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The Psychological Drivers of Self-Reported Risk Preference

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Why are some people more willing than others to take risks? While behavioral tasks (e.g., monetary lotteries) are often regarded as a gold standard for capturing a person's risk preference, recent studies have found stated preferences (e.g., responses to hypothetical scenarios) to exhibit higher reliability, convergent validity, and test–retest stability. Yet, little is known about the psychological drivers of stated preferences. Central to the stated preference approach, the psychological risk-return model conceptualizes a person's propensity to engage in an activity or behavior as a tradeoff between their risk perceptions and expected benefits. To cast a light on the psychological drivers of risk preference within the psychological risk-return framework, in a series of studies participants reported how they evaluated the risks and benefits of activities and their propensity to engage. Individual differences in analytic and intuitive thinking dispositions were also measured. Some participants referred explicitly to risks and rewards of activities when deriving their risk propensity, which was associated with sensitivity to their risk perception and expected benefit ratings. Associations with thinking dispositions indicated that participants who considered risks and rewards were more disposed to analytic thinking. Participants' reports also revealed a broad repertoire of psychological drivers (e.g., intuition, imagination, and feeling) of their evaluations of activities. These were stable over time, associated with thinking dispositions, and influenced their risk preference. The findings provide support for the psychological risk-return model of risk preference. A multifaceted model of preference is urged by the findings to acknowledge the multiple co-occurring psychological drivers of risk preference.

Keywords: risk preference, process tracing, stated preferences, self-report measures, thinking disposition

Why are some people more willing than others to take a risk? This is an important question as a person's risk preferences determine life choices, such as whether to smoke, invest in a business venture, or have an extramarital affair, with consequences for their health, finances, and relationships. Two research traditions have emerged that seek to explain individual differences in risk preference. The *revealed preference* tradition, popular in economics, emphasizes behavioral measures, often involving monetary lotteries or game-like tasks in the laboratory and observations of real behaviors in naturalistic settings (e.g., Bechara et al., 1997; Falk et al., 2018; Holt & Laury, 2002). The *stated preference* tradition instead uses self-reports and responses to hypothetical scenarios (e.g., going skydiving) to capture a person's propensity to take risks (Blais & Weber, 2006; Rolison & Shenton, 2020; Weber et al., 2002). Central to the stated preference approach, the psychological risk-return model conceptualizes a person's propensity to engage in an activity or behavior as a tradeoff between their risk perceptions and expected benefits (Weber et al., 2002). Yet, little is known about the psychological processes that drive people's stated preferences. The objective of this article is to fill a gap in our understanding of risk preference by casting a light on the psychological drivers of people's stated preferences within a psychological risk-return framework.

Behavioral measures within the revealed preference tradition are viewed by some as a gold standard for capturing risk preference (Charness et al., 2013), owing in part to their control of confounding factors. Stated preferences instead are often viewed with suspicion on the basis that they are susceptible to social desirability bias (Fisher, 1993; Nederhof, 1985) or insufficient self-insight for accurate self-reporting of attitudes and preferences (Greenwald & Banaji, 1995; Nisbett & Wilson, 1977). Yet recent studies have actually found stated risk preference measures to exhibit high levels of reliability, convergent validity, and test–retest stability (Beauchamp et al., 2017; Frey et al., 2017, 2021; Weber et al., 2002). Conversely, poor convergence has been observed among behavioral measures and low test–retest reliability (Frey et al., 2017; Mata et al., 2011). Thus, while stated preference measures show promise for revealing valuable insights into risk preference, there exists a dearth of understanding into their driving processes.

Verbal reports by participants of their own thought processes during decision-making tasks provide rich insight into conscious and deliberative processes that drive behavior (Cokely & Kelley, 2009; Payne, 1976; Rolison et al., 2012). Protocol analysis is widely

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The author is thankful to Peter Gooding (PG) for categorizing a subset of participants' written accounts for the assessment of interrater reliability.

Each study design and hypotheses were preregistered (Study 1: https://aspredicted.org/ne7ve.pdf; Study 2a: https://aspredicted.org/bm4ju.pdf; Study 2b: https://aspredicted.org/vm3ju.pdf; Study 3: https://aspredicted.org/blind.php?x=QY6_FG1).

The raw data are available on the Open Science Framework (OSF: https://osf.io/d9pka/?view_only=2ca82d29a4624e5b97b5e302bc3809b6).

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used for identifying psychological processes at play during decision-making and typically involves a qualitative analysis of participants' concurrent (during decision-making) or retrospective (after decision-making) verbal reports (Kuusela & Paul, 2000). With its broad scope, protocol analysis is especially useful at early stages of scientific enquiry (Payne et al., 1978), and as such, is well suited to identifying the various possible psychological drivers of people's stated risk preferences. Protocol analysis also enables participants' reported strategies to be coded and summarized in order to capture tendencies across participants. For example, Cokely and Kelley (2009) found that participants' verbal reports of their decisions about monetary gambles were more consistent with heuristic-type decision processes than expected value processes.

Arslan et al. (2020) (see also Steiner et al., 2021) enquired into people's introspections when answering the general risk question (GRQ; Dohmen et al., 2011): "Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?" Participants were asked to state their preference on a 10-point scale and to provide a written explanation of their answer. Novice coders were able to infer participants' stated risk preferences from their short written accounts (containing a median of 10 words), indicating that people's written explanations provide valid cues to their risk preference. In their written accounts, participants typically referred to voluntary behaviors with risk of harm, spanning a range of life domains (e.g., physical, financial, and social). Participants referred infrequently to cumulative or delayed risks (e.g., smoking) or passive risks (e.g., natural hazards). Intriguingly, participants also rarely referred to monetary gambles or gambling, a staple of the revealed preference tradition. Instead, participants' written accounts referred to the types of voluntary behaviors depicted by hypothetical scenarios used in stated preference measures (e.g., "Taking a ride home in a taxi that does not have seatbelts"; Blais & Weber, 2006; Rolison & Shenton, 2020; Weber et al., 2002). The Domain Specific Risk-Taking scale (DOSPERT; Weber et al., 2002), for example, comprises hypothetical voluntary behaviors across a range of life domains, and thus, potentially provides greater insight into the risk preferences that determine people's life choices than those revealed by behavioral measures in the laboratory.

Important to the stated preference tradition, the psychological risk-return model conceptualizes a person's propensity to take risks as a tradeoff between the expected benefit and perceived riskiness of choice options (Weber, 1997; Weber et al., 2002; Weber & Milliman, 1997). Within this perspective, expected benefit is equated with expected value, and risk perception is conceived as a variable that differs across individuals and contexts (e.g., life domains; Weber et al., 2002). It is important to acknowledge that the expected benefit of a choice option could be conceived differently, such as the maximum outcome value. Within the psychological risk-return model, a person's preference for a choice option is determined:

$$\text{Risk preference} = a(\text{expected benefit}) + b(\text{risk perception}) + c. \quad (1)$$

Risk preference can be measured in a variety of ways, but presently is measured as a person's self-reported propensity to engage in an activity or behavior (e.g., "What is the likelihood that you would…"). In Equation 1, a person's risk preference is decomposed into their perception of the riskiness of the option (i.e., risk perception), their expectations of benefit, and their risk attitude (risk perception coefficient *b*), which characterizes a tradeoff between their risk perception and expected benefit (Weber et al., 2002). For instance, a person may be more willing than another person to engage in an activity either because they perceive less risk or because they are more tolerant (i.e., less sensitive) of the risk they perceive, despite perceiving the same magnitude of risk.

A wealth of research, typically using the DOSPERT scale, has attributed individual differences in self-reported risk propensity to differences in the magnitude of stated expected benefit and risk perception, and to differences in risk attitude (Figner & Weber, 2011; Hanoch et al., 2006; Rolison & Shenton, 2020; Weber et al., 2002). For instance, Rolison and Shenton (2020) found that in some life domains (e.g., recreational) women were more sensitive than men to the risks they perceived, indicating gender differences in risk attitude. Regarding people's introspections, Steiner et al. (2021) had participants list reasons (known also as *aspects*) that crossed their mind when answering the GRQ. Participants commonly referred to rewards, gains, and benefits when listing proaspects (supporting risk-seeking) and to risk, safety, and losing when listing contra-aspects (supporting risk-avoidance), suggesting that people may distinguish between perceived risks and benefits also in how they conceive of their own risk preference.

What are the drivers of risk preference within a risk-return framework? In the current research, participants described (Study 1) or identified (Studies 2a, 2b, and 3) how they evaluated the expected benefits and perceived riskiness of hypothetical activities, as well as their propensity to engage. Analysis is performed on participants' retrospective protocols to identify how they arrived at their evaluations of activities. As such, the current focus is on identifying the psychological processes that drive risk preference, rather than the sequence of processes or steps taken by participants to arrive at their evaluations (Kuusela & Paul, 2000; Payne et al., 1978). The resources that participants verbally report may involve cognitive processes at various levels of processing. For instance, a process may involve deliberative rule-based integration of the perceived risks and benefits of activities. Other resources may refer to processes that involve intuition or gut-feeling that are not fully accessible to verbal report. Participants may also refer to various representations, such as their personal definition of risk (e.g., variance of possible outcomes, worst possible outcome). As the various processes and representations participants can articulate in their verbal reports are so diverse, henceforth they will be referred to collectively as mental *resources* as this broad term conveys that they provide a resource that can be drawn on by a person to arrive at an evaluation.

Participants are likely to report using mental resources related to *reward* to evaluate their expected benefit of activities. In keeping with the psychological risk-return framework (Weber et al., 2002), participants are asked in the current studies to state the benefits they personally would expect to obtain from engaging in activities, from not at all beneficial to extremely beneficial. An alternative approach could be to ask participants about the best or worst possible benefits of activities, potentially triggering different mental resources for expected benefit evaluations. In Steiner et al. (2021) participants frequently referred to benefits and rewards when introspecting on their general risk preference, indicating that participants intuitively consider benefits and rewards to reason about their own preferences. The nature of perceived riskiness is far less clear as from a psychological perspective it is not typically defined in relation to a specific aspect of an activity, such as the variance of its outcomes as in financial models (Weber, 1997; Weber et al., 2002). The term "risk" is subject to a variety of definitions and conceptions in the academic literature (Aven, 2012). Given this lack of agreement among theorists about the definition or meaning of risk, laypeople may similarly use a variety of resources to conceptualize and judge the riskiness of an activity. One possibility is that participants will focus more on the severity of possible negative outcomes (e.g., risk of serious injury or death) than on their likelihood, as laypeople tend to view some risks, such as hazards, in terms of their catastrophic potential (Slovic, 1987). Thus, participants may refer to resources related to *harm* when evaluating risk. An important theoretical question is whether participants draw simultaneously on multiple resources to capture the multifaceted nature of risk, or whether resources vary widely across participants as they narrow in on one specific lay definition of risk.

Central to the psychological risk-return model is the notion that perceived risks and rewards are integrated in a tradeoff to determine risk propensity (Weber, 1997; Weber et al., 2002). An important theoretical question is whether people draw on additional resources to evaluate their propensity to take a risk. In Arslan et al. (2020), participants commonly referred to their past experiences as justifications of their answers to the GRQ. Thus, participants may draw on resources related to *experience*, such as whether they have engaged in similar behaviors in the past and whether this resulted in positive or negative outcomes. As indicated by fuzzy-trace theory, participants may refer also to *intuition*, drawing on intuitive processes, rather than computing a tradeoff between perceived risks and rewards (Reyna, 2004). Use of such resources would imply that people do not restrict themselves to a strict computation of risk-reward tradeoffs as implied by the psychological risk-return model of preference.

Whether a person computes a risk-reward tradeoff or uses other analytic resources to evaluate risky options likely depends on individual differences in thinking disposition. The *Need for Cognition* (NfC) scale (Cacioppo et al., 1996; Cacioppo & Petty, 1982) measures a person's willingness and desire to engage in effortful cognitive tasks (e.g., "I prefer complex to simple problems"), capturing dispositions toward analytic thinking. The *Faith in Intuition* (FiI) scale (Epstein et al., 1996; Pacini & Epstein, 1999) instead measures a person's trust in their intuitions and feelings (e.g., "I believe in trusting my hunches"), capturing dispositions toward intuitive thinking. NfC and FiI are proposed to map onto separate *analytic–rational* and *intuitive–experiential* modes of processing, respectively, rather than opposite ends of a single dimension, and so tend to be uncorrelated (Epstein et al., 1996). A dispositional tendency to engage in analytic thinking is also commonly measured by performance scores on the Cognitive Reflection Test (CRT; Toplak et al., 2011, 2014). Higher CRT scores are associated with conflict detection and reasoning accuracy (Bago & De Neys, 2019; Thomson & Oppenheimer, 2016; Travers et al., 2016) as well as detecting and dismissing fake news (Pennycook & Rand, 2019). Higher CRT scores are also associated with higher NfC and lower FiI (Pennycook et al., 2016). With regard to dispositional differences in the driving processes of people's risk preference, it is hypothesized that dispositions favoring analytic thinking will be associated with *risk* and *reward* resources as indicative of a risk-reward tradeoff. Conversely, dispositions favoring intuitive thinking will be associated with resources related to *intuition* and *feeling*.

In sum, the current studies investigate the resources that drive people's stated risk preference. In Study 1, participants provide written accounts explaining the mental processes that drive their perceptions of risk and benefit and their propensity to engage in activities. Study 2a employs a different method of eliciting participants' resources, in which participants identify the resources they used among those revealed in Study 1. Study 2b assesses the test–retest stability of participants' resources and tests for associations between participants' resources and their thinking disposition. In Study 3, the order in which participants' evaluate their expected benefits, risk perceptions, and risk propensity is manipulated to investigate how participants draw on their expected benefit and risk perception ratings to inform their risk propensity and their use of mental resources.

Study 1

Method

Participants

Two hundred and four U.S. residents were recruited via Amazon's Mechanical Turk in exchange for $1 compensation. Participants took a median of 10 min and 17 s to complete the study. The Amazon Mechanical Turk platform provides data of comparable quality and reliability to face-to-face and behavioral testing methods, as well as providing a sample that is socioeconomically diverse (Casler et al., 2013; Gibson et al., 2011). To guarantee data quality, only participants who had passed attention checks and engagement measures via CloudResearch® were eligible for participation in the study. At the beginning of the study, participants provided their year of birth, gender, education, and employment status. At the end of the study, they also provided their age in years. To further improve data quality, two participants who provided an age that differed by more than 2 years of their reported year of birth were excluded from the sample.

The final sample included two hundred and two participants (56% female, age range = 19–75, $M_{age} = 41.13$ years, $SD = 13.08$). The final sample size is comparable with other studies using process-tracing methods to capture information processing underlying self-reported risk preference (e.g., Steiner et al., 2021). The sample size exceeds the minimum recommendation of $n = 150$ for assessing correlations as recommended by Schönbrodt and Perugini (2013). Regarding employment, most were in full-time ($n = 151$, 76%) or part-time ($n = 25$, 13%) employment. Few participants were retired ($n = 12$, 6%), unemployed ($n = 6$, 3%), a homemaker ($n = 5$, 3%), or a student ($n = 1$, 1%). Regarding education, few indicated high school as their highest educational attainment ($n = 20$, 10%), close to a quarter indicated some college ($n = 49$, 24%), close to half indicated a university degree ($n = 96$, 48%), and close to one-fifth indicated a postgraduate degree ($n = 37$, 18%). Ethical approval for the study protocol was provided by the internal ethics review board. All participants provided electronic informed consent before participating in the study.

Materials and Procedure

Participants were presented 12 hypothetical activities (Appendix A for full list of items), drawn from a previous study that ensured the items were suitable for a diverse age range (Rolison et al., 2019). Twelve activities were used in order to span multiple life domains (recreational, social, financial, and health; see Appendix A) in order to elicit from participants diverse resources applicable to various decision-making contexts and situations.

Participants first reported their expected benefit of engaging in each activity on a 7-point scale, ranging from *not at all beneficial* (value of 0) to *extremely beneficial* (value of 6). Below their expected benefit ratings, participants described how they evaluated the activities. Specifically, they were asked: (a) "Please describe how you judged the rewards (or benefits) you would obtain from engaging in the activities above"; (b) "Did you use any particular strategies or sources of information to make your judgments?"; (c) "Did you approach all the activities in the same way, or did you notice that your approach (e.g., strategy or sources of information) depended on which activity you were evaluating?"; and (d) "Looking at the activity above that you rated as most rewarding, please describe why you believe this activity would be most rewarding for you." These four questions were designed to elicit broad descriptions (Question 1), identify specific strategies or sources of information (Question 2), identify variability in strategies or sources of information (e.g., across activities; Question 3), and elicit descriptions that justify expected benefit ratings (Question 4).

Participants then reported their risk perception for each activity on a 7-point scale, ranging from *not at all risky* (value of 0) to *extremely risky* (value of 6) and described how they evaluated the activities in response to Questions 1–4, with modified wording to correspond with the risk perception subscale. Finally, participants reported their risk propensity for each activity on a 7-point scale, ranging from *extremely unlikely* (value of 0) to *extremely likely* (value of 6) and described how they evaluated the activities in response to Q1–Q4, with modified wording to correspond with the risk propensity subscale (see Appendix B for full instructions). Participants rated the activities and provided their written account for the expected benefit subscale, followed by the risk perception subscale, and finally the risk propensity subscale. This sequence was used to avoid influencing participants' expectations of benefit with their perceptions of risk. For instance, it may be more challenging for participants to reflect on the benefits of an activity and the resources they used having already identified the potential risks. Participants' responses to Questions 3–4 were excluded from all subsequent analyses as their responses did not yield any additional insight into their resources beyond their responses to Questions 1–2. Including responses to Questions 3–4 did not alter the results.

The study's design and hypotheses were preregistered (https://aspredicted.org/ne7ve.pdf). For the raw data: https://osf.io/d9pka/?view_only=2ca82d29a4624e5b97b5e302bc3809b6.

Results

Coding Scheme: Resources

Across Questions 1–2, participants wrote a mean of 27.73 ($SD =$ 18.93) words for the expected benefit subscale, 23.69 ($SD = 16.78$) words for the risk perception subscale, and 22.16 ($SD = 15.94$) words for the risk propensity subscale. A one-way analysis of variance indicated a significant negative trend in number of words written as participants succeeded to each subsequent subscale, $F_{(1,\ 201)} = 31.32$, $p < .001$. This may suggest that participants exerted less effort into their written accounts as they progressed to each subsequent subscale. Alternatively, as many participants described using the same resources across subscales (see section "Associations Between Resources"), participants may have used fewer words to repeat descriptions of their resources. A coding scheme of resources was created by the author for each subscale based on a qualitative analysis of participants' written accounts. Key words and phrases indicated a resource. The number of different resources generated for each subscale in the coding scheme was determined by participants' written accounts. Where a participants' written account could not be attributed to an existing resource in the coding scheme, a new resource was constructed that articulated the participants' account. A random subset ($N = 50$) of written accounts for each subscale were categorized by an independent rater (PG; see Acknowledgments) using the coding scheme. Cohen's κ scores for these subsets were .73 for the expected benefit subscale, .63 for the risk perception subscale, and .76 for the risk propensity subscale, indicating substantial interrater reliability (Cohen, 1960). The independent rater did not identify any additional resources required for the coding scheme to accommodate participants' written accounts. Table 1 provides the resources with summary descriptions.

Descriptive Statistics

Participants provided a mean rating of 2.18 ($SD = 0.91$) on the expected benefit subscale, 3.31 ($SD = 0.82$) on the risk perception subscale, and 2.27 on the risk propensity subscale ($SD = 0.94$).

Resources Informing Expected Benefit, Risk Perception, and Risk Propensity

A mean of 1.53 ($SD = 0.73$) resources were identified in participants' written accounts for each subscale (expected benefit: $M =$ 1.88, $SD = 1.08$; risk perception: $M = 1.30$, $SD = 0.77$; risk propensity: $M = 1.43$, $SD = 0.93$). Provided in Table 1 is the percentage of participants who referred to each resource in their written accounts. When evaluating the expected benefit of engaging in the activities, the majority (69%) of participants referred to the *reward* of the activity. However, close to a third also referred to *harm* (32%; e.g., potential harm) or *risk* (29%; e.g., risk of negative consequences) associated with the activities. When evaluating the expected benefit, participants had not yet been enquired about their risk perception, indicating that many participants considered potential harm and risk associated with engaging in the activities when evaluating the benefit. Some participants also referred to resources involving *experience* (15%), *feeling* (14%), *imagination* (13%), *intuition* (12%), or *knowledge* (3%).

When evaluating their risk perception, the majority of participants referred to *harm* (57%) or *risk* (34%) associated with the activities. None referred to *reward*. Some described using *intuition* (14%), *experience* (12%), *imagination* (6%), or *knowledge* (6%; Table 1). When evaluating their risk propensity, many participants referred to *reward* (29%), *risk* (21%), or *harm* (11%). Participants also referred to *anticipate behavior* (29%) or *experience* (24%), suggesting that they were attempting to anticipate their behavior or draw on how they have behaved on previous occasions. Some participants also referred to *imagination* (8%), *intuition* (6%), *feeling* (6%), *opportunity* (5%), or *comfort* (1%; Table 1).

Associations Between Resources

To investigate patterns of association between resources, co-occurrences were assessed using the "cooccur" package (Version 1.3) in *R* (Version 4.1.1; Griffith et al., 2016). Expected frequencies

Table 1
Percentage of Participants Who Identified Each Resource

Study	Expected benefit (%)	Risk perception (%)	Risk propensity (%)	Resource	Description
S1	32	57	11	Harm	Considering the potential harm associated with engaging in the activities (e.g., physical, mental, or financial harm)
S2a	61	64	50		
S2b	61	70	52		
S1	29	34	21	Risk	Using one's perceptions of the risks associated with engaging in the activities (e.g., risk of negative consequences)
S2a	70	78	67		
S2b	73	87	70		
S1	15	12	24	Experience	Using one's previous experiences, such as with similar activities (e.g., prior experience, life experiences)
S2a	58	50	59		
S2b	64	54	63		
S1	12	14	6	Intuition	Using one's intuition or gut feeling
S2a	42	45	32		
S2b	41	45	36		
S1	13	6	8	Imagination	Using one's imagination to visualize engaging in the activities (e.g., mental simulation)
S2a	48	40	39		
S2b	48	41	40		
S1	3	6		Knowledge	Using knowledge or information about oneself or the activities (e.g., self-knowledge, scientific knowledge)
S2a	64	55			
S2b	64	62			
S1	69		29	Reward	Using one's expectations about the rewards (or benefits) of engaging in the activities (e.g., enjoyment)
S2a	62		36		
S2b	64		40		
S1	14		6	Feeling	Considering how the activities would make one feel or react in real life
S2a	59		44		
S2b	60		52		
S1			29	Anticipate behavior	Considering how likely one would be to engage in the activities (e.g., whether or not one would engage in them)
S2a			57		
S2b			59		
S1			5	Opportunity	Considering whether one would be able or have the opportunity to engage in the activities in real life
S2a			36		
S2b			34		
S1			1	Comfort	Considering how comfortable one is about engaging in the activities (e.g., comfort level)
S2a			49		
S2b			57		

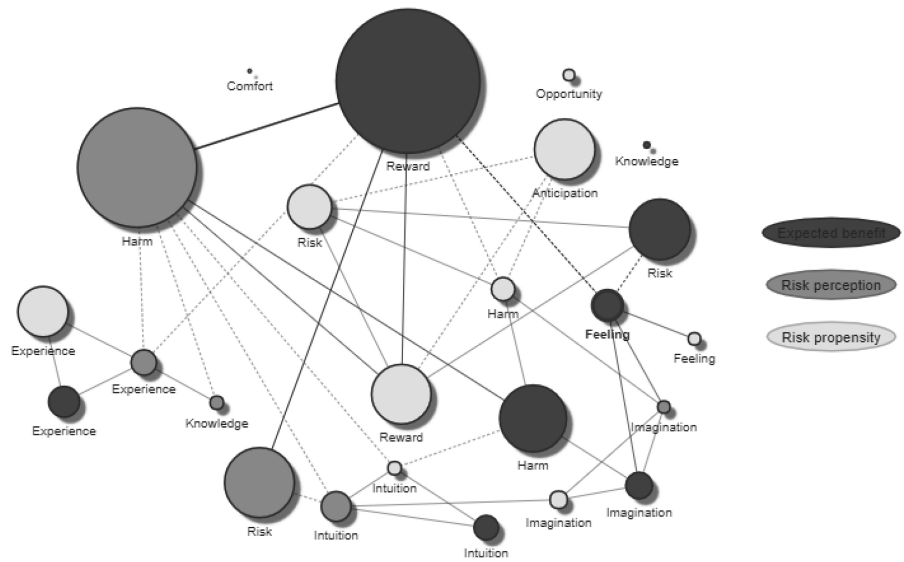
of pairwise co-occurrences were estimated assuming the resources were randomly distributed and statistically independent of each other (Veech, 2013). The observed frequencies of pairwise co-occurrences were then compared with the expected frequencies to test for significant differences from chance. This method of co-occurrence analysis traditionally has been used to study animal species co-occurrence patterns underlying community structure and assembly (e.g., Gotelli & McCabe, 2002). In the present context, co-occurrence patterns provide a window onto the structure and assembly of participants' resources used for evaluating their risk preference.

Provided in Appendix C are the probabilities of co-occurrence above and below the observed frequencies given the occurrences are randomly distributed and independent. These are provided for each pairwise co-occurrence where the probability of co-occurrence above or below the observed frequency is equal to or less than the α criterion of .05, indicating significant co-occurrence. Figure 1 provides a visual representation of the significant co-occurrences of resources identified in participants' written accounts. Solid edges indicate significant positive co-occurrences, whereas dashed edges indicate significant negative co-occurrences. Edge thickness corresponds to the probability of co-occurrence of the two resources, indicating their strength of association (see Appendix C for numerical values). Inspecting Figure 1, participants referred to some of the same resources to inform their expected benefit, risk perception, and risk propensity. Specifically, participants who referred to *harm* to inform their expected benefit were more likely to refer to *harm* when reporting their risk perception. Participants who referred to *feeling* to inform their expected benefit were more likely to refer to this resource for informing their risk propensity. *Experience*, *intuition*, and *imagination* co-occurred across the expected benefit, risk perception, and risk propensity subscales (Figure 1). Moreover, *experience*, *intuition*, and *imagination* were either uncorrelated or negatively correlated with *risk* and *reward* resources. *Reward*, when used to inform expected benefit, co-occurred with multiple other resources, including *reward* for evaluating risk propensity and *risk* and *harm* for evaluating risk perception. Moreover, when evaluating their risk propensity, participants who referred to *risk* as a resource were more likely to refer to *reward* (Figure 1).

Associations Between Resources and Expected Benefit, Risk Perception, and Risk Propensity

Are participants' resources associated with their evaluations of expected benefit, risk perception, and risk propensity? To answer this question, correlation analyses were conducted between participants' mean expected benefit, risk perception, and risk propensity ratings and the resources identified in their written accounts for the

Figure 1
Co-Occurrence of Resources in Study 1



Note. Solid edges indicate significant positive co-occurrences. Dashed edges indicate significant negative co-occurrences. Edge thickness corresponds to the probability of co-occurrence.

corresponding subscale. Table 2 provides the Pearson r and 95% confidence intervals (CIs) for each of the correlations. Referring to the *risk* resource to inform expected benefit ratings was associated with expecting less benefit from the activities, indicating that considering the risk of activities moderated expectations of benefit. Referring to *experience* to evaluate risk perception was associated with lower risk perception. Referring to *reward* to evaluate risk propensity was associated with higher risk propensity, perhaps because the rewards were more salient to those participants or because considering the rewards made the rewards more salient.

Resources and Integration of Risks and Benefits

Are participants' resources associated with the integration of risks and benefits to inform their risk propensity? To answer this question, a censored Bayesian mixed-effects general linear model with a Gaussian link was conducted on risk propensity ratings at the item level. A censored model was conducted as the data included a disproportionate number of responses at the lowest end of the response scale (i.e., "extremely unlikely"; 839 responses of a total 2,424; 35%), indicating possible floor effects in the data. Risk perception and expected benefit ratings at the item level were included as predictors. Whether or not participants referred to the *risk* and *reward* resources to inform their risk propensity were also included as predictors. Random intercepts were included for participants to account for repeated measurements within participants and random slopes were included for the risk perception and expected benefit predictors. The model was fitted using the "brms" package in *R* (Bürkner, 2017). Four chains were produced, each with 3,000 iterations, 1,500 warmup iterations, and a thinning rate of 1. A "credible effect" was inferred when the 95% credible intervals of a model coefficient did not include 0 (Kruschke, 2010). The model priors were minimally informative default priors. Convergence was checked via inspection of the four parallel chains ($\hat{R}$ values < 1.01; effective sample sizes $>1{,}000$; Bürkner, 2017) for the current and subsequent analysis.

The analysis revealed that lower risk perception ($b = -0.58$, 95% credible interval [CI] [-0.67, -0.50]) and higher expected benefit ($b = 0.88$, [0.81, 0.96]) were associated with higher risk propensity. The *risk* resource was also associated with higher risk propensity ($b = 0.41$, [0.02, 0.79]). In a second block, two-way interaction terms were included between risk perception and the *risk* resource and between expected benefit and the *reward* resource. These interaction terms test whether the *risk* and *reward* resources moderated the influence of risk perception and expected benefit ratings on risk propensity. There were no credible moderating effects of the *risk* or *reward* resources.

In the above model, the slopes for risk perception and expected benefit ratings measure participants' sensitivity to perceived risks and benefits. Steeper slopes indicate higher sensitivity to changes in risks and benefits, but do not imply more consistent integration of perceived risks and benefits. For instance, a participant may exhibit low sensitivity to changes in the magnitude of risks and benefits they perceive, but be highly consistent in how they integrate their perceived risks and benefits to inform their risk propensity, indicating greater computation of risk-reward tradeoffs. The residuals of the estimated risk propensity at the item level within each participant in the model provide an individual differences measure of the consistency with which perceived risks and benefits were integrated to inform risk propensity. Using the distributional regression approach, the model above was extended to predict the error term (σ) in estimated risk propensity from whether or not participants reported using the *risk* and *reward* resources to inform their risk propensity. Participants who referred to using the *risk* ($b = -0.30$, 95% CI [-0.41, -0.18]), but not the *reward* ($b = -0.00$, [-0.11, 0.10]), resource exhibited smaller residual errors, indicating that they more consistently integrated their ratings to inform their risk propensity. This finding indicates that use

Table 2
Correlations Between Resources and Expected Benefit, Risk Perception, and Risk Propensity Subscales

	Subscale					
	Expected benefit		Risk perception		Risk propensity	
Resource	Pearson *r*	95% CI	Pearson *r*	95% CI	Pearson *r*	95% CI
			Study 1			
Harm	−.07	[−0.20, 0.07]	−.02	[−0.16, 0.12]	−.06	[−0.20, 0.08]
Risk	−.18	[−0.31, −0.04]	−.02	[−0.16, 0.12]	−.04	[−0.18, 0.10]
Experience	−.02	[−0.16, 0.12]	−.19	[−0.32, −0.06]	.13	[−0.01, 0.26]
Intuition	−.04	[−0.18, 0.10]	.03	[−0.11, 0.17]	−.05	[−0.19, 0.08]
Imagination	−.02	[−0.15, 0.12]	−.01	[−0.14, 0.13]	.04	[−0.10, 0.18]
Knowledge	−.09	[−0.22, 0.05]	−.01	[−0.15, 0.13]		
Reward	−.03	[−0.17, 0.11]			.18	[0.04, 0.31]
Feeling	−.12	[−0.25, 0.02]			−.03	[−0.17, 0.11]
Anticipate behavior					−.09	[−0.23, 0.05]
Opportunity					−.06	[−0.20, 0.07]
Comfort					−.02	[−0.16, 0.12]
			Study 2a			
Harm	−.15	[−0.28, −0.01]	.10	[−0.04, 0.23]	−.18	[−0.31, −0.05]
Risk	−.27	[−0.39, −0.13]	.04	[−0.10, 0.18]	−.14	[−0.28, −0.01]
Experience	.05	[−0.09, 0.18]	−.04	[−0.18, 0.09]	.07	[−0.06, 0.21]
Intuition	−.08	[−0.22, 0.05]	.07	[−0.07, 0.20]	−.02	[−0.15, 0.12]
Imagination	−.08	[−0.22, 0.06]	.08	[−0.06, 0.22]	.06	[−0.08, 0.20]
Knowledge	−.11	[−0.24, 0.03]	.00	[−0.14, 0.14]		
Reward	−.15	[−0.28, −0.02]			.04	[−0.09, 0.18]
Feeling	−.08	[−0.21, −0.06]			−.02	[−0.16, 0.12]
Anticipate behavior					−.08	[−0.21, 0.06]
Opportunity					.12	[−0.02, 0.25]
Comfort					−.04	[−0.18, 0.10]

Note. CI = confidence interval.

of the *risk* resource was associated with greater integration of perceptions of the activities to inform risk propensity.

Summary

Participants referred to a variety of resources in their written accounts. Some resources (e.g., *experience*, *intuition*, *imagination*) were used to inform multiple aspects of their evaluations of the activities. An association between the *risk* and *reward* resources for evaluating risk propensity indicated that some participants explicitly integrated their perceived risks and rewards. Some resources were associated with participants' evaluations of the activities. In particular, referring to the *risk* resource to inform expected benefit ratings was associated with expecting less benefit, indicating that perceived risk moderated expectations of benefit. Participants who said they used the *risk* resource more consistently integrated their ratings of the activities to inform their risk propensity.

Study 2a

The aim of Study 2a was to provide a replication of Study 1 using a different method of eliciting participants' resources. Rather than describe their resources in written accounts, participants selected the resources they used among those revealed in Study 1. This method enabled participants to report resources among those already identified that may be omitted from brief written accounts. For instance, some participants may focus their written accounts on only the most prominent or salient resources or the first ones that come to mind.

Method

Participants

Two hundred and twelve U.S. residents were recruited via Amazon's Mechanical Turk following the same procedure as described in Study 1. Participants received $1 compensation and took a median of 5 min and 15 s to complete the study. Different participants were recruited to the sample used in Study 1. Six participants who provided an age that differed by more than 2 years of their reported year of birth were excluded from the sample. The final sample included two hundred six participants (57% female, age range = 19–71, $M_{age} = 41.92$ years, $SD = 12.99$). Regarding employment, most were in full-time ($n = 156$, 76%) or part-time ($n = 20$, 10%) employment. Few participants were retired ($n = 10$, 5%), unemployed ($n = 9$, 4%), a homemaker ($n = 8$, 4%), or a student ($n = 3$, 2%). Regarding education, few indicated high school as their highest educational attainment ($n = 17$, 8%), over a quarter indicated some college ($n = 57$, 28%), close to half indicated a university degree ($n = 98$, 48%), and close to one-fifth indicated a postgraduate degree ($n = 34$, 17%). Ethical approval for the study protocol was provided by the internal ethics review board. All participants provided electronic informed consent before participating in the study.

Materials and Procedure

Study 2a followed the same procedure as Study 1 with the exception that after evaluating the activities of each subscale, rather than provide written accounts explaining their evaluations, participants were presented descriptions (see Table 1 for descriptions) of the resources created for each subscale in Study 1 from which they selected those they used. Minor alterations were made to the pronouns of the resource descriptions to refer to participants' own behavior. For example, "using one's intuition or gut feeling" (*intuition*) was replaced with "using your intuition or gut feeling." Participants could select as few or as many resources as they wished.

The study's design and hypotheses were preregistered (https://aspredicted.org/bm4ju.pdf). For the raw data: https://osf.io/d9pka/?view_only=2ca82d29a4624e5b97b5e302bc3809b6.

Results

Descriptive Statistics

Participants provided a mean rating of 2.17 ($SD = 0.93$) on the expected benefit subscale, 3.19 ($SD = 0.87$) on the risk perception subscale, and 2.27 on the risk propensity subscale ($SD = 0.91$).

Resources Informing Expected Benefit, Risk Perception, and Risk Propensity

Participants reported using a mean of 4.22 ($SD = 2.08$) resources for each subscale (expected benefit, $M = 4.64$, $SD = 2.23$; risk perception, $M = 3.32$, $SD = 1.71$; risk propensity, $M = 4.68$, $SD = 2.82$). Provided in Table 1 is the percentage of participants who identified using each resource. Overall, participants reported using a larger number of resources in comparison to those identified in their written accounts in Study 1. Consistent with the findings of Study 1, *risk* featured prominently among participants' resources and was most frequently identified by participants for informing their expected benefit, risk perception, and risk propensity. Replicating findings of Study 1, *reward* was also among the most frequently identified resources for informing expected benefit (62%), *harm* was among those most frequently identified for informing risk perception (64%), and *experience* (59%) and *anticipate behavior* (57%) were among the resources most frequently identified for informing risk propensity.

Associations Between Resources

Figure 2 provides a visual representation of the significant co-occurrences of resources (see Study 1 for analytic method). The resources co-occurred to a greater extent than in Study 1, due in part to the higher number of identified resources in general. Consistent with the findings of Study 1, participants referred to some of the same resources to inform multiple aspects of their evaluations of activities. *Imagination*, *intuition*, *experience*, and *harm*, co-occurred across the expected benefit, risk perception, and risk propensity subscales (Figure 2). However, these resources were more strongly associated with *risk* and *reward* than in Study 1 (Figure 2; see Appendix C for numerical values). This was because *risk* and *reward* featured prominently with multiple co-occurrences with other resources. In particular, when *risk* was identified for informing risk perception or expected benefit, it co-occurred with multiple other resources. When *reward* was identified for informing expected benefit, it co-occurred with multiple other resources, including *risk* and *harm* for informing risk perception. As in Study 1, some participants referred to both *risk* and *reward* to inform their risk propensity.

Associations Between Resources and Expected Benefit, Risk Perception, and Risk Propensity

As in Study 1, correlation analyses were conducted between participants' mean expected benefit, risk perception, and risk propensity ratings and the resources they identified for the corresponding subscale (Table 2). Replicating findings of Study 1, identifying the *risk* resource to inform expected benefit was associated with expecting less benefit from the activities. Additionally, participants who said they used the *reward*, *harm*, or *feeling*, resources to inform their expected benefit ratings also expected less benefit. Regarding risk propensity, participants who reported using the *risk* or *harm* resources to inform their risk propensity rated a lower risk-taking propensity.

Resources and Integration of Risks and Benefits

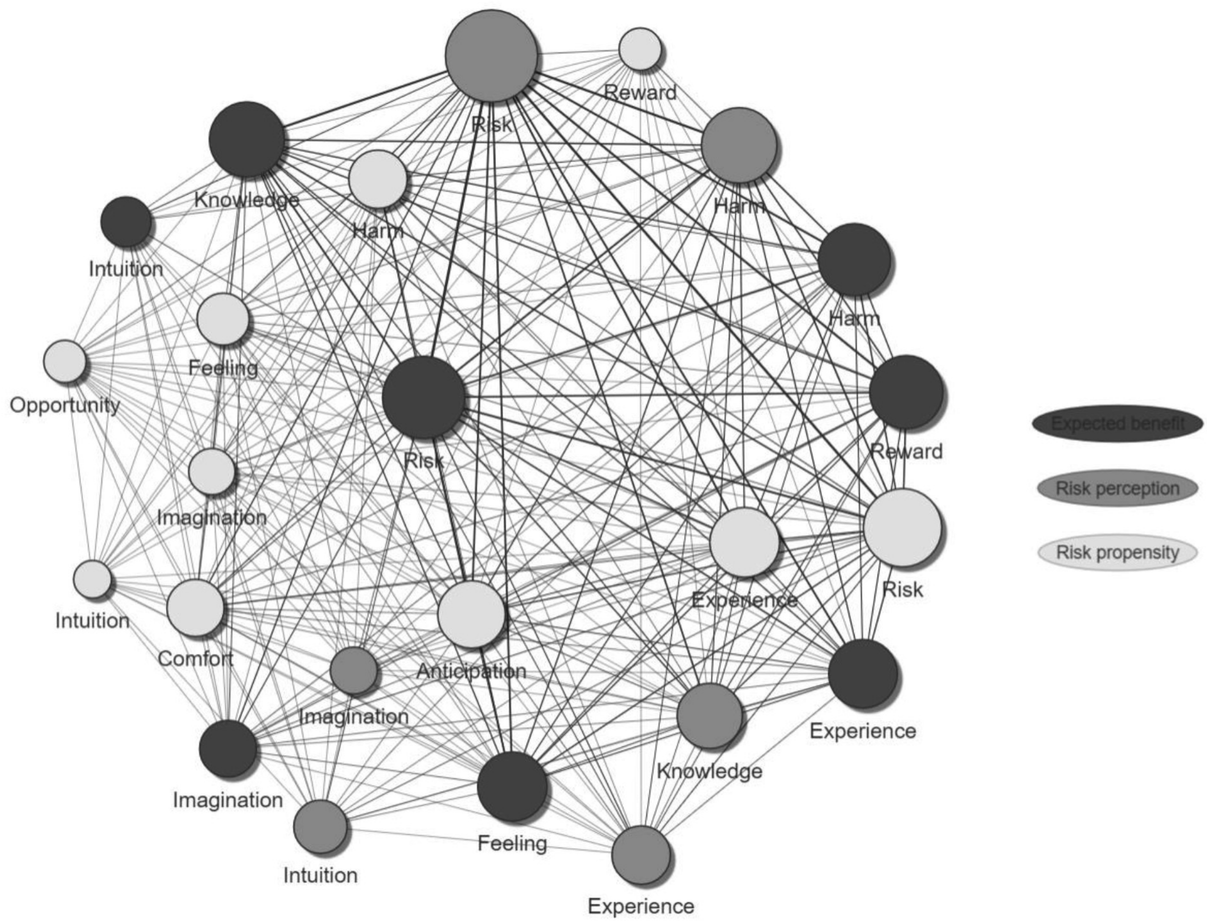
As in Study 1, a censored Bayesian mixed-effects general linear model with a Gaussian link was conducted on risk propensity ratings at the item level. Similar to Study 1, the data included a disproportionate number of responses at the lowest end of the response scale (i.e., "extremely unlikely"; 752 responses of a total 2,472; 30%), warranting a censored model. Risk perception and expected benefit ratings at the item level were included as predictors. Whether or not participants identified using the *risk* or *reward* resources to inform their risk propensity ratings were also included as predictors. Random intercepts were included for participants and random slopes were included for the risk perception and expected benefit predictors. Lower risk perception ($b = -0.48$, 95% CI [−0.55, −0.41]) and higher expected benefit ($b = 0.83$, [0.76, 0.91]) were associated with higher risk propensity. In a second block, two-way interaction terms revealed that participants who reported using the *reward* resource were more sensitive to their expected benefit ratings ($b = 0.20$, [0.05, 0.35]; simple slope: $b_{present} = 0.96$, [0.83, 1.08]) than those who did not report using the *reward* resource (simple slope: $b_{absent} = 0.76$, [0.67, 0.85]). There was no credible moderating effect of the *risk* resource on sensitivity to risk perception ($b = -0.09$, [−0.23, 0.04]).

Finally, as in Study 1, participants who reported using the *risk* ($b = -0.13$, 95% CI [−0.22, −0.04]), but not the *reward* ($b = 0.02$, [−0.07, 0.12]) resource exhibited smaller residual errors in estimated risk propensity (see Study 1 for analytic method), indicating that the risk resource was associated with greater integration of ratings to inform risk propensity.

Study 2b

Study 2a replicated many of the findings of Study 1 using a different method of eliciting participants' resources. The aims of Study 2b were: (a) to assess the test–retest stability of participants' resources and (b) to test for associations between participants' resources and their thinking disposition. Regarding test–retest stability, those who participated in Study 2a were invited to participate in Study 2b around one month following their participation in Study 2a and identified for a second time their resources. Regarding thinking disposition, it was hypothesized that dispositions favoring an analytic–rational processing mode would be associated with the *risk*, *reward*, or *harm* resources as these resources are likely to involve intentional integration of risks and rewards. An analytic–rational thinking disposition

Figure 2
Co-Occurrence of Resources in Study 2a



Note. Solid edges indicate significant positive co-occurrences. Dashed edges indicate significant negative co-occurrences. Edge thickness corresponds to the probability of co-occurrence. Edge thickness was squared to increase visible differences in co-occurrence.

may also be associated with the *knowledge* resource as use of knowledge or information about oneself or the activities (e.g., self-knowledge, scientific knowledge) is likely to involve elaborate and reflective thinking. Conversely, it was hypothesized that dispositions favoring an intuitive–experiential processing mode would be associated with the *experience*, *feeling*, *imagination*, and *intuition* resources as these resources are likely to involve intuitive processing. An intuitive–experiential thinking disposition may also be associated with the *comfort* (e.g., comfort level) and *anticipate behavior* (e.g., whether or not one would engage in them) resources as these resources are likely to involve less elaborate and reflective thinking.

Method

Participants

Participants who took part in Study 2a were invited to participate in Study 2b. Participants were offered \$1.25 compensation, slightly more than in Study 2a to encourage participation. Participants took a median of 7 min and 33 s to complete the study. One hundred forty five participants, 70% of Study 2a participants, accepted the invitation and completed Study 2b 25–31 days ($M = 27.40$ days, $SD = 1.38$) following completion of Study 2a. Although the Study 2b sample size was smaller than in Studies 1 and 2a, it still approached the minimum recommendation of $n = 150$ for assessing correlations (Schönbrodt & Perugini, 2013). The Study 2b sample did not differ significantly from the Study 2a sample in terms of *age* (age range = 22–71, $M_{\text{age}} = 43.70$ years, $SD = 12.90$, independent samples *t*-test), $t(349) = 1.27$, $p = .206$; *gender* (40% female), $\chi^2(1) = 0.01$, $p = .934$; *employment* (full-time [$n = 112$, 77%], part-time [$n = 12$, 8%], retired [$n = 8$, 6%], unemployed [$n = 6$, 4%], homemaker [$n = 6$, 4%], student [$n = 1$, 1%], Mann–Whitney test, $p = .383$); or *education* (high school [$n = 7$, 5%], some college [$n = 40$, 28%], university degree [$n = 76$, 52%], postgraduate degree [$n = 22$, 15%], Mann–Whitney test, $p = .686$). Ethical approval for the study protocol was provided by the internal ethics review board. All participants provided written informed consent before participating in the study.

Materials and Procedure

Participants rated their expected benefit, risk perception, and risk propensity for the 12 items used in Study 1 and Study 2a and identified their resources for each subscale following the same procedure used in Study 2a.

Cognitive Reflection Test (Five Items). Participants completed five CRT items comprised of four items from Thomson and Oppenheimer (2016), including “If you’re running a race and you pass the person in second place, what place are you in?” (Q1; correct answer: second place), “A farmer had 15 sheep and all but eight died. How many are left?” (Q2; correct answer: eight), “Emily’s father has three daughters. The first two are named April and May. What is the third daughter’s name?” (Q3; correct answer: Emily), and “How many cubic feet of dirt are there in a hole that is 3′ deep × 3′ wide × 3′ long?” (Q4; correct answer: none), and one item from Bago and De Neys (2019), “A banana and an apple cost $1.40. The banana costs $1.00 more than the apple. How much does the apple cost?” (Q5; correct answer: $0.20). The items were presented in a randomly generated order for each participant. Correct answers were summed across the five items to produce an overall CRT score. The Cronbach’s α—measuring scale internal consistency reliability—was 0.69.

Need for Cognition (Five Items; Cronbach’s $\alpha = 0.86$). Participants completed the five-item NfC scale developed by Epstein et al. (1996) to assess analytic–rational thinking (e.g., “I prefer complex to simple problems”). Participants were asked to “indicate whether or not the statement is characteristic of you or of what you believe” on a 5-point scale ranging from *completely uncharacteristic of me* (value of 1) to *completely characteristic of me* (value of 5). Mean scores across the five items were used as an overall measure of NfC.

Faith in Intuition (Five Items; Cronbach’s $\alpha = 0.94$). Participants completed the five-item FiI scale developed by Epstein et al. (1996) to assess intuitive–experiential thinking (e.g., “I trust my initial feelings about people”). Participants were asked to “indicate whether or not the statement is characteristic of you or of what you believe” on a 5-point scale ranging from *completely uncharacteristic of me* (value of 1) to *completely characteristic of me* (value of 5). Mean scores across the five items were used as an overall measure of FiI.

Participants completed the CRT, NfC, and FiI scales in separate blocks in a randomly generated order for each participant. The study’s design and hypotheses were preregistered (https://aspredicted.org/vm3ju.pdf). For the raw data: https://osf.io/d9pka/?view_only=2ca82d29a4624e5b97b5e302bc3809b6.

Results

Descriptive Statistics

Regarding thinking dispositions, participants answered a mean of 3.02 ($SD = 1.42$) of five CRT items correctly, exhibited a mean of 3.49 ($SD = 1.01$) on the NfC scale, and a mean of 3.43 ($SD = 0.97$) on the FiI scale. Regarding risk preferences, participants provided a mean rating of 2.02 ($SD = 0.88$) on the expected benefit subscale, 3.17 ($SD = 0.84$) on the risk perception subscale, and 2.20 on the risk propensity subscale ($SD = 0.97$).

Resources and Thinking Disposition

Higher CRT scores, $r(145) = .22$, 95% CI [.07, .37], and NfC, $r(145) = .17$, [.02, .33], but not FiI, $r(145) = -.05$, $p = .564$, were associated with participants using a greater number resources to inform their evaluations in Study 2b. To test for associations between resources in Study 2b and thinking disposition, Pearson point–biserial correlations were conducted between CRT, NfC, and FiI scores and whether or not participants identified using each resource for each subscale. Table 3 provides the Pearson *r* and 95% CIs for each correlation. To aid inspection of the associations between the thinking dispositions and resources, Figure 3 provides a network plot of the correlations. The edges indicate correlations equal to or greater than .10 (i.e., at least a small effect size) and their thickness corresponds to the strength of the association. The node layout was determined by a force-directed algorithm, such that positively correlated nodes attract each other and uncorrelated or negatively correlated nodes repel each other (Fruchterman & Reingold, 1991). Inspecting Figure 3, CRT and NfC were both associated with the *imagination*, *knowledge*, and *experience* resources (see also Table 3). CRT was additional associated with the *reward*, *risk*, *harm*, *anticipate behavior*, and *opportunity* resources. These findings provide some support for the hypothesis that analytic thinking would be associated with the *risk* and *reward* resources in so far as their associations with CRT scores. FiI was instead associated with the *intuition* and *feeling* resources (Figure 3; Table 3), which supports the hypothesis that dispositions favoring intuitive thinking would be associated with resources related to *intuition* and *feeling*.

The correlations between thinking disposition and reported resource use one month earlier (Study 2a) were also assessed. The Pearson *r* and 95% CIs for each correlation are provided in Appendix C. As in Study 2b, NfC was associated with the *knowledge* and *experience* resource, but in contrast to Study 2b, was not associated with *imagination*. CRT scores were correlated with the *harm* and *anticipate behavior* resources and the *risk* and *reward* resources, replicating the hypothesized association between the latter resources and analytic thinking. However, CRT scores exhibited weaker correlations with the *imagination* and *opportunity* resources than observed for associations with resources reported in Study 2b. As in Study 2b, FiI was associated with the *intuition* and *feeling* resources.

Thinking Disposition and Integration of Risks and Benefits

Are participants’ thinking dispositions associated with the integration of risks and benefits to inform risk propensity? To answer this question, a censored Bayesian mixed-effects general linear model with a Gaussian link was conducted on risk propensity ratings at the item level. Risk perception and expected benefit ratings at the item level, and CRT, NfC, and FiI, were included as predictors. Random intercepts were included for participants and random slopes were included for the risk perception and expected benefit predictors. Lower risk perception ($b = -0.55$, 95% CI [−0.65, −0.47]) and higher expected benefit ($b = 0.87$, [0.77, 0.97]) were associated with higher risk propensity. In a second block, two-way interaction terms were included between risk perception ratings and the thinking dispositions and between expected benefit ratings than the thinking dispositions. Higher CRT ($b = -0.08$, [−0.14, −0.02]) and FiI ($b = -0.13$, [−0.23, −0.04]) scores were associated with higher sensitivity to risk perception. Higher NfC was associated with higher sensitivity to expected benefit ($b = 0.14$, [0.05, 0.24]).

Using the distributional regression approach, the model above was extended to predict the error term (σ) in estimated risk propensity from individual differences in CRT, NfC, and FiI. There were no credible effects of CRT, NfC, or FiI scores on residual errors.

Table 3
Correlations Involving Thinking Dispositions and Resources Reported in Study 2b

		Thinking disposition					
		Cognitive Reflection Test		Need for Cognition		Faith in Intuition	
Subscale	Resource	Pearson *r*	95% CI	Pearson *r*	95% CI	Pearson *r*	95% CI
Expected benefit	Harm	.19	[0.03, 0.34]	.10	[−0.06, 0.26]	−.07	[−0.23, 0.10]
	Risk	.15	[−0.01, 0.31]	.09	[−0.08, 0.24]	−.07	[−0.23, 0.10]
	Experience	−.02	[−0.18, 0.14]	.21	[0.05, 0.36]	−.10	[−0.26, 0.07]
	Intuition	.03	[−0.14, 0.19]	−.09	[−0.25, 0.07]	.15	[−0.01, 0.31]
	Imagination	.20	[0.04, 0.35]	.20	[0.04, 0.35]	−.16	[−0.32, −0.00]
	Knowledge	.02	[−0.14, 0.18]	.15	[−0.01, 0.31]	−.00	[−0.17, 0.16]
	Reward	.32	[0.17, 0.46]	.03	[−0.13, 0.20]	−.02	[−0.18, 0.14]
	Feeling	−.01	[−0.17, 0.16]	−.03	[−0.19, 0.14]	.10	[−0.06, 0.26]
Risk perception	Harm	.17	[0.01, 0.32]	.06	[−0.10, 0.22]	−.08	[−0.24, 0.08]
	Risk	.05	[−0.11, 0.21]	.01	[−0.16, 0.17]	.02	[−0.14, 0.18]
	Experience	.07	[−0.09, 0.23]	.18	[0.02, 0.34]	−.03	[−0.19, 0.13]
	Intuition	.03	[−0.14, 0.19]	−.11	[−0.27, 0.06]	.17	[0.00, 0.32]
	Imagination	.15	[−0.02, 0.30]	.09	[−0.08, 0.25]	−.01	[−0.17, 0.16]
	Knowledge	.12	[−0.04, 0.28]	.13	[−0.04, 0.28]	−.05	[−0.22, 0.11]
Risk propensity	Harm	.11	[−0.05, 0.27]	.13	[−0.03, 0.29]	−.02	[−0.19, 0.14]
	Risk	.06	[−0.10, 0.22]	.03	[−0.14, 0.19]	.05	[−0.12, 0.21]
	Experience	.21	[0.05, 0.36]	.19	[0.03, 0.35]	−.10	[−0.26, 0.06]
	Intuition	−.10	[−0.26, 0.06]	−.01	[−0.17, 0.16]	.10	[−0.06, 0.26]
	Imagination	.18	[0.02, 0.33]	.24	[0.08, 0.39]	−.04	[−0.20, 0.12]
	Reward	.24	[0.08, 0.38]	.10	[−0.07, 0.26]	−.07	[−0.23, 0.09]
	Feeling	−.04	[−0.20, 0.13]	.03	[−0.13, 0.19]	.02	[−0.15, 0.18]
	Anticipate behavior	.29	[0.13, 0.43]	.09	[−0.07, 0.25]	−.07	[−0.23, 0.09]
	Opportunity	.17	[0.01, 0.33]	.12	[−0.05, 0.27]	−.13	[−0.29, 0.03]
	Comfort	.10	[−0.06, 0.26]	.10	[−0.06, 0.26]	−.16	[−0.31, 0.01]

Note. CI = confidence interval.

Test–Retest Stability of Resources

To assess the test–retest stability of resources, a multilevel logistic regression analysis was conducted on the resources participants identified in Study 2b, including as a predictor the resources they identified in Study 2a. Subscale (expected benefit, risk perception, risk propensity) and thinking dispositions (CRT, NfC, FiI) were also included as predictors to test for differences in test–retest stability according to subscale and thinking disposition. Random intercepts were included for participants to account for repeated measurements. The model fit was further improved with the inclusion of random slopes for the Study 2a predictor ($\chi^2 = 22.81$, $p < .001$). Resources identified in Study 2a were positively associated with those identified in Study 2b ($b = 1.51$, $t = 12.81$, $p < .001$), indicating test–retest stability of resources. There was an 82% probability that participants would identify the same resource in the test and retest stages. At the participant level, the slopes for the Study 2a predictor provide an estimate of each participant's test–retest stability. Inferred from the participant-level slopes, the probability that participants would identify the same resource in the test and retest stages ranged from 55% to 94% and was equal to or greater than 80% for 59% of participants, indicating high test–retest stability for the majority of participants.

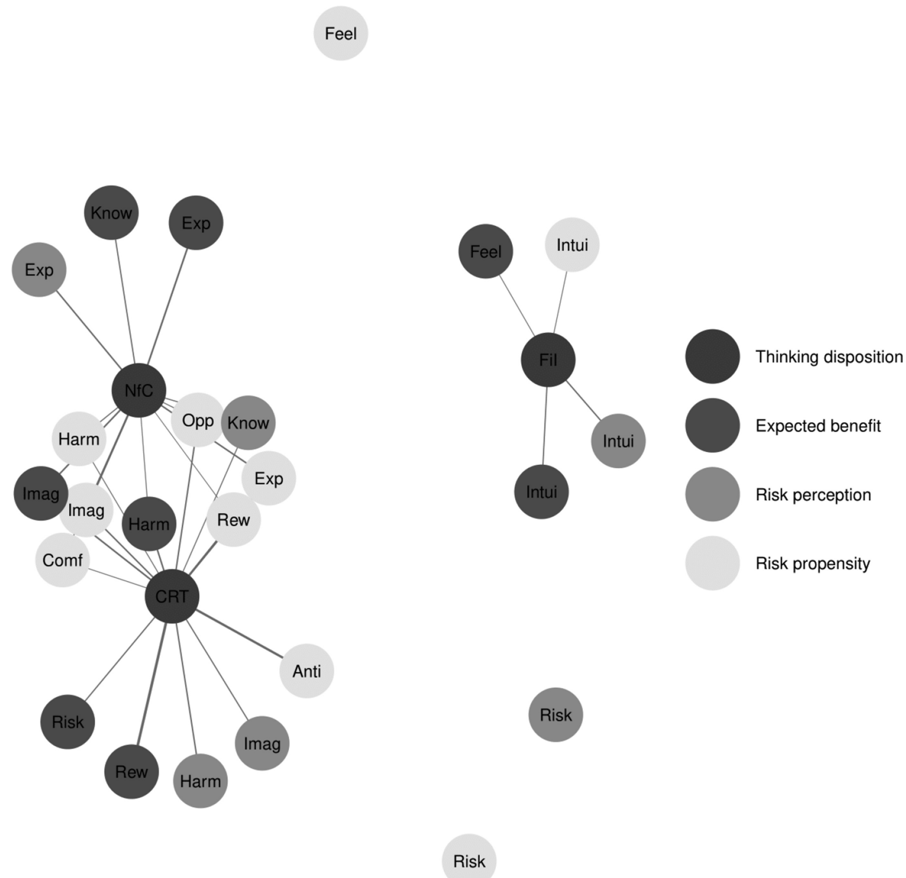
In a second block, two-way interaction terms were included between the Study 2a predictor and subscales and thinking dispositions. These revealed that test–retest stability was significantly higher for the risk perception ($b = 0.45$, $t = 2.15$, $p = .032$; $b_{\text{simple slope}} = 1.94$, $t = 9.87$, $p < .001$) compared to the risk propensity ($b_{\text{simple slope}} = 1.45$, $t = 10.12$, $p < .001$) subscale, but not compared to the expected benefit subscale ($b = 0.21$, $t = 0.99$, $p = .324$; $b_{\text{simple slope}} = 1.72$, $t = 9.96$, $p < .001$), and that test–retest stability was not significantly higher for the expected benefit subscale compared to the risk propensity subscale ($b = 0.23$, $t = 1.21$, $p = .225$). There were no significant interactions involving the thinking dispositions, indicating that test–retest stability did not differ significantly according to thinking disposition.

Study 3

In Studies 1 and 2a, participants who reported using the *risk* resource more *consistently* integrated their perceptions of the activities to inform their risk propensity (i.e., smaller residual error in estimated risk propensity). For participants who reported using the *reward* resource, their expected benefit ratings were more *strongly* associated with their risk propensity ratings (in Study 2a), but were not more *consistently* associated with their risk propensity ratings (in Studies 1 or 2a). In both studies, participants rated first their expected benefits for activities, then their risk perceptions, and lastly, their risk propensity. Thus, when evaluating their risk propensity, participants' risk perception ratings may have been more easily retrievable from memory than their expected benefit ratings as they rated their risk perceptions immediately prior to rating their risk propensity. Hence, the order in which participants completed the risk perception and expected benefit subscales may have influenced associations with their risk propensity ratings. One aim of Study 3 was to investigate whether the order in which participants evaluate their expected benefits and risk perceptions influences associations with risk propensity.

Figure 3

Network Plot of Correlations Involving Thinking Dispositions and Resources in Study 2b



Note. Edges indicate correlations equal to or greater than .10. Edge thickness corresponds to the strength of association. Positively correlated nodes are located closer in distance and uncorrelated or negatively correlated nodes are located further apart. CRT = Cognitive Reflection Test; NfC = Need for Cognition; FiI = Faith in Intuition; Exp = experience; Intui = intuition; Imag = imagination; Know = knowledge; Rew = reward; Feel = feeling; Anti = anticipate behavior; Opp = opportunity; Comf = comfort.

A second aim of Study 3 was to seek causal evidence for whether participants who report using the *risk* or *reward* resources integrate their perceptions of risks and benefits to inform their risk propensity ratings. In Studies 1 and 2a, participants evaluated their risk perceptions and expected benefits before rating their risk propensity. This procedure enabled participants to draw on their prior ratings of the risks and benefits of activities to inform their risk propensity. In Study 3, some participants instead rate their risk propensity first, before evaluating the risks and benefits of activities. This manipulation should disrupt integration of risk perception and expected benefit ratings to inform risk propensity, weakening their association with risk propensity ratings.

Method

Participants

Six hundred and fourteen U.S. residents were recruited via Amazon's Mechanical Turk following the same procedure as described in the preceding studies. Participants received $1 compensation. Participants took a median of 4 min and 43 s to complete the study. Different participants were recruited to the samples used in the preceding studies. Five participants who provided an age that differed by more than 2 years of their reported year of birth were excluded from the sample. The final sample included 609 participants (57% male, age range = 19–75, $M_{\text{age}} = 39.04$ years, $SD = 10.93$). Regarding employment, most were in full-time ($n = 475$, 79%) or part-time ($n = 49$, 8%) employment. Few participants were retired ($n = 19$, 3%), unemployed ($n = 27$, 4%), a homemaker ($n = 23$, 4%), or a student ($n = 12$, 2%). Regarding education, few indicated high school as their highest educational attainment ($n = 97$, 16%), over a quarter indicated some college ($n = 181$, 30%), close to half indicated a university degree ($n = 259$, 43%), and few indicated a postgraduate degree ($n = 72$, 12%). Ethical approval for the study protocol was provided by the internal ethics review board. All participants provided electronic informed consent before participating in the study.

Materials and Procedure

As in Study 2a, participants completed the expected benefit, risk perception, and risk propensity subscales. However, the order in which the subscales were completed differed across conditions. Participants completed the expected benefit (*B*) subscale either before ($n = 309$) or after ($n = 300$) the risk perception (*R*) subscale, and completed the expected benefit and risk perception subscales either before ($n = 309$) or after ($n = 300$) the risk propensity (*P*) subscale. Hence, participants completed the three subscales in one of four possible orders: BRP, RBP, PBR, and PRB. After evaluating the activities of each subscale, participants selected which resources—created for each subscale in Study 1—they used to inform their ratings.

The study's design and hypotheses were preregistered (https://aspredicted.org/blind.php?x=QY6_FG1). For the raw data: https://osf.io/d9pka/?view_only=2ca82d29a4624e5b97b5e302bc3809b6.

Results

Descriptive Statistics

Participants provided a mean rating of 2.31 ($SD = 1.89$) on the expected benefit subscale, 3.09 ($SD = 1.88$) on the risk perception subscale, and 2.68 on the risk propensity subscale ($SD = 2.12$).

Resources and Integration of Risks and Benefits

To test for effects of subscale order on associations between risk perceptions, expected benefits, and risk propensity, a censored Bayesian mixed-effects general linear model with a Gaussian link was conducted on risk propensity ratings at the item level. Similar to Studies 1, 2a, and 2b, the data included a disproportionate number of responses at the lowest end of the response scale (i.e., "extremely unlikely"; 1,835 responses of a total 7,368; 25%), warranting a censored model. Risk perception and expected benefit ratings at the item level were included as predictors. Whether or not participants reported using the *risk* or *reward* resources to inform their risk propensity ratings were also included as predictors. Whether participants completed the risk propensity subscale first or last and whether they completed the expected benefit subscale before or after the risk perception subscale were also included as predictors. Random intercepts were included for participants and random slopes were included for the risk perception and expected benefit predictors.

Lower risk perception ($b = -0.63$, 95% CI [−0.67, −0.58]) and higher expected benefit ($b = 0.69$, [0.65, 0.73]) ratings were associated with higher risk propensity. In a second block, two-way interaction terms were included between risk perception and expected benefit ratings and each other predictor in the model. Participants who reported using the *reward* resource were more sensitive to their expected benefit ratings ($b = 0.08$, [0.00, 0.16]; $b_{\text{present}} = 0.76$, [0.67, 0.84]) than those who did not report using the *reward* resource ($b_{\text{absent}} = 0.68$, [0.60, 0.76]). In contrast to Studies 1 and 2a, participants who reported using the *risk* resource were more sensitive to their risk perception ratings ($b = -0.10$, [−0.18, −0.01]; $b_{\text{present}} = -0.53$, [−0.61, −0.46]) than those who did not report using the *risk* resource ($b_{\text{absent}} = -0.43$, [−0.53, −0.33]).

Participants were more sensitive to their risk perception ratings if they evaluated the risks of activities before the benefits ($b = -0.20$, 95% CI [−0.29, −0.12]; simple slopes: $b_{\text{risk perception first}} = -0.63$, [−0.73, −0.54]; $b_{\text{expected benefits first}} = -0.43$, [−0.53, −0.33]; see Figure C1). Participants were more sensitive to their expected benefit ratings if they evaluated the benefits of activities before the risks ($b = -0.17$, [−0.26, −0.09]; simple slopes: $b_{\text{expected benefits first}} = 0.68$, [0.60, 0.76]; $b_{\text{risk perception first}} = 0.51$, [0.43, 0.59]; see Figure C2) or if they evaluated their risk propensity last ($b = 0.13$, [0.05, 0.21]; simple slopes: $b_{\text{risk propensity last}} = 0.81$, [0.72, 0.89]; $b_{\text{risk propensity first}} = 0.68$, [0.60, 0.76]; see Figure C3). These findings indicate that the order in which the subscales were completed influenced the extent to which perceived risks and benefits are associated with risk propensity. Moreover, the stronger association between expected benefit and risk propensity than between risk perception and risk propensity in Studies 1 and 2a can be partially attributed to the ordering of the expected benefit subscale before the risk perception subscale. Three-way interaction terms were included in a subsequent block to test whether the order in which the subscales were completed affected the moderating effects of the *risk* and *reward* resources on the association between risk perception and expected benefit and risk propensity. There were no significant three-way interactions.

As discussed in Studies 1 and 2a, steeper slopes for the risk perception and expected benefit predictors indicate higher *sensitivity* to risk perception and expected benefit ratings, but do not imply more *consistent* integration of risk perception and expected benefit ratings to inform risk propensity. The residuals of the estimated risk propensity ratings provide a measure of the consistency with which perceived risks and benefits were integrated to inform risk propensity. The two-way interaction model above was used to predict the error term (σ) in estimated risk propensity. The *risk* and *reward* resources, whether participants completed the risk propensity subscale first or last, and whether they completed the expected benefit subscale before or after the risk perception subscale were included as predictors of the error term. In contrast to Studies 1 and 2a, overall participants who reported using the *risk* resource did not exhibit smaller residual errors in estimated risk propensity ($b = 0.02$, 95% CI [−0.02, 0.07]), and participants who reported using the *reward* resource exhibited larger residual errors ($b = 0.05$, [0.00, 0.10]). If participants evaluated their risk propensity last, rather than first, they also exhibited larger residual errors ($b = 0.06$, [0.02, 0.11]).

Two-way interaction terms predicting residual error were included in a subsequent block. Whether participants completed the risk propensity subscale first or last interacted with reported use of the *risk* ($b = -0.20$, 95% CI [−0.30, −0.10]; see Figure C4) and *reward* ($b = 0.14$, [0.04, 0.25]; see Figure C5) resources. Additionally, whether participants completed the risk propensity subscale first or last interacted with whether they completed the expected benefit subscale before or after the risk perception subscale ($b = 0.14$, [0.05, 0.24]; see Figure C6). Probing the above interactions, when participants evaluated their risk propensity last, those who reported using the *risk* resource exhibited smaller residual errors, although the difference was not credible ($b = -0.08$, [−0.17, 0.01]). When participants evaluated their risk propensity first, those who reported using the *risk* resource instead exhibited larger residual errors ($b = 0.12$, [0.03, 0.21]). However, participants who reported using the *risk* resource did exhibit smaller residual errors if they evaluated their risk propensity last (vs. first; $b = -0.15$, [−0.24, −0.07]), but there was no credible difference for participants who did not report using the *risk* resource ($b = 0.05$, [−0.04, 0.14]). Regarding use of the *reward* resource, when participants evaluated their risk propensity last, those who reported using the *reward* resource exhibited larger residuals than those who did not report using this resource ($b = 0.11$, [0.02, 0.20]), but not if they evaluated their risk propensity first ($b = -0.04$, [−0.12, 0.05]). Finally, participants exhibited larger residual errors if they evaluated their risk propensity last, but only if they evaluated the risks of the activities before the benefits ($b = 0.19$, [0.09, 0.28]), and not if they first evaluated the benefits ($b = 0.05$, [−0.05, 0.14]).

Associations Between Resources and Expected Benefit

In Studies 1 and 2a, participants who identified using the *risk* resource to inform their expected benefit ratings, expected less benefit from the activities. To test whether this tendency was altered by the order that the subscales were completed, a censored Bayesian mixed-effects general linear model with a Gaussian link was conducted on expected benefit ratings at the item level. As in the analysis of risk propensity, the data included a disproportionate number of responses at the lowest end of the response scale (i.e., "not at all beneficial"; 1,847 responses of a total 7,368; 25%), warranting a censored model. Whether or not participants reported using the *risk* resource to inform their expected benefit ratings, whether participants completed the risk propensity subscale first or last, and whether they completed the expected benefit subscale before or after the risk perception subscale, were included as predictors. Random intercepts were included for participants. As expected, participants who reported using the *risk* resource rated lower expected benefits ($b = -0.25$, 95% CI [−0.47, −0.03]). Two-way interaction terms were included in a second block. There were no significant interactions.

Summary

The order in which the subscales were completed influenced the extent to which perceived risks and benefits were associated with risk propensity. *Sensitivity* to the *risk* and *reward* resources does not appear to depend on the order that the subscales are completed. Conversely, participants who used the *risk* resource more *consistently* integrated their perceptions when the risk propensity subscale followed the risk perception subscale. Participants who reported using the *reward* resource instead exhibited larger residual errors if they rated their risk propensity last (vs. first). The order in which the subscales were completed also influenced the residual errors in estimated risk propensity.

General Discussion

The main objective of the current research was to fill a gap in our understanding of risk preference by casting a light on the psychological drivers of people's stated preferences. Central to the stated preference tradition, the psychological risk-return model conceptualizes risk propensity as a tradeoff between perceived risks and benefits of choice options (e.g., Weber et al., 2002). Three studies were conducted in order to understand the psychological drivers of people's stated preferences within a risk-return framework.

Resources Informing Risk Preference

In their written accounts (Study 1) and identifications (Studies 2a and 3), participants reported using *risk* and *reward* resources to derive their risk perception and expected benefit for activities, respectively. Some participants also reported using *risk* and *reward* to inform their risk propensity. These findings support the psychological risk-return model (e.g., Weber, 1997; Weber et al., 2002; Weber & Milliman, 1997) as they imply that for some participants the risks and rewards of activities were drivers of their risk propensity. Although previous research has demonstrated that risk perception and expected benefit ratings are correlated with risk propensity (Blais & Weber, 2006; Hanoch et al., 2006; Rolison & Shenton, 2020; Weber et al., 2002), such correlational findings are supportive of the psychological risk-return model as only an as-if model of behavior. The current findings reveal that some participants explicitly considered the risks and benefits of activities when deriving their risk propensity.

Participants who reported using the *reward* resource to inform their risk propensity were more sensitive to their expected benefit ratings in their risk propensity ratings (Studies 1, 2a, and 3). Participants who reported using the *risk* resource to inform their risk propensity were more sensitive to their risk perception ratings (Study 3). These findings reveal novel associations between reported use of a resource (e.g., *reward*) and *sensitivity* to perceptions (e.g., expected benefits) related to the resource in risk preference. Study 3 was designed to disrupt the associations between resource use and risk preference by manipulating the order in which the subscales were completed. The logic was that participants would be less likely to draw on their risk perception and expected benefit ratings to inform their risk propensity if they first evaluated their risk propensity. Participants rated their expected benefits either before or after their risk perceptions, and rated their risk propensity either first or last. Participants were found to be more sensitive to their expected benefit (or risk perception) ratings if they rated them first, indicating that the order in which the subscales were completed affected participants' sensitivity to their ratings. Nonetheless, subscale order did not affect the association between use of the *risk* or *reward* resource and sensitivity to risk perception or expected benefit ratings. Thus, participants who reported using the *risk* or *reward* resource were sensitive to their perceived risks and benefits, regardless of whether they made their ratings before or after rating their risk propensity.

In a regression model, the coefficient slopes for the risk perception and expected benefit predictors measure a person's *sensitivity* to their ratings. Steeper slopes indicate high sensitivity to changes in perceived risks and benefits. Yet a person may be sensitive to their risk perceptions or expected benefits, but be inconsistent in how they integrate their perceptions to inform their risk propensity. In the regression model, the residuals of the estimated risk propensity ratings measure the *consistency* with which perceived risks and benefits are integrated to inform risk propensity. In Studies 1 and 2a, participants who reported using the *risk*, but not the *reward*, resource to evaluate their risk propensity exhibited smaller residual errors, indicating that they more consistently integrated their ratings to inform their risk propensity. Why was use of the *risk* resource, but not the *reward* resource, associated with smaller residual errors? In Studies 1 and 2a, participants rated first their expected benefits, followed by their risk perceptions and risk propensity. One possibility is that participants' risk perception ratings were more easily retrievable from memory than their expected benefit ratings when evaluating their risk propensity. In Study 3, participants rated either their risk perceptions before their expected benefits or their expected benefits before their risk perceptions. The order in which the two subscales were completed did not affect the association between use of the *risk* and *reward* resources and residual errors in estimated risk propensity. Therefore, it appears that while participants who reported using the *reward* resource were more sensitive to their expected benefit ratings, they were no more consistent in integrating their ratings to inform their risk propensity, even when they evaluated their expected benefits immediately prior to their risk propensity.

In Study 3, whether the risk propensity subscale was completed first or last affected the associations between use of the *risk* and *reward* resources and residual errors in estimated risk propensity. Participants who reported using the *risk* resource exhibited smaller residual errors if they evaluated their risk propensity last (vs. first), whereas participants who reported using the *reward* resource exhibited larger residual errors if they evaluated their risk propensity last (vs. first). These findings suggest that when the *risk* resource was used, consistent integration of perceptions was hampered if participants rated their risk propensity first as they were not able to draw on their ratings. Therefore, these findings provide some indication that participants who reported using the *risk* resource were integrating their perceptions of the activities to inform their risk propensity. Based on these findings, it is also possible to speculate why the *reward* resource was not associated with smaller residual errors. One possible explanation is that the risk perception and expected benefit ratings were not independently associated with risk propensity and that use of the *risk* and *reward* resources did not draw solely on their respective risk perception and expected benefit subscales. In all three studies, participants who reported using the *risk* resource to inform their expected benefit ratings provided lower ratings of expected benefit. In Study 3, this tendency was not altered by manipulating the order in which the subscales were completed. Consequently, the *risk* resource may have influenced both the risk perception and expected benefit ratings, bringing about a stronger dependency between the two subscales, resulting in more consistent risk propensity ratings. In this same process, an association between the *reward* resource and consistency in risk propensity ratings would be weakened.

These findings suggest that participants who reported using the *risk* resource intentionally integrated their perceptions, computing a risk-reward tradeoff to derive their intentions to engage in risky activities. Equally, the computation of a risk-reward tradeoff was recounted in participants' verbal reports of the resources they used. The psychological model of risk-reward tradeoffs conceptualizes risk and reward broadly as psychological constructs that vary across individuals and contexts (e.g., Figner & Weber, 2011; Weber et al., 2002), but is mute on the psychological processes that drive these constructs. The current findings provide an important piece to this puzzle, evidencing that explicit processes drive a risk-reward tradeoff for some individuals. Hence, for some decision-makers risks and rewards are considered during a reasoning process that leads to a more consistent integration of perceived risks and rewards when deriving intentions to engage in risky activities.

The order in which the subscales were completed influenced the extent to which perceived risks and benefits were associated with risk propensity. Other studies have shown stated risk preference measures to exhibit high levels of test–retest reliability. Yet these studies typically assessed only participants' risk propensity (Beauchamp et al., 2017; Frey et al., 2017, 2021; except Weber et al., 2002). Asking participants to evaluate the risks and benefits of activities encourages them to furnish their risk propensity ratings with their ratings of risk perception and expected benefit. As such, the test–retest reliability of stated risk propensity measures may potentially be affected by whether participants are asked also to evaluate the risks and benefits of activities. A fruitful direction for future research would be to investigate whether test–retest reliability of stated risk preference measures is affected by whether participants are required to evaluate the risks and benefits of activities.

Higher CRT scores and NfC ratings were associated with higher sensitivity to risk perception and expected benefit ratings, respectively, in participants' risk propensity ratings (Study 2b). Further, higher CRT scores were associated with more consistent integration of perceived risks and benefits, as indicated by smaller residual errors in estimated risk propensity (Study 2b). Though it may not be clear why CRT and NfC should be separately associated with sensitivity to perceived risks and rewards and their integration, as both are indicative of analytic thinking (Cacioppo et al., 1996; Epstein et al., 1996; Toplak et al., 2011, 2014), these findings suggest that a disposition toward analytic thinking was associated with greater integration of perceived risks and rewards when deriving intentions to engage in risky activities. This novel conclusion is important to our understanding of risk preference for three main reasons. First, it supports the current proposal that risks and rewards are considered during an explicit reasoning process when deriving risk propensity. Second, it suggests that only some decision-makers intentionally engage in risk-reward tradeoffs, and typically those disposed to analytic thinking. Third, it bridges the stated preference and revealed preference traditions with common psychological processes as higher CRT scores are correlated also with expected-value choices on behavioral tasks (Frederick, 2005).

A central tenet of the psychological risk-return model is that perceived risks and rewards are integrated in a tradeoff to determine risk propensity (Weber, 1997; Weber et al., 2002). Yet participants referred to (Study 1) and identified (Study 2a) a variety of resources that were not directly related to risk or reward aspects of activities. Some resources related more to information sources (e.g., *experience*, *knowledge*) or to processes or strategies (e.g., *intuition*, *imagination*). When evaluating their risk propensity, participants additionally identified *anticipate behavior* (i.e., considering how likely one would be to engage in the activities [e.g., whether or not one would engage in them]), *opportunity* (i.e., considering whether one would be able or have the opportunity to engage in the activities in real life), and *comfort* (i.e., considering how comfortable one is about engaging in the activities [e.g., comfort level]) as resources for evaluating their intentions to engage in activities. These resources imply that participants used various sources of information and strategies beyond the tradeoff between perceived risks and benefits to inform their risk propensity.

Some resources, including *experience*, *intuition*, and *imagination*, were used by some participants to inform multiple aspects of their risk preference. Moreover, *experience*, *intuition*, and *imagination* were uncorrelated or negatively correlated with *risk* and *reward* in Study 1, albeit exhibiting stronger correlations with *risk* and *reward* in participants' identifications in Study 2a. Seemingly, some resources, namely *experience*, *intuition*, and *imagination*, did not necessarily relate to participants' explicit consideration of risk and reward. Instead, some participants indicated that they used resources other than those related to the risks and rewards of activities to inform their behavioral intentions. These findings imply that people have available a repertoire of mental resources that they use for evaluating activities. The computation of a risk-reward tradeoff is not the only psychological process used to derive behavioral intentions, even when participants are asked explicitly to evaluate their risk perception and expected benefit for activities before evaluating their risk propensity. In a protocol analysis of choices for monetary gambles, Cokely and Kelley (2009) observed large individual differences in the decision processes reported by participants, only some of which related to expected value considerations. Hence, in both stated and revealed preference measures, risk preference often does not reflect a single psychological process.

Individual differences in some resources emerged as a driver of individual differences in risk preference. Intriguingly, in Studies 1 and 2a, participants who indicated that they used *risk* to evaluate the expected benefit of activities expected less benefit, presumably as a reflection of the risk they perceived. An assumption of the psychological risk-return model is that perceived risks and benefits provide separate contributions to a person's risk propensity. Linear regression models are used to measure the unique contribution of expected benefit and risk perception ratings to risk propensity (e.g., Blais & Weber, 2006; Weber et al., 2002). However, the current findings indicate that some participants consider an activity's potential risk when evaluating their expected benefit, implying that risk perception can feed into expected benefit ratings. This was the case even though in some conditions participants evaluated their expected benefit before evaluating their risk perception. It is possible that for some participants expected benefit ratings represent net ratings of the expected value of activities given perceptions of their risk. These findings further indicate that individual differences in the resources people use to evaluate activities influence individual differences in risk preference. Individual differences in resources may also contribute to observed variability of internal consistency reliability in stated preference measures (e.g., DOSPERT; Shou & Olney, 2020). A more complete model of risk preference is one that acknowledges the multiple co-occurring resources that drive people's evaluations of risky options.

Simultaneous Use of Resources

Analysis of participants' written accounts in Study 1 indicated that they typically used more than one resource simultaneously to evaluate their risk preference. Participants reported using a larger number of resources simultaneously in Studies 2a and 2b when they were required to select the resources they used among those identified in Study 1. One possible explanation for this difference between studies is that participants focused their written accounts on the most important or salient resources, or the first ones that came to mind, omitting others they used. Studies 2a and 2b replicated many of the findings of Study 1, indicating similarities in the resources participants reported using in their written accounts and selections. Future research could explore variations on these elicitation methods. One method would be to limit the number of resources participants can select to ensure that they select the resources they consider most important to their evaluations. Doing so may increase associations among resources and between resources and risk preference and thinking disposition by omitting resources that play a less important role. Another method would be to have participants rank the resources they select according to their importance for informing their evaluations. Resources ranked as more important should be more strongly associated with other highly ranked resources as well as risk preference and thinking disposition.

The Nature of Risk Perception

The current findings help resolve the lack of agreement among theorists about the definition or meaning of risk (Aven, 2012). Risk perception is conceptualized broadly as a psychological construct in the risk-return model (e.g., Figner & Weber, 2011; Weber et al., 2002). Yet, the nature of this construct has remained unclear. Here, participants drew simultaneously on multiple resources to inform their perceptions of risk, indicating a multifaceted nature of risk. Participants' resources were stable over time (Study 2b), indicated also by high participant-level test–retest stability for the majority of participants. Resources were also most stable over time for the risk perception subscale. These findings indicate that participants employed a consistent concept of risk perception over time, albeit one that was multifaceted and which drew on various sources. Participants differed in the constellation of resources they used, suggesting that people possess a personal definition of risk that differs across individuals. Therefore, risk perception may best be conceived as a multifaceted psychological construct that differs in its nature across individuals and is defined in part by the resources people draw on to evaluate risky options.

Thinking Dispositions and Mental Resources

It was hypothesized that a dispositional tendency toward an *intuitive–experiential* thinking style (i.e., higher FiI) would be associated with using nonanalytic resources, including *intuition*, *feeling*, and *imagination*, on the basis that *intuitive–experiential* thinking contains facets related to intuition, emotion, and imagination (Norris & Epstein, 2011). Partially confirming this hypothesis, higher FiI was correlated with using the *intuition* and *feeling* resources. Thus, participants who indicated an *intuitive–experiential* thinking style used some of the resources corresponding to their thinking disposition to evaluate their risk preference.

However, surprisingly, FiI was negatively correlated with the *imagination* resource (at least for evaluating expected benefit), and instead, an analytic thinking disposition (i.e., higher CRT & NfC) was correlated with the *imagination* resource. In Norris and Epstein (2011), the imagination facet is captured by self-report items that relate to visually imagining experiences (e.g., "I enjoy reading things that evoke visual images," "I enjoy imagining things"). NfC is also potentially related to a form of imagination, to the extent that individuals high in NfC desire engaging in effortful cognitive tasks that may require imagination and mental simulation. Moreover, NfC is correlated with the Big-Five factor Openness to Experience (Sadowski & Cogburn, 1997), which is characterized by curiosity, creativity, and imagination (Blagrove & Hartnell, 2000; McCrae, 1993). In Studies 2a and 2b, the description of the *imagination* resource referred to mental simulation (i.e., "using one's imagination to visualize engaging in the activities [e.g., mental simulation]"). Higher CRT scores were also correlated with the *imagination* resource. One interpretation of the CRT is that higher scores indicate an actively open-minded thinking disposition as good CRT performance requires seeking alternatives to intuitive responses (Campitelli & Gerrans, 2014; Campitelli & Labollita, 2010). Therefore, the *imagination* resource in the context of evaluating risk preference appears to reflect analytic thinking and may involve active mental simulation (e.g., of possible outcomes of engaging in risky behaviors).

In Studies 2a and 2b, the *experience* resource was described as "using one's previous experiences, such as with similar activities (e.g., prior experience, life experiences)." Higher NfC was correlated with use of the *experience* resource for all three subscales and higher CRT scores were associated with using this resource for evaluating risk propensity. High NfC individuals engage in more elaboration of information than individuals low in NfC and reflect more on their own thoughts (Cacioppo et al., 1996; Petty et al., 2002). Higher CRT scores are associated with tendencies to engage in extended analytic thinking (Toplak et al., 2011, 2014). One possibility is that in the current research higher NfC participants engaged in more elaborated thinking about their own thoughts and experiences with an activity, drawing more on their experiences than lower NfC participants. While this interpretation is speculative, it does suggest that people who engage in more extensive thinking about information and their own thoughts, as indicated by higher NfC and CRT scores, use different resources to others when evaluating their risk preference.

Finally, higher CRT scores and NfC, but not FiI, were associated with participants using a greater number resources to inform their evaluations of activities. These findings resonate with those of Cokely and Kelley (2009), who found that higher CRT scores were associated with a greater number of verbalized considerations in a protocol analysis of choices for monetary gambles. The current findings provide a further bridge between stated and revealed preference measures of risk preference. Namely, people disposed to analytic thinking engage in more thorough, reflective, and elaborative cognition in both their stated and revealed preferences, as evidenced here by greater use of resources to inform stated preferences and a greater number of verbal considerations in studies of revealed preference (Cokely & Kelley, 2009).

Limitations

In Study 1, a coding scheme was created in which resources were derived from participants' written accounts. Key words and phrases indicated a resource (e.g., *harm*; participant account: "anything that might result in physical harm"). Like any qualitative method, this coding scheme is potentially prone to bias and error. However, many of the findings of Study 1 were replicated in Studies 2a and 2b using a different method of eliciting participants' resources based on their identifications of those created in Study 1. The replication of findings across studies indicates that the coding scheme yielded valid resources. The resources were associated with individual differences in thinking disposition and exhibited test–retest stability as further indications of their validity and reliability. Moreover, resources elicited from participants' written accounts reflect those identified in judgment and decision-making research, such as intuition (Hogarth, 2010), gut feeling (e.g., Gigerenzer, 2007), experience (Arslan et al., 2020), imagination (Koehler, 1991), and harm (Slovic, 1987). Nonetheless, there exist alternative methods that may be suited to extracting the resources participants describe in their written accounts. For example, machine learning algorithms could be used to identify resources as themes in their written accounts (Sebastiani, 2002). Autocoding tools are also available that automatically detect themes in text (e.g., NVivo; QSR International, 2022). A second important consideration concerns participants' conscious access to resources they used to evaluate their risk preference. Heuristics that reside in intuitive processing, such as the availability heuristic—by which a person evaluates the likelihood of an event based on the ease with which examples are brought to mind—may not be accessible to conscious awareness or easily verbalized (Kahneman & Frederick, 2002). As such, participants' written accounts and identifications are unlikely to have captured the full repertoire of resources they used to evaluate their risk preference. The psychological risk-return model was used as a framework for studying risk preference. Within this framework, expected benefit is conceived as the benefits a person expects to obtain from engaging in an activity. Participants reported using a variety of resources to inform their expected benefits, including *reward*, *risk*, and *harm*. Alternative methods could be used to elicit participants' perceptions of the benefits of activities, such as the best possible benefit, potentially triggering use of different resources. A fruitful direction for future research would be to investigate whether people draw on different mental resources to evaluate activities depending on the method used to elicit their risk preferences. The current investigation aimed at exposing the various mental resources people use to inform their risk preference. Future research could seek to narrow a focus on specific resources to better understanding the nuanced role they play in driving risk preference.

Conclusions

Previous studies within the stated preference tradition provide correlational evidence in support of the psychological risk-return model as an as-if model of risk-taking behavior. The current findings provide evidence that some people integrate their perceived risks and benefits when evaluating risky options. The integration of risks and benefits appears to be intentional for people who are disposed to think analytically. Yet, people also have a large repertoire of mental resources that they use for evaluating activities, beyond perceived risks and benefits. The resources people use to derive their risk preference are driven in part by their thinking disposition. Theoretical models of risk preference should acknowledge the multiple co-occurring resources that drive people's evaluations of risky options.

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(*Appendices follow*)

Appendix A

Table A1
Risky Activity Items Used in Studies 1–2b

Domain	Item
Recreational	1. Going camping in the wilderness. 2. Taking a ride through the countryside on the back of a high-performance motorcycle. 3. Going winter swimming in an icy lake as part of a sporting event.
Social	1. Admitting your tastes are different from those of a friend. 2. Disagreeing with an authority figure or person of influence on a major issue. 3. Moving to a city far away from your close friends and family.
Financial	1. Betting on the outcome of a sporting event. 2. Investing in a speculative but potentially lucrative stock on the stock market. 3. Using your credit card to pay for an item on an unfamiliar website.
Health	1. Starting a new intense exercise routine. 2. Using a sun bed in a tanning studio to top up your vitamin D levels. 3. Taking a ride home in a taxi that does not have seatbelts.

Appendix B

Study 1 Instructions

Expected Benefit

For each activity below, please indicate the *rewards (or benefits)* you personally would obtain from engaging in the activity.

(12-item scale)
(Question 1) Please describe how you judged the rewards (or benefits) you would obtain from engaging in the activities above.
(Question 2) Did you use any particular strategies or sources of information to make your judgments?
(Question 3) Did you approach all the activities in the same way, or did you notice that your approach (e.g., strategy or sources of information) depended on which activity you were evaluating?
(Question 4) Looking at the activity above that you rated as most rewarding, please describe why you believe this activity would be most rewarding for you.

Risk Perception

People often see some risk in situations that contain uncertainty about what the outcome or consequences will be and for which there is a possibility of negative consequences. However, riskiness is a very personal and intuitive notion, and we are interested in *your gut-level assessment of how risky* each situation is for you.

For each activity below, please indicate how *risky you perceive* each situation *for you personally* if you were to find yourself in that situation.

(12-item scale)
(Question 1) Please describe how you judged how risky it would be for you to engage in the activities above.
(Question 2) Did you use any particular strategies or sources of information to make your judgments?
(Question 3) Did you approach all the activities in the same way, or did you notice that your approach (e.g., strategy or sources of information) depended on which activity you were evaluating?
(Question 4) Looking at the activity above that you rated as most risky, please describe why you believe this activity would be most risky for you.

Risk Propensity

For each activity below, please indicate the *likelihood* that you would engage in the activity if you were to find yourself in that situation.

(12-item scale)
(Question 1) Please describe how you judged the likelihood that you would engage in the activities above.
(Question 2) Did you use any particular strategies or sources of information to make your judgments?

(*Appendices continue*)

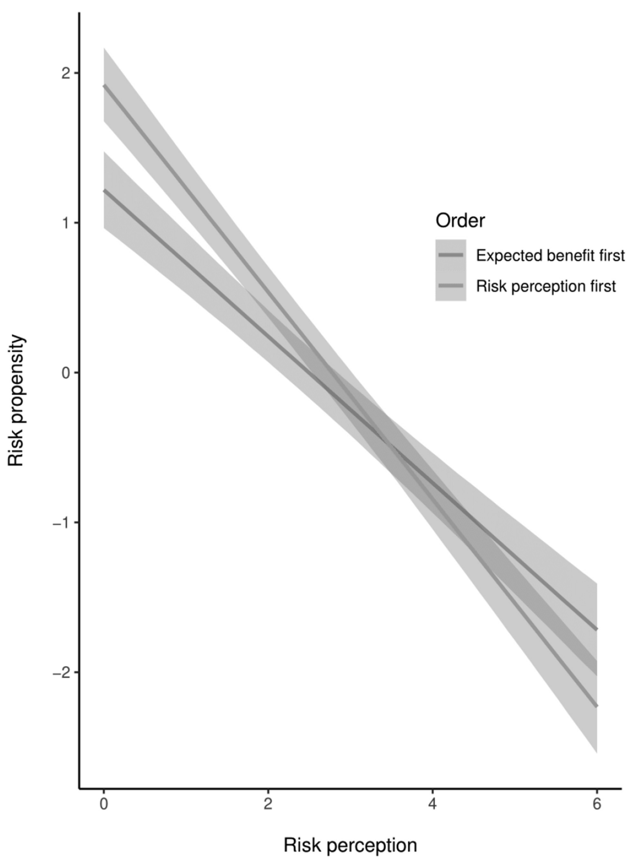
(Question 3) Did you approach all the activities in the same way, or did you notice that your approach (e.g., strategy or sources of information) depended on which activity you were evaluating?

(Question 4) Looking at the activity above that you rated you would be most likely to engage in, please describe why you believe you would most likely engage in this activity.

Appendix C

Figure C1

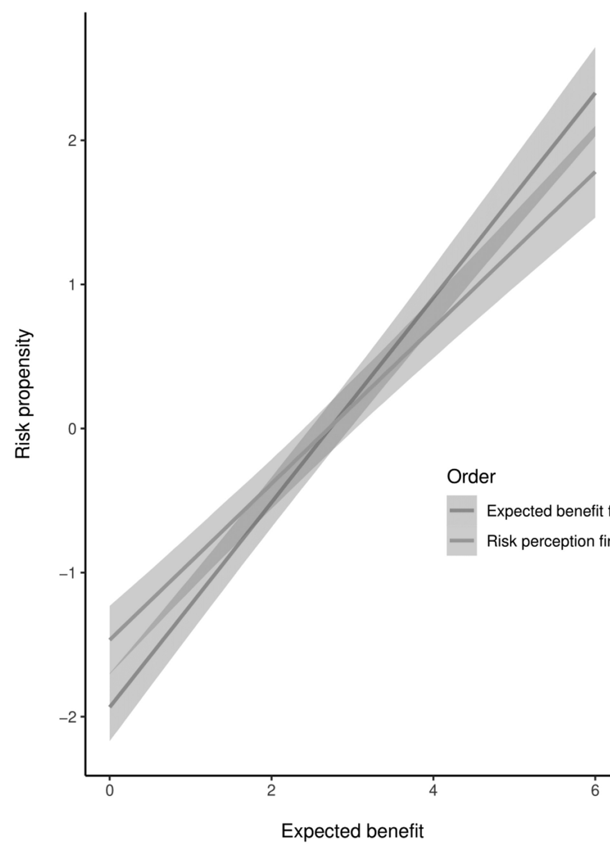
Moderating Effect of Subscale Order on the Association Between Risk Perception and Risk Propensity in Study 3



Note. Shared areas indicate 95% confidence intervals.

Figure C2

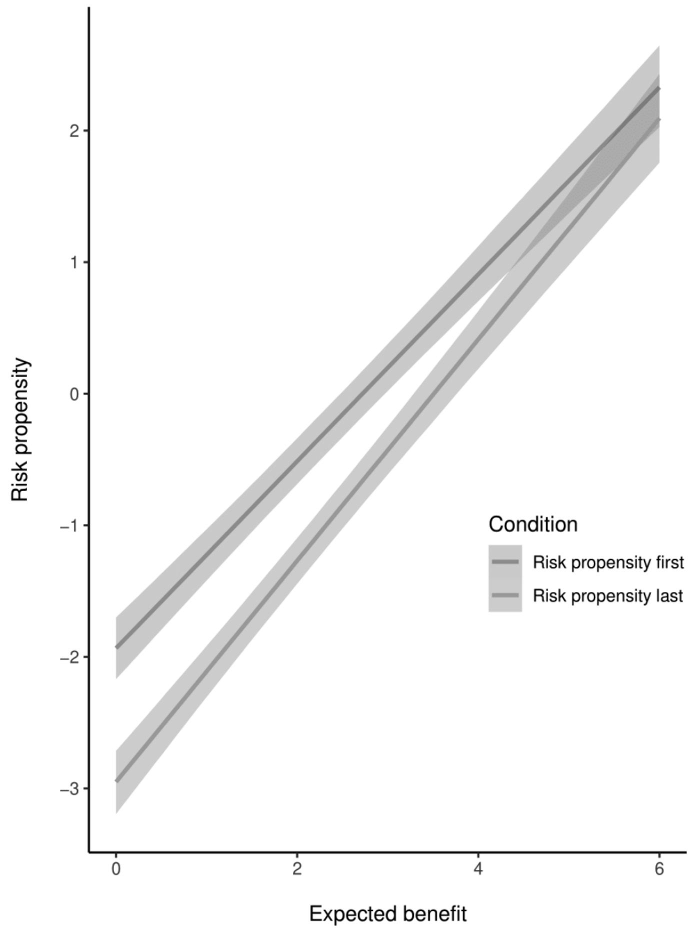
Moderating Effect of Subscale Order on the Association Between Expected Benefit and Risk Propensity in Study 3



Note. Shared areas indicate 95% confidence intervals.

(*Appendices continue*)

Figure C3
Moderating Effect of Condition on the Association Between Expected Benefit and Risk Propensity in Study 3

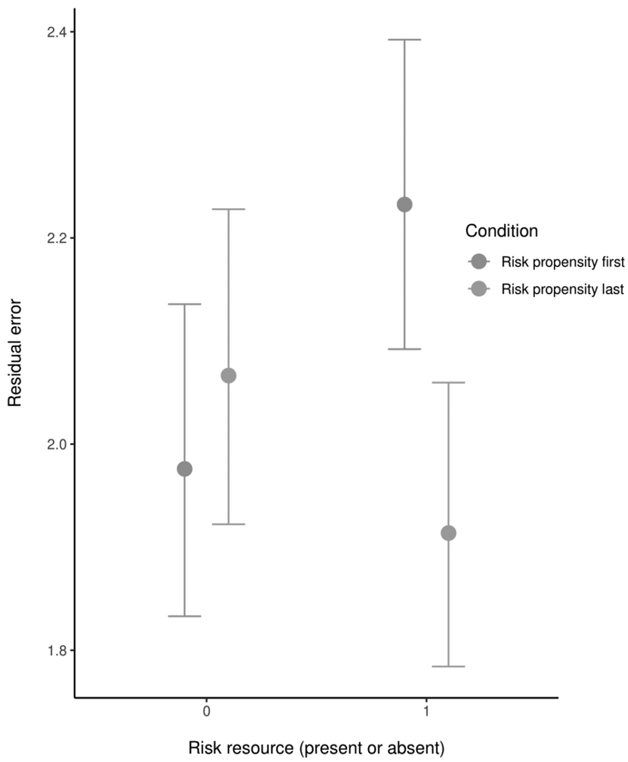


Note. Shared areas indicate 95% confidence intervals.

(*Appendices continue*)

Figure C4

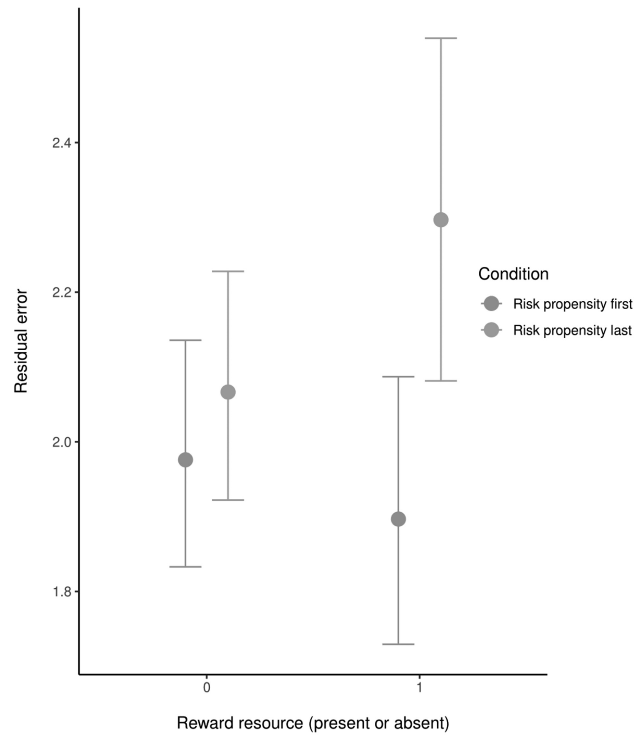
Moderating Effect of Condition on the Association Between Use of the Risk Resource and Residual Error in Estimated Risk Propensity in Study 3



Note. Shared areas indicate 95% confidence intervals.

Figure C5

Moderating Effect of Condition on the Association Between Use of the Reward Resource and Residual Error in Estimated Risk Propensity in Study 3

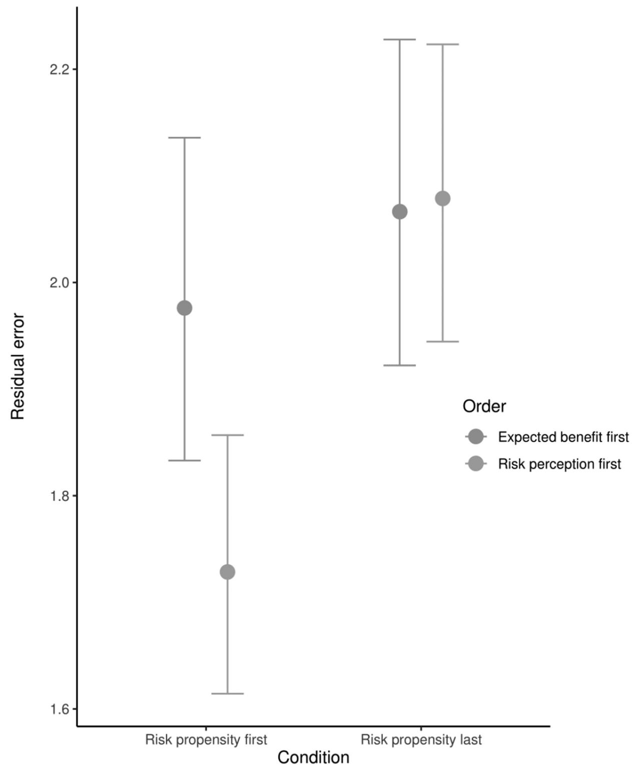


Note. Shared areas indicate 95% confidence intervals.

(*Appendices continue*)

Figure C6

Moderating Effect of Subscale Order on the Effect of Condition on Residual Error in Estimated Risk Propensity in Study 3



Note. Shared areas indicate 95% confidence intervals.

(*Appendices continue*)

Table C1
Study 1: Co-Occurrence

Resource		Observed frequency of co-occurrence	Expected frequency of co-occurrence	$p_{(\text{co-occurrence})}$	$p_{(\text{co-occurrence} < \text{observed frequency})}$	$p_{(\text{co-occurrence} > \text{observed frequency})}$
Pair_1	Pair_2					
B:Risk	B:Feeling	4	8.5	.042	.0347	.9899
B:Risk	L:Risk	27	12.6	.062	1.0000	.0000
B:Risk	L:Reward	23	16.9	.084	.9866	.0300
B:Reward	B:Feeling	13	20.1	.100	.0027	.9993
B:Reward	R:Experience	12	17.3	.086	.0148	.9955
B:Reward	R:Harm	95	80.4	.398	1.0000	.0000
B:Reward	R:Risk	56	47.1	.233	.9991	.0028
B:Reward	L:Reward	49	40.2	.199	.9995	.0019
B:Reward	L:Harm	11	15.9	.079	.0189	.9943
B:Imagination	B:Harm	14	8.4	.041	.9963	.0121
B:Imagination	B:Feeling	10	3.7	.018	.9999	.0009
B:Imagination	R:Imagination	9	1.5	.008	1.0000	.0000
B:Imagination	L:Imagination	7	2.2	.011	.9997	.0021
B:Intuition	R:Intuition	12	3.4	.017	1.0000	.0000
B:Intuition	L:Intuition	6	1.5	.008	.9999	.0015
B:Harm	R:Harm	48	37.3	.185	.9997	.0008
B:Harm	L:Harm	13	7.4	.037	.9975	.0093
B:Harm	L:Intuition	1	4.2	.021	.0411	.9947
B:Feeling	R:Imagination	7	1.7	.009	1.0000	.0003
B:Feeling	L:Feeling	6	1.7	.009	.9997	.0027
B:Experience	R:Experience	12	3.7	.018	1.0000	.0000
B:Experience	L:Experience	14	7.3	.036	.9992	.0031
R:Experience	R:Harm	6	14.4	.071	.0003	.9999
R:Experience	R:Knowledge	6	1.6	.008	.9998	.0019
R:Experience	L:Experience	15	6.1	.030	1.0000	.0000
R:Intuition	R:Harm	10	16.7	.082	.0064	.9981
R:Intuition	R:Risk	4	9.8	.048	.0097	.9977
R:Intuition	L:Intuition	9	1.9	.009	1.0000	.0000
R:Intuition	L:Imagination	6	2.4	.012	.9957	.0207
R:Imagination	L:Harm	4	1.4	.007	.9943	.0343
R:Imagination	L:Imagination	5	1.0	.005	.9999	.0013
R:Harm	R:Knowledge	3	7.5	.037	.0107	.9982
R:Harm	L:Reward	40	33.3	.165	.9888	.0249
R:Harm	L:Intuition	4	7.5	.037	.0433	.9893
L:Risk	L:Reward	26	12.3	.061	1.0000	.0000
L:Risk	L:Harm	9	4.9	.024	.9907	.0306
L:Risk	L:Anticipation	4	12.6	.062	.0006	.9999
L:Reward	L:Anticipation	7	16.9	.084	.0004	.9999
L:Harm	L:Anticipation	1	6.7	.033	.0025	.9998

Note. $p_{(\text{co-occurrence} < \text{than observed frequency})}$ and $p_{(\text{co-occurrence} > \text{than observed frequency})}$ are given that the occurrences are randomly distributed and independent of each other. Corresponding values ≤ .05 (α criterion) indicate a negative or positive co-occurrence, respectively, that is significantly different from chance.

(*Appendices continue*)

Table C2
Study 2a: Co-Occurrence

Resource		Observed frequency of co-occurrence	Expected frequency of co-occurrence	$p_{(\text{co-occurrence})}$	$p_{(\text{co-occurrence} < \text{observed frequency})}$	$p_{(\text{co-occurrence} > \text{observed frequency})}$
Pair_1	Pair_2					
B:Risk	R:Risk	130	112.6	.557	1.0000	.0000
R:Risk	L:Risk	121	106.3	.526	1.0000	.0000
R:Harm	R:Risk	122	103.1	.510	1.0000	.0000
B:Knowledge	R:Risk	109	101.5	.503	.9975	.0070
B:Reward	R:Risk	116	99.2	.491	1.0000	.0000
B:Harm	R:Risk	111	96.8	.479	1.0000	.0000
B:Risk	L:Risk	111	95.6	.473	1.0000	.0000
R:Risk	L:Experience	109	93.7	.464	1.0000	.0000
B:Feeling	R:Risk	102	92.9	.460	.9996	.0014
B:Experience	R:Risk	101	92.9	.460	.9986	.0041
B:Risk	R:Harm	111	92.7	.459	1.0000	.0000
B:Risk	B:Knowledge	104	91.3	.452	1.0000	.0000
R:Risk	B:Anticipation	104	91.3	.452	1.0000	.0000
B:Risk	B:Reward	105	89.2	.442	1.0000	.0000
R:Harm	L:Risk	105	87.5	.433	1.0000	.0000
R:Risk	R:Knowledge	99	87.4	.433	1.0000	.0000
B:Risk	B:Harm	107	87.1	.431	1.0000	.0000
B:Knowledge	L:Risk	96	86.2	.427	.9993	.0021
B:Risk	L:Experience	94	84.2	.417	.9993	.0019
B:Reward	L:Risk	97	84.2	.417	1.0000	.0000
B:Risk	B:Feeling	97	83.5	.414	1.0000	.0000
B:Risk	B:Experience	93	83.5	.414	.9991	.0025
B:Knowledge	R:Harm	92	83.7	.414	.9965	.0084
B:Risk	B:Anticipation	103	82.1	.407	1.0000	.0000
B:Harm	L:Risk	98	82.2	.407	1.0000	.0000
B:Reward	R:Harm	105	81.7	.405	1.0000	.0000
B:Reward	B:Knowledge	92	80.5	.398	.9999	.0005
B:Harm	R:Harm	104	79.8	.395	1.0000	.0000
R:Risk	L:Harm	94	79.5	.394	1.0000	.0000
L:Risk	L:Experience	89	79.5	.394	.9987	.0033
B:Feeling	L:Risk	90	78.9	.390	.9998	.0006
B:Experience	L:Risk	91	78.9	.390	.9999	.0002
B:Risk	R:Knowledge	93	78.6	.389	1.0000	.0000
B:Harm	B:Knowledge	87	78.5	.389	.9963	.0087
L:Risk	B:Anticipation	84	77.5	.384	.9823	.0357
R:Harm	L:Experience	92	77.2	.382	1.0000	.0000
B:Reward	B:Harm	95	76.7	.380	1.0000	.0000
B:Feeling	R:Harm	92	76.5	.379	1.0000	.0000
B:Experience	R:Harm	85	76.5	.379	.9963	.0087

Note. $p_{(\text{co-occurrence} < \text{than observed frequency})}$ and $p_{(\text{co-occurrence} > \text{than observed frequency})}$ are given that the occurrences are randomly distributed and independent of each other. Corresponding values $\leq .05$ (α criterion) indicate a negative or positive co-occurrence, respectively, that is significantly different from chance. As a large number of co-occurrences were significant, only 39 co-occurrences with the highest probability of co-occurrence are provided, ordered from highest to lowest probability of co-occurrence.

(*Appendices continue*)

Table C3
Correlations Involving Thinking Dispositions and Resources Reported in Study 2a

		Thinking disposition					
		Cognitive Reflection Test		Need for Cognition		Faith in Intuition	
Subscale	Resource	Pearson *r*	95% CI	Pearson *r*	95% CI	Pearson *r*	95% CI
Expected benefit	Harm	.13	[−0.03, 0.29]	.14	[−0.03, 0.29]	.01	[−0.15, 0.17]
	Risk	.17	[0.01, 0.33]	.11	[−0.05, 0.27]	.04	[−0.12, 0.20]
	Experience	−.02	[−0.18, 0.15]	.16	[−0.01, 0.31]	.03	[−0.14, 0.19]
	Intuition	−.04	[−0.20, 0.12]	.12	[−0.04, 0.28]	.21	[0.05, 0.36]
	Imagination	−.06	[−0.22, 0.10]	.09	[−0.08, 0.25]	−.01	[−0.18, 0.15]
	Knowledge	.01	[−0.15, 0.17]	.17	[0.01, 0.33]	−.02	[−0.18, 0.14]
	Reward	.23	[0.07, 0.38]	.09	[−0.07, 0.25]	−.13	[−0.29, 0.03]
	Feeling	.08	[−0.08, 0.24]	.10	[−0.06, 0.26]	.10	[−0.06, 0.26]
Risk perception	Harm	.17	[0.01, 0.32]	.16	[−0.01, 0.31]	.05	[−0.12, 0.21]
	Risk	.16	[−0.00, 0.32]	.13	[−0.04, 0.29]	.04	[−0.12, 0.20]
	Experience	−.03	[−0.20, 0.13]	.14	[−0.02, 0.30]	.12	[−0.05, 0.27]
	Intuition	−.02	[−0.19, 0.14]	.10	[−0.06, 0.26]	.17	[0.00, 0.32]
	Imagination	−.08	[−0.24, 0.08]	.01	[−0.15, 0.18]	.04	[−0.12, 0.20]
	Knowledge	.02	[−0.14, 0.18]	.25	[0.09, 0.40]	.14	[−0.02, 0.30]
Risk propensity	Harm	.05	[−0.11, 0.21]	.06	[−0.10, 0.22]	.02	[−0.14, 0.19]
	Risk	−.00	[−0.16, 0.16]	.11	[−0.05, 0.27]	.00	[−0.16, 0.17]
	Experience	.02	[−0.14, 0.18]	.14	[−0.03, 0.29]	−.04	[−0.20, 0.13]
	Intuition	−.03	[−0.19, 0.13]	.07	[−0.09, 0.23]	.06	[−0.11, 0.22]
	Imagination	.02	[−0.15, 0.18]	.06	[−0.11, 0.22]	−.03	[−0.19, 0.14]
	Reward	.03	[−0.14, 0.19]	.13	[−0.03, 0.29]	.05	[−0.12, 0.21]
	Feeling	.01	[−0.16, 0.17]	.15	[−0.01, 0.31]	.02	[−0.14, 0.18]
	Anticipate behavior	.23	[0.07, 0.38]	.12	[−0.04, 0.28]	−.04	[−0.21, 0.12]
	Opportunity	−.04	[−0.20, 0.12]	.07	[−0.10, 0.23]	−.01	[−0.18, 0.15]
	Comfort	−.01	[−0.18, 0.15]	.20	[0.04, 0.35]	−.03	[−0.19, 0.13]

Note. CI = confidence interval.

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