to withhold a response if an orange circle was presented. Participants had 2 seconds to provide a response before it moved on to the next trial. Both the accuracy of the response and the RT (when a response was made) were logged on each trial. Participants completed 80 trials of the task. Half of the trials contained a blue circle and half of the trials contained an orange circle. No feedback was received on the trials.

Procedure

Two participants arrived at the research lab for each session. The participants were randomly assigned to either the individual experimental condition or the dyad condition. If only one participant signed up or showed up for the session, they were assigned to the individual condition. Participants first read and signed the consent form, and then filled out a brief demographic form that asked for age, gender, ethnicity, and race.

Participants were then escorted to individual computer stations. They first were provided instructions and completed two attention tasks using PsychoPy software. Participants in both conditions then completed the first block of the risky choice task individually. The risky choice task was programmed using PsychoPy software as well.

The second block of the risky choice task differed for participants in the two conditions. For participants in the individual condition, the block was completed the same as the previous block. For participants in the dyad condition, the two participants were brought together in a new computer workstation and were instructed to complete the risky choice task together. On each trial the dyad only made one choice, so they needed to reconcile any disagreement together before making a choice.

The third block of the risky choice task was the same for participants in both conditions. The risky choice task was completed individually with participants in the dyad condition back at their original computer workstations. After the completion of the third decision-making block, all participants were debriefed and granted their SONA credits.

Data Analysis Plan

Risk preferences on the risky choice task were measured in two ways. First, the proportion of trials that an individual/dyad chose the risky option was used as an overall measure of risk taking. Because 24 of the 36 trials had a choice option that would be considered advantageous based on expected value theory, a second metric was constructed based on the proportion of trials that an individual/dyad chose the options that were higher in expected value (i.e. the option that would be recommended based on economic “rationality”). For this metric, the 12 risky neutral trials were ignored due to them not involving an advantageous option from an economic rationale perspective. Both of these metrics were then explored through descriptive statistics and plots to check distributional assumptions for the subsequent statistical tests. All study materials, data, and analysis scripts will be uploaded to the Open Science Framework (OSF) after the completion of the study.

Results

Risky Choice Descriptive Analysis

Before testing the hypotheses and research questions, it was important to first ensure that the risky choice task was interpreted correctly by participants. Specifically, it would be expected that participants' preference for the risky option would go down from the risky advantageous trials to the risky equal trials to the risky disadvantageous trials. The analysis here is restricted to the block 1 risky choice trials, because at that point the experimental manipulation had not occurred. As expected, the proportion of trials participants selected the risky option was highest in the risky advantageous trials (M = .48, SD = .21), in the middle for the risky equal trials (M = .38, SD = .22), and lowest in the risky disadvantageous trials (M = .23, SD = .20). These differences were supported by a significant repeated-measures analysis of variance (ANOVA), $F(2, 128) = 61.73$, $p < .001$, $\eta_p^2 = .49$. Moreover, pairwise comparisons demonstrated that all three trial types significantly differed from one another (ps < .001). These results demonstrate that participants responded to risky choice trial parameters in the expected direction. Following this demonstration, the results of the hypotheses and research questions are now presented.

Hypothesis 1: The Averaging Effect

The first hypothesis was that risky choice preferences in the dyad condition during block 2 would be significantly related to the average of the two group members' individual preferences exhibited during block 1. A Pearson correlation between the two metrics was positive and approaching a large effect size ($r = .46$, $p = .10$), but failed to reach statistical significance. The correlation being non-significant is likely due to the current small number of dyads ($n = 14$). Figure 1 depicts a scatter plot showing this positive relationship between the average block 1 risk preferences and the block 2 dyad preferences during collaboration.

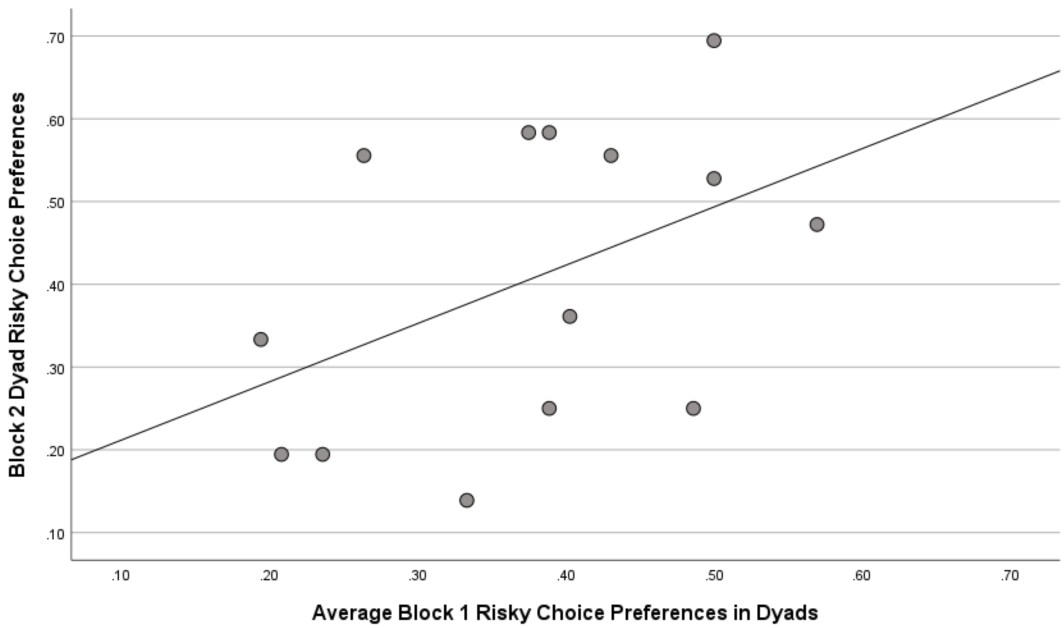

Figure 1. The relationship between the average of the two dyad members' block 1 risky choice preferences and the subsequent risky choice preferences exhibited by the dyad together during block 2.

Hypothesis 2: The Convergence Effect

Hypothesis 2 predicted that participants in the dyad condition would exhibit more similar risk preferences during the post-collaborative block 3 compared to the pre-collaborative block 1 (i.e., a social influence convergence effect). Within-dyad difference scores were created by taking the absolute magnitude difference between risky choice proportions between the two dyad members. As a result, a value of 0 would occur if the two dyad members chose the risky option at an equal rate. Increasing values between 0 and 1 would imply increasing discrepancy in preferences between the two dyad members. These within-dyad difference scores were calculated for both blocks 1 and 3 to investigate changes from pre- to post-collaboration.

Though Hypothesis 2 focused on participants in the dyad condition, participants in the individual condition served as a control group. That is, a concern about any demonstrated convergence effect in the dyad condition is that it could be some type of statistical artifact (e.g., regression-to-the-mean). To guard against this interpretation, within-dyad difference scores were also calculated for participants in the individual condition. This was accomplished by pairing together participants in the individual condition with their neighbor in subject number (e.g., participants 1 and 2, 3 and 4, etc.). These groups are referred to as Nominal Dyads, since they did not actually collaborate together but are simply serving as a control group for the Real Dyads.

A mixed ANOVA was carried out with a within-subject component of risky choice block (pre-collaborative block 1 vs. post-collaborative block 3) and a between-subject component of condition (Real Dyad condition vs. Nominal Dyad control condition). The results are visualized in Figure 2.

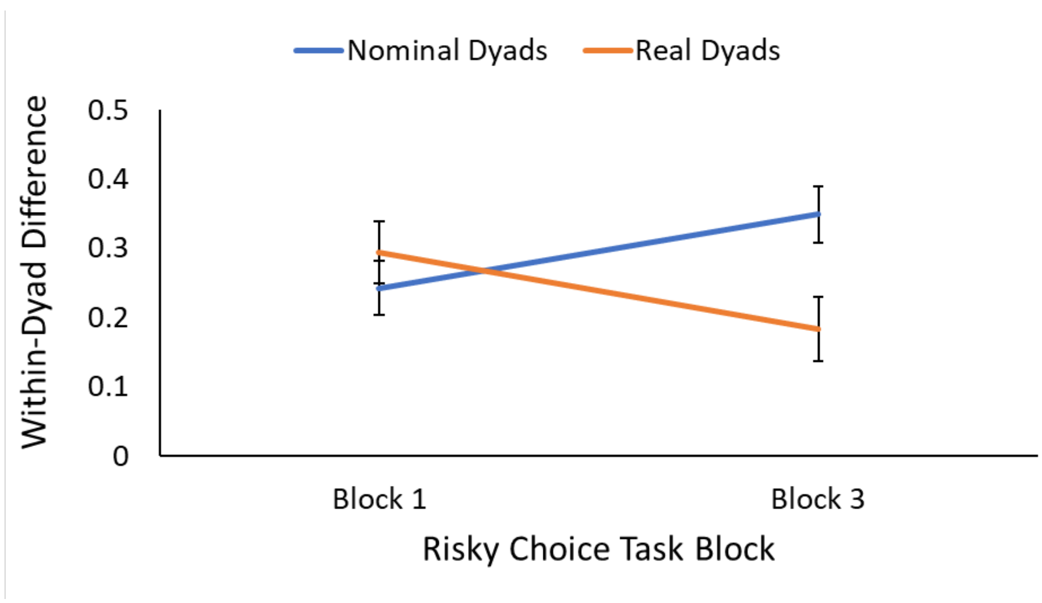

Figure 2. The average difference in risky choice preferences between dyad members from pre-collaboration (Block 1) and post-collaboration (Block 3). Nominal Dyads were created from participants in the individual experimental condition to operate as a control comparison.

As can be seen in Figure 2, a significant interaction was found between condition and block, $F(1, 30) = 10.80$, $p = .003$, $\eta_p^2 = .27$. Pairwise comparisons demonstrated that participants in the dyad condition became significantly more similar in risky choice preferences from block 1 ($M = .29$, $SD = .17$) to block 3 ($M = .18$, $SD = .15$) ($p = .03$). In contrast, participants in the individual condition (i.e., the Nominal Dyads) actually became more dissimilar from block 1 ($M = .24$, $SD = .17$) to block 3 ($M = .35$, $SD = .19$) ($p = .02$). Though the latter comparison was not hypothesized, it helps demonstrate that the convergence effect shown in the real dyad condition does not appear to be a statistical artifact.

Hypothesis 3

Hypothesis 3 predicted that participants in the dyad condition would adjust their risk preferences from block 1 to block 3 at a greater rate than participants in the individual condition. This is due to participants in the dyad condition experiencing the social collaborative experience during block 2. To measure change in risk preferences, absolute difference scores were constructed between participants' risky choice proportions in blocks 1 and 3. These change scores were then entered into an independent samples *t*-test. The results demonstrated that participants in the dyad condition adjusted their risk preferences at a higher rate ($M = .18$, $SD = .15$) than participants in the individual condition ($M = .09$, $SD = .08$), $t(63) = 3.19$, $p = .002$, Cohen's $d = 0.80$ (a large effect).

Attention and Risky Decision Making

The next set of analyses focus on the three research questions that include the individual difference factor of attention. Though two attention tasks were administered to participants (a

Stroop task and a Go/No-go task), all results below only focus on the Stroop task as the measure of attention. This is due to the Go/No-go task currently demonstrating a strong ceiling effect. Because some of the below research questions involved categorizing members of the dyad as having higher vs. lower attention, the ceiling effect of the Go/No-go task would reduce the number of dyads to a number that would prevent meaningful statistical analyses. The Stroop task currently exhibited more variability and allowed every dyad but one to differentiate a higher vs. lower attention member. However, it is also important to note again that these analyses are tentative and subject to change when the complete sample size is obtained.

Attentional control on the Stroop Task was operationalized four ways: overall accuracy across all trials, accuracy on the congruent trials, accuracy on the incongruent trials, and the difference in accuracy between the congruent trials and the incongruent trials. Because attentional control is often believed to be most important on the Stroop Task when there is an incongruence between the text and font color of the target word, the latter difference score measures the relative deficit participants exhibited on the incongruency trials compared to their "baseline" accuracy on the congruency trials.

RQ1: What is the relationship between performance on the attention measures and risk preferences exhibited during the first block of risky choice trials for all participants?

See Table 1 for the correlations between performance on the Stroop Task and risk preferences exhibited by participants during the first block of risky choice trials (i.e., before the experimental manipulation occurred). Non-normality was present in the attention data. Therefore, Spearman's correlation coefficients are reported here. As can be seen, no significant correlations were found between performance on the Stroop Task and risk preferences during block 1 (whether operationalized as overall proportion of risky choices or the correctness of risky decisions based on expected values).

Table 1

Table of Spearman Correlations for Stroop Task and Block 1 Trials

	1	2	3	4	5	6
1. Overall Stroop Task Performance	--					
2. Congruent Trials	.376**	--				
3. Incongruent Trials	.994**	.287*	--			
4. Difference in Trials	-.912**	-.076	-.933**	--		
5. Block 1 Overall Performance	-.019	-.069	-.019	-.012	--	
6. Block 1 Correct Responses	-.078	-.064	-.078	.093	.004	--

Note: * p < .05, ** p < .01, *** p < .001, two-tailed. *N* = 65

RQ2: For participants in the dyad condition, will members with higher (or lower) attentional control affect the dyad decision-making process more during the second block of the risky choice trials?

To investigate RQ2, members in each dyad were categorized as the member with either higher or lower attention based on performance on the Stroop Task (except for one dyad where both members scored exactly the same on the Stroop Task and therefore could not be differentiated). In contrast to Hypothesis 1 above where dyad risk preferences during block 2 were correlated with the average of the dyad members' pre-collaborative block 1 risk preferences, RQ2 involved correlating dyad risk preferences during block 2 with the block 1 risk preferences of the higher attention member and the lower attention member separately. A stronger correlation was observed between dyad risk preferences and the risk preferences of the higher attention member (r = .47, p = .109) compared to the lower attention member (r = .12, p = .694).

To further explore the above effect, a multiple linear regression was carried out with dyad risk preferences during block 2 as the criterion variable and the block 1 risk preferences of the higher and lower attention members as the two predictors. The model had a high R^2 of .32 but did not reach statistical significance likely due to the small sample size of dyads, $F(2, 10) = 2.39$, $p = .142$. However, preliminary inspection of the regression coefficients provided interesting trends (see Table 2). Though both predictors exhibited a positive relationship with the criterion variable, the standardized beta coefficient was notably higher for the risk preferences of the higher attention member ($\beta = .60$, $p = .058$) than the risk preferences of the lower attention member ($\beta = .35$, $p = .238$). If these trends remain upon the obtaining of the full sample size, they suggest a contextualization of the averaging effect results found in Hypothesis 1. Specifically, though both members' individual risk preferences appear to relate to the dyads' decisions during collaboration, it appears that more weight may be applied to the risk preferences of the dyad member with higher attention.

Table 2. Block 2 Dyad Risk Preferences Predicted by Block 1 Risk Preferences of the Higher and Lower Attention Dyad Members

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	.078	.171		.457	.657
Higher Attention Dyad Member	.469	.220	.603	2.136	.058
Lower Attention Dyad Member	.359	.286	.354	1.256	.238

RQ3: For participants in the dyad condition, how will attention relate to the extent participants adjust their risk preferences following collaboration with their partner during the second block?

The third research question investigated how attention related to the extent participants in the dyad condition adjusted their risk preferences from pre- to post-collaboration. To measure change in risk preferences, the same absolute difference scores between block 1 and block 3 risk preferences from Hypothesis 3 were used. Spearman's correlations revealed no significant relationships between changes in risk preferences and the four attention metrics on the Stroop Task: overall Stroop Task accuracy (r_s = .04, p = .846), congruency trial accuracy (r_s = .14, p = .475), incongruency trial accuracy (r_s = .01, p = .950), and congruency-incongruency difference scores (r_s = -.03, p = .901).

Discussion

The primary objective of this thesis was to examine how an individual difference cognitive factor (attentional control) relates to risky choice preferences in both an individual and social laboratory setting. The preliminary results contribute to the literature with the finding that social influence can affect individual risk preferences, while also extending the research in exploring a novel component of the effect of attentional control on risky choice in group decision-making environments. The hypotheses in the present study mainly focused on replicating various social influence effects that have been observed in other decision domains (i.e., delay-based decisions) in the risky decision-making domain. Additional research questions then investigated the relationship between attentional control and these hypothesized social influence effects.

The first hypothesis focused on better understanding how dyads make risky decisions. Specifically, it was hypothesized that dyad risk preferences would be positively related to a combination (average) of the two members' respective individual preferences. This was tested by correlating risk preferences exhibited by dyads in the collaborative second block with the average of the two members' baseline risk preferences recorded during the first block. Despite not reaching statistical significance likely due to the current small number of dyads (n = 14), a moderate to strong positive correlation was observed between dyad risk preferences and the member's averaged individual risk preferences. This finding supports the presence of an averaging effect in dyad risky decision making that has been found in group decision making in other decision domains (e.g., delay discounting; Bixter et al., 2017).

The second hypothesis tested the extent collaboration in the dyad condition would lead to social influence on the individual risk preferences of dyad members. This was accomplished by exploring if risk preferences during the post-collaborative third block were more similar between dyad members compared to their baseline risk preferences during the first block. A convergence effect was observed where risk preferences did become significantly more similar within dyad members following collaboration. Moreover, participants in the individual condition provided a relevant control condition for this hypothesis. Specifically, nominal dyad pairs were created to see if two participants' risk preferences naturally converge over time (e.g., as a statistical artifact such as regression-to-the-mean). Results demonstrated that the nominal dyads did not become significantly more similar over time (in fact they tended to diverge), suggesting that the convergence observed in the dyad condition likely stems from social influence. Presumably, participants in the dyad condition were exposed to the new risk preferences of their partner during block 2. This exposure presented not only the ability to alter each other's risk preferences during collaboration, but went on to influence the direction of their individual risk preferences (e.g., more risk averse or more risk tolerant) even when the members went back to making decisions individually.

The third hypothesis provided further support of social influence occurring in the dyad condition. Specifically, it was investigated if participants in the dyad condition adjusted their risk preferences from the first block to the third block significantly more than participants in the individual condition. When analyzing absolute differences in risky choice proportions between these two blocks, participants in the dyad condition were found to adjust their risk preferences at a significantly higher rate than participants in the individual condition. This finding is in accordance with the above findings and suggests that social context plays a prominent role in shaping changes in risk preferences at the individual level.

Conceptualizing how risky decision outcomes may be influenced by social context is vital given that engaging in group environments is a common occurrence. The influence group environments can potentially have on risky decision making is with respect to social norms theory that propose the idea that the direction of effects of social context on risk behavior will depend on specific expectations about the behavior that is endorsed by the specific group (Tomova et al., 2018). The preliminary results of the current thesis provide evidence that observing others' risk preferences when working collaboratively on a probabilistic reward task can subsequently influence an individual’s own risk preferences. These findings support prior research (Brunette, 2015; Chung et al., 2015; Reiter et al., 2019), demonstrating that risk preferences can systematically be altered by both observation and collaboration with others. With respect to Reiter et al. (2019), who found risk contagion to be positively associated with real-life social integration, the current findings suggest a convergence effect following social interaction. Risk contagion is defined as the modulation of individual risk preferences through observing and learning from others’ risky behaviors (Reiter et al., 2019). The detection of a convergence effect occurring post-collaboratively within the dyad condition connects directly to this idea, since risk preferences significantly changed and became more similar once individuals were exposed to another’s risk preferences.

Additionally, another component of this study was to further demonstrate that expectation models are able to effectively measure risk preferences. With respect to Holt and Laury (2002), Anderson and Mellor (2008), and Barsky et al., (1997), it is known that utilizing an experimental setting and a probabilistic reward task to infer individual risk preference is able to relate to several other forms of consequential behavioral outcomes, including drinking, unsafe sexual practice, and smoking. The present study offers additional insight that this approach is applicable beyond the individual level and can successfully model risk preferences within a dynamic social environment.

Another aim of the current thesis was to explore the extent an individual difference factor (attentional control) relates to the above risky decision making effects (both at the individual level and in the dyads). With the prior understanding that risk preferences are dependent on probability computations, it is often assumed that participants possess the ability to accurately and effectively compute expected value, something that would be reliant on underlying cognitive mechanisms (Amador-Hidalgo et al., 2021). Furthermore, behavior that is reward-driven has been found to enhance selective attention. Thus, in order to be capable of optimal decision-making amongst a group setting could require increased attentiveness. Relevant literature on this topic has suggested that learned stimulus-reward associations, something that is largely influential in guiding behavior and aids in estimating reward value, can enhance one's ability to quickly identify and differentiate stimuli, something that is largely dependent on attentional control, making it an important process to consider in reward-driven risk analysis (Roper et al., 2014).

Overall, the majority of the thesis research questions did not provide meaningful results of a relationship between attentional control and risky decision making. This is likely due to limitations from the current small sample size as well as the attention tasks displaying a bit of a ceiling effect (see Limitations below for details). However, the second research question was able to detect a potential trend that could provide insight into the interrelated relationship of cognitive (attentional) mechanisms and social environments. Specifically, the results tentatively suggest that dyad members with higher attention may affect the dyad decision-making process more than the dyad members with lower attention. The preliminary results demonstrated a noticeably stronger correlation between dyad block 2 risk preferences and the baseline block 1 risk preferences of the higher attention dyad member. This potential relationship could bring to light a unique dynamic that could be occurring between cognitive processing and a social environment. Therefore, it will be important to see if this trend holds up and becomes statistically significant once the full sample size is achieved. If so, these results would suggest that those with higher attentional control might affect the decisions made in small-group settings to a greater extent, demonstrating a complex interaction between cognitive mechanisms and risk preferences exhibited in a collaborative environment. These findings, if substantiated, could also further suggest there may be underlying mechanisms involved that are perhaps rooted in one's individual confidence, motivation, or personality that may be constituting this relationship between one's attentional control and their behavior in groups. However, further research would need to be conducted to further support this claim.

Implications

Better understanding potential influences of risk preference and decision making is important in effectively being able to instill strong decision making skills and effective risk aversion tactics in individuals. There are confounding obligations expected in those of an adult age that consist of career, finances, or family duties that present scenarios that may lead to serious consequences without the proper ability to assess risk (Spohn et al., 2022). The preliminary findings of the current study have the potential to expand our knowledge of what may influence risk preferences at both the individual and small-group level.

Much of the literature on improving the processing of risk remains at the adolescent and child levels. While understanding influences of adolescent and child risky decision making is of course valuable, understanding risky decision-making at the adult-level furthers this line of research. Understanding what influences risk preferences in adulthood offers unique insight into how decisions might be evaluated when the losses/gains may be from a more critical standpoint. There are several consequences that coincide with poor risk behaviors including premature death, disabilities, and increased incidence of chronic diseases (Sohrabivafa et al., 2017). On a less severe scale, making large purchases, needing to pay bills, credit card usage, or having children are all situations that require the weighing of risk and reward. Despite the present study only addressing hypothetical economic risk, as previously discussed, utilizing expectation models in an experimental setting is associated in a cross-domain fashion with various different consequential risk behaviors (Anderson & Mellor, 2008).

Limitations and Future Directions

Several limitations should be considered when interpreting this study's findings. To begin, this study only presents tentative results that are subject to change once the full target sample size is achieved. Currently, there are 65 participants included in the above analyses, but the data collection will remain ongoing until the target sample of 200 participants is achieved. Further, using an undergraduate research pool to obtain participants for this study caused the vast majority of the participants to be aged between 18-21 years old. Despite having a few older participants that widened the age range, the mean age of participants remained at around 19 years old. With this in mind, the majority of the sample consisted of college-aged individuals who possess unique cognitive processing abilities that may differ from individuals in the general population (Reiter et al., 2019). To make this study more generalizable to the entire adult population, future studies should accumulate a sample with more diverse age groups. Additionally, both of the cognitive attention tasks displayed ceiling effects which made it difficult to properly analyze attentional control in the smaller sample size. This ceiling effect was likely due to the tasks being too simple for the participants and could have resulted in the measurement to lose diagnostic value. Future studies should utilize cognitive tasks that are more challenging in order to get greater variability.

The present findings broaden the understanding of the influence social context has on the risky decision making process. Future research could extend this understanding by analyzing risky decision making from a cross-cultural lens, with the introduction of potential differences that are apparent between individualistic and collectivist cultures. An individualistic society emphasizes a culture where individuals behave in accordance with their own self-interests and personal preferences, and this culture would be most apparent in the present sample given the individualistic nature of the United States. Given this study's focus on social context, findings may be different and could present an even stronger effect in a country that follows a collectivist culture, where individuals may be regarded as more interdependent and might take other's opinions into a deeper consideration (Spohn et al., 2022).

Beyond the present study's mentioned limitations that could have affected the research questions dealing with attentional control, there are several other considerations that could have generated the non-significant findings. Visual attention allows one to adapt to moment-by-moment environmental change, as well as to respond to salience and rewards (Roper et al., 2014). Discussed by Ghosh and Maunsell (2022), there is a notable relationship between attentional mechanisms and reward, more specifically emphasizing that past literature has had difficulty dissociating attention processes from reward expectation (Ghosh and Maunsell, 2022). Sufficient attentional deployment can aid the process of maximizing rewards while minimizing losses, which is a crucial component in the decision making process (Roper et al., 2014). However, this relationship has been found to weaken when external reward expectation is low. For example, an individual that is unmotivated is not likely to respond to a rewarding stimulus. However, when reward is defined by motivating factors, attention and reward expectations tend to co-occur. Through neuroimaging studies it has been observed that neural correlates associated with reward processing and attention processing involve similar brain region activity (Ghosh and Maunsell, 2022). Based on the non-significant results found in the current thesis, it is important to note that it did not take into account motivational mechanisms and reward expectations. Future studies could seek to increase task motivation such as using real rewards instead of hypothetical rewards, which may then demonstrate a stronger direct relationship between attentional mechanisms and risky decision making.

Additionally, as previously discussed by Lilleholt (2019), when analyzing cognitive ability it is important to address that cognition is multidimensional. It is important to identify particular mechanisms that can relate to decision outcomes. Despite this study executing this point with a focus on attentional control, there are other components of executive functioning that might display a stronger effect on the risky decision making process. Donati et al. (2014) investigated decision making with respect to fluid intelligence and probabilistic reasoning. Results suggested that having greater fluid intelligence was directly related to having a greater ability to reason in probabilistic terms, and this led to a greater chance of making advantageous choices. In other words, probabilistic reasoning acted as a mediator between fluid intelligence and decision making. This suggests that in a real-world setting when presented with a risky choice, the findings of Donati et al. (2014) propose that probabilistic reasoning could play a crucial role in helping make advantageous choices. Perhaps addressing other components of executive functioning could help gain further insight into how executive functioning may play a role in shaping risk preferences in both individual and small-group settings.

Conclusions

Though preliminary, the results of the current thesis suggest a strong impact of social context on shaping risk preferences. Specifically, individual participants exhibit significantly similar risk preferences after interacting with one another in a collaborative environment. The results that include the individual difference factor of attention were largely non-significant. Yet, some potential trends within the dyad data were that the member with higher attention may have exerted a stronger impact on the dyad decision-making process than the member with lower attention (as measured by the Stroop task). However, any definitive conclusions relating to these results will need to wait until the full sample size is achieved.

The current study builds upon existing research as well as provides telling insight into influential components of risky decision making. Building on the previously discussed claim provided by de-Juan-Ripoll et al. (2021), the best understanding of risky decision making is dependent on the consideration of decision features, situational factors, and individual differences. The present study utilized these three elements in an interrelated fashion to attempt to better understand how these factors may interact with each other to produce an effect on the risky decision making process. Despite promising research that has analyzed these elements at the individual level, not considering the interaction of these influences is too narrow of an approach. Here, multiple lines of research were combined to exemplify that decision making is multi-faceted and complex. This knowledge is paramount to help improve the understanding of an individual's ability to strategically assess risk in the presence of others.

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