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RESEARCH NOTE

Risk-Taking and Creativity: Convergent, but Not Divergent Thinking Is Better in Low-Risk Takers

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The relationship between risk-taking and creativity is critical to understanding social harmony and innovation. Although some studies have assessed the link between risk-taking and divergent thinking, the association between risk-taking and convergent thinking remains unclear. Two studies were conducted to systemically investigate whether risk-taking is linked to convergent thinking. In Study 1, a sample of 127 healthy participants performed a Chinese remote associate test (RAT) and completed a risk-taking questionnaire. As predicted, risk-taking was negatively correlated with RAT performance, implying that risk-taking has a negative association with convergent thinking. Study 2 was an online survey study that replicated Study 1 and extended the measures to include self-rated risk and a measure of divergent thinking (the alternate uses task). The findings were fully replicated, showing that low risk-taking goes with better convergent thinking and risk-taking was not significantly correlated with divergent thinking. Furthermore, the risk-taking/convergent-thinking relationship was best described by a linear regression model in both studies. Taken together, these results suggest that appropriate reductions in risk-taking can boost convergent thinking.

The relationship between risk-taking and creativity is particularly important and interesting because these two constructs are crucial to the maintenance of social harmony and the development of scientific technology. Mounting evidence suggests that everyone lives in a highly complex, and therefore risky, society in which each person is confronted by various difficult to predict challenges. Perhaps due to the pervasiveness of risks and risk-taking in contemporary society, Beck (2002) has argued that society is

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becoming a “risky society, (p. 39).” Against this background, the study of how, when, and why people take risks seems especially important, as it may unravel better ways of managing risk or ways of enabling more people to benefit from risk-taking, e.g., through making large profits from highly risky investments (e.g., Platt & Huettel, 2008; Sternberg & Lubart, 1992). The concept of creativity is similar to that of risk-taking. Being creative often involves, sometimes even requires, taking some degree of risk, and it can also generate considerable improvements in quality of life and wellbeing, including enabling individuals to mate with attractive partners, promoting development of high-tech devices and scientific inventions, leading to medical breakthroughs that improve health and enabling individuals to make large profits from entrepreneurial activities (Baas, Koch, Nijstad, & De Dreu, 2015; Sternberg & Lubart, 1992). Despite such similarities, the actual relationship between creativity and risk-taking is still unclear.

The possibility that such a relationship might exist has long been recognized. Many early studies on creative thinking show that risk-taking is integral to creativity (Dewett, 2007; Eisenman, 1987; Feist, 1998; Sternberg & Lubart, 1992). Perhaps influenced by this view of the relationship, Williams’s (1980) well-known 50-item scale for measuring creativity personality, the William Test of Creative Propensity, includes a risk-taking subscale. At the end of the 20th century, the significance of investigating the link between risk(-taking) and creativity has been successively elevated by the achievement motivation theory (Dewett, 2006; Zhou & George, 2001) and creativity’s investment theory (Sternberg, 2006; Sternberg & Lubart, 1992), both of which posit that taking sensible risks is a prerequisite for creativity.

Although the theoretical significance of the relationship between creativity and risk-taking has been recognized, there have been only a few empirical studies examining it. Eisenman (1987) found positive correlations between risk-taking and three separate indicators of creativity, namely creative attitude, divergent thinking and creative preference for complexity, in a sample of middle-class men. Creativity and risk-taking were also found to be positively correlated in separate samples of advertising executives (El-Murad & West, 2003) and employees working in research and development (Dewett, 2006, 2007). A recent study of 120 undergraduate students (Simmons & Ren, 2009) also documented a positive relationship between situational risk and creativity as measured by the in-basket task (e.g., Shalley, 1991). A positive relationship in students has also been reported by Tyagi, Hanoch, Hall, Runco, and Denham (2017), but only between high-level, biographical measures of creativity and social risk-taking, while neither divergent nor convergent thinking (as assessed by the alternate uses task [AUT] and the remote associates task [RAT], respectively) correlated with any risk-taking measure. In summary, some aspects of creativity

have been linked to some aspects of risk-taking in diverse samples (varying from undergraduates to employees to middle-class men) and using diverse methods of assessing creativity and risk-taking.

With the exception of Tyagi et al., the relevant studies (e.g., Dewett, 2007; Eisenman, 1987; Shen, Yuan, Liu, Yi, & Dou, 2016; Tyagi et al., 2017) have focused on the association between risk-taking and divergent thinking (brainstorming-like creativity; see Guilford, 1967), while the relationship between risk-taking and convergent (“deep”, p. 97) thinking has received almost no attention. Divergent thinking involves generating many possible solutions to an often vaguely defined problem or puzzle, whereas convergent thinking relies on speed, accuracy, logic and the capacity to quickly recognize the best, correct solution to a clearly defined problem (Cropley, 2006; Lee & Theriault, 2013). Importantly, a growing number of empirical studies consolidate previous ideas that convergent thinking is dissociable from divergent thinking. Hommel and colleagues showed that divergent and convergent thinking are differently affected by mood induction (Akbari Chermahini & Hommel, 2012), individual dopamine levels (Akbari Chermahini & Hommel, 2010), physical exercise (Colzato, Szapora, Pannekoek, & Hommel, 2013), and meditation (Colzato, Szapora, Lippelt, & Hommel, 2017). They observed that divergent thinking both improves and is improved by mood, and has an inverted U-shape relationship with dopamine levels, whereas convergent thinking lowers mood and tends to be negatively correlated with dopamine levels. This implies that creativity is no homogeneous concept, but relates to different, separable subprocesses that are likely to reflect different mechanisms. We, therefore, agree with Tyagi et al. (2017) that the present inconsistency in findings on the relationship between risk-taking and creativity are likely to reflect the use of different tests and methods to assess the underlying concepts, but we do not share their optimism that a “holistic” approach that considers as many creativity measures as possible will make it easier to come to a conclusion. Many available measures have been developed for practical, rather than theoretical, reasons (leaving their relationships entirely undefined) and for the purpose of personality assessment, rather than the identification of the underlying cognitive mechanisms, which makes us skeptical about a multidimensional approach will lead to theoretically interpretable outcomes.

This study, therefore, focused on a single convergent-thinking task, the RAT. One reason for this is because this task has been often used in studies on the cognitive and neural mechanisms underlying this aspect of creativity (e.g., Akbari Chermahini & Hommel, 2010, 2012; Kounios et al., 2006; Shen, Yuan, Liu, & Luo, 2016; Subramaniam, Kounios, Parrish, & Jung-Beeman, 2009). Another reason is because of the observation that psychological safety improves creativity as assessed by the RAT

(Mikulincer, Shaver, & Rom, 2011). Considering that psychological safety implies the opposite of risk, this research predicted that risk-taking would be negatively correlated with convergent thinking (RAT performance). To test this hypothesis, Study 1, a laboratory study with computerized cognitive measures of risk-taking and convergent thinking (using a Chinese version of the RAT) was devised. The findings were consistent with our hypothesis, suggesting that convergent thinking seems better in less risk-taking individuals. Given that these findings are inconsistent with the observations of Tyagi et al. (2017), whose article appeared only after having run our first study, a replication was designed to extend our findings in another, more heterogeneous sample in Study 2, which also compared the risk-taking measure and creativity task that were used in Study 1 with another risk-taking measure and a divergent-thinking task, respectively.

STUDY 1

Method

Participants

A sample of 127 paid volunteers was recruited for this study. The sample consisted of healthy, right-handed undergraduates from two universities (87 men, 40 women) aged between 19 and 28 years ($M = 20.96$, $S.D. = 1.42$). All the participants are native Chinese and gave written, informed consent prior to participation, had no history of neurological disorder or psychiatric illness, had not been exposed to similar cognitive tasks and had normal or corrected-to-normal vision.

Measures

Risk-taking preference. The risk-taking preference index (RPI; Hsee & Weber, 1997, 1999) is a commonly used tool for measuring individuals' preferred level of risk-taking which has good cross-national validity (Hsee & Weber, 1999). An RPI score is computed from responses to a set of 14 questions related to two types of situation and can range from 1 (*most risk-averse*) to 8 (*most risk-seeking*). In the gain situations, if a participant chooses the *sure* option in all of the given seven questions, her/his RPI equals 1 (*most risk-averse*). If she/he chooses the risky option in all seven questions, her/his RPI equals 8 (*most*

risk-seeking). According to Hsee and Weber (1999), if the participant chooses the risk option in question 1 through question $i-1$, and the *sure* option in Question i through question 7, her/his RPI is scored as i . The reverse marking scheme is used in the loss situations.

Convergent thinking. A Chinese RAT was utilized to assess convergent creativity. The task is a variant of the English-language RAT originally developed by Mednick (1968). In the original RAT, each item consists of three "clue" words that can be associated with a "solution" word to form a compound word or specify a semantic association (Shen, Yuan, Liu, Yi, & Dou, 2016). Our Chinese version has been validated and has already been used in research with native Chinese participants (e.g., Huang, 2017; Wo, Chen, Liu, & Lin, 2010). Like the original RAT, our version requires respondents to choose a fourth (solution) word or Chinese character-pair that can be associated with each triad. All items are constructed in such a way that only a solution is possible. For example, the solution to the triad *orbit* (轨道), *weather* (气象), *earth* (地球) is *satellite* (卫星) and the problem *candle* (蜡烛), *cigarette* (香烟), *girl* (女孩) is *match* (火柴). This study used 54 of the 97 RAT items (6 items were used in practice and 48 in experimental testing). The difficulty of this subset of RAT items ranged from 0.2 to 0.8 in a sample of 141 undergraduates.

Procedure

All participants completed the two cognitive tasks (the RAT, used to measure convergent thinking, and the RPI, used to measure risk-taking preference) individually, in a dimly lit room sitting approximately 70 cm away from the computer monitor. After completing the first task, participants were allowed to take a brief break (about 90 s), during which they had to remain quietly at their desk. After this, they completed the second task. The order of the two tasks was counterbalanced across participants.

The participants were invited to individually complete the pencil-and-paper survey on the RPI. As in the RAT, all the items were presented using E-prime 2.0 software. The stimulus presentation process is illustrated in Figure 1. Each trial started with the participant fixating on a cross positioned in the center of the screen for 0.5 s to ensure that she or he would see the problem words, which were presented subsequently. The problem words

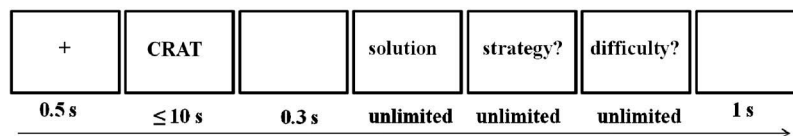


FIGURE 1 Schematic diagram of the trial procedure for the Chinese RAT.

were presented together, in their normal orientation, in a horizontal line across the screen. Participants were instructed to press the space bar as soon as they had thought out the solution and were given 10 s to do so. When the participant pressed the space bar, a white screen was displayed for 0.3 s, then the participant was required to enter her or his solution in the designated spot. Participants were instructed to not to enter anything at this point if they had not worked out a solution before the disappearance of the problem words. There are two ratings without any time limit, involving solution strategy (insight vs. non-insight) and difficulty level individually, before the ended white screen persisting for 1 s.

Results

Descriptive statistics for convergent thinking and risk-taking are listed in Table 1. Given the gender imbalance in the sample and previous reports that gender is associated with both risk-taking (e.g., Cárdenas, Dreber, Von Essen, & Ranehill, 2012) and creativity (Abraham, Thybusch, Pieritz, & Hermann, 2014; Abraham, 2016; Shen, Liu, Shi, & Yuan, 2015), independent-sample *t*-tests were applied to assess whether gender was associated with any of the variables investigated. The association between gender and solution time just failed to reach significance, $t_{(125)} = 1.96$, $p = 0.052$, Cohen's $d = 0.37$, and gender was not associated with any of the other dependent variables, all $|t|s < 1.5$, all $ps > 0.05$. Most importantly, Pearson correlation analysis revealed a significant negative correlation between risk-taking and RAT solution accuracy, $r_{(127)} = -0.20$, $p < 0.05$.

To determine the nature of the relationship between risk-taking and RAT solution accuracy, this study calculated curve (including logarithmic model and quadratic model) and linear regressions. As illustrated in Figure 2, the results showed the quadratic model is inappropriate ($p > 0.05$) and the effects of gender and age are insignificant across three regression models. The logarithmic and linear model are both significant, but the linear regression model ($R^2 = 4\%$) is relatively better than the logarithmic regression model ($\beta = -0.18$, $SE = 0.04$, $t_{125} = -2.07$, $p < 0.05$, $R^2 = 3\%$) in accounting for the variance. Accordingly, the linear model was accepted (see Table 2), which implies there is linearly

TABLE 1
Descriptive result on RPI and RAT performance

Variable	Solution Accuracy (%)	RPI
Male	46.58 (11.85)	8.15 (2.00)
Female	48.85 (11.98)	8.65 (1.98)
Total	47.29 (11.89)	8.31 (2.00)

Mean is listed in the Table 1 and Standard Deviation is placed in the parenthesis.

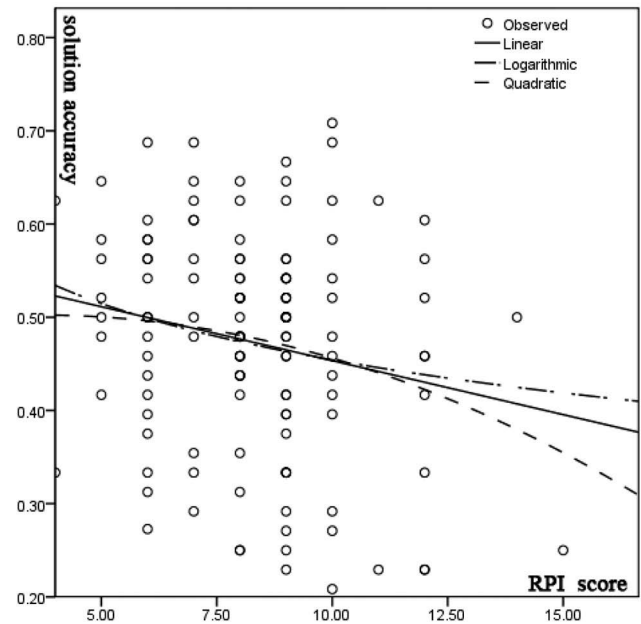


FIGURE 2 Performance in the convergent creativity task as a function of RPI score.

TABLE 2
Linear regression analysis results on two measures of risk-taking and RAT performance

Study	Predictors	B	β	SE	t
Study1	RPI	-0.012	-0.195	0.005	-2.22*
Study 2	RPI	-0.009	-0.163	0.004	-2.04*
	subjective risky level	-0.002	-0.204	0.001	-2.57*

Notes: * indicates $p < 0.05$.

negative association between risk-taking and convergent thinking performance, so that low-risk takers show better performance in convergent thinking than high-risk takers.

Discussion

Consistent with the prediction of an inverse relationship between risk-taking and convergent thinking, our study revealed that participants' risk-taking level is negatively correlated with the RAT performance. Although this result is contradictory with popular belief mentioned in some self-help books that argue for the facilitating effect of risk-taking on creative performance, the present finding is consistent with several previous studies on convergent thinking (e.g., Mikulincer et al., 2011). Yet it is also important to point out that our finding is inconsistent with the results of Tyagi and colleagues (2017), which were published after our Study 1 was completed. They found no relationship between performance in the RAT or in the AUT, a measure of divergent thinking, with any of their indicators of risk-

taking. Before considering some possible explanations for this discrepancy, it was deemed important to confirm that our finding is sufficiently robust and replicable. Therefore, the design of Study 1 was replicated in an online setting (Study 2), which permitted us to test participants with various kinds of Chinese culture backgrounds. Study 2 also extended the design by adding a second measure of risk-taking, based on self-report, and a divergent-thinking task—the AUT that was also used by Tyagi et al. It was expected that risk-taking would again be negatively correlated with convergent thinking.

STUDY 2

Method

Participants

The sample comprised 198 Chinese people (51 men) from 11 provinces/regions of China. All participants were recruited through campus advertisements, forum posters, telephone messages, or emails. A total of 44 respondents was excluded due to incomplete responses in one or more of the three measures (two creativity measures and the RPI measure), or because of suspiciously short (< 650 s) or long ($> 9,000$ s) overall response time, or due to indications of random response patterns (e.g., more than 10 or 15 response repetitions). The final sample included 154 healthy and well-educated volunteers (40 men) from eight provinces/regions of China, aged between 15 and 47 years ($M = 21.24$, $S.D. = 4.05$). All participants provided informed consent prior to participation, had no (self-reported) history of neurological disorder or psychiatric illness, and had not yet been exposed to similar cognitive tasks.

Measures

Risk-taking preference. In addition to the risk-taking measure used in Study 1, this study also adopted another self-reported risk-taking measure in which the participants were asked to directly score their own adventurousness on the scale, ranging from 0 to 100.

Convergent thinking. This measure was same as that in Study 1. However, the 48 RAT items were represented on a web page listing all items, rather than item-by-item.

Divergent thinking. The AUT was adopted to assess individuals' divergent thinking and creative potential (Runco & Acar, 2012). Participants were asked to generate as many different uses as possible for four common objects, namely leather shoes, shoebox, candle, and iron nail. The participants' responses were initially screened to exclude irrelevant responses and were then independently

rated by three trained postgraduate students on three of the four¹ standard AUT dimensions, namely fluency (the total sum of intelligible responses), flexibility (the number of categories in which these responses fell), and originality (2 points for responses with a total frequency of less than 5% in the sample; 1 point for a frequency of 5–10%). Tutorials were given to raters for the AUT together with the definition of each indicator to score. In line with Amabile's (1982) consensual assessment technique, raters used their own definitions of creativity. The inter-rater reliability was 1 for fluency; 0.95–0.98 for flexibility; and 0.79–0.83 for originality.

Procedure

This study was conducted online and data were collected via the web-based questionnaires hosted by wenjuanxing (www.sojump.com), a Chinese professional survey platform similar to SurveyMonkey. The participants were invited to individually provide the demographic information, and work through the risk-taking questions and the creativity tests. The order of the four measures was fixed: demographic information, divergent thinking task, risk-taking measure, and convergent thinking task. All the tasks were presented in an online survey web service without any time restriction, but the participants were encouraged to complete each divergent thinking item within the maximum 3 minutes.² To ensure the validity and reliability of the results, three forward and backward self-paced turning pages (individually to present the measures on demographic information and divergent thinking, risk-taking, and convergent thinking) were designed. The participants were compensated by a raffle ticket of 10 Yuan or course credit after completing their test.

Results

Independent *t*-tests did not yield any differences between women and men on the creativity and risk-taking measures. The Pearson correlation analyses revealed a significant correlation between RAT accuracy and both the risk preference, as assessed by RPI ($r = -0.163$, $p < 0.05$), and the self-reported adventurousness score ($r = -0.204$, $p < 0.05$). Even though the measures of convergent thinking and of divergent thinking were correlated (Table 3), there was no significant correlation

¹The elaboration score was not meaningful enough, as only a few elaborated responses were provided by participants.

²The response time was controlled by the participants through their own timing tools (e.g., timing software in their computers/telephones or alarm clocks/watches). To ensure that participants followed the rules and completed each divergent thinking item within the time interval, they were informed that the response time for each item was automatically monitored by the web service platform and their time-keeping performance would be rewarded.

TABLE 3
the correlations among different measures of creativity and risk preference

Measures	Subjective Risk Level	RPI	RAT		
			Accuracy	Fluency	Flexibility
RPI	.031				
RAT accuracy	-.204*	-.163*			
Fluency	-.117	-.095	.375**		
Flexibility	-.117	-.083	.378**	.981**	
Originality	-.114	-.069	.356**	.801**	.836**

Notes: * indicates $p < 0.05$, ** indicates $p < 0.01$, *** indicates $p < 0.001$.

between the two risk-taking scores and any of the three indicators of divergent thinking (i.e., flexibility, originality, and fluency). As subjective risk level and RPI are two different indicators of risk-taking, rather than two different observed variables, they were entered into two independent regression models (rather than as two predictors into one regression model³). As shown in Table 2, the linear regression analysis results showed that both the RPI ($R^2 = 3\%$) and subjective risk level ($R^2 = 4\%$) reliably predicted the RAT solution accuracy.

GENERAL DISCUSSION

The results from this online study demonstrate a significant negative association between risk-taking and convergent thinking as assessed by RAT, corroborating our finding from Study 1. Importantly, the link between the two constructs was further supported by additional results showing a negative correlation between RAT accuracy and the level of self-reported adventurousness. It is interesting to note that the two risk-taking measures did not correlate, and yet both measures were correlated with convergent thinking. This implies that our two measures picked up different aspects of risk-taking, which nevertheless share the negative association with convergent thinking. Hence, the underlying association seems to be rather robust and, as in Study 1, it seems to be rather linear.

One explanation for the observed correlation between convergent and divergent thinking involves the time limits used when testing. Time limits might have inhibited the participants' divergent thinking performance, particularly their originality. Participants in a time-limited context are often less original than otherwise because they have expectations about

tests that are contrary to divergent thinking and the finding of original and remote associates. That being said, several previous studies have administered divergent thinking tasks with limited time interval, some even going as far as to limit divergent thinking to 3 min (Fink, Graif, & Neubauer, 2009) or even some shorter interval (e.g., Forthmann, Holling, Çelik, Storme, & Lubart, 2017). Hence, even if originality was attenuated by the timing, the same thing applies to some of the related studies in the field.

The findings for convergent thinking in Study 2 were, again, inconsistent with previous observations of Tyagi et al. (2017), who found no relationship. Several factors may be responsible for this inconsistency. First, Tyagi and colleagues have used a different measure of risk-taking. Although this might have been responsible for the different outcomes, the fact that the same negative correlation was found for both of our measures of risk-taking renders this possibility not particularly likely. Second, Tyagi and colleagues have pointed out that their version of the RAT turned out to be rather difficult, presumably too difficult for many participants, which must have rendered the test undiagnostic. In comparison, our findings do not suggest any particular measurement problem, such as a floor or ceiling effect, which arguably renders our findings more robust with respect to the convergent thinking measure. Third, and perhaps most interestingly, various authors have considered the possibility that sample characteristics might play an important role (e.g., Dewett, 2004, 2007; Fleming & Weintraub, 1962). Indeed, given that Chinese culture defines and values creativity differently from Western culture (Shen, et al., *in press*; Lan & Kaufman, 2012; Niu & Kaufman, 2013), the discrepancy to the findings of Tyagi et al. (2017) may also indicate an interesting cultural difference that calls for further investigations. In this context, it may be important to note that our Study 2 revealed significant positive correlations between convergent and divergent measures. In previous studies that one of us carried out in the Netherlands, these correlations were close to zero and, if anything, negative (e.g., Akbari Chermahini & Hommel, 2010). The fact that these correlations were far from zero and positive in this study, which used a Chinese sample, might be related to the dominant role in widespread use of dialectical thinking in Chinese thought (Shen, Yuan, Zhao, et al., *in press*). This tradition considers two things with opposite characteristics as an integrated continuum so that two contradictory things should not necessarily be treated as two independent things, but as two sides of the same (integrated) thing. Although this is an interesting possibility, we admit that it remains speculative and is not exclusive. For example, consistent with our results, Wu, Chang, and Chen (2017) reported a similar positive correlation between convergent thinking and divergent thinking, which, however, is ascribed to the common involvement of associative process in these two types of creative thinking (Lee & Theriault, 2013; Shen,

³ Nonlinear (including logarithmic and quadratic) regressions of these two risk-taking measures on the Chinese RAT solution accuracy and on the three indicators of divergent thinking were also calculated, but none of them reached the level of statistical significance ($p > 0.05$), except the quadratic model of the RPI (only for the square of the RPI on the average originality score; $\beta = -0.66$, $SE = 0.003$, $t_{151} = -2.27$, $p < 0.05$).

Yuan, Liu, & Luo, 2017). Accordingly, future studies should conduct cross-culture design to further investigate these interesting speculations.

Even though convergent and divergent thinking scores were correlated in our study, convergent thinking in a tighter, more reliable link to risk-taking than divergent thinking had. This tighter link makes functional sense: Divergent thinking requires an individual to explore several cognitive paths, which sometimes may involve taking some risks to generate multiple solutions to a puzzle or problem. Convergent thinking, in contrast, involves focusing on finding the single correct solution, which is less likely to require risk-taking. Our findings suggest that convergent thinking may benefit from risk-avoidance, which fits with the observation that being conservative or taking less risk can promote convergent problem-solving (Bassett-Jones, 2005). Considering the positive relationship between risk-taking and impulsivity (disinhibition), our findings also fit with the observation that performance on cognitive inhibition tasks was positively correlated with RAT performance (Koppel & Storm, 2014).

Taken altogether, our findings have a number of interesting implications for future studies. First, the true nature of risk-taking remains unclear, which calls for further investigation. Our results do not provide information for determining the specific nature of risk (-taking) in creativity because risk(-taking) can be situational (e.g., willingness to take risks; see Dewett, 2006) or cross-situational in nature, or can operate as (intrinsic) motivation or as propensity (e.g., Simmons & Ren, 2009). Future studies should, therefore, continue to investigate the complex relationship between risk-taking and creativity. Second, the relationship between creativity and risk-taking is likely to be linear but not follow an (inverted) U-shaped relationship, which has implications for attempts to foster creativity in educational or organizational settings. Finally, the negativity of the correlation between risk-taking and convergent thinking suggests that risk-taking should not be considered integral to creativity as a whole, which stands in stark contrast to often-found recommendations in self-help books on creativity training. Nevertheless, our results do imply that psychological safety plays an important role in nurturing creativity and convergent thinking in particular.

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