Framing of online risk: Young adults' and adolescents' representations of risky gambles

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Abstract

Young people can be particularly vulnerable to victimisation online. Despite widespread Internet safety training, data reveal that risky online behaviours are commonplace among young people. To date there has been little research investigating the psychological mechanisms underpinning these risky online behaviours. Drawing on fuzzy trace theory, we examined if adolescents' risky online behaviours were based on both gist/intuitive and verbatim/quantitative representations of risks while adults' risky online behaviours were based mainly on gist representations. One hundred and twenty-four adolescents (aged 13-17 years) and 172 young adults (aged 18-24 years) indicated their risky choice preferences for divulging personal information online (using an adaptation of the Asian-disease problem). Overall gambling behaviour was linked to sensation seeking. However, as predicted, adolescents were more likely to choose the risky options, but adults were more likely to exhibit framing biases, independent of sensation seeking. These results support the conclusion that young adults rely more on gist representations, whereas adolescents rely more on verbatim (and gist) representations. Our findings provide important and novel insights into ways in which online safety training and risk communication could be effectively tailored to different age groups

Keywords: Online risk-taking; adolescent; young adult; fuzzy-trace theory; framing effect

Although the majority of (young) Internet users enjoy positive experiences online (EU Kids Online, 2014), surveys carried out across Europe (Livingstone & Bober, 2004; Livingstone, Haddon, Görzig, & Ólafsson, 2011), the United States (Madden et al., 2013), and Asia (Liau, Khoo, & Ang, 2005) reveal that children and adolescents are exposed to various online risks. These risks can include exposure to inappropriate advertising, pornography, hate sites, cyber bullying, identity theft, and sexual solicitation (Livingstone, Mascheroni, Olafsson et al, 2014; Ybarra, Mitchell, Finklehor, & Wolak, 2007). In light of this, the U.K. Council for Child Internet Safety developed a range of training materials, made available to teachers, parents and carers, in order to help educate children over 5 years of age (Byron, 2010). Nevertheless, these materials are not yet incorporated into the U.K.'s school curriculum. Consequently the focus on, and quality of, internet safety training within schools varies widely, with many young people continuing to engage in risky online behaviours (Livingstone et al, 2011). Furthermore, the psychological factors underlying young people's online risk taking are not well understood so far. Given the importance of gaining better insight into online risk taking we drew on fuzzy trace theory (FTT) to investigate young people's risky online tendencies.

A plethora of research has shown that adolescents are more likely than children and adults to engage in risky (offline) activities (Blum & Nelson-Mmari, 2004; Centers for Disease Control and Prevention, 2011; Currie et al., 2012; Quinn & Fromme, 2011; Zweig, Lindberg, & McGinley, 2001). FTT (Reyna & Brainerd, 1995, 2011) has emerged as one of the major paradigms to successfully explain adolescents' and adults' risk taking in domains such as health (Reyna, 2008) and sexual behaviour (Mills, Reyna, & Estrada, 2008; Reyna & Adam, 2003). Capitalizing on FTT allowed us to assess young people's perceptions of risk and reward and their conceptualization and representation of risky online activities.

At the heart of FTT lies the idea that people use two forms of mental representation when making risky decisions. Verbatim representations are based on specific details of events or judgements using exact quantitative information. Gist representations, on the other hand, come from the meaning associated with events that create intuitive, qualitative representations influenced by an individual's culture, emotional state, experience, and knowledge (Reyna & Farley, 2006).

FTT argues that the ability to form both gist and verbatim representations of events improves developmentally with these representations stored and processed in parallel (Rivers, Reyna, & Mills, 2008). Forming gist representations alongside verbatim knowledge is a cognitive ability that improves with age (Reyna & Brainerd, 1995) which appears to be related to reduce risk-taking behaviour in real-life situations (Reyna et al., 2011). Adults prefer to draw on the simplest level of representation (i.e., gist representations) by default, starting by considering risk categorically (some risk vs. no risk) when making risky decisions. If catastrophic risks (e.g., loss of life) are non-negligible, then typically the action is avoided (Reyna et al, 2015): possibility, rather than degrees of probability, governs action.

The ability to extract simple gist representations, and use these representations as default strategies, develops between adolescence and adulthood. Therefore, combined with increased sensation seeking or sensitivity to rewards compared to adults, adolescents tend to weigh up the pros and cons of an action (i.e., verbatim representations) rather than relying on gist to simply avoid risks (Reyna et al., 2015). Adolescents' stronger reliance on verbatim over gist representations can lead to them taking greater risks compared to adults, particularly when the potential benefits of the activity are weighed against objectively low potential risk (Reyna et al., 2011).

Research on FTT has used the classic framing task (Tversky & Kahneman, 1981) to capture the role of gist and verbatim representations in risky decision making. Participants are

presented with several scenarios—framed as either a loss or a gain of human life—where an outbreak of a deadly disease is expected to kill 600 people. Participants are able to choose between options that could limit the number of casualties. In the gain frame, if they choose option A, 400 lives will be saved (the sure option) and 200 will die. If they choose option B, however, (the risky choice), there is a 1/3 probability that 600 lives will be saved, and a 2/3 probability that no lives will be saved. In the loss frame, participants are informed that if they choose option C, 400 people will die (the sure option). In contrast, if they pick option D (the risky choice), there is a 1/3 probability that no one will die, and a 2/3 probability that 600 people will die.

Rationally speaking, participants who choose option A in the gain frame (the sure option) should also choose option C in the loss frame (sure option) sustaining a risk averse attitude. Likewise, participants choosing option B in the gain frame (the risky or gamble option) should also choose option D in the loss frame (gamble option), sustaining a risk-seeking attitude, since these options share equal expected value in terms of lives saved or lost. However, studies have repeatedly shown that people prefer option A over B in the gain frame and option D over C in the loss frame, displaying risk aversion for gains and risk seeking for losses (Kühberger, 1998; Reyna & Brainerd, 1991; Tversky & Kahneman, 1986).

FTT proposes that the framing effect is based on simple gist representations of options and simple principles (e.g., saving lives is good) applied to those representations. In the gain frame, saving some lives for sure is better than potentially saving no lives, and in the loss frame potentially nobody dying is better than some people dying for sure (Rivers et al., 2008). Because people rely on the gist of the options, and they intuitively seek to save lives (gist), they chose the option of saving lives (rather than the possibility of saving none in the gamble) even if they fully consider the quantitative (verbatim) information that would lead to an elimination of the framing effect (Broniatowski & Reyna, 2015; Reyna et al., 2011).

Indeed, studies using adaptations of the Asian disease problem, replacing numerical information with the statements 'some' and 'none' (Kühberger & Tanner, 2010; Reyna & Brainerd, 1991), have consistently shown framing effects. When participants are asked to focus specifically on the numerical information (Reyna, 2012), think for a prolonged period of time about their choice (Takemura, 1994), or provide a justification for their decisions (Fagley & Miller, 1987), the framing effect disappears altogether.

Reyna et al. (2011) adapted the Asian disease problem to explore developmental differences in the framing task. For adolescents (14-17 years) and young adults (18-22 years) risk taking decreased as the levels of risk increased, and both age groups were also sensitive to the levels of reward choosing to gamble less as the potential stakes (rewards or 'losses') in the gamble option increased. However, age differences emerged with regard to the framing effect. When small and medium levels of rewards ($5 and $20) were at stake, both adolescents and young adults displayed risk aversion tendencies in the gain frame but increased risk seeking in the loss frame. However, when the reward was highest ($150) the young adult group showed reduced levels of standard framing while the adolescent group displayed an extreme version of this reduction in standard framing, termed reverse-framing, and chose to gamble more often in the gain frame. This developmental increase in cognitive bias is predicted by FTT (Broniatowski & Reyna, 2015; Reyna et al, 2015): Although both gist and verbatim representations of risk are encoded, adults relied more heavily on gist-influenced reasoning drawing upon the some-none (categorical) gist to avoid sure losses for the possibility of no losses, or choosing to gain something to avoid the possibility of gaining nothing. Adolescent's still-developing gist reasoning strategies, however, resulted in them using both intuitive and analytic forms of reasoning, while also showing higher sensitivity to rewards (Reyna et al., 2011). This was particularly evident as the quantitative difference between the sure and gamble outcomes increased (differences of $5 at the lowest level

compared to differences of $75 at the highest level). A stronger reliance on verbatim compared to gist representations therefore resulted in a decrease in, and eventual reversal of, the framing effect in adolescents. While sensation seeking was significantly correlated with gambling in the framing task, Reyna et al (2011) found that sensation seeking was independent of the framing effect; that is, young adults displayed increased framing bias because of an increase in gist reasoning and not because of a decrease in sensation seeking.

In the present study we investigated (1) if the framing effect could be observed in scenarios reflecting risky online gambling situations, and (2) if developmental differences existed in adolescents' and young adults' framing and reliance on gist and verbatim representations. Adolescents and young adults were presented with framing tasks similar in structure and design to those developed by Reyna et al. (2011) but in the context of risky online behaviour. Reyna et al (2011) highlighted how gambling behaviour in the framing task was related to real-life risk taking behaviour. Therefore, individual's gambling behaviour in the present study could be indicative of increased risk of online victimisation linked to risky behaviours such as online personal information disclosure (Ybarra et al, 2007).

A number of specific predictions were made. First, young adults should display the typical framing effect showing risk aversion in gain frames and risk seeking in loss frames. This pattern of behaviour would reveal young adults' preference for gist reasoning about online risk. We also predicted that the framing effect would be significantly diminished in adolescents, suggesting their greater reliance on verbatim compared to gist reasoning about risk. Additionally, as the stakes (the potential rewards or losses) and the level of risk increased we expected the rate of gambling behaviour to decrease, reflected by a smaller framing effect for both age groups. While sensation seeking might be related to overall risk taking/gambling, the framing bias should be unaffected by sensation seeking, differentiating

between risk-taking tendencies and developmental differences in mental representations of risk.

Method

Participants

Participants were students from three educational establishments in the southwest of England: one secondary school (N=89; 62 females; M_{age}=14.52 years; SD=1.4; age range 13–18 years), one further education (FE) college (N=52; 34 females; M_{age}=17.02 years, SD=1.09; age range 16–19 years), and one university (N=155; 129 females; M_{age}=19.23 years; SD=1.10; age range 18–24 years). The secondary school and college students were invited to volunteer to participate in the study and received no incentives or compensation for their involvement. Undergraduate students participated for course credit. For analyses, participants were split into two age groups: adolescents (13–17 years) and young adults (18–24 years). Aside from age and sex, no other demographic information was collected.

Materials

Participants were presented with 12 scenarios describing an online gambling problem in the form of an online music quiz. Six of the scenarios were presented in terms of potential gains, whereby participants were told they had won a music voucher and could choose to take the sure option and keep the voucher (option A), or take the gamble option (option B) by providing a little personal information in order to be entered into a draw. By entering the draw participants could double their winnings or potentially win nothing (see Table 1 for scenario examples). The remaining six scenarios were presented in terms of potential losses where participants were given a hypothetical endowment from which value could be lost. Choosing the sure option (option A) would result in the participant losing half of the value of the music voucher. Choosing the gamble option (option B) involved providing personal information to enter a draw, which could result in the participant retaining the full value of

the voucher or losing it all. In both gain- and loss-framed scenarios the net value to be won or lost was the same.

For option B, the risk of winning nothing in the gain frame or losing everything in the loss frame was one-half or three-quarters. In both gain and loss frames potential rewards could be small (£5), medium (£20), or large (£150). The combination of type of frame (2: gain, loss), level of risk (2: one-half, three-quarters), and level of reward (3: small, medium, large) resulted in 12 different scenarios. The potential gains (and losses) were hypothetical. Participants scored 0 for choosing the sure option and 1 for choosing the gamble option. Following Reyna, Chick, Corbin, and Hsia (2014), we calculated an overall framing bias score by subtracting the proportion of risky choices in the gain frame from the proportion of risky choices in the loss frame. Scores could range from -1.0 (all risky choices in the gain frame, none in the loss frame) to 1.0 (standard framing bias: all risky choices in the loss frame, none in the gain frame). A positive score indicated standard framing whereas a negative score indicated reverse framing. All scenarios were pilot-tested with an independent sample of adults (see Technical Appendix 1 in the supplemental materials for methods and results).

Participants also completed the Brief Sensation Seeking Scale for adolescents (BSSS-8; Hoyle, Stephenson, Palmgreen, Lorch & Donohue, 2002) using a 5-point Likert scale scored from 1 (*strongly disagree*) to 5 (*strongly agree*) to indicate their agreement with eight statements such as "I would like to try bungee-jumping" and "I get restless when I spend too much time at home". Scores were averaged ($\alpha = .78$).

Procedure

The study received ethical clearance from the university's ethics committee. Parental consent was obtained from the parents of all students under 18 years old. Those with parental consent and those over 18 years old were then invited to participate.

Students from the secondary school and the FE college completed paper copies of the questionnaire in their tutor groups during morning registration periods lasting 20 minutes. An information sheet was provided to each student after which students personally gave consent to participate. Afterward participants were debriefed verbally and in written form. All students in Years 9 and 11 at the secondary school, and all students at the FE college were invited to participate. Data collection ceased when all volunteers had been included in the study. For the undergraduate students, the questionnaire was converted into a web-based survey. Respondents were invited to participate in the research study and provided consent by ticking a check box. Once again, data collection continued until data from all volunteers had been collected. Data from the paper questionnaire responses were manually entered into an excel spreadsheet and combined with the electronically collated data from the undergraduate sample. All data were then analysed using IBM SPSS statistical analysis package.

Results

Table 2 displays the mean number of gamble choices made (option B in the gain frame and option D in the loss frame) and mean sensation seeking by age (raw frequency scores can be obtained from Technical Appendix 2 in the supplemental materials. This appendix also includes the probability scores for gambling in the gain and loss frames, the indifference points, and the frame size, for each age group, calculated in logarithmic units. The raw data file containing all framing and sensation seeking scores can be found in Technical Appendix 3 in the supplemental materials). Adolescents gambled more than the young adults overall but there was only a statistically significant difference in the gain frame, $t(294)=2.65$, $p=.008$. Mean sensation seeking scores did not differ by age, $t(294) = .69$, $p = .494$. An Analysis of Covariance (ANCOVA) with age (adolescent; young adults) as between-subjects factor, mean sensation seeking score as the covariate, and mean number of gambles as the dependent variable found a significant effect of sensation seeking, $F(1, 295) =$

5.88, p = .016, η2p = .02. Participants higher in sensation seeking gambled more. No significant effect of age was found.

The mean framing score was positive and significantly different from 0 in both age groups [adolescents: M = .11, SD = .28, t(123)=4.36, p<.001; young adults: M = .20, SD = .29, t(171)=9.06, p<.001]. An ANCOVA with age (adolescent; young adult) as the between-subjects factor, risk (low; high), reward (small; medium; large) as within-subject factors, and sensation seeking as covariate revealed significant main effects of reward, F(1, 277) = 6.97, p=.001, η2p = .03, age, F(1, 277) = 6.16, p=.014, η2p = .02, and a marginally significant interaction of risk X age, F(1, 277) = 3.43, p=.06, η2p = .01. Sensation seeking and risk were not significant.

Adolescents' framing score was significantly lower than that of adults. Post-hoc analysis revealed that the main effect of reward was only statistically different between the small and large levels (p=.001). The effect of level of risk on framing was investigated with a paired-samples t-test comparing framing score in the low-risk and high-risk scenarios for each age group. Young adults framing score was significantly higher in the low-risk scenarios compared to the high-risk scenarios, t(172) = 2.92, p = .004, but no differences were found for the adolescent group (see Figure 1).

Discussion

Despite huge investment to enhance online safety awareness for children and families (Department for Children, Schools and Families, 2008; European Commission, 2016), young people continue to take risks online (Livingstone et al., 2011; Liau et al., 2005; Madden et al., 2013). Indeed, the young people in these studies were often willing to give up extensive personal information. For educational programmes to work effectively it is vital to understand not only the psychological processes that contribute to online risk taking, but also

how best to communicate online safety messages to individuals of different ages to ensure maximum impact and success.

We investigated the psychological mechanisms underlying young people's risky online behaviour by drawing on FTT. FTT suggests that individuals increasingly employ gist-based intuition as they age and gain experience, preferring to rely on categorical (gist) representations of risky choices than to rely on close analysis of the probabilities of potential risks and rewards (i.e., verbatim representations; Reyna et al., 2011). By tailoring the Asian disease problem to fit an online risk-taking dilemma, our novel study assessed if age differences exist in the preference for gist and verbatim representations when facing online risk scenarios.

Previous FTT research utilising the framing task found that adults predominantly relied on gist representations when making risky choices and showed standard framing effects, that is, displayed risk-averse behaviour for gains and risk-seeking behaviour for losses. However, adolescents, who rely on both gist and verbatim representations when making risky choices, showed a reduced or no framing effect (Reyna et al., 2011). In the current study both adolescents and young adults preferred to choose the sure option in the gain frame but the gamble option in the loss frame, displaying the standard framing effect. However, this framing effect was significantly reduced in adolescents, in line with FTT's and our predictions. Thus, young adults showed an increased reliance on the gist of risk taking in online environments, drawing on intuition and experience to avoid risk. Reductions in the framing effect have been observed when participants are instructed to analyse the Asian disease scenario quantitatively (e.g., Fagley & Miller, 1987; Reyna & Brainerd, 1991; Takemura, 1994). Our results suggest that the reduced framing effect for adolescents was due to their lower cognitive ability to gistify, resulting in increased reliance on verbatim reasoning, which led to more analytical consideration of the risky online choice scenarios.

We also found that this effect was independent of sensation seeking. Specifically, our findings highlight that while higher rates of gambling are linked to higher sensation seeking, regardless of age, the increased framing effect in young adults is driven by a developmental change in mental representations about risk.

Although statistically significant, the framing effect in both age groups was small. These results, however, mirror previous research where adaptations of the Asian disease problem used money or property as opposed to human lives (Kühberger, 1998; Ronnlund, Karlsson, Laggnas, Larsson, & Lindstrom, 2005; Wang, 1996). Wang (1996) attributes this increasing likelihood to gamble in risky choices concerning human lives to individuals' higher aspirations for lives than for money or property. Another explanation for the reduction in framing bias can be attributed to the within-subjects design which has been found to produce smaller effects (Broniatowski & Reyna, 2015) potentially linked to the individual's attentiveness to the quality and consistency of their responses, or need for cognition (NFC: Broniatowski & Reyna, 2015; Corbin et al, 2015). Individuals with higher NFC are able to monitor the consistency of their responses to the gain and loss scenarios in within-subjects designs, producing a smaller framing effect.

Adolescents chose to gamble more often than young adults overall (and significantly more often in the gain frame). This increase in gambling behaviour was linked to increased sensation seeking, however we did not find that adolescents scored higher on sensation seeking compared to young adults. In line with previous work (Reyna et al., 2011) gambling behaviour decreased as the potential gains/losses and the magnitude of risk increased. However, adolescent's gambling tendencies were less influenced by the level of risk or the size of the potential reward. It seems adolescents were more objective in their assessment of the magnitude of risk and potential reward using verbatim reasoning and chose to gamble or not according to this assessment. Although frames shared equal expected value, adolescent's

judgements were less influenced by the framing of the scenario compared to young adults'. Therefore, adolescents' gambling decisions were fairly consistent across frames, risk levels, and rewards. In contrast, not only was the behaviour of young adults more influenced by the frame, but they also gambled significantly less as the risks and the stakes (either potential losses or gains) increased.

Overall, the rate of gambling in our online scenarios was rather low, revealing findings more akin to an extreme bias in risk preferences (i.e. always choosing the risky option or always choosing the safe option) regardless of the frame, known as bidirectional framing (Wang, 1996). Our participants did appear particularly risk averse and showed a higher than expected reluctance to choose the gamble option. Crucially, the gamble option in the risky choice scenario also required individuals to provide personal details to be entered into the "prize draw". Whether the high rate of sure option choices was a result of general risk aversion (i.e., unwillingness to gamble regardless of the stakes/potential rewards) or due to the requirement to disclose personal information as part of the gamble cannot be disentangled in our study and certainly requires further investigation.

This relatively low rate of risk taking may also be the result of using a scenario that is more reflective of real-life decision making. As opposed to making life-saving decisions, deciding whether to disclose personal information online—in order to gamble, communicate with another person, or purchase goods or services—is a rather daily occurrence that should be familiar to individuals of most age groups. Future research should take individuals' online experiences of victimisation into account as those who have experienced victimisation online may display more risk averse online behaviour as a result (e.g., Levin, Bossard, Gaeth, & Yan, 2014).

Overall, this study provides an important contribution to the corpus of research that investigates young people's online behaviour. We demonstrated that young people are often

willing to divulge a range of private, personal information online to unknown entities, which could potentially result in online privacy risks of various kinds. We also showed developmental differences in online risk representation with young adults preferring to relying on gist representations and adolescents relying both on gist and verbatim representations. This has clear implications for improving the effectiveness of online safety training programmes for young people. Indeed, studies on FTT-inspired interventions (e.g., Mills et al., 2008; Reyna & Mills, 2014) suggest that increasing gist reasoning strategies regarding sexual behaviour reduce risk taking in adolescents. Earlier research has suggested that young people's online risk taking behaviour can be predicted by FTT (e.g. White, Gummerum & Hanoch, 2015), such that gist reasoning about online risk is related to lower rates of past online risk taking and reduced intentions to take future risks online, while verbatim reasoning is predictive of increased past and intended online risky behaviour. Therefore, similar interventions to those developed by Reyna and Mills (2014) could prove useful in targeting and modifying young people's online risk-taking behaviours, to ensure that young people reap the full benefits of all the Internet has to offer without the potential negative consequences.

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Table 1

Gain and Loss Frames of the Online Gambling Scenarios

Frame	Example
Gain	"Imagine you take an online music quiz one day and get all the answers correct. A pop-up informs you that you have won a £5 online music voucher. However if you fill out a form with your full name, address, email, date of birth, and mobile phone number you will be entered into a draw to win a £10 music voucher. You now have a choice. If you chose option A you will win £5 for sure. If you chose option B you have a ½ chance of winning a £10 voucher but a ½ chance of winning nothing."
Loss	"Imagine you take an online music quiz one day and get all the answers correct. At the end of the quiz you have £10 worth of 'virtual' winnings, half of which can be exchanged for real cash. However if you fill out a form with your full name, address, date of birth, email, and mobile phone number you will be entered into a draw to win a bigger prize. You now have a choice. If you chose option A you will lose £5 of virtual money for sure. If you chose option B you have a ½ chance of losing all £10 but a ½ chance of losing nothing."

Table 2

Mean Number of (Standard Deviation in Parenthesis) and Percentage of Gamble Choices Made in the Gain Frame, in the Loss Frame, and in Total, Mean Framing Scores, and Mean Sensation Seeking Scores (Standard Deviation in Parenthesis) for the Adolescent and Young Adult Age Groups

Measure	Adolescents	Young adults
Gain frame gambles	1.11 (1.64)	0.69 (1.07)
Gain frame gambles (%)	18.5	11.5
Loss frame gambles	1.78 (1.84)	1.90 (1.82)
Loss frame gambles (%)	29.67	31.67
Mean gambles	2.89 (3.03)	2.59 (2.41)
Mean gambles (%)	24.10	21.58
Framing score	.11 (.28)	.20 (.29)
Mean Sensation Seeking	3.56 (.74)	3.51 (.71)

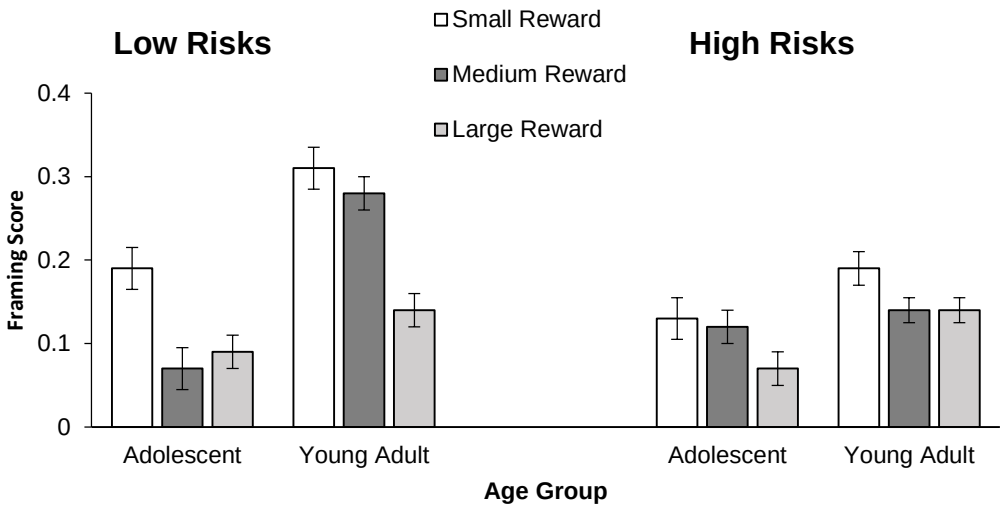

Figure 1. Framing score of adolescents and young adults for low and high risks and for small, medium, and large rewards (error bars show standard errors).