

Research Report

Explaining Contradictory Relations Between Risk Perception and Risk Taking

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ABSTRACT—*Different studies have documented opposite relations between perceived risk and behavior. The present study tested a theoretical explanation that reconciles these conflicting results. Adolescents (N = 596) completed alternative measures of risk perception that differed in cue specificity and response format. As predicted by fuzzy-trace theory, measures that emphasized verbatim retrieval and quantitative processing produced positive correlations between perceived risk and risky behavior; risk perceptions reflected the extent to which adolescents engaged in risky behavior. In contrast, measures that assessed global, gist-based judgments of risk produced negative correlations; higher risk perceptions were associated with less risk taking, a protective rather than reflective relation. Endorsement of simple values and principles provided the greatest protection against risk taking. Results support a dual-processes interpretation of the relation between risk perception and risk taking according to which observed relations depend on whether the cues in questions trigger verbatim or gist processing.*

Adolescent risk taking has serious economic, psychological, and medical consequences (Maynard, 1997). Smoking, drug use, unprotected sex, and unsafe driving take substantial tolls in health care costs and property damage, as well as human suffering and lost potential. Perceptions of risk have been linked to such behaviors both theoretically and empirically (Fishbein, 2003; Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004). The typical theoretical prediction is that risk perception is negatively correlated with risk-taking behavior (i.e., perceived risk is *protective*): The higher the perceived risk of a behavior, the lower the tendency to engage in that behavior. Indeed, this negative

correlation has been observed (for a review, see Reyna & Farley, 2006). Paradoxically, however, the opposite relation—a positive correlation between risk perception and behavior—has also been observed (i.e., perceived risk is *reflective*): The higher the perceived risk of a behavior, the higher the tendency to engage in it (e.g., R.J. Johnson, McCaul, & Klein, 2002; Reyna & Farley, 2006). As Kotchick, Shaffer, Forehand, and Miller (2001) explained, each of these inconsistent findings “makes some sense” conceptually (p. 502): Knowledge that one is engaging in risky activities may lead to a heightened sense of personal risk (positive correlation), and a reduced sense of vulnerability may contribute to greater risk taking (negative correlation; see also Brewer, Weinstein, Cuite, & Herrington, 2004).

These inconsistent results underscore the need for a better theoretical grasp of the circumstances that produce one relation or the other. Dual-processes theories, and fuzzy-trace theory in particular, provide opposing mechanisms that predict inconsistent responses under well-specified conditions (Brainerd & Reyna, 2005; Reyna, 2004). According to fuzzy-trace theory, people think about risk in different ways, anchored at one extreme by qualitative thinking based on simple gist representations, such as “avoid risk,” and at the other extreme by quantitative thinking involving trading off risks and benefits. The latter type of thinking is associated with increased risk taking because trading off risks and benefits often objectively favors risk taking (especially if one considers the risk of a single act as opposed to the cumulative risk of repeating that single act multiple times; Reyna, 2004). Because the objective risk of the act being contemplated is low (e.g., the risk of HIV infection from a single act of unprotected sex), the magnitude of benefits can trump the magnitude of risks if the decision maker is thinking quantitatively. In contrast, global risk avoidance ignores the magnitude of potential benefits and, thus, should be protective, a prediction supported by laboratory research (Reyna & Ellis, 1994) and by studies of real-life risk taking (Reyna & Farley, 2006).

Research also demonstrates that the memory representations that support quantitative trading off versus global risk avoidance

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are different and that cues in questions selectively elicit one or the other type of representation (Reyna & Brainerd, 1995; Seamon et al., 2002). Specific cues are more likely to elicit verbatim memories of having engaged in actual risky behaviors or not (i.e., true memories) than to elicit gist representations that support global risk avoidance. For example, specific questions such as “Are you likely to get pregnant or get someone pregnant in the next 6 months?” cue memories of pregnancy-related activities that are used to produce an estimate of risk. Risk takers who retrieve memories of unprotected sex will provide correspondingly high risk estimates, but the *same cue* reminds risk avoiders of their low-risk activities (e.g., chaperoned dances or lonely Saturday nights), and consequently they will provide low estimates. Because specific cues elicit risk perceptions that are guided by true memories of behavior, estimates reflect that behavior, producing a positive correlation.

Questions about risks such as getting HIV-AIDS or getting pregnant are more specific (and are linked to specific behaviors, such as having unprotected sex) than are global questions, such as “Overall, for you, which of the following best describes the risks of having sex: low, medium, or high?” We are not saying that specific behaviors are never retrieved with a global cue (such as a general question), but rather are saying that research has shown that such cues tend to elicit gist representations more often than verbatim representations (see Table 1 for the wording of specific-risk and global-risk questions).

Hence, questions with specific cues to behavior (e.g., questions that cue “unprotected sex”) are predicted to elicit a posi-

tive (reflective) relation between risk perception and behavior. The more that risky behaviors are retrieved, the greater the perception of risk will be, and a positive correlation between risk perception and risk taking will be produced. However, questions with global cues about risk perceptions should produce a negative (protective) relation between risk perception and behavior because they draw on gist representations of risks such as HIV-AIDS, which are risk avoidant (Reyna & Farley, 2006): The bottom-line gist of such risks (e.g., HIV-AIDS) is that they are categorically “bad,” and thus should be avoided. That is, gist representations about such risks as HIV-AIDS are qualitative, not quantitative, and they do not lend themselves to trading off degrees of risk (see also Reyna & Farley, 2006). (Gist representations are assumed to operate prospectively on risk taking because they characterize a kind of thinking about risky decisions that, in turn, determines behavior; they are also assumed to operate retrospectively in guiding risk assessments because cues in questions trigger retrieval of such gist representations; see Discussion.) Adolescents who think about risk in gist terms (e.g., as categorically bad) are more likely than others to perceive the gist of risk as high and to avoid risk (Reyna & Ellis, 1994; Reyna & Farley, 2006). Therefore, the more that gist representations are retrieved, the higher the perception of risk will be and the less risk taking will have occurred. That is, when global questions are asked, people who tend to think about risk in gist terms will report a higher perception of risk than people who do not tend to think about risk in gist terms. The resulting correlation between risk perception and risk taking will be negative.

TABLE 1
Gist and Verbatim Measures of Risk Perception Used in This Study

Scale	Items
Gist measures	
Categorical risk	Even low risks happen to someone; It only takes ONCE to get pregnant or get an STD; Once you have HIV-AIDS, there is no second chance; Even if you use condoms, eventually you'll get an STD if you have sex enough; Even low risk adds up to 100% if you keep doing it; If you keep having unprotected sex, risk adds up and you WILL get an STD; If you can't handle getting protection, you are not ready for sex; When in doubt about having sex, delay or avoid it; If you keep having unprotected sex, risk adds up and you WILL get pregnant or get someone pregnant
Gist principles	Avoid risk; Better to be safe than sorry; I have a responsibility to myself to wait to have sex; I have a responsibility to my parents/family to not have sex; Better to not have sex than hurt my parents/family; I have a responsibility to my partner to not put him/her at risk; I have a responsibility to God to wait to have sex; Better to not have sex than risk getting HIV-AIDS; Better to not have sex than risk getting pregnant or getting someone pregnant; Better to focus on school than have sex; Better to wait than to have sex when you are not ready; Better to have fun (sex) while you can (R); Having sex is better than losing a relationship (R); Having sex is worth risking pregnancy (R); Known partners are safe partners (R)
Global risk	Overall, for you, which of the following best describes the risks of having sex?
Verbatim measures	
Specific risk	I am likely to get pregnant (or get someone pregnant) in the next 6 months; I am likely to have an STD by age 25; I am likely to have an STD in the next 6 months; I am likely to have HIV-AIDS by age 25; I am likely to have HIV-AIDS in the next 6 months
Quantitative risk	What are the chances that you have an STD?

Note. Participants provided dichotomous responses to items on the gist-principles scale, and these responses were summed to calculate an overall score. Responses to the categorical-risk and specific-risk scales were made on 5-point scales (0 = *strongly disagree*, 4 = *strongly agree*), and these responses were averaged to calculate an overall score. Response options for the global-risk question were “low,” “medium,” and “high.” Responses to the quantitative-risk question were given on a subjective probability scale from 0 through 100. Items that were reverse-coded are marked (“R”). STD = sexually transmitted disease (this term was defined for participants).

Note that these predictions apply within the same individuals. Surprisingly, the same people should exhibit both positive and negative correlations between risk perception and risk taking, depending on the retrieval cues that questions provide: Risk takers will describe themselves as at higher risk when they are cued to think about their specific behaviors and at lower risk when they are cued to think about their global perceptions, but those who do not take risks will do the opposite. Thus, at the level of correlations, risk perceptions are predicted to be both protective and reflective of risk-taking behaviors, owing to an underlying interaction between people's history of risk taking and the retrieval cues in questions about risk taking.

In this article, we report a study that tested this explanation of inconsistent findings about relations between risk perception and risk behavior by manipulating the retrieval cues in questions about risk perception. A general theme of our theoretical analysis is that making finer-grained distinctions among levels of risk leads to riskier behavior. To perform an additional test of that hypothesis, we subdivided gist representations into those that conceptualized gist in categorical terms and those that conceptualized risk in ordinal terms, by asking participants whether they endorsed either of two principles: "No risk is better than some risk" (categorical) and "Less risk is better than more risk" (ordinal). These principles describe the same risk relation (i.e., more risk is bad), but are framed in absolute versus relative terms. The direction of the risk relation is the same. According to fuzzy-trace theory, however, endorsement of the absolute principle should be associated with less risk taking than endorsement of the relative principle because the latter makes finer distinctions among degrees of risk.

METHOD

Participants were 596 students from high schools in Arizona, Texas, and New York. Their ages ranged from 14 through 18 years ($M = 15.5$, $SD = 1.0$). The sample was 47% Caucasian, 17% Hispanic, and 25% African American; 11% classified themselves as "other." Females constituted 57% of the sample, and 41% of participants were sexually active.

We constructed alternative measures of risk perception that varied in the cues presented (specific or global) and the level of precision required in the response (verbatim or gist). As we have discussed, the use of verbatim and gist representations is influenced by both the specificity of cues in questions and by the levels of precision required in the response (see Reyna & Brainerd, 1995). (The measures and their items are shown in Table 1.) Two specific verbatim scales were constructed. First, a specific-risks scale contained five items that mentioned concrete consequences of risky sexual behavior (e.g., pregnancy, HIV-AIDS) and required personal risk estimates of those consequences on 5-point scales ranging from *strongly disagree* to *strongly agree* (scored from 0 to 4 and then averaged; $\alpha = .81$). Such cues are likely to trigger verbatim memories of prior be-

haviors, such as instances of unprotected sex, and, therefore, a verbatim-analytic mode of processing. We constructed a second specific verbatim measure as a convergent-validity check. This measure required participants to quantify their risk of having an STD on a subjective probability scale from 0 to 100.

Three global gist scales were also constructed. The first scale (categorical risk) contained nine items that measured categorical thinking about risk (e.g., "Even low risks happen to someone"). Ratings were made on a 5-point scale ranging from *strongly disagree* to *strongly agree* (scored from 0 to 4 and then averaged; $\alpha = .71$). The second scale (gist principles) contained 15 principles (e.g., "Avoid risk") that participants endorsed (or not) by checking off all items that applied to them ($\alpha = .82$); the number of endorsements was summed. The third gist measure (global risk) simply asked participants to rate the personal risk of having sex as "low," "medium," or "high."

To test our more fine-grained prediction about levels of gist, we assessed the tendency to process gist absolutely versus relatively by asking participants whether they endorsed two principles: "No risk is better than some risk" and "Less risk is better than more risk." They could endorse neither, one, or both of these items.

Scores on the preceding scales were related to two outcome measures. First, participants were asked a dichotomous (yes/no) behavioral question, "Have you ever had sex?" Second, participants responded to a series of five questions that measured behavioral intentions to have sex and included such items as "Do you think you will have sex (or have sex again) before you turn 20?" "Do you think you will have sex (or have sex again) during the next year?" and "Do you think you will have sex (or have sex again) before you are in a serious relationship or in love?" Ratings were made on a 5-point scale ranging from *very unlikely* to *very likely* (scored from 0 to 4 and then averaged; $\alpha = .91$).

RESULTS

Instruments measuring related constructs correlated positively: The two verbatim risk measures—specific-risk perception and quantitative estimate of contracting a sexually transmitted disease (STD)—correlated positively, $\rho(568) = .31$, $p < .001$. The three gist risk measures also correlated positively with one another—categorical thinking about risk and endorsement of gist principles, $\rho(594) = .38$, $p < .001$; categorical thinking about risk and perception of global risk, $\rho(594) = .22$, $p < .001$; and perception of global risk and endorsement of gist principles, $\rho(594) = .29$, $p < .001$. However, although all of the measures concern risk, the verbatim and gist measures did not correlate positively. Thus, the overall pattern of correlations demonstrated convergent and divergent validity for these measures.

Each of the 10 correlations between risk perception and risk taking was significant and in the predicted direction (see Fig. 1): Scores on the two verbatim measures correlated positively with risk-taking behavior and behavioral intentions (reflective rela-

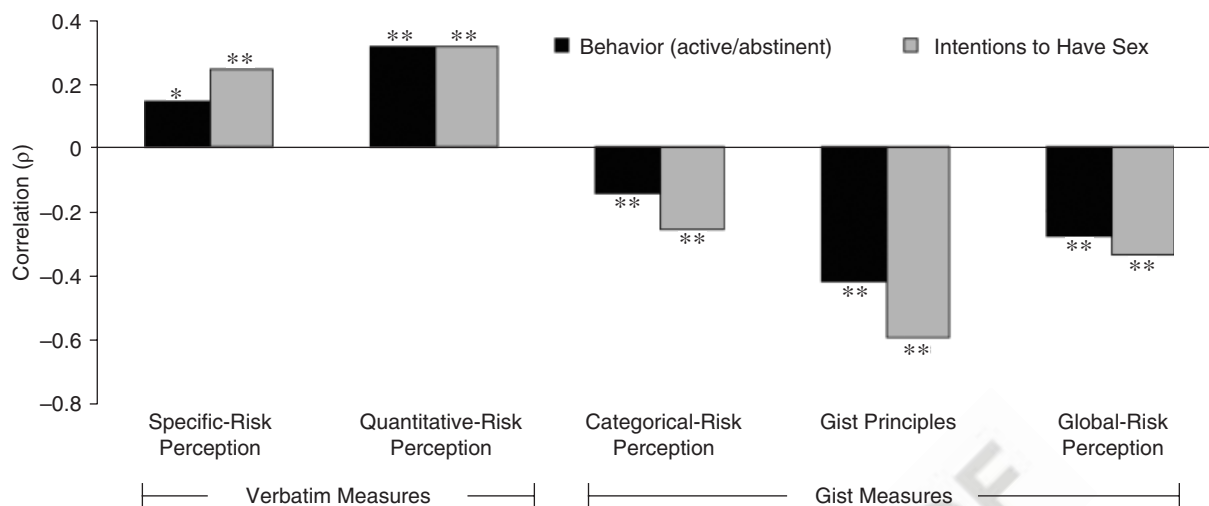


Fig. 1. Correlations (ρ) between perceived risk and behavioral measures of risk taking, behavioral intentions and self-reported sexual behavior (sexually active or not). Asterisks indicate the level of significance of the correlations * $p < .005$, ** $p < .001$.

tions), but scores on the three gist measures correlated negatively with the same behavioral measures (protective relations).¹

Ratings of global risk perception correlated negatively with quantitative estimates of risk of having an STD, $\rho(566) = -.16$, $p < .001$, and with specific-risk perceptions, $\rho(594) = -.11$, $p < .01$. Hence, as predicted, participants who rated themselves toward the low end of the global-risk scale (i.e., who perceived their global risk to be low) gave themselves ratings toward the high end of the quantitative-risk and specific-risk scales (i.e., estimated they had high STD risk and high specific personal risk), and vice versa.

Finally, participants who endorsed the absolute principle “No risk is better than some risk” were more likely than others to endorse the relative version of the same principle, “Less risk is better than more risk.” However, adolescents were more than twice as likely to be sexually active (61% vs. 30%) if they endorsed the relative principle but not the absolute one than if they endorsed the absolute principle but not the relative one; endorsing both principles or neither principle was associated with intermediate levels of sexual activity (44% and 46%, respectively). Findings were confirmed by a best-fitting hierarchical model relating endorsement of the principles and sexual behavior. This model included all first-order effects and two-way associations, $G^2(1) = .008$ (see Table 2). Endorsing the absolute principle was negatively correlated with intentions to have sex, $r_{pb}(592) = -.16$, $p < .001$; endorsing the relative principle was positively correlated with intentions to have sex, $r_{pb}(592) = .16$, $p < .001$.

DISCUSSION

Paradoxically, risk perceptions are sometimes related positively and sometimes related negatively to risk taking, a fact that has

¹Unavailability of sexual partners attenuated the correlations. Age artifacts (younger subjects have simple gists and less sex compared with older subjects) do not explain negative correlations.

vexed reviewers of this literature. Predictions about these relations are central to the major theories of risk taking. Because contradictory results are typically found in different studies (with different subjects and assessments), their interpretation is ambiguous in ways that interpretation of a within-subjects comparison is not. We compared relations between risk perception and risk taking for the same individuals, and tested the

TABLE 2

Partial-Association Measures and Relative Contributions of Endorsement of Absolute Versus Relative Principles and Sexual History to Predicting Cell Frequencies

Effect	Partial-association chi-square	Standardized log-linear parameter estimate
First-order effects		
Absolute principle	181.90**	-11.80
Relative principle	0.82	2.14
Sexual history	19.02**	2.03
Second-order effects		
Absolute Principle \times Relative Principle	39.28**	6.00
Absolute Principle \times Sexual History	10.62*	-3.25
Relative Principle \times Sexual History	11.04**	3.29

Note. Partial-association tests and parameter estimates are alternative ways of assessing effects in multiway frequency analysis, an extension for more than two discrete variables of the familiar chi-square test for independence. A log-linear model is developed for (the log of) expected frequency as a function of the effects in the design. The “dependent” variable is cell frequency, and the effects assessed include one-way associations (e.g., are people more likely to be sexually active or abstinent?), as well as higher-order associations (analogous to interactions; e.g., do differences in the frequencies of active and abstinent adolescents depend on whether they endorse the absolute principle?). The partial-association chi-square gives the unique contribution of the effect to the model. Standardized parameter estimates give an indication of the relative importance of the various effects on the model; the largest standardized parameter estimate has the most influence on cell frequency.

* $p < .005$. ** $p < .001$.

counterintuitive prediction that correlations could be reversed by eliciting verbatim (specific) versus gist (global) processing; this prediction was confirmed with multiple measures.

Thinking categorically about risk (“It only takes once . . .”), endorsing simple values (“Avoid risk”), and globally assessing one’s risk as high were associated with reductions in risk taking, a protective relation. The strongest protective relation was between endorsement of simple values (gist principles) and risk taking. Specific questions, in contrast, elicited judgments that reflected risky behavior. Each of these findings was replicated for behavioral intentions, which are known predictors of risky behavior. These results confirm the theoretical prediction that measures that elicit specific memories of risk-relevant behaviors produce positive correlations with behavior, but measures that elicit global perceptions (gist) produce negative correlations. Thus, these results explain prior contradictory findings.

Note that gist processing is theorized to operate prospectively to guide real-life decision making; adolescents who perceive risks qualitatively, retrieve simple values, and combine these elements in a noncompensatory fashion (i.e., risk is not traded for reward) are less likely to take risks than are other adolescents (Reyna & Ellis, 1994; Reyna & Farley, 2006). This conclusion is also supported by the analysis of absolute versus relative thinking. Adolescents who endorsed the proposition that risk is either present or not (i.e., the absolute principle) were half as likely to be sexually active as were adolescents who thought about risk as present to a lesser or greater degree (i.e., in relative terms). Endorsement of the absolute version of the risk-is-bad principle was also associated with behavioral intentions to take fewer risks; endorsement of the relative version of the same principle—a version that made finer-grained distinctions about degrees of risk—was associated with the opposite intentions.

The contradictory relations between risk perceptions and risk taking are starkly illustrated by the negative relation between the global and specific risk-perception measures. Participants who reported perceptions of lower global risk estimated their specific risks as higher for STDs, pregnancy, and HIV-AIDS, and vice versa—and these measures were related to behavior in opposite ways. Thus, risk takers denied vulnerability (and risk avoiders keenly perceived it) when risks were assessed based on global gist perceptions, but risk takers acknowledged their vulnerability when cued to retrieve specific behaviors (and risk avoiders had fewer such behaviors to retrieve).

In sum, we obtained evidence for the idea that when adolescents think that taking risks is a bad option, they perceive those risks more acutely and tend to avoid them. These results support the protective relation between risk perceptions and behaviors that is posited in such models as the theory of reasoned action and the behavioral decision-making framework. We also obtained evidence for the commonsense idea that if adolescents retrieve memories of their own behaviors, more risk taking will result in higher perceptions of personal risk exemplified by those behaviors. Simply shifting the retrieval cues in questions from verbatim

to gist produced opposite correlations between risk perceptions and risk taking. These effects mirror those of verbatim and gist cues in memory tests, which also elicit opposite correlations between these two kinds of cues and false memories (Brainerd, Reyna, & Mojardin, 1999), uniting false memory and risk perception as examples of retrieval-dependent dual processes (E.J. Johnson, Haubl, & Keinan, 2007; Kahneman, 2003). Thus, adolescents hold contradictory views of their own vulnerability, with can be elicited by the right cues. Making adolescents aware of their contradictory risk perceptions is therefore a promising approach to reducing unhealthy risk taking.

REFERENCES

- Brainerd, C.J., & Reyna, V.F. (2005). *The science of false memory*. New York: Oxford University Press.
- Brainerd, C.J., Reyna, V.F., & Mojardin, A.H. (1999). Conjoint recognition. *Psychological Review*, *106*, 160–179.
- Brewer, N.T., Weinstein, N.D., Cuite, C.L., & Herrington, J. (2004). Risk perceptions and their relation to risk behavior. *Annals of Behavioral Medicine*, *27*, 125–130.
- Fishbein, M. (2003). Toward an understanding of the role of perceived risk in HIV prevention research. In D. Romer (Ed.), *Reducing adolescent risk: Toward an integrated approach* (pp. 49–55). Thousand Oaks, CA: Sage.
- Halpern-Felsher, B.L., Biehl, M., Kropp, R.Y., & Rubinstein, M.L. (2004). Perceived risks and benefits of smoking: Differences among adolescents with different smoking experiences and intentions. *Preventive Medicine*, *39*, 559–567.
- Johnson, E.J., Haubl, G., & Keinan, A. (2007). Aspects of endowment: A query theory of value construction. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*, 461–474.
- Johnson, R.J., McCaul, K.D., & Klein, W.M.P. (2002). Risk involvement and risk perception among adolescents and young adults. *Journal of Behavioral Medicine*, *25*, 67–82.
- Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist*, *58*, 697–720.
- Kotchick, B.A., Shaffer, A., Forehand, R., & Miller, K.S. (2001). Adolescent sexual risk behavior: A multi-system perspective. *Clinical Psychology Review*, *21*, 493–519.
- Maynard, R.A. (1997). *Kids having kids: Economic costs and social consequences of teen pregnancy*. Washington, DC: Urban Institute Press.
- Reyna, V.F. (2004). How people make decisions that involve risk: A dual-processes approach. *Current Directions in Psychological Science*, *13*, 60–66.
- Reyna, V.F., & Brainerd, C.J. (1995). Fuzzy-trace theory: An interim synthesis. *Learning and Individual Differences*, *7*, 1–75.
- Reyna, V.F., & Ellis, S.C. (1994). Fuzzy-trace theory and framing effects in children’s risky decision making. *Psychological Science*, *5*, 275–279.
- Reyna, V.F., & Farley, F. (2006). Risk and rationality in adolescent decision making: Implications for theory, practice, and public policy. *Psychological Science in the Public Interest*, *7*(1).
- Seamon, J.G., Luo, C.R., Kopecky, J.J., Price, C.A., Rothschild, L., Fung, N.S., & Schwartz, M.A. (2002). Are false memories more difficult to forget than accurate memories? The effect of retention interval on recall and recognition. *Memory & Cognition*, *30*, 1054–1064.

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