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Cognitive Bias and Adolescent Risk-taking

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COGNITIVE BIAS AND ADOLESCENT RISK-TAKING

Mayuko Nakamura

64 Pages

Although the framing effect (i.e., the tendency of people to react differently to a particular choice depending on whether the choice is presented as a loss or as a gain) is a well-established cognitive bias among the adult population, there have been a limited number of studies with adolescent samples. In the present study, high school students (14-18) and college students (18-26) were asked to make choices in several decision problems including the classic Asian Disease Problem (Tversky & Kahneman, 1981) and modified “adolescent-relevant” versions that are applicable to the real-world experiences of adolescents. Individual difference measures, including rational and experiential thinking styles, impulsivity, and personality (i.e., neuroticism and openness to new experiences) were also measured to analyze whether these constructs moderate individual susceptibility to framing effects. The present study demonstrated that high school students were less susceptible to the college students compared to the adults. Adolescent-relevant scenarios did not yield statistically significant difference in risky choices; however, a trend was found in that the 12th graders made most risky choices in these scenarios compared to 9th graders or college students. As for individual differences, rational thinking style moderated the susceptibility to framing effects. College students with moderate and high Rational Thinking scores were most susceptible to the framing effect. There was also a large framing effect for high school students in the low rational thinking group. Although the present study benefited from the strengths from within-subject design that allows comparisons of individual level differences, fatigue effects from answering similar experimental questions might

have affected the results of the study. Future studies may want to address this issue by varying the order of experimental tasks.

KEYWORDS: Adolescent, Decision-Making, Risky Choices, Biases, Framing, Individual Differences

COGNITIVE BIAS AND ADOLESCENT RISK-TAKING

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COGNITIVE BIAS AND ADOLESCENT RISK-TAKING

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M.N.

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CHAPTER I: STATEMENT OF THE PROBLEM

Adolescence is an important time period when people face a number of critical decisions including friendship, sexuality, healthy life styles, drug and alcohol use, future goals, and careers (Steinberg, 2010). Many of these decisions – such as those involving drugs, alcohol, and sexual behaviors – involve risks that often have long-term physical and psychological implications.

The Centers for Disease Control and Prevention (CDC) has conducted a survey of ninth through twelfth grade students using the Youth Behavior Surveillance System since 1990. The primary purpose of the survey is to monitor health risk behaviors that contribute significantly to the leading causes of death, disability, and social problems in the United States. These health risks, such as risky sexual behaviors, substance use, unhealthy dietary behaviors, and inadequate physical activity are often established during adolescence. According to the most recent survey results, 66.2% of ninth through twelfth grade students have had at least one drink of alcohol, 40.7% have used marijuana, 41.1% have used cigarettes, and 40.9% of sexually active adolescents surveyed did not use condoms (Kann et al., 2014). Thus, risky behaviors are prevalent among the adolescent population; therefore, it is important for developmental psychologists to study the risky behaviors of adolescents in order to help policy makers, schools, educators, and health practitioners to implement effective preventative measures.

The majority of studies on adolescent risk-taking behaviors have been conducted in the form of self-report surveys (see Reyna & Farley, 2006 for a review). Although it is important to consider various factors that could predict adolescents' risk-taking behaviors, the correlational nature of survey methods may not lead to any strong inferences about the mechanism(s) of risky decision-making processes. Understanding the mechanisms of risky decision-making processes,

with the support of a strong theoretical framework, is necessary in order to create effective intervention and prevention programs for adolescents (Rivers, Reyna, & Mills, 2008).

Unfortunately, research on decision-making processes has largely been “developmental” (Albert & Steinberg, 2011). That is, although a number of studies have been conducted using adult samples, especially with college student samples, the majority of studies have not explored the developmental trajectory of decision-making processes. In the current study, I examine adolescent risky decision making using framing effects paradigm. The framing effect is one of the well-studied cognitive biases. People tend to make different decisions depending on whether equivalent options are presented (or “framed”) as either a loss or as a gain. In my review of the literature, I start with the adult decision-making literature to give an overview of the theoretical frameworks. I discuss relevant experimental findings about framing effects. I then discuss the developmental implications for risky decision-making processes during adolescence.

CHAPTER II: REVIEW OF THE LITERATURE

Dual-Processing Accounts of Judgment and Decision-Making

Literature in the field of judgment and decision-making has analyzed decision-making processes using a variety of information-processing theories as the conceptual frameworks. Among cognitive and social psychology models, dual-process theories have recently gained acceptance by researchers in the field as a solid construct to explain various mental processes from social biases to learning to decision-making (Chaiken & Trope, 1999; Evans, 2003; Sloman, 1996; Smith & DeCoster, 2000; Stanovich & West, 2000). Although the terminologies or distinctions of the processes may be different (Stanovich, West, & Toplak, 2011), dual-process theories in general propose that there are two different kinds of mental processing: one that is fast, automatic, intuitive, and experiential; and another that is slow, deliberate, analytic, and rational (Kahneman, 2011). In spite of the wide acceptance of the dual process perspective, researchers have not agreed on the terminologies for these systems, using a variety of contrasting sets of terms such as System 1 versus System 2 (Evans, 2003; Kahneman & Fredrick, 2002), Type 1 and Type 2 processing (Evans, 2008, Stanovich et al., 2011), experiential versus rational (Epstein, 1994), associative versus rule-based (Sloman, 1996), intuitive versus analytic (Reyna & Brainerd, 2011) and so on. Moreover, there has been discussion as to whether these represent types of processes or different systems (for extended discussion see Keren & Schul, 2009). Discussion on the most accurately represented sets of terminology is out of scope of this study; thus, for the sake of the discussion below, I use the terms experiential and analytical as adopted by Slovic et al. (2005), and will refer to these as types of processing because it implies less rigid structures, and there is thus far little evidence in support of separate cognitive systems (Keren & Schul, 2009).

Developmental Views of Dual-Processing Theories in Adolescent Decision-Making

Traditional judgement and decision-making literature builds on a normative view of rational decision making (Albert & Stenberg, 2011) and claims that analytical processing yields “better” results by overriding the intuitive decisions made via experiential processing (Evans, 2003, Klaczynski, 2005, Stanovich, 1999). Stanovich and colleagues (2011) explain that in this view, experiential processing may produce responses that are “non-optimal” in particular contexts if they are not overridden by analytical processing. Many of these claims come from the heuristics and biases literature (see Evans, 2003 for review), which focuses on documenting and explaining the various types of reasoning failures as being the result of intuitive decisions. Developmental researchers who have subscribed to the normative view of rational decision-making mainly focus on examining aspects of rational cognitive processes in which adolescents were deficient relative to adults; in this view, the developmental path is seen as a simple transition from experiential to analytical processing (Albert & Stenberg, 2011). However, more recent adolescent research that is based on dual-process theories considers the developmental course as an increase in both analytical and experiential processing, and posits that adolescents use more experiential processing than analytical processing in social contexts that activates their increasingly rich social schemas (Albert & Stenberg, 2011).

Fuzzy-trace theory (Reyna & Brainerd, 1995) is one of the dual-process theories that tries to explain the developmental path where both analytical and experiential processing increase as cognitive development progresses. In fuzzy-trace theory, one type of processing uses simple, gist mental representations (gist-based processing) and the other type of processing uses detailed, quantitative mental representations (verbatim-based processing). When a comparison is made between fuzzy-trace theory and traditional dual process theories, it is explained that gist-based

processing in fuzzy-trace theory heavily relies on experiential processing whereas verbatim-based processing relies on analytical processing. However, fuzzy-trace theory posits that advanced judgment and decision-making is based on gist-based processing (i.e., experiential processing) as opposed to verbatim-based processing (i.e., analytical processing). Thus, fuzzy-trace theory presents an opposite view from the normative view of rational reasoning. In terms of developmental progression, a fuzzy-trace theory account suggests that decision-making becomes less “analytical” and more “experiential” as development progresses. Additionally, proponents of fuzzy-trace theory consider heuristics, biases, and cognitive inconsistencies as a side effect of advanced gist-based processing, that is, children and adolescents become more prone to heuristics and biases because they have become better at experiential processing with age (Reyna et al., 2005; Rivers et al., 2008). Although the proponent of fuzzy trace theory and other dual processing theorists are trying to explain the developmental path with various experiments on cognitive biases, studies have not uniformly found the patterns of increase in experiential processing (Evans, 2001; Klaczynski, 2002; Stanovich, Toplak & West, 2008).

Framing Effects

Of the many well-known cognitive biases, the framing effect is widely studied in many fields, including economics, psychology, healthcare, and businesses (see Levin, Schneider & Gaeth, 1998 for review). The framing effect is the robust tendency for people to make different decisions depending on whether (equivalent) options are presented (or “framed”) as either a loss or as a gain. Choices presented in terms of gains tend to elicit risk-averse behaviors, whereas choices presented in terms of losses tend to elicit risk-taking behaviors (Tversky & Kahneman, 1981). The framing effect was originally demonstrated by Tversky and Kahneman (1981, p. 453) in their famous “Asian Disease Problem” (see Figure 1).

In their original study, Tversky and Kahneman (1981) found that although the expected value of Programs A and B, and Programs C and D are equal, when the problem was presented with outcomes in the gain frame (i.e., in terms of lives saved; Problem 1), the majority of the participants (72%) chose Program A, the sure (non-probabilistic) option; therefore, considered risk-averse. They also found that when the problem was presented with outcomes in the loss frame (e.g., life lost, Problem 2), only 22% picked the sure option. The majority of participants (78%) chose Program D, the risky/probabilistic option; therefore, considered more risk-taking. In short, the framing effect refers to people's tendency to become risk-averse when facing potential gain and to become risk-taking when facing potential loss.

Since Tversky and Kahneman's original study, framing effects have been extensively studied. Research on framing effects began with studies that examined risk-averse tendencies in the gain frame and risk-taking tendencies in the loss frame in problem scenarios such as Asian Disease Problem and its variants, and gambling tasks (e.g., Frisch, 1993, Reyna & Brainerd, 1991). The field quickly expanded to include studies that examine the effects of framing with a variety of negative and positive outcomes (e.g., Linville, Fischer, & Fischhoff, 1993; Marteau, 1989; Wilson, Kaplan, & Schneiderman, 1987). Many studies were conducted to explore decision-making behaviors in various fields including healthcare, product marketing, and financial planning (see Levin, Schneider & Gaeth, 1998, for review). The term "framing effect" became widely used in that different operational definitions and different underlining mechanisms were all discussed under this same umbrella term.

Levin et al. (1998) created a typology of framing effects and classified studies into three categories: (a) risky framing, (b) attribute framing, and (c) goal framing effects. The risky framing effect refers to the standard tendency to prefer the sure option in a gain frame and the

risky (i.e., probabilistic) option in a loss frame (e.g., Asian Disease Problem, Tversky & Kahneman, 1981). The attribute framing effect refers to the tendency to give a better evaluation of an item when a key attribute is framed in positive rather than negative terms. For example, Levin and Gaeth (1988) found that consumers gave different judgement of the flavor of meat products based on how they were labeled (e.g., 75% lean ground beef for better tasting and less greasy than 25% fat ground beef). The goal framing effect refers to the differential impact of positive (i.e., the opportunity to make a gain or avoid a loss) or negative (i.e., the opportunity to make no gain or suffer a loss) framed messages. For example, Meyerowitz and Chaiken (1987) showed that women were more apt to perform breast self-examination (BSE) when presented with information stressing the negative consequences of not performing BSE than the positive consequences of performing BSE.

Piñon and Gambara (2005) conducted a meta-analysis of 51 studies on framing effects and examined the effect sizes for research studies that fit the three different framing effect types. They found that risky framing and goal framing had moderate effect size ($d = .437$ for sure option vs. risky framing, and $d = .444$ for negative vs. positive goal framing) whereas studies of attribute framing had smaller effect sizes ($d = .260$ for the same item emphasizing positive vs. negative attributes).

Kühberger (1998) also conducted a meta-analysis and instead classified framing effect studies by nine different types of cover stories (i.e., Asian Disease, Gambling, Tax evasion, Bargaining, Escalation of commitment, Game theory, Message compliance, Clinical reasoning, and Evaluation of objects). The Asian Disease cover story had the biggest effect size among all of those reviewed ($d = .57$). The gambling cover stories had the second biggest effect size ($d = .43$). Other cover stories, except for the Tax evasion ($d = .42$) cover story had very small effect

sizes ($d = -.08$ to $.17$). Thus, the various cover stories used to study the framing effect do not have an equal impact on choices made by participants.

Thus, the results from the above meta-analyses by Piñon and Gambará (2005) and Kuhberger (1998) demonstrated that framing effects research does yield a consistent pattern of results and risky framing effects, especially with Asian-Disease scenarios, and that this type of problem has yielded bigger effect sizes. Thus, in the current proposed study, Asian-Disease-like scenarios will be used in exploration of the susceptibility of framing effects among adolescents.

Framing Effects and Individual Differences

Although these meta-analyses have explored the scenario characteristics and types of framing (Kühberger, 1998; Piñon & Gambará, 2005), a meta-analysis has thus far not been conducted to understand the relationship between the susceptibility to framing effects and individual differences. In order to apply the results of framing effects to real-life interventions of risky behaviors, it is important to understand individual characteristics of those who are susceptible to framing effects.

Fagley and Miller (1990) examined the relationship among framing effects, gender, and risk-taking propensity. They used five variants of the Asian Disease Problem with different probabilities for the framing effects (e.g., $2/3$, $1/2$, $2/5$, etc.) and studied the interaction among the problem scenarios, gender, and the composite scores from two risk-taking propensity measures: the Choice Dilemma Questionnaire (CDQ, Kogan & Wallach, 1964) and the Risk Avoidance Scale (RAS, Shure & Meeker, 1967). They concluded that women are more susceptible to framing effects, and risk-taking propensity was not a significant predictor of susceptibility to framing effects.

McElroy and Seta (2003) examined framing effects and their relationship with individuals' thinking styles (i.e., analytic or holistic thinkers). They used a between-subject design where each participant was randomly assigned to one of the framing (gains/losses) condition. All participants took the Preference Test (PT; Zenhausern, 1978) before completing the Asian Disease Problem. The PT is a 20-item questionnaire to assess individuals' cognitive style (analytic vs. holistic) preference. Based on the result of the PT, the participants were divided into analytic thinkers (top half) or holistic thinkers (bottom half). Although a significant framing effect (i.e., sure options for the gain frame and risky/probabilistic options for the loss frame) was found in the analysis of all participants, the effect was most pronounced for holistic thinkers. Especially, when the top 25% of PT and the bottom 25% of PT were compared, the framing effect was clearly demonstrated among those who were relatively extreme in holistic thinking style (bottom 25% of PT). It is interesting to note that the participants of this study were all female; therefore, it is unclear if the same pattern would be found in male participants.

Fagley, Coleman, and Simon (2009) explored gender and perspective-taking ability as possible moderators of framing effects. They also employed a between-subject design where each participant was randomly assigned to one of the framing (gains/losses) conditions. Three variants of the Asian Disease Problem with 1/3 probability of the same expected value were given to the participants. In addition to the decision problems, each participant filled out two perspective-taking measures, the Multiple Perspectives Inventory (Gorenflo & Crano, 1998) to measure cognitive perspective-taking (CPT) ability and the Social Decentering Scale (Redmond, 1995) to measure affective perspective-taking (APT) ability. They found a significant main effect of frames and significant interaction of frames, gender, CPT and APT. Further analysis examined frame, CPT, and APT for men and women separately. They found that men showed a

moderate framing effect, whereas women showed a more complex pattern in which framing effects were moderated by CPT and APT. Women higher in affective perspective-taking but lower in cognitive perspective-taking showed the largest framing effect (i.e., preference for sure options in the gain frame condition and preference for risky/probabilistic options in the loss frame condition).

Shiloh, Salton, and Sharabi (2002) examined individual differences in rational and intuitive thinking styles as moderators of framing effects. They asked each participant to make choices between sure options and risky/probabilistic options in both loss and gain frames in five variants of the Asian Disease Problem. For individual difference measures, participants completed the Rational-Experiential inventory (REI; Epstein et al., 1995). Shiloh et al. analyzed the number of sure option selections as the dependent variable and frames, rational thinking style, and intuitive thinking style as independent variables. They found a three-way interaction of intuitive thinking style, rational thinking style, and framing and concluded that participants with high-rational/high-intuitive thinking styles and low-rational/low intuitive thinking styles demonstrated a significant framing effect (i.e., to select more sure choices for the gain frames compared to the loss frames) compared to those who were high-rational/low-intuitive or low-rational /high-intuitive.

Mahoney, Buboltz, Levin, Doverspike, and Svyantek (2011) examined the relationship among framing effects, gender, and risk-taking propensity. They used five variants of the Asian Disease Problem with different probabilities for the framing effects along with the Choice Dilemma Questionnaire (short-version of CDQ, Erker, 2000), the Risk Avoidance Scale (RAS, Shure & Meeker, 1967), the Stimulating Instrumental Risk Inventory (SIRI, Zaleskiewicz, 2001), and the REI (Pacini & Epstein, 1999). They found significant framing effects in a composite of

all five scenarios as well as at the individual scenario level (i.e., participants selected sure options on gain frames and risky/probabilistic options on loss frames for each of the cover stories). They found that 57.1% of participants manifested a “preference shift” – where across the five cover stories, there were more risky choices on loss frames than on gain frames. Complete “preference reversals” were more rare; only 9.2% chose the risky/probabilistic choice for all five loss frames and the sure choice for all five gain frames. As for individual differences, Mahoney et al. (2011) found that those classified as risk-averse on the CDQ measure showed a greater framing effect than the other risk groups; however, other risk style measures (RAS, SIRI and subscales of SIRI) did not show any interaction effect with frames. There were no significant framing effects involving rational or experiential thinking style on the REI. No gender difference was found for the framing effects.

Thus, the current literature with adult (i.e., college-aged) samples has explored the relationship between framing effects and individual differences in various cognitive styles including rational-thinking, intuitive/holistic thinking, affective and cognitive perspective-taking and risk-aversion. From these studies, one can speculate that there may be some relationship between rational and intuitive thinking styles and framing effects, although the study by Mahoney et al. (2011) did not find the relationship with these thinking styles. The rational and experiential thinking styles were explored in the current study with adolescent samples. Although the adult decision-making literature provides a good foundation to understand the underlying mechanisms of cognitive biases, given the fact that adolescents make more risky decisions, in the subsequent section, I examine the developmental literature on framing effects to better understand the developmental trajectories of risky decision making.

Developmental Studies of the Framing Effects

Although framing effects have been thoroughly explored in the adult decision-making literature, the number of developmental studies that examine this effect is limited. Reyna and Ellis (1994) examined framing effects in children ranging in age from 4 to 11 years. Unlike the original study by Tversky and Kahneman (1981) that used hypothetical scenarios, children were presented with an experimental task in which they could gain or lose prizes (i.e., brightly colored superballs). Reyna and Ellis presented the risky/probabilistic options with different levels of probability for losing balls or gaining balls. In order to simplify the presentation of probability, children were shown a spinner that corresponded to $1/2$, $2/3$, or $3/4$ chance of winning or losing. In the gain frame, children were asked to choose between the risky/probabilistic option of winning more balls at various probabilities ($1/2$, $2/3$, or $3/4$) on a wooden spinner or the sure option of getting a certain numbers of balls. In the loss frame, children were asked to choose between a risky/probabilistic option of losing more balls at various probabilities ($1/2$, $2/3$, or $3/4$) or the sure option of losing a certain numbers of balls. The researchers found that pre-school aged children did not exhibit framing effects, as their pattern of performance was the same in the gain and loss frames (28% and 26% choosing the sure option, respectively). The second graders exhibited “reverse framing,” which was defined as a greater preference for risky/probabilistic choices in the gain frame than in the loss frame. The fifth grade children, in contrast, demonstrated standard framing effects by choosing the sure option in the gain frame, but the risky/probabilistic option in the loss frame.

Chien, Lin, and Worthley (1996) examined framing effects with an adolescent sample (ninth and tenth graders) using the classic Asian Disease Problem (Tversky & Kahneman, 1981) and additional similar scenarios that involved gaining or losing money instead saving or losing

human lives. Unlike Tversky and Kahneman's study, they used a within-subject design asking all the participants to make decisions in both gain and loss frames. They found that the majority of adolescents (i.e., 71.6% for the Disease scenario and 56.5% for the Money scenario) selected the same response options both in the gain and loss frames; however, those who selected different options in the gain and loss frames exhibited the framing effect by choosing sure options in the gain frames and risky/probabilistic options in the loss frames. Additionally, Chien et al. examined individual differences such as gender and math placements (honor vs. regular), but did not find any significant differences in decision-making.

Levin and Hart (2003) examined children's (aged 5-7) risk-taking in loss and gain frames using a simplified version of the apparatus that Reyna and Ellis (1994) used. Children were asked to choose between risky/probabilistic gain of prizes (i.e., wrapped gift box with unknown content) and sure gain of prizes or between risky/probabilistic loss of prizes and sure loss of prizes, all resulting in equal expected value. They additionally collected data on measures of temperament including fearfulness, shyness, thrill seeking, impulsivity, and sadness in order to examine individual differences in the framing effect. Levin and Hart found that children chose more risky/probabilistic choices in the loss frame than in the gain frame but failed to demonstrate reversal of preference to sure options in the gain frame, which was found in the classic framing effect demonstrated in Tversky and Kahneman (1981). Shyness was negatively related to risk taking, whereas impulsivity was positively related to overall risk-taking choices. However, less sadness was related to more risk taking in the negative frame than in the positive frame. Levin and Hart stated that sadness in the children's temperament scale is related to neuroticism scale in the Big Five Personality Inventory for adults, whereas shyness in the children's temperament scale is inversely related to adult openness scale in the Big Five Personality Inventory.

Therefore, they concluded that the results from their study were consistent with adult literatures in individual difference in risk-taking, which demonstrated higher neuroticism and openness are related to more risk-taking behaviors.

Schlottman and Tring (2005) examined framing effects on decision making in 6 to 10-year-old children. They criticized Reyna and Ellis's (1994) Spinner task for not having a salient contrast between the loss and gain frames and implemented a task where children helped a puppet decide which way of sharing jellybeans between a puppet and an experimenter was better for the puppet. The sure option was presented as the puppet gaining/losing an exact amount of jellybeans and the risky/probabilistic option was presented as puppet gaining/losing a probabilistic amount of jellybeans (e.g., .25 probability of winning all 16 or .75 probability of winning none). They found that children preferred the sure option more in the gain frame than in the loss frame, demonstrating that in this context, children displayed the same pattern of framing effects as adults.

Reyna, Estrada, DeMarinis, Myers, Stanisz and Mills (2011) examined framing effects in samples of adolescents (aged 14 – 17) and young adults (aged 18 – 22) using the same spinner task as Reyna and Ellis (1994) but with three different levels of monetary rewards (\$5, \$20, and \$150). They also collected data about the participants' risky sexual behavior and intentions, and administered the Behavioral Activation Scale and Behavioral Inhibition Scale (BAS and BIS; Carver & White, 1994), the Sensation-Seeking Scale (Hoyle et al., 2002), and the Gist and Verbatim Scale (Mills et al., 2008). The Gist and Verbatim Scale includes questions for gist measures that were designed to draw on global attitudes and less mental presentations, and include questions for verbatim measures that were designed to elicit more specific or quantitative judgement (Reyna et al., p. 1129). They found that the adolescents and young adults exhibited

the standard framing effect (i.e., risk-taking in the loss frame and risk-aversion in the gain frame) for the majority of trials; however, on the trials where the rewards were large, adolescents demonstrated reversed framing (i.e., more risk-taking in the gain frame than in the loss-frame). Reyna and colleagues concluded that, as predicted by Fuzzy-trace theory, reverse framing was evidence of verbatim (i.e., analytical) processing. They also examined the relationship between framing effects and real-life risky sexual behaviors and concluded that age and verbatim responses were significant factors in predicting participants' risky sexual behaviors. Additionally, they found that BIS and sensation-seeking scales were correlated with age, but did not predict directly the participants' risky sexual behaviors.

Thus to date, only a limited number of developmental studies on framing effects have been conducted, despite the fact that framing effects have been demonstrated in various risky decision-making situations in the adult literature. One problem with developmental studies of framing effects is that most of them adopted tasks that involved an element of gambling and gaming such as a spinner that shows various winning/losing odds (Levin & Hart, 2003, Reyna & Ellis, 1994; Reyna et al., 2011). Gambling and gaming tasks may not be the best method to study adolescent decision-making because these types of task inherently generate emotional arousal, which may have an impact on the results (Cheung & Mikels, 2011). Additionally, these experimental tasks lack ecological validity, that is, they do not approximate real-life risk-taking settings, which may become a threat to external validity as well (Reyna et al., 2011). Another consideration of gambling tasks is that children are not familiar with the gambling tasks because organized gambling is typically illegal for children under 18. The results from gambling or gaming tasks have to be critically analyzed in terms of these validities.

Moreover, developmental research on framing effects has just begun to examine individual differences in decision making. Unlike the adult literature, which has studied wide spectrum of individual differences such as rational and experiential thinking style preference (LeBoeuf & Shafir, 2003; McElroy & Seta, 2003; Shiloh, Salton & Shrabi, 2002), and working memory capacity (Corbin, McElroy & Black, 2010) and non-cognitive domains such as self-esteem (McElroy, Seta & Waring, 2007) and personality (Levin, Gaeth, Schreiber & Lauriola, 2002), only a few developmental studies (Chien, Lin & Worthley, 1996; Levin & Hart, 2003; Reyna et al., 2011) have examined individual differences in relation to the framing effects.

Thus, the number of developmental research studies on the framing effect is limited and additional studies are needed in order to better understand the developmental path of cognitive biases, especially during adolescence, and in non-gaming or non-gambling contexts. Current dual-process theories (Chaiken & Trope, 1999; Evans, 2003, Kahneman, 2011), which are used to explain the framing effect and other cognitive heuristics in the adult literature, are largely silent with respect to predictions about the development of analytic and experiential processing. Fuzzy-trace theory (Reyna & Brainerd, 1995) is a theoretical framework that has been used to explain developmental differences in the framing effect. In the developmental view of fuzzy-trace theory, children are less influenced by framing effects compared to adults, because children tend to use verbatim-based (i.e., analytical) processing. As development progresses, adolescents use more gist-based (i.e., experiential) processing and become susceptible to framing effects. Additionally, individual difference measures were analyzed in order to examine adolescents' susceptibility to framing effects.

Present Study

As discussed earlier, many researchers have studied the development of risk-taking behaviors through analyses of actual risk-taking rates. Although it is important to fully understand their current behaviors and their relationship with potential contributing factors of the behaviors, it is also important to understand the processes of decision-making that leads to these risky behaviors. Therefore, the present study examined one aspect of adolescent decision-making processes by analyzing framing effects (i.e., choices presented in terms of gains tend to elicit risk-averse behaviors, whereas choices presented in terms of losses tend to elicit risk-taking behaviors) using adolescent-relevant scenarios. The present study examined whether or not younger (aged 14-15) and older (aged 16-18) adolescents were susceptible to framing effects like adults, but specifically in the context of the types of “risky” decisions that adolescents are likely to face. Additionally, the present study addressed several important issues that had been identified from the literature review. The present study addressed the issue of task-relevance by using the original framing effect task (i.e., the Asian Disease Problem) and contrasting performance on this version with ecologically valid and adolescent-relevant cover stories that are applicable to the real-world experiences of adolescents. It also addressed the issue of individual differences by relating framing effects to various individual measures including personality, impulsivity, and thinking style preferences (i.e., rational vs. experiential).

Hypotheses and Research Questions

Hypotheses

1. Developmental Patterns in the Standard Framing Effects Task. Although the Asian Disease Problem is used frequently to assess susceptibility of framing effects in adult samples, there are a limited number of adolescent studies that use the Asian Disease Problem. Most other studies

with children use gaming/gambling tasks. The present study explored the susceptibility to framing effects using the classic Asian Disease Problem with adolescent and college age samples. I hypothesized that the standard pattern of framing effects (i.e., more likely to select sure options in gain frames and selecting risky/probabilistic options in loss frames) would be more likely among the college-aged groups compared to the high school groups when they were presented with original Asian Disease Problem.

2. *Developmental Patterns for Different Scenarios.* The developmental literature on cognitive biases demonstrates that adolescents tend to use more experiential processing in social contexts and are prone to a variety of other cognitive biases (Albert & Steinberg, 2011; Klaczynski, 2002). Thus, I hypothesized that 12th graders would be most likely to choose the risky/probabilistic options when presented with adolescent-relevant scenarios compared to the classic Asian Disease Problem, relative to the other three age groups.

Exploratory Research Questions: Individual Differences in Susceptibility to Framing Effects

1. *Thinking Style.* Previous research with adults investigated experiential/holistic thinking and rational/analytical styles as potential individual difference moderators of framing effects (Mahoney et al., 2011; McElroy & Seta, 2003; Shiloh et al., 2002) and yielded mixed results. No developmental literature with adolescents has explored thinking styles as potential moderators. Additionally, dual process theory and fuzzy-trace theory have not demonstrated a clear developmental path through adolescence on the potential effects of thinking styles on framing effects. Therefore, my first exploratory question is whether or not (a) experiential thinking style would moderate susceptibility to framing effects; and (b) rational thinking style would moderate susceptibility to framing effects.

2. *Personality.* Levin and Harts (2003) explored children's temperament and found that shyness in children's temperament scale moderates the occurrence of framing effects, whereas sadness in children's temperament scale moderates overall risk-taking in the framing tasks. Thus far, no studies have been conducted with adolescents to explore the influence of personality on the tendency to be susceptible to framing effects. As mentioned in Levin and Harts (2003), fearfulness in the children's temperament scale is related to neuroticism scale in the Big Five Personality Inventory for adults (Rusting, 1998), whereas shyness in the children's temperament scale is inversely related to adult openness scale in the Big Five Personality Inventory (Levin et al., 2002). Therefore, my second exploratory question was whether or not (a) openness to experience would moderate susceptibility to framing effects; and (b) neuroticism would moderate susceptibility to framing effects.

3. *Impulsivity.* Impulsivity is a personal trait that has been cited as a predictor of various risk-taking behaviors among adolescents including risky sexual behaviors (Dir, Coskunpinar, & Cyders, 2014 for review) and substance use (Collado, Felton, MacPherson, & Lejuez, 2014; Dick, Smith, Olausson, Mitchell, Leeman, O'Malley, & Sher, 2010; Elkins, King, McGue, & Iacono, 2006). Therefore, my third exploratory question was whether or not (a) functional impulsivity would moderate susceptibility to framing effects; and (b) dysfunctional impulsivity would moderate susceptibility to framing effects.

CHAPTER III: METHOD

Participants

There were four groups of participants: (a) 52 ninth-graders between 14-16 (mean age = 14.54, SD = .07, percentage female = 51.92%), (b) 29 twelfth-graders between 17-18 (mean age = 17.62, SD = .115, percentage female = 51.72%) in high school, (c) 31 younger emerging adults between 18-19 (mean age = 18.77, SD = .076, percentage female = 87.10%), and (d) 38 older emerging adults between 20-24 (mean age = 20.88, SD = .19, percentage female = 78.95%).

Based on a power analysis using G*Power for a repeated measures design and effect sizes found in the framing effects literature, the target number of participants was between 25 to 33 participants in each age group. For the purposes of some of the analyses involving individual difference variables, however, participants were combined into two age groups: high school students (i.e., ninth and twelfth graders) and college students (i.e., younger emerging adults and older emerging adults).

Procedure

High School participants were recruited from local high schools, and college students were recruited using the SONA system for psychological research at Illinois State University. Prior to the study, I contacted school boards, school districts, principals, and teachers in order to obtain necessary approvals to conduct a study at schools. A parental consent form was sent via students to all parents at the high schools where administrators agreed to allow students to participate. Only the students with signed parental consent forms were allowed to participate in the study. Students under 18 who volunteered to participate also completed an informed assent document. Students who had reached the age of 18 signed their own informed consent document.

Participants then completed a paper-and-pencil booklet including experimental scenarios and individual difference measures of thinking styles, impulsivity, and personality. At the conclusion of the data collection, participants were asked to complete demographic survey (e.g., gender and race) and read a debriefing statement that included appropriate contact information for questions about the study and their rights as a participant.

The participants were tested in groups. For participants in high school, they were tested in their classrooms as part of the health or English classes. The students who were not participating in the study or finished the experimental tasks earlier than other students were given another task (e.g., reading a brochure about healthy eating). College students were tested in small classrooms.

High school participants were eligible to enter a raffle to win one of two \$25 Amazon.com gift cards. Interested participants gave their email address on separate piece of paper for drawing. The raffle information was not entered in the database and there was no attempt to match participant email addresses with other data collected in the study. College students received extra credit for their classes via the SONA system.

Materials

The Asian Disease Problem

The Asian Disease Problem is a classic paradigm used to demonstrate the framing effect (Tversky & Kahneman, 1981). Participants read a hypothetical scenario where a new disease would be expected to kill 600 people and are asked to choose between “certain” and “risky” programs to combat the disease. The Asian Disease Problem consists of two options that are presented in two different “frames” (Figure 1).

A “gain frame” (Problem 1 in Figure 1) was presented in terms of lives saved whereas a “loss frame” (Problem 2 in Figure 1) was presented in terms of lives lost. For each

frame, there were two programs that participants can choose from. A “sure” or non-probabilistic option was written in a way that exact number of people would be either killed or saved (e.g., 400 people will be saved). A “risky” or probabilistic option was written in a way that certain percentage of people would be either killed or saved (e.g., 2/3 of people will be killed). The probabilities of lives saved or lost in the “sure” or the “risky/probabilistic” program were identical.

Modified Adolescent-Relevant Problem Scenarios

Previous research with adult sample has demonstrated the framing effects where choices involving gains (as in the gain frame) are often risk-averse in that people choose the certain option, whereas choices involving losses are often risk-taking in that people choose the risky option in a variety of modified scenarios (e.g., Gambling, Tax evasion, Bargaining, Message compliance, Clinical Reasoning, and Evaluation of objects; see Kühberger, 1998, for review). In addition to the classic Asian Disease scenario described above, this study provided several additional scenarios that were modified to examine decision making behaviors in potential risky situations of adolescents’ lives (see Appendix C). Topics for modified scenarios included sexually transmitted infections, underage drinking, and illegal drug use. The format of the problems follows that used by Mahoney et al. (2010). The probabilities and payoffs in the problems were varied in the range specified by summary studies of framed risky choice (Kühberger, 1998, 1999). In his meta-analysis, Kühberger (1989, 1999) recommended the probabilities in the risky option to range from one-third to one-half and the payoffs to range from 60 to 10,000 people or objects. Because this recommended payoff range is quite large, my materials included scenarios that ranged from 400 to 4,000 people being affected (see Appendix C). In addition to addressing these concerns about probabilities and payoff range from the

existing framing literature, varying these problem characteristics made the study more interesting for participants and to prevent potential fatigue in answering multiple questions about similar scenarios (Mahoney et al., 2010).

Rational-Experiential Inventory - Adolescents (REI-A)

A modified version of Rational-Experiential Inventory (REI; Epstein, Pacini, Denes-Raj & Heier, 1995) for adolescents by Marks, Hine, Blore and Phillips (2008) includes 20 items to assess preferences for processing information. It consists of two subscales, rational thinking and experiential thinking. Rationality thinking, measured by an adapted Need for Cognition Scale (NFC; Cacioppo & Petty, 1982), emphasizes a conscious and analytical approach whereas experiential thinking, measured by the Faith in Intuition (FI) scale, emphasizes pre-conscious, affective, and holistic approaches. The modified version (REI-A) has good international consistency for both thinking styles (rational $\alpha=0.89$; experiential $\alpha= 0.81$; Marks et al., 2008). In the current study, the reliability for the rational subscale was .86 and the reliability for the experiential scale was .79.

Dickman Impulsivity Inventory (DII)

The Dickman Impulsivity Inventory (DII; Dickman, 1990) is a 23-item self-report questionnaire developed to measure two types of impulsivity: Functional and Dysfunctional Impulsivity. Eleven items are designed to measure Functional Impulsivity and another 12 items to measure Dysfunctional Impulsivity. Functional Impulsivity is the tendency to act with relatively little forethought when such a style is optimal, whereas Dysfunctional Impulsivity is defined as the tendency to act with less forethought than most people of equal ability. Fino et al. (2014) reported a Cronbach's alpha of .81 for Dysfunctional Impulsivity and .78 for Functional

Impulsivity. In the current sample, the reliability was .77 for Dysfunctional and .68 for Functional impulsivity.

Mini-International Personality Item Pool (Mini-IPIP)

The Mini-IPIP (Donnellan, Oswald, Baird, & Lucas, 2006) is an abbreviated version of the Five-Factor Personality Inventory, and consists of 20 items measuring extraversion, conscientiousness, extraversion, agreeableness, openness to experience, and neuroticism. It has an acceptable internal consistency (i.e., Conscientiousness, $\alpha=.65$; Extraversion, $\alpha=.71$; Agreeableness, $\alpha=.70$; Openness to experience, $\alpha=.65$; Neuroticism, $\alpha=.62$). Only the subscales for Openness ($\alpha=.67$) and Neuroticism ($\alpha=.65$) were used in the current research.

CHAPTER IV: RESULTS

Each participant was given a score of 1 for choosing the risky/probabilistic choice, and 0 for choosing the sure choice for each of the eight problems in Appendix A. As there are 4 gain frames and 4 loss frames, two composites were tallied, with possible scores of 0-4 for gain frames, and 0-4 for loss frames, where a larger score is considered to reflect more risk-taking.

Framing Effects and Risky Choices

Framing effects have historically been defined as either preference shifts or reversals at the group level (Kuhberger, 1991). Following the method employed by Mahoney et al. (2011), I counted the frequency of (a) “preference reversals” (i.e., where participants select the sure option in every gain frame and choose the risky/probabilistic option in every loss frame), (b) “preference shifts” (i.e., more risky/probabilistic choices in loss frames than in the gain frames at composite level) and (c) “lenient interpretation of preference reversals” (i.e., where participants selected the sure options in most of the gain frames (i.e., 3 or 4 out of 4) and also choose the risky options in the most of the loss frames (i.e., 3 or 4 out of 4).

None of the participants in any of the four age groups demonstrated complete preference reversals. Table 1 presents percentage of preference shifts and lenient interpretation of preference reversals by age group. Chi-square tests were conducted in order to examine whether the proportion of participants showing preference shifts and lenient preference reversals was different for the age groups. There was no significant group difference for preference shifts, $\chi^2(3, N = 154) = 6.171, p = .104$, whereas there was significant group difference for lenient preference reversals, $\chi^2(3, N = 154) = 8.013, p = .046$. Younger emerging adults demonstrated the highest percentage of lenient preference reversals (67.7%) followed by older emerging adults (42.5%), 9th graders (39.6%), and 12th graders (36.7%).

As a preliminary analysis, I looked at the number of risky choices as a function of Age Group and Frame. A 2 (Frame: gain vs. loss) x 4 (Age: 9th grade, 12th grade, younger emerging adults, and older emerging adults) mixed Analysis of Variance (ANOVA) was conducted with the number of risky choices as the dependent variable. Frame was a repeated-measures factor and Age was a between-subjects factor. There was main effect of Frame, $F(1, 150) = 46.35, p < .01, \eta_p^2 = .236$, a main effect of Age, $F(3, 150) = 2.67, p = .048, \eta_p^2 = .051$, and a significant interaction of Frame and Age, $F(3, 150) = 3.349, p = .021, \eta_p^2 = .063$. An analysis of the simple effects revealed that for the 12th graders, the effect of Frame was not significant, $F(1, 150) = 1.356, p = .246, \eta_p^2 = .009$, because they were making more risky choices in both frames compared to other groups (see Figure 2). The effect of Frame was significant (and consistent with the classic framing effect) for the other three groups (all $ps < .001$).

Tests of Hypotheses and Exploratory Research Questions

Hypothesis one stated that the standard pattern of framing effects (i.e., more likely to select sure options in gain frames and selecting risky/probabilistic options in loss frames) would be more likely among the college-aged groups compared to high school student groups when they were presented with the original Asian Disease Problem. A 2 (framing effect: yes/no) x 4 (Age groups: 9th grade, 12th grade, younger emerging adults and older emerging adults) Chi-square test of association indicated that the proportion of participants showing the framing effect in each age group was significantly different, $\chi^2(3, N = 154) = 13.907, p = .003$. Among the college-aged groups, 54.8% of younger emerging adults and 35.0% of older emerging adults showed the framing effect on the Asian Disease Problem, whereas only 24.5% of 9th graders and 13.3% of 12th graders showed the framing effect (see Figure 3). Thus, hypothesis one was supported.

Hypothesis two stated that 12th graders would be most likely to choose the risky/probabilistic options when presented with adolescent-relevant scenarios compared to the classic Asian Disease Problem, relative to other three groups. For this analysis, I computed the percentage of risky choices on the two versions of the Asian Disease problem and on the six adolescent-relevant scenarios in order to compare across the two problem types. A 2 (Problem Type: adolescent-relevant vs. Asian Disease) x 4 (Age: 9th grade, 12th grade, younger emerging adults, and older emerging adults) mixed Analysis of Variance (ANOVA) was conducted with the percentage of risky choices as the dependent variable. Problem type was a repeated-measures factor and Age was a between-subjects factor. There was no main effect of Problem Type, $F(1, 150) = 9.66, p = .327, \eta_p^2 = .006$, no main effect of Age, $F(3, 150) = 2.058, p = .108, \eta_p^2 = .040$, nor a significant interaction of Problem Type and Age, $F(3, 150) = 1.438, p = .234, \eta_p^2 = .028$. Thus, hypothesis two was not supported.

Exploratory questions investigated the influence of thinking styles, personality, and impulsivity on framing effects. Following Mahoney et al. (2011), thinking style, personality, and impulsivity scores were trichotomized (low, middle, and high). Prior to this, I tested whether the age groups had similar distributions of scores. For thinking styles, there was a significance age group difference for experiential thinking scores, $F(3, 150) = 3.602, p = .015$. Although there was only a marginal age group difference for rational thinking scores, $F(3, 150) = 2.158, p = .095$, the distribution appeared to be different for each group; thus, each age group was trichotomized separately. Table 2 shows the range of scores for low, middle, and high for each group for rational and experiential Thinking scores. For personality, the neuroticism subscale demonstrated a significant difference in distribution of scores among age groups, $F(3, 150) = 2.694, p = .048$; therefore, it was trichotomized separately by age groups. Table 3 shows range

of scores for low, middle, and high for each group. Because the openness to experience subscale, and the dysfunctional and functional subscales of the Dickman Impulsivity Scale did not indicate age differences (all $ps > .05$), all participants were trichotomized using the same criteria regardless of age (see Table 4).

Additionally, for subsequent analyses of individual differences, I combined participants into two age groups (i.e., college vs. high school) because analyzing four groups of trichotomized individual difference variables would not have adequate power to detect any moderation of individual difference variables on framing effects.

Exploratory research question 1A examined whether or not experiential thinking style would moderate participants' susceptibility to framing effects. A mixed ANOVA was performed using the score on the experiential subscale of the REI (low, mid, high) and Age (high school vs. college students) as between-subject variables, and Frame (gain or loss) as a repeated measures factor. The number of risky/probabilistic choices (range 0-4) was the dependent variable. As shown in Table 5, there was an expected significant main effect of Frame, $F(1, 148) = 46.726, p < .001, \eta_p^2 = .24$, and expected significant interaction between Frame and Age, $F(1, 148) = 4.085, p = .045, \eta_p^2 = .03$. However, there was no significant interaction effect of Frame, Age, and Experiential Thinking scores, $F(2, 148) = 0.002, p = .998$. For between-subjects effects, there was no significant main effect of Age, $F(1, 148) = 0.035, p = .852$, and no main effect of Experiential Thinking, $F(2, 148) = .537, p = .585$; however, there was a significant interaction between Age and Experiential Thinking, $F(2, 148) = 3.325, p = .039, \eta_p^2 = .04$. Figure 4 illustrates the full design and demonstrates that college students with high experiential scores showed most pronounced pattern of framing effects (i.e., as represented by a large difference in the number of risky choices between the gain and loss frames). Additionally, Figure 5 illustrates

the interaction between experiential thinking style and age on risky choices. In terms of experiential thinking score, the difference between the number of risky choices (regardless of Frame) for high school and college students was only significant for those with low experiential thinking, $F(1,148) = 3.76, p = .05, \eta_p^2 = .025$. There were no significant differences in risky choices between high school and college students with moderate or high experiential thinking styles ($ps > .15$).

Exploratory research question 1B investigated whether or not rational thinking style would moderate participants' susceptibility to framing effects. A mixed ANOVA was performed using the score the Rational subscale of the REI (low, middle, and high) and Age (high school vs. college) as between-subject variables, and Frame (gain vs. loss) as a repeated-measures factor. The number of risky/probabilistic choices (range 0-4) was the dependent variable (Table 6). As expected, there was a significant main effect of Frame, $F(1, 148) = 58.61, p < .001$, and a significant interaction of Frame and Age, $F(1, 148) = 5.43, p = .03$. However, there was no significant main effect of Age, $F(1, 148) = .12, p = .73$, no significant main effect of Rational Thinking $F(2, 148) = 1.192, p = .31$, and no interaction between Age and Rational Thinking, $F(2, 148) = 1.36, p = .27$. Interestingly, there was a significant interaction of Frame, Age, and Rational Thinking, $F(2, 148) = 7.47, p = .001$. Although data shows framing effects for high school students in the low rational thinking group (as indicated by the difference between risky choices in the gain and loss frames), the college students with moderate and high rational thinking score were most susceptible to the framing effect (see Figure 6).

Exploratory research question two investigated the influence of personality on framing effects. For exploratory research question 2A, whether or not openness to experience in the Big Five Personality Inventory would moderate susceptibility to framing effects in adolescents and

emerging adults, a mixed ANOVA was performed using the score on the Openness to Experience subscale of the Mini-IPIP (i.e., low, mid, or high) and Age (High School or College) as between-subject variables, and Frame (gain or loss) as a repeated measures factor, with the number of risky choices (range 0-4) as the dependent variable. As expected based on earlier analyses, there was a main effect of Frame, $F(1, 148) = 49.219, p < .001$, and interaction effect between Frame and Age groups, $F(1, 148) = 5.217, p = .024$. However, there was no significant interaction effect between Frame and Openness to Experience score, $F(2, 148) = 2.293, p = .105$, between Age and Openness to Experience score, $F(2, 148) = 2.809, p = .063$, or among Frame, Age, and Openness to Experiences score, $F(2, 148) = 1.290, p = .278$. Thus, openness to experience did not moderate susceptibility to framing effects.

For exploratory research question 2B, whether or not neuroticism would moderate susceptibility to framing effects, a mixed ANOVA was performed using the score on the Neuroticism subscale (low, mid, and high) and Age (High School or College) as between-subject variables, and Frame (gain or loss) as a repeated measures factor, with the number of risky choices (range 0-4) as the dependent variable. As expected, there was a main effect of Frame, $F(1, 148) = 46.998, p < .001$, and an interaction between Frame and Age, $F(1, 148) = 3.865, p = .051$; however, there was no significant interaction between Frame and Neuroticism score, $F(2, 148) = 0.005, p = .995$, between Neuroticism and Age, $F(2,148) = 1.065, p = .347$, or among Frame, Age, and Neuroticism, $F(2, 148) = 0.177, p = .838$. Thus, neuroticism did not moderate susceptibility to framing effects.

Exploratory research question three investigated the influence of impulsivity on framing effects. For exploratory research question 3A, whether or not functional impulsivity would moderate susceptibility to framing effects, a mixed ANOVA was performed using the score on

the Functional subscale (low, mid, high) and Age groups (high school vs. college students) as between-subject variables, and Frame (gain or loss) as a repeated measures factor, with the number of risky choices (range 0-4) as the dependent variable. As expected, there was significant main effect of Frame, $F(1, 148) = 51.404, p < .001$, and significant interaction effect between Frame and Age, $F(1, 148) = 6.241, p = .014$. There was no significant interaction between Frame and Functional Impulsivity score, $F(2, 148) = 1.001, p = .370$, between Functional Impulsivity and Age, $F(2, 148) = 1.767, p = .174$, or among Frame, Age, and Functional Impulsivity score, $F(2, 148) = 1.359, p = .260$. Thus, functional impulsivity did not moderate susceptibility to framing effects.

For exploratory research question 3B, whether or not dysfunctional impulsivity would moderate susceptibility to the framing effects, a mixed ANOVA was performed using the score on the Dysfunctional subscale (low, mid, high) and Age groups (High School or College Students) as between-subject variables, and Frame (gain or loss) as a repeated measures factor, with the number of risky choices (range 0-4) as the dependent variable. There was the expected main effect of Frame, $F(1, 148) = 45.867, p < .001$. However, there were no significant interaction between Frame and Age groups, $F(1, 148) = 3.315, p = .071$, between Frame and Dysfunctional Impulsivity Score, $F(2, 148) = 0.275, p = .760$, between Dysfunctional Impulsivity Score and Age $F(2, 148) = 0.125, p = .862$. Additionally, there was no significant three-way interaction effect of Frame, Age, and Dysfunctional Impulsivity score, $F(2, 148) = 1.894, p = .154$. Thus, dysfunctional impulsivity did not moderate susceptibility to framing effects.

CHAPTER V: DISCUSSION

Although framing effects have been extensively studied within the adult population (i.e., college-aged participants), developmental studies of framing effects are limited. Fuzzy-trace theory (Reyna & Brainerd, 1995) is one of the few theories that aims to explain developmental differences in framing effects. The theory posits that children are less influenced by framing effects compared to adults, because children tend to use verbatim-based (i.e., analytical) processing, and as development progresses, adolescents use more gist-based (i.e., experiential) processing and thus become susceptible to framing effects. The present study, however, demonstrated that adolescents were less susceptible to framing effects compared with adults when the classic Asian Disease scenario was used. The original Asian Disease task was also used with an adolescent sample in the study by Chien, Lin, and Worthley (1996). Their study concluded that adolescents were susceptible to framing effects. In a closer look at their study, however, 71.6% of adolescents (66 out of 92 adolescents) selected the same option regardless of gain or loss frames. The present study showed a pattern similar to Chien et al.'s study such that 73% of high school students (61 out of 83 adolescents) selected the same option regardless of gain or loss frames. In Chien et al.'s study, of adolescents who choose different options for gain and loss frames, 73% displayed the classic framing effect. In the present study, 77% of adolescents who choose different options for gain and loss frames displayed the framing effect. Thus, the present study demonstrated the same developmental pattern as Chien et al.'s study. Because the overwhelming majority of adolescents chose the same options in both frames, the results of these studies do not support the claim made by the Fuzzy-trace theory that posits adolescents become susceptible to framing effects. The finding that adolescents are not necessarily affected by framing effects, aligns with findings that adolescents overall have a

tendency to engage in risk-taking behaviors (Kann et al., 2014). So, regardless of framing condition, they are more likely to choose the risky choice.

The present study also investigated whether or not adolescent-relevant scenarios would influence risky decision-making. The results showed that there was no significant difference in risky decision-making between the classic Asian Disease Scenarios and the adolescent-relevant scenarios. Although previous research shows that adolescents tend to use more experiential processing in social contexts and are prone to a variety of other cognitive biases (e.g., Albert & Steinberg, 2011; Klaczynski, 2002), adolescents and emerging adults in the present study did not seem to be influenced by the scenarios that resembled their social context.

Additionally, the present study investigated the influence of individual differences on framing effects with adolescent and college-aged samples. The study examined the effect of thinking styles (i.e., experiential thinking and rational thinking styles), personality dimensions (i.e., openness to new experience and neuroticism), and impulsivity (i.e., functional and dysfunctional impulsivity). As for experiential thinking, the results showed that college students with high experiential scores demonstrated the most pronounced pattern of framing effects. In the normative view of rational decision-making (Albert & Stenberg, 2011), cognitive biases occur due to experiential thinking processes that are not overridden by analytical thinking processes (Evans, 2003; Klaczynski, 2005; Stanovich, 1999). Thus, the current study confirms this view of rational decision making because college students who are high in experiential thinking failed to override their intuition.

As for rational thinking style, a three-way interaction between Age, Frame, and Rational Thinking was found. College students with moderate and high rational thinking scores were most susceptible to framing effects. Moreover, high school students in the low rational thinking group

were more susceptible to framing effects. This is a very interesting developmental change in that rational thinking style moderated the susceptibility of the framing effect in an opposite way between high school and college students. Previous studies of rational and experiential thinking styles with adult sample have not found consistent results and none of the developmental studies have looked at rational-experiential thinking styles as moderators (Mahoney et al., 2011; Shiloh et al., 2002). Thus, the present study demonstrated an interesting developmental path for how rational thinking style might influence the susceptibility of individuals to framing effects. High school students with low rational thinking scores failed to override their intuitive thinking. This finding also confirms the normative view of rational thinking (Albert & Stenberg, 2011) discussed for college students with high experiential thinking. However, the same explanation does not apply to the college students, because moderate- and high-rational thinkers failed to override their intuitive thinking. I speculate that college students with moderate-to-high rational thinking scores may also be high in experiential thinking. Shiloh, Salton, and Sharabi (2002) found that participants with the combination of high rational and high experiential scores and those with the combination of low rational and low experiential scores were most susceptible to the framing effect. Therefore, if college students with high experiential thinking scores were also high in rational thinking, the present finding of their high susceptibility to framing effects would replicate the finding from Shiloh et al. (2002). Unfortunately, this speculation cannot be tested in the present study because dividing the participants into four categories (i.e., high-experiential-high-rational, low-experiential-high-rational, high-experiential-low rational, and low-experiential-low-rational) would result in having too small number of participants in each category to yield significant power for the analysis.

The present study also investigated other individual difference measures including functional and dysfunctional impulsivity, and the neuroticism and openness to exploration subscales of Big Five Personality inventory. The results showed that none of these measures affected the susceptibility to framing effects in significant ways. As for personality measures, Levin and Hart (2003) examined moderation of the framing effect using children's temperament scores (which is related to Big Five personality traits in adults) and found that more sadness (which is related to neuroticism in Big Five personality traits) and less shyness (which is inversely related to openness to experience in Big Five personality traits) were related to more risk-taking behaviors in both the gain and loss frames. They also found that less sadness was related to framing effects (i.e., there was more risk-taking in the loss frame relative to the gain frame for those who were low in sadness). The present study, however, did not find any significant moderation of these personality measures on framing effects. In the present study, openness to experience and neuroticism did not influence susceptibility to framing effects for either the high school or college students. I speculate that individuals who were high in neuroticism in the present study may not have been affected by similar emotional arousal that children in Levin and Hart's experiment may have experienced. The present study used Asian Disease scenarios, whereas Levin and Hart's study used a spinner task. As discussed earlier, gambling and gaming tasks inherently generate emotional arousal (Cheung & Mikels, 2011), which may have an impact on their results, especially those with more sadness (i.e., equivalent to adult neuroticism). Moreover, although adolescent research often cites impulsivity for a predictor of various risk-taking behaviors (e.g., Robbins & Bryan, 2004; Romer, 2010; Steinberg, 2008), impulsivity – whether functional or dysfunctional -- did not influence the susceptibility to framing effects in the present study. I speculate that impulsivity may not have impacted

participants in this experimental task because the task is aimed to test reasoning in risky situations instead of actual behaviors in risky situations.

Strengths and Limitations

The present study examined the developmental course of framing effects using the classic Asian Disease task. As discussed earlier in my literature review, most of the developmental research on framing effects used gambling or spinner tasks. The present study was one of the few studies to examine framing effects with adolescents using the original task used by Tversky and Kahneman (1981). Using the same task with adults minimized the effect of emotional arousal typically found in gambling and spinner tasks, and made it more comparable to the results of the present study with extensive studies of framing effects with adult population.

The present study also examined framing effects and risky decision-making in various new ways. This study was the first developmental study that used modified scenarios that were relevant to adolescent lives, and these modified scenarios appear to be a good alternative to the classic Asian Disease scenario because adolescent-relevant scenarios did not yield significantly different results in framing effects from the Asian Disease scenario. Although Kühberger (1998) suggested that the Asian Disease cover story as the best cover story because it yields the biggest effect size, I posit that adolescent-relevant scenarios can be used in the future study to examine adolescent decision-making tendencies because these scenarios may provide more realistic choices in adolescents' lives.

In spite of its strengths, the current study had limitations that might have affected the results of the study. First, as already noted, the sample size was smaller than originally targeted and could not yield sufficient power for some of the analyses in the study, especially in the analysis of the effects of individual difference variables (i.e., thinking style, personality,

impulsivity) on framing effects for my exploratory research questions. If my sample sizes were larger, I may have been able to examine the four age groups separately and had adequate power to determine if some of these individual difference variables, for example, influenced the 9th and 12th graders differently.

The present study employed a within-subjects design and revealed interesting information that is not available in the between-subject design. The result showed that a notable number of adolescents (73% of high school students) were not influenced by the gain or loss frames, thus they selected the same type of response option for both frames. Although the within-subject design revealed this interesting finding, it also created some limitations to the study. The experimental booklet had a series of framing effects questions one after another and high school students may not have paid sufficient attention to each scenario and question. Although I replicated the experimental procedure used by Mahoney et al. (2011), the results may have been different if framing effects tasks were spread out across the experimental booklets.

Directions for Future Research

For future research, more studies of the framing effect with adolescent samples are needed in order to demonstrate clearer developmental path of cognitive biases in risky decision-making. Thus far, Chien, Lin, and Worthley (1996) is the only other study that has used the classic Asian Disease scenario with adolescent samples, and their study yielded similar results to those in the present study in that the majority of adolescent participants selected risky choices regardless of the gain and loss frames. Although the use of a within-subjects design helped both studies to examine risky decision-making across both gain and loss frames, and across various scenarios, another close analysis of framing effects with a more typical between-subjects design

(but that requires a much larger sample size) that minimizes potential fatigue effects could increase our understanding of developmental path of framing effects.

Additionally, I recommend inclusion of some of the design features illustrated in the present study: use of adolescent-relevant scenarios and use of various other individual difference measures to determine the extent to which the individual differences would affect the developmental path of risky decision-making. Although the present study did not find statistically significant difference between the classic Asian Disease scenarios and adolescents-relevant scenarios, adolescent-relevant scenarios would still increase ecological validity of the study that involves adolescents because these scenarios are based on the situations where adolescents are familiar with and make daily decisions. Moreover, the present study demonstrated rational thinking styles as a significant moderator in framing effects; thus, future research may want to examine other dimensions of individual measures that are often cited in the adolescent literature such as sensation seeking behaviors (Arnett, 1994; Steinberg, 2008; Albert & Steinberg, 2011) and risk-taking propensity (Lejuez, Aklin, Bornovalova, & Moolchan, 2005).

Conclusion

The present study found that adolescents (i.e., high school students) were less susceptible to framing effects compared to the college-age students on the classic Asian Disease problem and its modified scenarios. Unlike other developmental studies, which used spinner or gambling tasks, using the same task with adult studies resulted in ability to make comparison with adult literature. The strongest framing effects were found among the younger emerging adult college students, which is the population that has been studied most extensively.

Developmental literature on the framing effect is scarce; however, the review of literature in Chapter 2 and the findings from the present study revealed a very interesting developmental

path. Over the course of child to adult development, the following developmental patterns have been observed. Pre-school aged children did not exhibit framing effects, second graders exhibited “reverse framing” (i.e., a greater preference for risky/probabilistic choices in the gain frame than in the loss frame), and fifth graders demonstrated the standard framing effect (Reyna & Ellis, 1994). The high school students chose the same risky options regardless of frames, although those who did not choose the same option demonstrated framing effects (Chien et al., 1996 and present study). Younger college students demonstrated the most pronounced framing effects, whereas the older college students showed less framing effects compared with the younger college students. Although more studies are needed to have a solid understanding of this subject, it is interesting that younger college students who are likely to be subjects of “adult” studies in many psychological studies tend to show most pronounced framing effects. Close analyses of “adult” studies that separate subjects by age may be necessary to understand why younger college students have the most pronounced framing effects.

The present study also found that rational thinking style moderated the susceptibility to framing effects for high school and college students. I found that college students with moderate and high rational thinking score were most susceptible to the framing effect, whereas high school students with low rational thinking score were more susceptible to framing effect compared to those with moderate and high rational thinking scores. This finding has important practical implications for practitioners working with high school and college students. Although framing effects are a fairly robust phenomenon among adults, and have been used in many practical decision making domains including medical and financial decision making, not all adolescents and young adults are susceptible to framing effects. Thus, as practitioners work with adolescents and emerging adults, they should pay attention to this individual difference and use the most

appropriate method of intervention for individuals to help make sound decisions in risky situations.

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APPENDIX A: TABLES

Table A-1

Percentage of Participants Showing Preference Shifts and Lenient Interpretation of Preference Reversals by Age Group

	Preference shifts	Lenient reversals
9th grade ($n = 53$)	43.40%	39.60%
12th grade ($n = 30$)	26.70%	36.70%
Younger emerging adults ($n = 31$)	58.10%	67.70%
Older emerging adults ($n = 40$)	45.00%	42.50%
Total ($n = 154$)	43.50%	45.50%

Note: A preference shift is defined more risky choices in loss frames than in the gain frames at composite level (i.e., across all 8 scenarios). A lenient reversal is when a participant selects the sure option in *most* of the gain frames (i.e., 3 or 4 out of 4) and also selects the risky option in the *most* of the loss frames (i.e., 3 or 4 out of 4).

Table A-2

Trichotomized scores for Rational Thinking and Experiential Thinking for Each Age Group

		Rational Thinking			Experiential Thinking		
		low	middle	high	low	middle	high
9th grade	range	1.8-3.0	3.2-3.8	4.0-4.7	1.8-3.4	3.5-3.8	3.9-4.3
	<i>n</i>	19	17	17	21	14	18
12th grade	range	2.4-3.4	3.5-3.8	4.0-5.0	2.6-3.6	3.7-3.9	4.0-4.9
	<i>n</i>	11	7	12	12	11	7
Younger emerging adults	range	1.6-2.9	3.1-3.8	4.0-4.5	2.8-3.5	3.6-4.0	4.1-5.0
	<i>n</i>	10	12	9	9	10	12
Older emerging adults	range	2.4-3.2	3.4-4.0	4.1-4.9	2.4-3.5	3.6-3.9	4.0-5.0
	<i>n</i>	13	14	13	13	13	14

Note: Scores can range between 1 and 5

Table A-3

Trichotomized Scores for Neuroticism for Each Age Group

		Neuroticism		
		low	middle	high
9th grade	range	1.0-2.25	2.5-3.0	3.25-5.0
	<i>n</i>	15	21	17
12th grade	range	1.0-2.25	2.5-3.0	3.25-5.0
	<i>n</i>	10	12	8
Younger emerging adults	range	1.0-2.5	2.75-3.25	3.5-5.0
	<i>n</i>	10	12	9
Older emerging adults	range	1.0-2.75	3.0	3.25-5.0
	<i>n</i>	11	13	16

Table A-4

Trichotomized Scores for Openness to Experience, Functional and Dysfunctional Impulsivity

		low	middle	high
Openness to Experience	range	1.0-2.25	2.5-3.0	3.25-5.0
	<i>n</i>	61	53	40
Functional Impulsivity	range	0-4	5-7	8-10
	<i>n</i>	59	56	39
Dysfunctional Impulsivity	range	0-2	3-5	6-12
	<i>n</i>	67	42	45

Table A-5

Repeated Measure ANOVAs for Experiential Thinking (REI-E)

Effect	SS	df	MS	F	η^2
Between-subjects					
Group	.110	1	.110	.035	.000
REI-E	3.401	2	1.701	.537	.007
Group x REI-E	21.041	2	10.520	3.325*	.043
Error	468.262	148	3.164		
Within-subjects					
Frame	60.378	1	60.378	46.726**	.240
Frame x Group	5.279	1	5.279	4.085*	.027
Frame x REI-E	.115	2	.057	.044	.001
Frame x Group x REI-E	.006	2	.003	.002	.000
Error	191.242	148	1.292		

Note: * $p < .05$.; ** $p < .01$.

Table A-6

Repeated Measure ANOVAs for Rational Thinking (REI-R)

Effect	SS	df	MS	F	η^2
Between-subjects					
Group	.378	1	.378	.118	.001
REI-R	7.660	2	3.830	1.192	.016
Group4 x REI-R	8.725	2	4.362	1.358	.018
Error	475.353	148	3.212		
Within-subjects					
Frame	58.611	1	58.611	50.222**	.253
Frame x Group	5.427	1	5.427	4.651*	.030
Frame x REI-R	2.292	2	1.146	.982	.013
Frame x Group x REI-R	17.433	2	8.717	7.469*	.092
Error	172.723	148	1.167		

Note: * $p < .05$; ** $p < .01$.

APPENDIX B: FIGURES

Problem 1 (Gain frame): Imagine that the U.S. 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 estimate of the consequences of the programs is as follows:

If Program A is adopted, 200 people will be saved. (*Sure option*)

If Program B is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that no people will be saved. (*Risky/Probabilistic option*)

Which of the two programs would you favor?

The second problem is exactly the same cover story as above, but the outcome choices are different:

Problem 2 (Loss frame):

If Program C is adopted, 400 people will die. (*Sure option*)

If Program D is adopted, there is 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die. (*Risky/Probabilistic option*)

Which of the two programs would you favor?

Figure B-1. The original Asian Disease Problem from Tversky and Kahneman (1981).

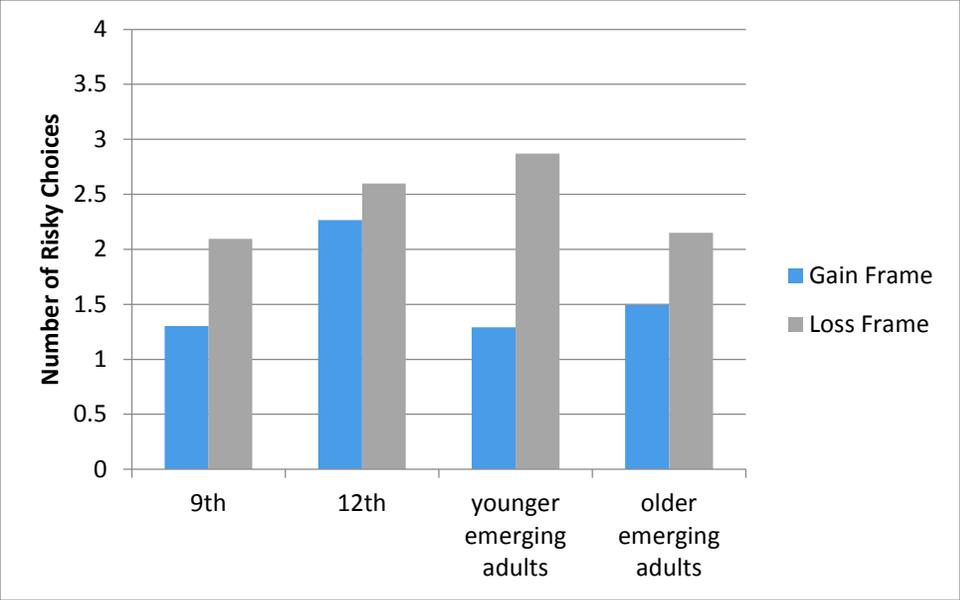


Figure B-2. The number of risky choices in the gain and loss frame for each age group. Number of risky choices can vary between 0 and 4.

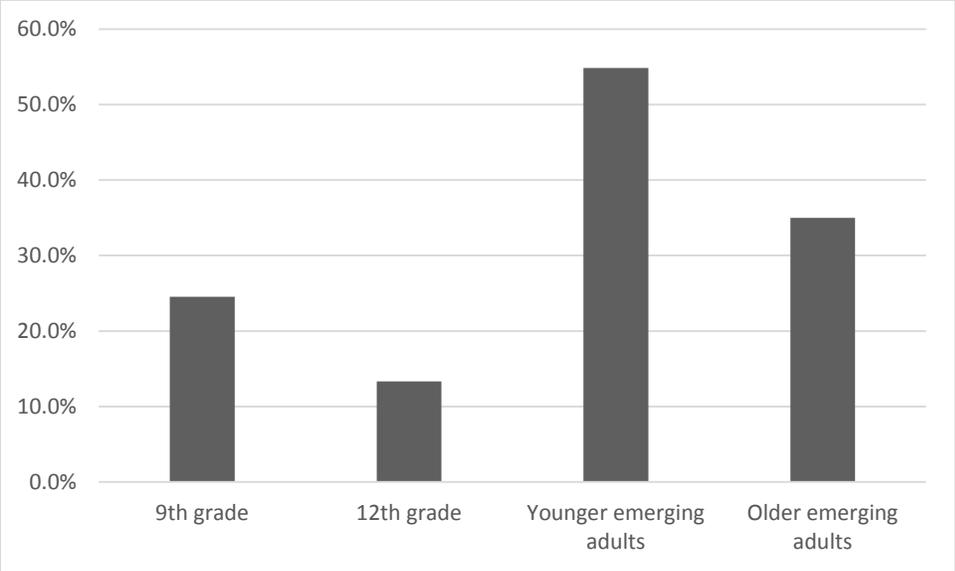


Figure B-3. Percentage of students showing the framing effect on the Asian Disease Problem

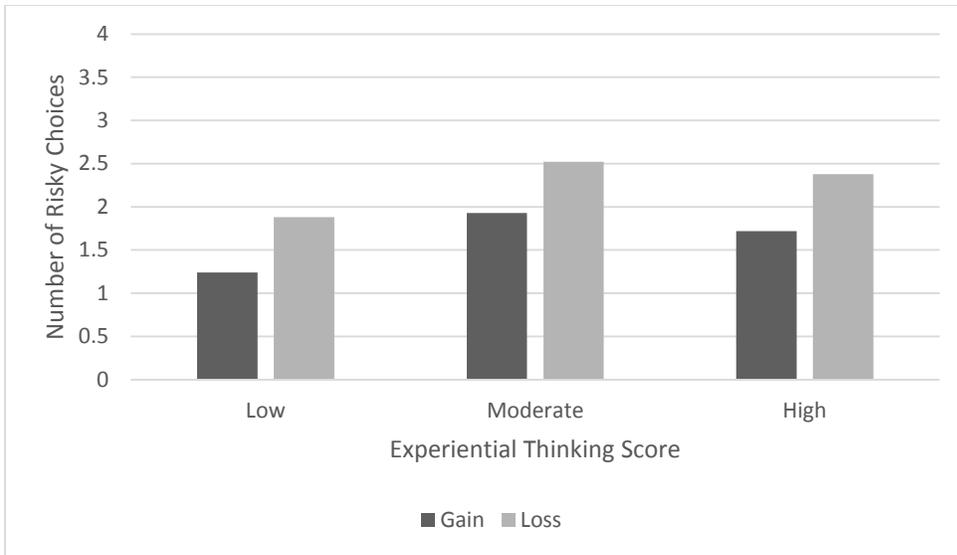


Figure B-4.1 Mean number of risky choices for high school students as a function of three levels of Experiential Thinking score and Frames. Number of risky choices can vary between 0 and 4.

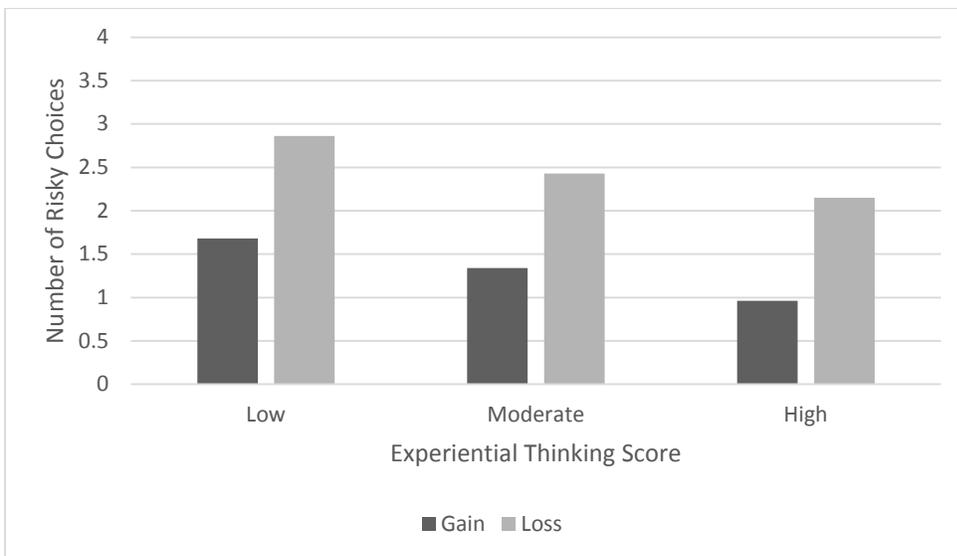


Figure B-4.2 Mean number of risky choices college students as a function of three levels of Experiential Thinking score and Frames. Number of risky choices can vary between 0 and 4.

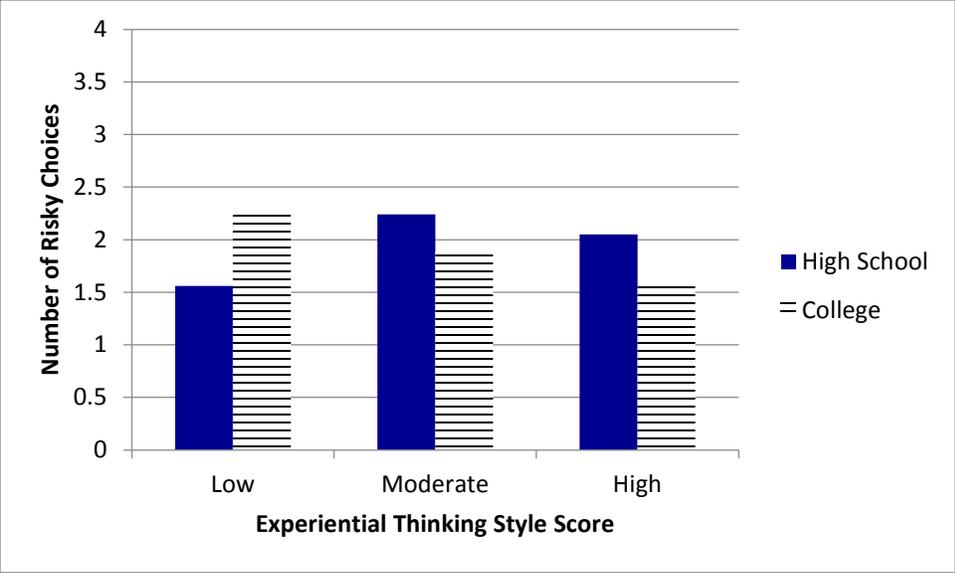


Figure B-5. Number of risky choices as a function of experiential thinking style and age group.

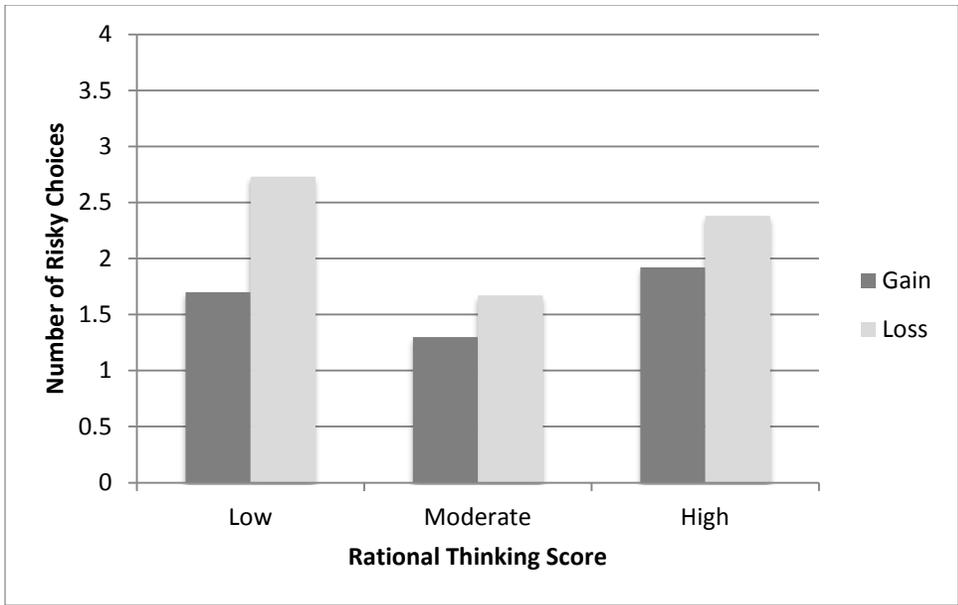


Figure B-6.1 Mean number of risky choices for high school students as a function of three levels of Rational Thinking score and Frames. Number of risky choices can vary between 0 and 4.

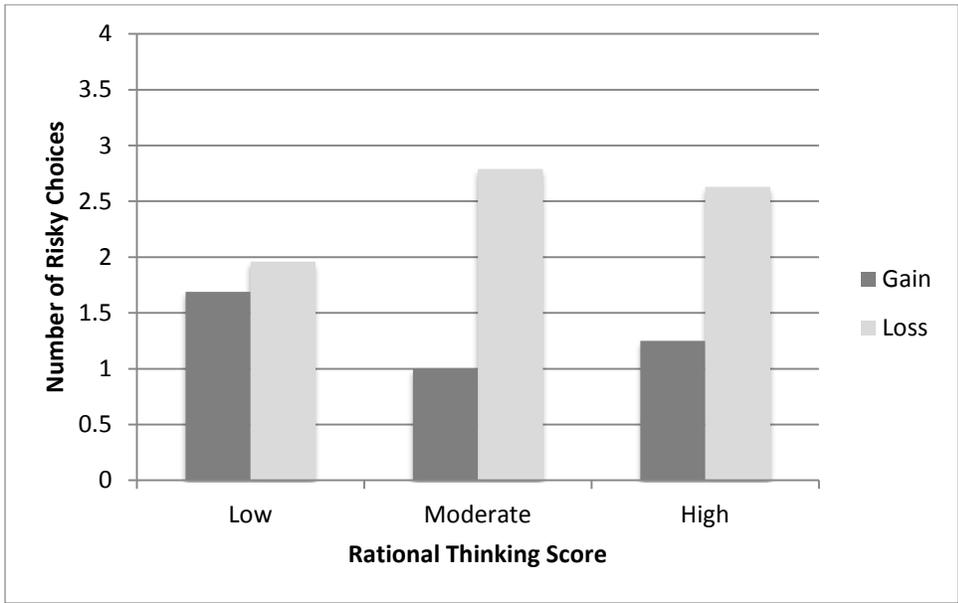


Figure B-6.2 Mean number of risky choices for college students as a function of three levels of Rational Thinking score and Frames. Number of risky choices can vary between 0 and 4.

APPENDIX C: ASIAN DISEASE PROBLEM AND MODIFIED ADOLESCENT-RELEVANT
VERSIONS

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.

Version 1 Gain Frame (V1G) – Classic Asian Disease Problem in the Gain Frame

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 that 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? _____

Version 1 Loss Frame (V1L) – Classic Asian Disease Problem in the Loss Frame

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 that 600 people will die.

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

Version 2 Gain Frame (V2G) – Adolescent-Relevant Version about Sexually Transmitted Infection in the Gain Frame

Imagine that your local health department is preparing for the outbreak of deadly sexually transmitted infection (STI), which is expected to affect 400 teenagers. Two alternative programs to combat the STI have been proposed. Assume that the exact scientific estimate of the consequences of the programs are as follows:

Program A: 100 teenagers will be protected against the STI.

Program B: 1/4 probability that 400 teenagers will be protected against the STI and 3/4 probability that no teenagers will be protected.

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

Version 2 Loss Frame (V2L) – Adolescent-Relevant Version about Sexually Transmitted Infection in the Loss Frame

Imagine that your local health department is preparing for the outbreak of deadly sexually transmitted infection (STI), which is expected to affect 400 teenagers. Two alternative programs to combat the STI have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 300 teenagers will be infected by the STI.

Program B: 1/4 probability that nobody will be infected by the STI, and 3/4 probability that 400 teenagers will be infected by the STI.

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

Version 3 Gain Frame (V3G) – Adolescent-Relevant Version about Texting while Driving in the Gain Frame

Statistics indicate that around 4000 teenagers per year are killed or seriously injured in Illinois because of texting while driving. Two alternative programs to enforce the law to prevent texting while driving have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 1600 teenagers will be saved from death or injury.

Program B: 2/5 probability that 4000 teenagers will be saved from death or injuries, and 3/5 probability that no teenagers will be saved from death or injury.

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

Version 3 Loss Frame (V3L) – Adolescent-Relevant Version about Texting while Driving in the Loss Frame

Statistics indicate that around 4000 teenagers per year are killed or seriously injured in Illinois because of texting while driving. Two alternative programs to enforce the law to prevent texting while driving have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 2400 teenagers will be killed or injured.

Program B: 2/5 probability that nobody will be killed or injured, and 3/5 probability that 4000 teenagers will be killed or injured.

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

Version 4 Gain Frame (V4G) – Adolescent-Relevant Version about Illegal Substances in the Gain Frame

Because of the introduction of highly addictive and lethal drugs (e.g., meth, “bath salts”), 450 teenagers are killed by overdosing illegal substances in your area every year. Two alternative programs to enforce the illegal substance law have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

Program A: 150 teenagers will be saved from death.

Program B: 1/3 probability that 450 teenagers will be saved from death, and 2/3 probability that nobody will be saved.

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

Version 4 Loss Frame (V4L) – Adolescent-Relevant Version about Illegal Substances in the Loss Frame

Because of the introduction of highly addictive and lethal drugs (e.g., meth, “bath salts”), 450 teenagers are killed by overdosing illegal substances in your area every year. Two alternative

programs to enforce the illegal substance law have been proposed. Assume that the exact scientific estimate of the consequences of the programs is as follows:

Program A: 300 teenagers will die.

Program B: $1/3$ probability that nobody will die, and $2/3$ probability that 450 teenagers will die.

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