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Individual differences in a within-subjects risky-choice framing study

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ABSTRACT

A within-subjects study investigated several different risky-choice framing problems patterned after Kahneman and Tversky's classic economic game, the Asian Disease problem, but included variations to increase generality. Risk-style and thinking-style were utilized to predict individual differences in response to the framing problems. Significant framing effects were found at both the item and composite level. Individual difference effects were rare when framing was strictly defined as a preference reversal. When a more encompassing preference shift defined framing, risk-averse individuals (measured by the Choice Dilemmas Questionnaire) and those scoring high on experiential (heuristic) thinking were more likely to show a framing effect. Discussion focuses on the meaning of these results in terms of individual susceptibility to framing.

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1. Introduction

One of the most important situational influences on risky-choice is the effect of framing (Tversky & Kahneman, 1981). Framing is the switch in individual risk preferences when different language is used to describe objectively equivalent problems (Tversky & Kahneman, 1981, 1984). In the classic "Asian Disease" problem developed by Tversky and Kahneman, participants were asked to choose between a risky and a riskless ("sure-thing") option. When outcomes were presented in terms of lives saved (gains), individuals were risk-averse; when outcomes were presented in terms of lives lost, individuals were risk-seeking. There was no difference in the actual outcomes in the gain and loss conditions; the only difference was the wording of the description.

Subsequent research showed the effects of framing on risky choice to be less universal than the original research suggested (Fagley & Miller, 1990; Fischhoff, 1983). The diversity of results in framing studies has led to a litany of research trying to confirm "when" and "where" framing affects risky choice. Levin, Schneider, and Gaeth (1998) argued that inconsistent results in framing studies occurred largely because researchers examined highly disparate phenomena under the framing effects rubric. In risky-choice framing: (a) what is framed is a set of options with different risk levels; (b) what is affected is risk preference; and (c) the effect is measured by a comparison of the frequency of choices of the risky option. Based on their meta-analysis, Kuehberger, Schulte-Mecklenbeck, and Perner (1999) noted that considerable variability in responses still existed even within the narrow risky-choice framing area. To some extent, these differences could be accounted for by problem characteristics such as probability, payoff, and problem domain (see also Weber, Blais, & Betz, 2002). However, the effect of framing on risky choice was not wholly contingent on problem characteristics. Some research has looked at individual differences to try and understand the varying nature of the framing effect (Lauriola, Russo, Lucidi, Violani, & Levin, 2005; Simon, Fagley, & Halleran, 2004). Other research has focused on whether framing is both a within-subject and between-subjects phenomena (Levin, Gaeth, Schreiber, & Lauriola, 2002).

The majority of framing and risky-choice studies have employed between-subjects designs, where one group receives loss-framed and the other group receives gain-framed problems (Kuehberger, 1998). In within-subjects designs, each participant receives both the gain- and loss-frame problems. While both designs can be a rich source of information, analysis of individual responses in within-subjects studies can establish the extent to which the traditional framing effect of risk-aversion in gain-frames and risk-seeking in loss-frames, as well as other responses to framing, occurs at the individual level (Frisch, 1993).

The results of within-subjects designs often show the traditional framing effect (Kuehberger, 1998). However, Frisch's (1993) within-subjects design resulted in only 29% of participants manifesting the predicted framing effect in gain and loss problems. Similarly, 29% of individuals in Stanovich and West (1998) showed the framing effect. The size of the framing effect in these studies

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was much smaller than the effect found in between-subjects studies (Tversky & Kahneman, 1981). However, it is important to note that framing effects can be defined strictly as a *preference reversal*, or more liberally as a *preference shift*. The strictest criterion for a framing effect is the "preference reversal" or "reflection effect" where the majority of choices to positively framed problems are for the risk-aversive option and the majority of choices for negatively framed problems are for the risky option. This is the pattern found by Tversky and Kahneman (1981) in their Asian Disease problem and the pattern predicted by their prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). However, Levin et al. (1998) in their survey of studies of risky-choice framing effects found another common pattern of results, the "preference shift" where more risky choices are made in the loss (negative) frame than in the gain (positive) frame but where there is not a literal reversal (e.g. 75% versus 55%). In the current study we consider both the traditional (strict) definition of risky-choice framing as a *preference reversal* and a less stringent definition of risky-choice framing as a *preference shift.*

1.1. Individual differences

Framing research has also attempted to identify personal characteristics that make individuals more or less susceptible to framing. Several individual differences have been posited as important. Kuehberger (1997) identified risk-style and thinking-style as important individual characteristics in risky-choice situations. Risk-style is considered a relatively stable continuous variable where at one end of the continuum are risk-seeking people and at the other are risk-averse people (Keeney & Raiffa, 1976).

Paper-and-pencil measures originally developed to measure specific risk behaviors are used as measures of risk-style in framing and risky-choice problems. For example, Fagley and Miller (1990) assessed risk-taking propensity (i.e. risk-style) as a combination of participants' scores on two self-report measures: Kogan and Wallach's (1964) Choice Dilemmas Questionnaire (CDQ) and Shure and Meeker's (1967) Risk Avoidance Scale (RAS). The CDQ was originally designed to measure group polarization in risky decision-making. The RAS was originally designed to assess risk-tendencies in bargaining and negotiations. The combination of these measures was justified as broadening the risk construct (Fagley & Miller, 1990). Fagley and Miller predicted risk-style would moderate the effect of framing on risky choice in five framed risky-choice problems from different task domains. Surprisingly, risk-style did not moderate the effects of framing on choice, nor show any significant relationship with risky choice. Erker (2000) conducted a study using the same composite risk-style measures and more complex dependent measures. Interestingly, in one condition Erker (2000) found that risk-averse participants generally chose the certain option and risk-seeking participants generally chose the risky option regardless of frame. Lauriola et al. (2005) also found risk-style moderated people's framing responses. They compared approach and avoidance response styles and found that scores on the Reward Responsiveness subscale of the BAS (Behavioral Activation System) predicted risk-seeking for positively framed risky health choices while scores on the anxiety subscale of the BIS (Behavioral Inhibition System) predicted risk-seeking for negatively framed choices.

Inconsistent findings for risk-style may be due to the fact that the risk measures utilized in these studies did not take into account what sort of risk is embodied in answering hypothetical risky gambles. The idea that risk is situation-specific has led researchers to try to identify what aspects of risk are important in a given situation, and thus they developed instruments measuring these important aspects (Yates & Stone, 1992). In fact, Blais and Weber (2006) recently identified five different risk domains: ethical, financial, health and safety, recreational and social. They believe that people both perceive risk differently and engage in different magnitudes of risky behavior contingent on the type of risk they encounter. Their measure, the Domain Specific Risk Attitude Scale (DOSPERT), has revealed consistent differences in risk perceptions and behavior across these domains. With this in mind, the current study focuses on risk within the health domain.

Zaleskiewicz (2001) investigated a relevant distinction in the risk construct, informed by research in both economic and psychological risk behavior, which may aid in understanding responses in framing and risky-choice situations. Zaleskiewicz proposed that risk-taking could be influenced by two different motivations he called instrumental and stimulating risk. Instrumental risk-takers take risks to achieve their goals. Facing a decision involving risk, instrumental risk-takers will carefully analyse the probabilities of success and choose the option that helps them achieve their goals. In contrast, stimulating risk-taking is specifically motivated by the affect associated with risk. This is a similar conceptualization of risk as Loewenstein, Weber, Hsee, & Welch's (2001) concept of 'risk as feelings' experienced at the moment an individual makes a decision. According to Zaleskiewicz, stimulating risk-takers find risk-taking exciting, and this excitement motivates engagement in further risk-taking. A decision based on stimulating risk is made rapidly; the emotion associated with the risk is the goal in and of itself (Zaleskiewicz, 2001). To assess these two aspects of risk, Zaleskiewicz developed the Stimulating Instrumental Risk Inventory (Stimulating Instrumental Risk Inventory), which was utilized to assess risk-style in the current research.

Cognitive variables have often been considered in framing situations. Stanovich and West have provided an extensive research program investigating the relationship between proxies of cognitive ability and various heuristics and biases, such as risky-choice framing (Stanovich & West, 1997, 1998, 1999, 2000, 2008). They recently concluded that cognitive ability is "relatively independent" of thinking biases such as the framing effect. However, they did note the potential for different cognitive ability effects in within-subject studies than between-subject framing studies.

Thinking-style has also been considered as a possible moderator of the framing effect. Epstein's (1998) Cognitive Experiential Self-Theory (CEST) distinguished between rational and experiential systems of thought, which are associated with different types of information processing. Heuristic processing, which allows quick decisions but is associated with judgment errors, is primarily associated with the experiential system. More deliberate thought processes, such as normative and statistical reasoning, are primarily associated with the rational system (Epstein, 1998). A fundamental tenet of CEST is that behavior is jointly determined by both processing systems. Epstein, Pacini, Denes-Raj, and Heier (1996) developed the Rational Experiential Inventory (REI) to measure rational and experiential thinking-styles. The present study uses the 24 item REI-short form (Norris & Epstein, submitted for publication).

Shiloh, Salton, and Sharobi (2002) believed that thinking-styles could explain differences in the effects of framing on risky choice. However, Shiloh et al. did not find that the rational system alone moderated the effect of framing on risky choice. Rather, only individuals with complementary (high rational/high experiential) and poor (low rational/low experiential) thinking-styles showed a framing effect. Along these lines, Simon et al. (2004) found that the framing effect was moderated by the combination of need for cognition and depth of processing. Based on these mixed findings and diverse explanations, further research is necessary to better understand how thinking-style and framing risky-choice situations are related.

1.2. Present study

This study examines individual responses to both gain- and loss-frames across five different risky-choice problems. Participant responses are investigated at the item-level (how each person responded to the gain and the loss-frame of a problem) and at the composite level (individual responses across the gain and loss-frame of all five risky-choice problems).

When deciding on the characteristics of the framing problems to use in this study, the authors relied on the Kuehberger et al. (1999) study. Kuehberger et al. (1999) found that probabilities (the percentage attached to the risky option), payoffs (the score of items affected), and problem domains (such as health or money) have an effect on individual choice preference. Specifically, higher probabilities led to more risk-aversion for gains and more risk-seeking for losses, while higher payoffs led to more risk-aversion regardless of framing. Furthermore, people responded qualitatively differently in some problem domains (human lives) than they did in others (financial problems). This study was not focused on the difference in participant responses across domains. Therefore, all framing problems were in the health domain, and dealt with life threatening human diseases: AIDS, lung cancer, leukemia, and the classic Asian Disease. Furthermore, the probabilities in the risky option ranged from one-third to one-half and the payoffs ranged from 60 to 10,000, in the range specified by Kuehberger et al. (1999). In addition to addressing these concerns in the framing literature, it was thought that varying these problem characteristics made the study more interesting for participants.

The present research will examine the extent to which risk-style and thinking-style determine choices in framed risky-choice situations. Risk-style will be assessed in two different ways. First, we employ the traditional method, using Kogan and Wallach's (1964) CDQ and Shure and Meeker's (1967) RAS. In this context where individuals receive both gain- and loss-framed forms of several risky-choice problems, risk-style is expected to emerge as a moderator of the framing effect. In addition, this study will use the SIRI (Zaleskiewicz, 2001) to assess how individuals' stimulating and instrumental risk motivations may affect their choices in framed risky-choice situations. This will be the first use of the SIRI measure in a decision-choice context. The use of this measure aims to establish whether a distinction between stimulating and instrumental motivated risk aids in understanding responses in framing and risky choice. Further, a comparison of these three risk-style measures will establish whether the old risk-style measures, or the newer, more narrow measures informed by the supposed situational-specificity of risk, are better for risk-style assessment.

The present research also examines the extent to which thinking-style leads individuals to be differentially susceptible to framing in risky-choice situations. Several studies have assessed thinking-style as a moderator of the framing effect (Shiloh et al., 2002; Smith & Levin, 1996). However, these studies have led to different conclusions about the nature of the effect. The 40-item REI (Epstein et al., 1996) has been proven a useful measure of thinking-style, and has predicted susceptibility to framing in risky-choice situations (Shiloh et al., 2002). Uniquely, the present study will utilize the shorter 24-item REI-short form. Here, thinking-style is measured when individuals receive multiple gain- and loss-framed risky-choice problems. A design where individuals receive multiple gain and loss-framed risky-choice problems may prove ideal for rational and experiential thinking-style to emerge as moderators of the framing effect.

Finally, this study investigates the effect of multiple individual differences simultaneously in a simple framing and risky-choice situation. This approach corresponds to Bromiley and Curley's (1992) within-situation trait approach, which has seldom been used when investigating individual differences in framed risky-choice problems. Despite the fact that multiple individual differences are thought to moderate the framing effect, research has too frequently looked at each individual difference in isolation. For example, separate literatures established risk-style (Fagley & Miller, 1990; Schneider & Lopes, 1986) and thinking-style (Shiloh et al., 2002) as having an impact in framed risky-choice situations. However, the relative importance of these individual differences was never established. The joint assessment of these distinct variables, may establish whether each moderates the effect of framing on risky choice. Perhaps the more important predictor will be identified.

This study furthers existing research in several ways. First, the use of multiple risky-choice framing problems in a within-subjects context increases reliability and generalizability. Second, this design may allow for a richer account of the effects of individual differences in risk-style and thinking-style. Third, this study introduces novel risk style measurement instruments to the risky decision literature.

The following hypotheses were examined in the current study:

Hypothesis 1a. Framing affects composite level risky choice.

Hypothesis 1b. Framing affects item-level risky choice.

In each case more risk-taking is predicted with negative frames than with positive frames.

Hypothesis 2a. Risk-style will moderate the effect of framing on item and composite level risky choice.

Hypothesis 2b. Thinking-style will moderate the effect of framing on item and composite level risky choice.

It was expected that people with moderate risk-styles would manifest the largest framing effects at the item and composite level because they would be more flexible. Both rational and experiential processing are hypothesized to moderate the extent to which framing affects risky choice. Previous studies found that thinking-style moderates the effects of framing on risky choice, but the nature of this relationship has varied (Shiloh et al., 2002; Smith & Levin, 1996). The present research replicates these studies, and extends them, with a different sample and different framing problems. Subsequent analyses will establish whether the results here are more similar to Smith and Levin's (1996) results or Shiloh et al.'s (2002) results. In this study, both rational and experiential processing are hypothesized to moderate the extent to which framing affects risky choice. Specifically, individuals with a low rational thinking-style score are predicted to show smaller framing effects than individuals with moderate or high rational thinking-style scores. Furthermore, individuals with high experiential scores are predicted to show larger framing effects than individuals with moderate or low experiential thinking-styles.

2. Method

2.1. Participants

The desired sample size for this study was at least 160 participants based on a power analysis. Given an expected medium effect size of .5 and $p < .05$ (Cohen, 1992), this leads to acceptable power of .99 (Cohen, 1998). A total of 184 undergraduates from two large mid-western universities voluntarily participated. The final sample exceeded the number of participants necessary for acceptable power. The sample consisted of 80 male and 104 female students with a mean age of 23 (SD = 6.38).

2.2. Design

This study used a within-subjects design to assess the impact of framing on risky choice. The independent variable was the frame of the risky-choice problem with two levels: gain and loss. For example, a gain-framed problem says that a particular choice may lead to a certain number of lives being saved, while a loss-framed problem says that the choice may lead to a certain number of lives being lost. The dependent variable was participants' dichotomous choice of either the riskless ("sure-thing") or risk-seeking ("risky") option to each framing problem. Each participant answered five gain-framed risky-choice problems and five matching loss-framed risky-choice problems. Additionally, participants completed individual difference measures of both risk-style and thinking-style which were viewed as potential moderators of framing effects.

2.3. Measures

2.3.1. Framed risky-choice problems

As seen in Appendix A, each problem required participants to choose between a riskless option where the outcome was known and a risky option of equal expected value where the outcome was unknown. The framing problems were adapted from earlier investigations of framed risky choice (Fagley & Miller, 1987; Levin & Chapman, 1990; Tversky & Kahneman, 1981). The problems dealt with life threatening human diseases: AIDS, lung cancer, leukemia, and two were variants of the Asian Disease problem. The probabilities and payoffs in the problems were varied in the range specified by summary studies of framed risky choice (Kuehberger, 1998; Kuehberger et al., 1999). The framing problems served as both item and composite level dependent variables. At the item-level, the dependent variable was each participants' choice of a sure-thing (coded as 0) or the risky option (coded as a 1). At the composite level, participants' scores ranged from 0 to 5, where a composite score of "0" indicated the choice of the sure-thing on all five problems, and a composite score of "5" indicated the choice of the risky option on all five problems. Participants' choice across all 10 items (0–5 across gain-framed problems, 0–5 across loss-framed problems) was an additional composite framing dependent variable.

2.3.2. Choice Dilemmas Questionnaire (CDQ)

The shortened version of the CDQ (Erker, 2000) consists of seven hypothetical choices, where individuals are required to indicate the minimum probability such that they would recommend a risky choice. The CDQ was originally designed by Kogan and Wallach (1964) to investigate the group polarization effect, but is often used to assess risk-style (Erker, 2000; Fagley & Miller, 1990). An alpha of .70 was obtained which is considered acceptable according to Nunnally (1978).

2.3.3. Risk Avoidance Scale (RAS)

The RAS consists of 24 items, where participants indicate their preference for participating in a potentially risky situation. Shure and Meeker (1967) found internal consistency reliability of .80. For the current study internal consistency was .84. For the purpose of increasing variance, the scale was expanded from a 3-point Likert scale to a 5-point Likert scale. An example is "I would like to dive from a high springboard" where participants indicated the extent of agreement with 1 "strongly disagree" to five "strongly agree" as anchors. Scores were summed over the 24 items to give a total risk-tendency score.

2.3.4. Stimulating Instrumental Risk Inventory (SIRI)

The SIRI (Zaleskiewicz, 2001) was used as a measure of risk-style and assesses stimulating and instrumental risk-tendencies. The measure uses a 4-point Likert scale with 1 "does not describe me at all" to four "describes me very well" as anchors. The stimulating subscale contains 10 items and the instrumental subscale has seven items. An example of a stimulating item is "I am attracted by different dangerous activities". An example of an instrumental item is "If there was a big chance to multiply the capital I would invest my money even in the shares of a completely new and uncertain firm". In the current study the stimulating subscale had an alpha of .72 and the instrumental subscale had an alpha of .79.

2.3.5. Rational Experiential Inventory (REI)

The REI-short form was used to measure both rational and experiential thinking-styles (Norris & Epstein, submitted for publication). Rational thinking-style was measured by the rational scale of the REI (which is actually a modified version of Cacioppo and Petty's (1982) need for cognition scale). In the current study the rational thinking-style had an alpha of .84 which is consistent with previous research. An example item is "I would prefer complex to simple problems". The 12-item Faith in Intuition subscale measures experiential thinking-style. An example item is "I believe in trusting my hunches". The experiential thinking-style scale had an alpha of .85 which is consistent with previous findings for internal consistency. Both subscales are answered on a 5-point Likert scale with 1 "Definitely False" to 5 "Definitely True" as anchors.

3. Results

Bivariate inter-correlations between and among each individual framing choice (gain- and loss-frames of each problem as well as composite gains and composite losses) were examined. The highest correlation between individual problems was between the two gain-framed Asian Disease problems (G1 and G2) (.60), and between the loss-framed leukemia and AIDS problems (L3 and L4) (.58). The correlation between number of risky choices for composite gains and composite losses was significant, $r = .42$ ($p < .01$).

3.1. Correlations between individual difference variables

Correlations between individual difference variables including gender are presented in Table 1. Several of the risk-taking measures were significantly correlated. The strongest correlation was between the RAS and the SIRI ($r = .65$, $p < .01$). In addition, CDQ scores showed negative correlations with the other risk measures, but since high scores on the CDQ are indicative of risk-aversion, the CDQ is conceptually positively related to the other risk-taking measures. The correlations between the demographics and

Table 1
Correlations between individual difference measures and gender.

	REI	RA	EX	SIRI	ST	IN	CDQ	RAS	GR
REI									
RA	.83**								
EX	.81**	.34**							
SIRI	.14	.05	.18*						
ST	.07	.05	.13	.86**					
IN	.16*	.09	.18*	.85**	.45**				
CDQ[a]	−.03	.05	−.10	−.38**	−.34**	−.30**			
RAS	.01	−.01	.03	.65**	.65**	.46**	.34**		
GR	−.02	−.13	.11	−.29**	−.22**	−.27**	−.01	−.27**	

Note: Rational Experiential Inventory (REI), $N = 183$, where RA = rational and EX = experiential. Stimulating Instrumental Risk Inventory (SIRI), $N = 182$, where ST = stimulating and IN = instrumental. Choice Dilemmas Questionnaire (CDQ), $N = 182$; Risk Avoidance Scale (RAS), $N = 184$; GR = gender, $N = 184$.

* $p < .05$.

** $p < .01$.

[a] For the CDQ, high scores were indicative of risk-aversion. Thus, negative correlations actually suggest the content of the measures are positively correlated.

individual difference variables showed that participants' gender (females = 1 and males = 0) correlated significantly with RAS ($r = -.27$, $p < .01$) and SIRI scores ($r = -.29$, $p < .01$), with women more likely to be risk-aversive. Given the correlations between gender and two of the individual difference measures, it was decided that gender was to be included as a between-subjects factor in subsequent analyses of individual differences.

3.2. The effect of frame on risky choice

Risky-choice framing effects have historically been defined as either preference shifts or preferences reversals. First we establish the existence of framing effects using both preference shift and preference reversal definitions but particularly when investigating individual differences in framing effects, we consider the framing effect as a continuous rather than a categorical variable. We employed Analysis of Variance (ANOVA) where the number of risky choices is the dependent variable and we look for interactions between framing condition and the various individual difference factors. We also used regression analysis with the difference between the number of risky choices in the loss and gain-frames as the criterion variable and the individual difference factors as predictors.

The first hypothesis explored the effects of framing at the composite level. Participants' composite number of risky choices on gain trials and loss trials were compared. As expected, there was a significant difference between composite gains and losses, $F(1, 183) = 89.8$, $p < .001$. The effect size was partial $\eta^2 = .33$, indicating a small to moderate-sized effect. On average, participants indicated a risk-averse preference on gain trials ($M = 1.73$ risky choices out of 5, SD = 1.72 and a risk-seeking preference on loss trials, $M = 3.07$, SD = 1.82). Overall, the data provide strong support for Hypothesis 1a.

The prevalence of framing effects was then compared employing the different criteria. While 57.1% of the sample (105/184) manifested a preference shift of more risky choices on loss trials than on gain trials at the composite level, only 9.2% (17/184) displayed "perfect" preference reversals (where participants selected the sure-thing option in every gain-frame, and also chose the risky option in every loss-frame). A more lenient interpretation of preference reversal (where participants selected the sure-thing option in most gain-frames and the risky option in most loss-frames) resulted in 35.5% (65/184) showing an effect.

Hypothesis 1b investigated differences in participant responses in gains and losses at the level of individual problems (see Table 2). For this analysis, five paired sample *t*-tests were conducted to ascertain if, as expected, mean participant risky choice was significantly different in gain-frames than in loss-frames for each specific problem. *p*-Values were adjusted through the use of the Bonferroni correction. For all five gains and matching losses, number of risky choices on gain trials was significantly lower than on loss trials, as hypothesized. The mean differences across the five gain and loss problems ranged from .15 to .34, indicating the size of the effect differed from problem to problem. Nonetheless, the results provide consistent support for Hypothesis 1b.

Table 2
Paired sample *t*-tests: comparison of gain- to matching loss-framed risky-choice items.

	Mean difference	*t*
G1L1	−.30	−7.67*
G2L2	−.24	−5.69*
G3L3	−.29	−6.94*
G4L4	−.15	−3.50*
G5L5	−.34	−8.44*

Note: Analyses are based on $N = 184$. The problem domain for each pair of problems is as follows: G1L1 = Asian Disease, G2L2 = Asian Disease, G3L3 = Lung Cancer, G4L4 = AIDS, and G5L5 = Leukemia.
* $p < .01$.

3.3. Individual differences and framing

To examine the effects of the individual differences variables utilizing repeated-measures ANOVA, a decision was made to trichotomize the individual difference variables. A split at 33% and 66% was performed on all the individual difference variables. Table 3 provides a summary of the scoring key and cutoff scores for each variable. The practice of splitting individual difference variables into groups is common in the framing and thinking-style literature (Shiloh et al., 2002; Smith & Levin, 1996). Given the within-subjects nature of this study, it was believed the trichotomized variables facilitated interpretation.

To assess the individual difference variables as moderators of the framing effect, repeated-measures ANOVAs were performed using number of risky choices as the dependent variable, framing condition as a within-subjects factor, and the individual difference variables as between-subjects factors. These analyses allow examination of the framing effect at different levels of each individual difference variable. Gender was included for the risk-style hypotheses as a between-subjects factor due to its correlation with the risk scales.

Table 4 presents results when risk-style, measured by the CDQ was entered as the between-subjects factor. A significant main effect for framing was found with no significant main effect for gender. Additionally, there was not a significant interaction between frame and gender. There was no main effect for the CDQ. However, there was a significant interaction between CDQ and framing. A graph plotting this interaction is presented for illustrative purposes (see Fig. 1). The graph shows that individuals who scored as risk-averse on the CDQ showed a greater framing effect than the other risk groups. This result conflicts with the hypothesis that the largest framing effect occurs in individuals with moderate risk-styles because risk-averse individuals showed lower risk-taking than others on gain trials but not on loss trials. The results show support for CDQ risk as a moderator of the framing effect at the composite level.

When RAS was examined as a between-subjects factor, the predicted interaction between RAS scores and frame was not significant. When risk-style as measured by the SIRI was examined as a between-subjects factor, no significant interaction emerged between frame and SIRI scores. When risk-style as measured by the stimulating and instrumental subscales of the SIRI were examined as between-subjects factors treating stimulating and instrumental

Table 3
Key for trichotomized individual difference variables.

Scale	Risk-averse	Risk-moderate	Risk-seeking
CDQ	47–70	37–46	7–36
N	68	56	60
RAS	27–63	64–73.99	74–100
N	58	62	64
SIRI	27–35	36–42	43–59
N	53	63	66
ST	9–14.99	15–18.99	19–32
N	46	71	65
IN	8–14	15–18	19–28
N	59	61	62
Scale	Low	Moderate	High
EX	12–39	40–44	45–58
N	61	58	64
RA	16–39	40–45	46–60
N	58	59	66

Note: ST = stimulating subscale; IN = instrumental subscale; EX = experiential subscale; and RA = rational subscale.

Table 4
Repeated-measures ANOVAS for framed risky-choice problems with risk-style measures.

Effect	SS	df	MS	*F*	η^2
CDQ					
Between-subjects					
Gender	7.57	1	7.57	1.69	.01
CDQ	3.16	2	1.58	.35	.00
Gender × CDQ	8.22	2	4.11	.92	.01
Error	799.05	178	4.49		
Within-subjects					
Frame	148.42	1	148.42	82.99**	.33
Frame × Gender	1.94	1	1.94	1.08	.01
Frame × CDQ	11.56	2	5.78	3.23*	.04
Frame × Gender × CDQ	.73	2	.37	.21	.00
Error	318.33	178	1.79		
RAS					
Between-subjects					
Gender	9.45	1	9.45	2.101	.01
RAS	7.97	2	3.99	.89	.01
Gender × RAS	1.00	2	.50	.11	.00
Error	800.31	178	4.50		
Within-subjects					
Frame	155.08	1	155.08	85.09**	.32
Frame × Gender	.68	1	.68	.37	.00
Frame × RAS	1.84	2	.92	.51	.01
Frame × Gender × RAS	4.35	2	2.18	1.12	.01
Error	324.42	178	1.82		
SIRI					
Between-subjects					
Gender	3.05	1	3.05	.68	.00
SIRI	1.18	2	.59	.13	.00
Gender × SIRI	14.26	2	4.13	1.58	.02
Error	794.19	176	4.51		
Within-subjects					
Frame	137.25	1	137.25	76.03*	.30
Frame × Gender	2.50	1	2.50	1.38	.01
Frame × SIRI	.67	2	.34	.19	.00
Frame × Gender × SIRI	1.38	2	.69	.68	.00
Error	317.74	176	1.81		

* $p < .05$.
** $p < .01$.

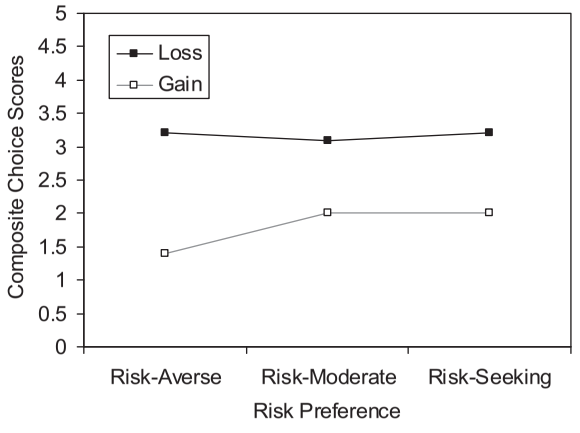

Fig. 1. Interaction between composite framing and CDQ risk scores. *Note*: Choice scores varied from 0 to 5 where 0 = risk-averse and 5 = risk-seeking. Gains = composite scores in gain-framed problems. Losses = composite scores in loss-framed problems.

risk as separate risk motivations, no significant main effect for stimulating risk or instrumental risk was found. Further, there was no significant two-way interaction between frame and the stimulating subscale, or between framing and the instrumental subscale. These results do not provide a great deal of support for risk-style as a moderator, as only one of the four risk style variables resulted in a significant interaction.

When rational and experiential thinking-style were assessed as the two between-subjects factors, no significant main effect or interactions involving rational processing emerged. See Table 5 for a summary of these results. There was a significant main effect for experiential processing on overall risky choice, with individuals moderate in experiential processing more likely to make risky choices. The interaction between framing and experiential processing was not significant. Thus, to this point, no support is provided for either part of Hypothesis 2.

A repeated-measures ANOVA was performed with frame (gain and loss) as a within-subjects factor and thinking-style measured by the experiential subscale of the REI and risk-style, measured by the CDQ, as between-subjects factors (see Table 6). This analysis focused on the joint effect of CDQ risk and experiential processing-style on framing and risky choice. CDQ risk again emerges as a significant moderator of the effect of framing and risky choice at the composite level. In addition, experiential processing had a significant main effect on framing and risky-choice composite scores, but experiential processing did not emerge as a significant moderator. There were no significant interactions between frame, CDQ risk and experiential scores. These results suggest that while CDQ risk-moderates the effect of framing on risky choice, experiential thinking-style does not moderate this relationship. Of the two individual differences variables, only CDQ risk influenced the effect of framing on risky choice.

Table 5
Repeated-measures ANOVA for framed risky-choice problems and rational and experiential subscales scores.

Effect	SS	df	MS	*F*	η^2
Between-subjects					
Rational	7.56	2	3.78	.89	.01
Experiential	33.78	2	16.89	3.97*	.04
Rational × Experiential	19.52	4	4.89	1.15	.03
Error	739.38	174	4.25		
Within-subjects					
Frame	144.75	1	144.75	80.40**	.32
Frame × Rational	1.65	2	.83	.46	.01
Frame × Experiential	9.37	2	4.68	2.60	.03
Frame × Rational × Experiential	6.35	4	1.59	.88	.02
Error	313.24	174	1.80		

* $p < .05$.
** $p < .01$.

Table 6
Repeated-measures ANOVA for framed risky-choice problems and CDQ and experiential subscale scores.

Effect	SS	df	MS	*F*	η^2
Between-subjects					
CDQ	1.35	2	.67	.15	.00
EX	40.21	2	20.10	4.59*	.05
CDQ × EX	4.19	4	1.05	.24	.01
Error	762.06	174	4.38		
Within-subjects					
Frame	154.54	1	154.54	89.13**	.34
Frame × CDQ	13.50	2	6.75	3.89*	.02
Frame × EX	10.22	2	5.11	2.95	.03
Frame × CDQ × EX	7.71	4	1.93	1.11	.03
Error	301.71	174	1.73		

* $p < .05$.
** $p < .01$.

Repeated-measures ANOVAs were performed with item-level gains and losses as within-subject variables, and trichotomized risk-style and thinking-style individual differences as between-subject variables. For the second Asian Disease problem, there was a significant interaction between experiential thinking-style and framing ($F(2174) = 5.17$, $p < .01$, such that people high in experiential thinking were more likely to show a framing effect. For the lung cancer problem, there was a marginally significant interaction between CDQ risk and framing ($F(2181) = 3.01$, $p = .05$). No other significant interactions were found.

To further test Hypothesis 2, a regression analysis examined if individual differences and gender would predict the composite framing variable (number of risky choices on loss trials minus gain trials). Results showed that experiential thinking ($\beta = .238$, $p < .07$), Choice Dilemmas Questionnaire Risk ($\beta = .152$, $p < .07$), and instrumental risk ($\beta = -.48$, $p < .10$) were marginally significant predictors.

t-Tests were run to see if gender or individual differences variables (risk-style or thinking-style) resulted in a framing effect (defined as preference shift) across all the framing problems. Gender was the only significant variable in these analyses ($t = -2.31$, df = 182, $p < .05$), with women emerging as more likely than men to show a framing effect.

Additional *t*-tests were conducted for each individual framing problem to see if gender (given its significant relationship in overall framing) or individual differences variables (risk-style or thinking-style) related to the preference shift framing effect. For the Asian Disease problem, gender ($t = -2.04$, df = 182, $p < .05$) was the only significant variable, with females showing a larger framing effect. For the variant of the Asian Disease problem, gender ($t = -2.6$, df = 182, $p < .01$) and experiential thinking ($t = -2.2$, df = 181, $p < .05$) were significant. Specifically, females showed a higher framing effect than males and individuals higher in experiential thinking were more likely to manifest the framing pattern. For the lung cancer problem, individuals who were CDQ risk-averse were more likely to show a framing effect ($t = -2.8$, df = 182, $p < .01$). For the leukemia problem, there was a tendency for CDQ risk-averse individuals to be more likely to show the framing effect ($t = -1.87$, df = 182, $p = .06$). For the AIDS problem, neither individual differences nor gender emerged as significant. Experiential thinking was marginally significant ($t = -1.76$, df = 181, $p = .08$), suggesting individuals higher in experiential thought were more likely to show a framing effect. However, these results are weaker and are of marginal reliability under strict tests that adjust for Type I error.

Given that CDQ and experiential thinking emerged as significant, further analyses examined risk-style and thinking-style together for their potential influence on preference shift. A median split was performed on the Choice Dilemmas Questionnaire and the Experiential Thinking Scale to create a new variable whereby individuals either scored high on experiential thinking and low on CDQ risk (high EX/low CDQ risk) or scored low on experiential thinking and high on CDQ risk (low EX/high CDQ). While median splits are associated with a loss of power, they are often used in the decision-making literature to simplify the exposition (e.g. Peters et al., 2006). An independent samples *t*-test ($t = -4.20$, df = 181, $p < .001$) showed individuals who were risk-averse and high in experiential thinking (cautious and intuitive) were more likely to manifest a framing effect than individuals with the opposite profile (risky and deliberative) with a fairly large mean difference of .31. Hypothesis 2 must then be amended to take into account the joint effects of thinking-style and risk attitude.

4. Discussion

This study extends research on the effect of framing on risky choice behavior and individual characteristics as moderators of the framing effect. It is unique in giving participants multiple framing problems (gains and losses) in a within-subjects design. The use of multiple framing items addresses reliability and generalizability issues of previous within-subjects studies, which often employed a single framing item. Framing researchers have suggested that some people may be able to recognize gains and losses as equivalent in within-subjects studies (Kahneman, 2003; LeBoeuf & Shafir, 2003), particularly those with high cognitive ability (Stanovich & West, 2008). This should reduce framing effects if individuals strive to appear consistent. The use of multiple problems likely diminished the frequency of this occurring while allowing a better understanding of the nature and magnitude of the framing effect at the individual level.

4.1. The effect of framing on risky choice

The framing effect was evident at both the item and composite level. This is consistent with prior research which found within-subjects framing designs result in significant framing effects (Frisch, 1993; Levin et al., 2002; Stanovich & West, 1998). The present findings are unique in that each individual received several gain- and loss-framed problems in a single session. Looking at gain- and loss-frames as composites can improve reliability in within-subjects framing studies, much as it did earlier in framing research in between-subjects studies. Furthermore, as the framing problems dealt with different probabilities and payoffs, and different diseases within the health domain, the present research provides a more generalizable slice of framing and risky-choice problems than previous within-subjects research. Overall, item-level analysis provides support for the conclusions found at the composite level as the framing effect was significant for each problem.

4.2. Individual differences as moderators of the effect of framing on risky choice

Individual differences results varied dramatically contingent on whether a preference reversal or a preference shift was the criterion. Results for preference reversals show that individuals who are risk-averse show a larger framing effect at the composite level than risk-moderate or risk-seeking individuals. This effect was found only when risk was measured with the Choice Dilemmas Questionnaire, and it appears to be a small effect appearing only at the composite level. This finding is unique to this study and suggests that "risk-aversion" as a trait may predict risk-taking in gain-framed problems but not in loss-framed problems. If there had been reduced risk-taking in both gains and losses, an increased framing effect would not have been observed. This is consistent with results reported by Weller, Levin, and Denburg (2010) where age-related differences in risk-taking emerged for risky gains but not risky losses.

Defining framing more generally as a preference shift and measuring its effects in terms of the difference in number of risky choices between loss and gain trials revealed more pronounced individual differences, especially for the CDQ risk measure. Individuals who are CDQ risk-averse were more susceptible to the framing effect.

4.3. Framing and thinking-style

Individual cognitive differences have long been considered moderators of the framing effect (Smith & Levin, 1996). Despite prior belief, neither experiential thinking- style nor rational thinking-style emerged as a moderator of the effect of framing on risky choice. However, framing effects may occur among groups with specific patterns of both rational and experiential thinking-style (Shiloh et al., 2002).

Similar to risk-style, individual differences in thinking-style mattered more with preference shift framing. Specifically, people high in experiential thinking were more likely to show the framing effect for certain problems.

Finally, when the effects of a risk measure and a cognitive measure were combined, some interesting results emerged. Individuals who were risk-averse and high in experiential thinking were significantly more likely to manifest a preference shift. The finding that two different individual differences are both important could begin to point the way to identify profiles of individuals who are susceptible to or resistant to framing effects.

The present study sought to simultaneously examine two important individual differences, risk-style and thinking-style, as moderators of the effect of framing on risky choice. The effects of risk-style and thinking-style on preference reversal were largely missing in this study, suggesting they only occur under specific environmental and experimental circumstances. Clearly, the effect of risk-style and thinking-style as moderators are more visible when preference shift is the criterion.

In classic economic theory and decision-making primary attention was paid to the nature of the decision problem and little attention was paid to the way it was framed or individual differences in the making of the decision. The seminal work of Kahneman and Tversky changed the playing field in economic decision-making as they showed that the framing of the decision and individual differences could have an influence on the decisions being made. This study continued in that tradition and showed that some individual differences variables and the combination of those variables influenced the decision-making process.

Putting this into perspective, think of the following scenario: imagine an individual having to make the decision to get the vaccine for the swine flu or to not get vaccinated. Several factors will influence this decision. The potential outcome of the decision and how it is framed will clearly be one factor, such as how taking the vaccine will affect the likelihood of successfully avoiding the swine flu (positive frame) or not avoiding it (negative frame). However, several other factors may also influence the decision such as the level of cognitive analysis an individual brings to the problem, their propensity to take risks, their prior experience with decisions of this type, and personality factors. In this study individuals who are risk-aversive are especially apt to avoid risks in the gain-frames, suggesting that the amount of health risks that a person is willing to take depends jointly on their personality and the way the medical choices are framed.

4.4. Implications for future research

Within-subject designs offer researchers options. For example, research could utilize within-subjects designs to identify people who are resistant or immune to framing, and then examine their unique characteristics. The relationship between rational and experiential thinking-style and framing found in this study is consistent with other emerging research. Research needs to better understand the relationship between rational and experiential thinking-style, as direct relationships between these variables (found in the present study as well as in Levin et al. (2002)) may mask any interaction between framing and thinking-style. A possible avenue for this research is to look at the effects of experiential processing on other framing types, without the presence of risk, similar to that of Lauriola et al. (2005).

The results reported here concerning different individual difference effects across types of framing support the distinctions made by Kuehberger (1998) and Levin et al. (1998) who emphasize the importance of different operationalizations of framing and conclude that "not all frames are created equal". The addition here is that within-subject versus between-subjects framing is an important distinction, as is whether a strict 'preference reversal' or a more general 'preference shift' is the defining criterion.

5. Conclusion

The present within-subjects design with multiple framed decision problems appears to be successful for investigation of the framing effect, as individuals show similar reactions to framing problems here as has been found in other research. While this study clearly does not provide sufficient information to predict exactly who is and who is not susceptible to framing, it does provide suggestive evidence of the existence of constellations of people who are particularly susceptible. This information is potentially useful for a variety of reasons. Behavioral decision researchers have argued that those who are resistant to framing are more likely to be competent decision-makers (Parker & Fischhoff, 2005). In fact, resistance to framing (measured by people's answers to valence-framing problems) is one of the six components of the Adult Decision-Making Competence scale (Parker, Bruine de Bruin, & Fischhoff, 2007). Also, businesses could use information about resistance to framing to provide developmental feedback to individuals and to help determine the composition of teams being developed with diverse problem-solving skills and styles. Future research of this kind might prove useful in identifying individuals most likely to make competent decisions in various business settings.

Appendix A. Framing and risky-choice problems

The following section includes a number of situations in which you are asked to make a decision. Please read each individual situation carefully, and choose the option which you prefer. There are no right or wrong answers.

A.1. Gain-framed problem 1 (G1)

Imagine that the US is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed.

Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 200 people will be saved.
Program B: 1/3 probability 600 people will be saved and 2/3 probability that nobody will be saved.

Which of the two programs (A or B) do you favor? _____

A.2. Gain-framed problem 2 (G2)

Imagine that your community is preparing for the outbreak of an unusual Asian disease, which is expected to kill 60 people. Two alternative programs to combat the disease have been proposed.

Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 20 people will be saved.
Program B: 1/3 probability that 60 people will be saved and 2/3 probability that nobody will be saved.

Which of the two programs (A or B) do you favor? _____

A.3. Gain-framed problem 3 (G3)

The National Cancer Institute has two possible treatments for lung cancer which could become standard treatments across the country.

Treatment A: Of every 1000 people who get lung cancer, 400 will be saved.
Treatment B: 2/5 chance that 1000 of every 1000 who get lung cancer will be saved and 3/5 chance that no people of every 1000 who get lung cancer will be saved.

There are adequate resources to implement only one treatment program. Which of the two treatments (A or B) would you favor for national implementation? _____

A.4. Gain-framed problem 4 (G4)

The National Cancer Institute has two possible treatments for leukemia which could become standard treatments across the country.

Treatment A: Of every 10,000 people who get leukemia, 5000 will be saved.
Treatment B: 1/2 chance that 10,000 of every 10,000 who get leukemia will be saved and 1/2 chance that no people of every 10,000 who get leukemia will be saved.

There are adequate resources to implement only one treatment program. Which of the two treatments (A or B) would you favor for national implementation? _____

A.5. Gain-framed problem 5 (G5)

The United States is expecting the outbreak of a new strain of AIDS which is expected to kill 2000 persons. Two alternative programs were developed to combat the disease. Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 800 people will be saved.
Program B: 2/5 probability that 2000 people will be saved and 3/5 probability that no people will be saved.

Which of the two programs (A or B) do you favor? _____

A.6. Loss-framed problem 1 (L1)

Imagine that the US is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed.

Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 400 people will die.
Program B: 1/3 probability that nobody will die and 2/3 probability 600 people will die.

Which of the two programs (A or B) do you favor? _____

A.7. Loss-framed problem 2 (L2)

Imagine that your community is preparing for the outbreak of an unusual Asian disease, which is expected to kill 60 people. Two alternative programs to combat the disease have been proposed.

Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 40 people will die.
Program B: 1/3 probability that nobody will die and 2/3 probability that 60 people will die.

Which of the two programs (A or B) do you favor? _____

A.8. Loss-framed problem 3 (L3)

The National Cancer Institute has two possible treatments for lung cancer which could become standard treatments across the country.

Treatment A: Of every 1000 people who get lung cancer, 600 will die.
Treatment B: 2/5 chance that no people of every 1000 who get lung cancer will die and 3/5 chance that 1000 people of every 1000 who get lung cancer will die.

There are adequate resources to implement only one treatment program. Which of the two treatments (A or B) would you favor for national implementation? _____

A.9. Loss-framed problem 4 (L4)

The National Cancer Institute has two possible treatments for leukemia which could become standard treatments across the country.

Treatment A: Of every 10,000 people who get leukemia, 5000 will die.
Treatment B: 1/2 chance that no people of every 10,000 who get leukemia will be die and 1/2 chance that 10,000 of every 10,000 who get leukemia will die.

There are adequate resources to implement only one treatment program. Which of the two treatments (A or B) would you favor for national implementation? _____

A.10. Loss-framed problem 5 (L5)

The United States is expecting the outbreak of a new strain of AIDS which is expected to kill 2000 persons. Two alternative programs were developed to combat the disease. Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 1200 people will die.
Program B: 2/5 probability that nobody will die and 3/5 probability that 2000 people will die.

Which of the two programs (A or B) do you favor? _____

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