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Does Insight Problem Solving Predict Real-World Creativity?

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Insight problems are commonly used to assess creative problem solving. Such problems are often employed by proponents of the associative view of creativity—the notion that creative ideas result from unconscious processes. Surprisingly little is known, however, about how well performance on insight problems predicts real-world creativity. In two studies, we explored the contribution of several classic insight problems in creative achievement (Study 1; $n = 133$) and everyday creative behavior (Study 2; $n = 173$). We also assessed the role of personality and fluid intelligence, two well-established predictors of real-world creativity, to determine their relative influence beyond the effect of insight. Both studies found no evidence for a relationship between insight problem solving and creative behavior and achievement. Openness to experience and fluid intelligence, however, showed notable effects on both behavior and achievement. The present work thus raises the question of whether insight problem solving relates to real-world creativity.

Keywords: Insight, problem solving, creative achievement, convergent thinking, fluid intelligence, openness to experience, remote associates

Some of the most important scientific discoveries are believed to have been conceived during moments of spontaneous insight—the "aha!" experience. Researchers often cite subjective reports of eminent historical figures when framing the longstanding mystery surrounding unconscious problem solving (Weisberg, 2006), and a large literature has sought to demystify the phenomenon of insight (e.g., Bowden, Jung-Beeman, Fleck, & Kounios, 2005; Schooler, Ohlsson, & Brooks, 1993). The notion that creative ideas arise from such unconscious, associative processes was proposed a half-century ago by Mednick (1962) and remains influential in modern creativity research (Gupta, Jang, Mednick, & Huber, 2012; Runco, 2007). Yet despite insight's longstanding tradition in the creativity literature, surprisingly little is known about whether these tasks actually predict real-world creativity. In contrast, divergent thinking—another widely used measure of creative thought—predicts both quantity of creative achievements (Torrance, 1988; Plucker, 1999; Kim, 2008) and quality of creative performance (Beaty, Smeekens, Silvia, Hodges, & Kane, 2013; Fink, Graif, & Neubauer, 2009; Gibson, Folley, & Park, 2009). To date, it remains unclear if the ability to solve insight problems similarly predicts creative achievement. In the present research, we explored the role of insight problem solving in two types of real-world creativity—creative achievements and everyday creative behaviors—to determine if problem-solving performance translates into meaningful creative outcomes.

Insight problems are ill-defined—the method for solving them is not immediately obvious, given the initial task state and operators (i.e., the information known about the problem). Finding the right solution often involves reframing one's mental approach by restructuring the problem (Weisberg, 1995; see Table 1 for examples). The Remote Associates Task (RAT; Mednick, 1962) is also commonly used to assess insight problem solving (Bowden et al., 2005). In this task, a series of three seemingly unrelated words are presented (e.g., *crab, pine, sauce*), and solvers must determine the one word that the three words have in common (*apple*). Solutions to RAT items and other insight problems often spontaneously occur to people outside of conscious awareness, and thus researchers hypothesize that unconscious processes are at work (Schooler, Ohlsson, & Brooks, 1993).

The notion that creative ideas arise from unconscious processes has been drawn into question by recent work on controlled aspects of creative thought (Beaty & Silvia, 2013; Gilhooly, Fioratou, Anthony, & Wynn, 2007; Jauk, Benedek, Dunst, & Neubauer, 2013; Lee & Therriault, 2013; Nusbaum & Silvia, 2011; Nusbaum, Silvia, & Beaty, in press). For example, fluid intelligence (Gf)—a general cognitive ability associated with domain-general reasoning and controlled attention (Kane et al., 2004)—predicts the creative quality of ideas generated during divergent thinking (Nusbaum & Silvia, 2011) and novel metaphor production (Beaty & Silvia, 2013; Silvia & Beaty, 2012). Such findings implicate a range of controlled processes in creative cognition, such as the ability to strategically search memory (Silvia, Beaty, & Nusbaum, 2013) and inhibit salient but unoriginal ideas (Beaty & Silvia, 2012). Such work supports an executive theory of creative thought, and departs from the longstanding associative theory of creativity—the notion that creative ideas result from unconscious processes (Mednick,

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Table 1
Insight Problems and Between-Person Solution Rates: Study 1 and Study 2

Insight problem (with solution)	% Solved: Study 1	% Solved: Study 2
Mr. Hardy was washing windows on a high-rise office building when he slipped and fell off a 60-foot ladder onto the concrete sidewalk below. Incredibly, he did not injure himself in any way. How is this possible?	29% (38)	21% (33)
He is on one of the lower rungs of the ladder.		
Our basketball team won 72–49, and yet not one man scored as much as a single point. How is that possible?	28% (37)	21% (33)
It was a women's or coed basketball team.		
A man in a town married 20 women. He and the women are still alive, and he has had no divorces or annulments. He is not a bigamist (meaning he is not legally married to more than one woman at once), and he broke no law. How is that possible?	23% (30)	19% (31)
He is a priest.		
A young boy turned off the lights in his bedroom and managed to get into bed before the room was dark. If the bed is 10 feet away from the light switch and the light bulb and he uses no wires, strings, or other contraptions to turn off the light, how did he do it?	20% (27)	20% (33)
It was still daylight/Light was still coming in from outside.		

Note. The number of participants that produced the correct solutions is in parenthesis.

1962; Runco, 2007). Nevertheless, the extent to which controlled or unconscious thought processes actually predict real-world markers of creativity remains unclear.

There is some reason to suspect that performance on insight problems may be related to creative achievement. For example, insight problem solving correlates with divergent thinking fluency and intelligence (Gilhooly & Murphy, 2005). Both variables, in turn, consistently—albeit modestly—predict creative achievement (Jauk, Benedek, & Neubauer, 2014; Kim, 2008). Elementary students who performed well on divergent thinking tasks turned out to lead highly creative careers several decades later, according to Torrance's (1988) longitudinal study and Plucker's (1999) reanalysis of the same data. Furthermore, a recent study found that divergent thinking predicted expert ratings of jazz improvisation performance in a sample of semiprofessional jazz musicians (Beaty et al., 2013). Because insight problem solving is related to divergent thinking (Lee & Therriault, 2013) and intelligence (Gilhooly & Murphy, 2005), performance on such tasks might also predict real-world creative achievement. In the present research, we explored whether the ability to solve several classic insight problems translates into real-world creative performance.

Study 1

Our first study assessed whether insight problem solving predicts creative achievements. We administered four commonly used problems to measure individual differences in insight problem-solving ability (DeYoung, Flanders, & Peterson, 2008; Gilhooly & Murphy, 2005; Weisberg, 1995). We also administered the Creative Achievement Questionnaire (CAQ; Carson, Peterson, & Higgins, 2005), a popular measure of creative productivity in 10 domains (Silvia, Wigert, Reiter-Palmon, & Kaufman, 2012). Finally, we assessed individual differences in personality using the NEO Five Factor Inventory (FFI; Costa & McCrae, 1992). Because personality correlates with creative ability—most notably, the facet openness to experience (Feist, 1998; Nusbaum)—we included the NEO to test the incremental validity of insight problem solving, and to control for a well-established "third variable."

Method

Participants. The sample included 133 undergraduate students from the University of North Carolina at Greensboro (96 women, 37 men; mean age = 19.74, *SD* = 4.39). Students received credit toward a research option in their psychology course.

Procedure. Upon entering the lab, students completed consent forms and were briefed on the purpose of the study. Students then completed insight problems and self-report measures of personality and creative accomplishment. All measures were administered on desktop computers using MediaLab v2010 software.

Creative achievement. We administered the CAQ to measure significant creative accomplishments (Carson et al., 2005). The CAQ assesses self-reported creativity in 10 domains (e.g., music, visual arts, and scientific discovery). Participants respond to a series of achievement statements that increase in significance (e.g., creative writing; "My work has been printed and sold publicly"). Each of the seven achievement statements receives a weight when endorsed, and the weights are summed for a domain achievement score. A global score is derived by summing the achievement scores across the 10 domains.

Insight problems. Participants were given eight minutes to work on four classic insight problems, which were taken from DeYoung et al.'s (2008) research. Table 1 lists the problems with their solutions. After each problem, participants were asked to indicate whether they knew the solution from a previous encounter to the problem; this allowed us to control for problem familiarity. Responses were typed into text boxes and later scored for accuracy.

Personality. Participants also completed the NEO Five Factor Inventory (FFI; Costa & McCrae, 1992). The NEO assesses five major factors of personality: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. Participants indicate their level of agreement with each of the 60 items (1 = *strongly disagree*, 5 = *strongly disagree*).

Results

Data reduction and modeling. We examined the relationship between insight and creative achievement using structural equation

Table 2
Within-Person Solution Rates: Study 1 and Study 2

	Study 1	Study 2
0	45% (60)	57% (97)
1	25% (33)	21% (36)
2	19% (26)	15% (25)
3	7% (9)	4% (7)
4	4% (5)	3% (6)

Note. The number of participants that produced the correct solutions is in parenthesis.

modeling. Insight was specified as a latent variable indicated by the four insight tasks. The tasks were modeled categorically to reflect the dichotomous solution outcome. The variance of the latent insight variable was fixed to one (Kline, 2011). The global CAQ score was log-transformed to normalize the highly skewed distribution (Carson et al., 2005; Silvia et al., 2012). To control for problem familiarity, we modeled problems familiar to participants as missing values. The solution rates of the four problems were low ($M = .99$; $SD = 1.12$; see Tables 1 & 2) but consistent with past research (DeYoung et al., 2008).

Insight and creative achievement. We began by modeling the latent insight variable as a predictor of global creative achievement. Interestingly, the effect of insight on creative achievement was effectively zero ($\beta = -.022$)—problem-solving performance showed no relation to real-world creativity. Because the global CAQ variable may have masked the effects of individual domains (e.g., scientific discovery), we also examined the role of insight in each of the 10 domains. Consistent with our first model, this analysis showed mostly small and nonsignificant effects of insight across domains. The effect of insight on achievement in drama, however, was moderate and significant ($\beta = .235$; see Table 3).

Personality and creative achievement. Our next analysis examined the role of personality in creative achievement. The five factors of personality were modeled as predictors of the global CAQ. As expected, openness to experience was the strongest predictor of achievement ($\beta = .358$; see Table 4). We also found a moderate effect of extraversion ($\beta = .270$), and a small, negative effect of agreeableness ($\beta = -.162$). Taken together, this analysis replicates past research in personality (Carson, Peterson, & Higgins, 2003) and suggests that insight problem solving is largely unrelated to real-world creativity.

Study 2

The null effect of insight on achievement in Study 1 was surprising, given insight's widely assumed role as a mode of creative thought. In Study 2, we sought to replicate this finding and explore the role of insight in everyday creative behavior. Study 1 suggests that the ability to solve insight problems is mostly unrelated to achieving significant levels of creativity. But does the ability to solve insight problems predict everyday creativity? Study 2 also examined the role of fluid intelligence (Gf) in creative behavior and achievement. Because intelligence was associated with creative achievement in previous research (Jauk et al., 2014; Kim, 2008), we expected Gf to predict achievement here, too. Study 2 thus explored whether real-world creativity is related to controlled (i.e., Gf) or unconscious (i.e., insight) thought processes.

Method

Participants. The sample comprised of 173 UNCG undergraduates (120 women, 54 men; Mean age = 19.20, $SD = 3.58$). Students received credit toward a research option in a psychology course for their participation.

Procedure. An experimenter distributed consent forms and explained the purpose of the study. Participants completed the same four insight problems used in Study 1 (see Table 1). They also completed two self-reported creativity questionnaires, two Gf tasks, and the NEO-FFI (Costa & McCrae, 1992).

Creative achievement and everyday behavior. To assess creative achievement, we again administered the CAQ (Carson et al., 2005); to assess everyday creative behavior, we administered the Biographical Inventory of Creative Behavior (BICB; Batey, 2007). The BICB measures 34 common creative activities (e.g., starting a club, writing a poem, and designing a website). Participants respond *yes* (scored as 1) or *no* (scored as 0) based on whether they were involved in each activity within the past 12 months.

Gf. Participants completed two measures of inductive reasoning: a paper folding task (10 items, 3 minutes; Ekstrom et al.,

Table 3
Standardized Effects of Insight on the CAQ and Its Domains: Study 1 and Study 2

	Study 1			Study 2		
Model	β	*p*	95% CI	β	*p*	95% CI
CAQ total						
CAQ	−.022	.854	−.256, .212	−.021	.835	−.224, .181
CAQ domains						
Architecture	.029	.711	−.126, .184	.091	.170	−.039, .222
Culinary arts	−.269	.100	−.589, .051	.073	.409	−.100, .246
Creative writing	−.049	.722	−.316, .219	−.061	.567	−.268, .147
Dance	−.177	.174	−.433, .078	−.177	.411	−.397, .163
Drama	.235	.046	.004, .467	−.117	.465	−.137, .300
Humor	.052	.679	−.196, .301	.053	.660	−.182, .287
Inventions	.050	.586	−.131, .232	.032	.704	−.135, .200
Music	.008	.947	−.218, .233	−.008	.948	−.237, .221
Scientific discovery	.121	.393	−.156, .398	.032	.721	−.145, .210
Visual arts	−.102	.489	−.391, .187	−.023	.831	−.238, .191

Table 4
Standardized Effects of Personality on Creative Achievement: Study 1

	β	*p*	95% CI
Neuroticism	.022	.792	−.141, .184
Extraversion	.270	.001	.109, .432
Openness to experience	.358	<.001	.219, .496
Agreeableness	−.162	.048	−.322, −.002
Conscientiousness	.045	.554	−.104, .193

1976) and a series completion task (13 items, 3 minutes; Cattell & Cattell, 1961/2008). The paper folding task presents images of a piece of paper being folded and then finally punched with a hole. Participants are asked to imagine the final state of the paper when it is completely unfolded. The series completion task presents images drawn within small boxes that change according to a specific rule. Participants must discern the rule guiding the changing images and determine the next successive item in the series.

Results

As in Study 1, insight was modeled as latent variable indicated by the four tasks, and the variance of the factor was fixed to one. Gf was also modeled as a latent variable, with the two reasoning tasks—paper folding and series completion, each standardized—serving as indicators. The 10 CAQ domains were summed and log-transformed, and the 34 BICB items were averaged to form a composite variable (Batey, 2007; Cronbach's alpha = .82). Solution rates for the four insight problems were comparable to Study 1 (M = .76; SD = 1.07; see Tables 1 & 2).

Insight and creative activity. We first attempted to replicate the results of Study 1. The latent insight variable was thus modeled as a predictor of the global CAQ. The effect of insight on creative achievement was virtually the same as in Study 1 (β = −.021)—problem solving ability was again unrelated to real-world creativity. We then examined the role of insight in each of the 10 domains. Although Study 1 found a moderate effect of insight on achievement in the drama domain, this effect did not replicate: insight failed to predict all 10 domains (see Table 3).

But does insight relate to everyday creative behavior? We added the BICB variable to the model as a multivariate outcome with the CAQ. Insight's effect on the BICB, however, was effectively zero (β = .001)—problem-solving ability was unrelated to everyday creativity activities. Taken together, these results draw into question the validity of insight tasks in measuring creative achievement and behavior.

Insight, intelligence, and personality. We then examined the influence of insight, personality, and fluid intelligence (Gf) in creative behavior and achievement. This approach allowed us to test the relationships among established predictors of creative behavior—Gf and personality—and explore whether they influence the contribution of insight in the model.

We began by assessing the role of personality. As expected, openness showed the strongest effects on behavior (β = .317) and achievement (β = .371)—as openness increased, people reported more daily creative activities and significant creative accomplishments. The other personality variables showed notable effects on problem solving as well (see Table 5).

Our next model assessed the role of insight, openness, and Gf in creativity. Of particular interest here was whether Gf—a measure of cognitive control—or insight—a measure of unconscious thought—were more strongly related to creative behavior and achievement. The BICB and CAQ were modeled as multivariate outcomes, predicted by insight, openness, and Gf (see Figure 1). Consistent with past research (Gilhooly & Murphy, 2005), insight problem solution and Gf were strongly correlated (r = .44); however, only Gf predicted creative achievement (β = .290; see Table 6). The effect of insight on creative achievement was negative but not significant (β = −.222), as was its effect on everyday creative behavior (β = −.168). Openness showed significant effects on the CAQ (β = .381) and the BICB (β = .289). Taken together, these results replicate previous findings on the role of intelligence and personality, and suggest that the ability to solve insight problems is unrelated to real-world creativity.

Discussion

Two studies found no evidence for a relationship between insight problem solving and self-reported creativity. In Study 1, performance on four classic insight problems was unrelated to self-reported creative achievement. Study 2 replicated the null effect of insight on achievement and provided an extension by showing no relation between insight and everyday creative behavior. In contrast, we found notable effects of Gf on achievement and openness on behavior. Although the effect of Gf was much larger than the average effect reported in a recent meta-analysis of intelligence and creative achievement (Kim, 2008), this was not surprising because latent variable models remove error variance and increase effect sizes (Kline, 2011). Taken together, the present work provides further support for the notion that creativity involves controlled, strategic thought processes (Beaty & Silvia, 2012, 2013; Benedek, Beaty et al., 2013; Benedek, Franz, Heene, & Neubauer, 2012; Gilhooly et al., 2007; Jauk, Benedek, Dunst, & Neubauer, 2013; Jauk et al., 2014; Lee & Therriault, 2013; Nusbaum & Silvia, 2011; Silvia & Beaty, 2012).

Table 5
Standardized Effects of Personality on Creative Achievement and Behavior: Study 2

	CAQ			BICB		
	β	*p*	95% CI	β	*p*	95% CI
Neuroticism	.109	.167	−.046, .264	−.189	.040	−.370, −.009
Extraversion	.118	.105	−.025, .261	.123	.116	−.030, .324
Openness	.371	<.001	.243, .499	.317	<.001	.172, .461
Agreeableness	−.127	.060	−.260, .005	−.150	.060	−.306, .006
Conscientiousness	.101	.191	−.050, .251	.045	.611	−.129, .220

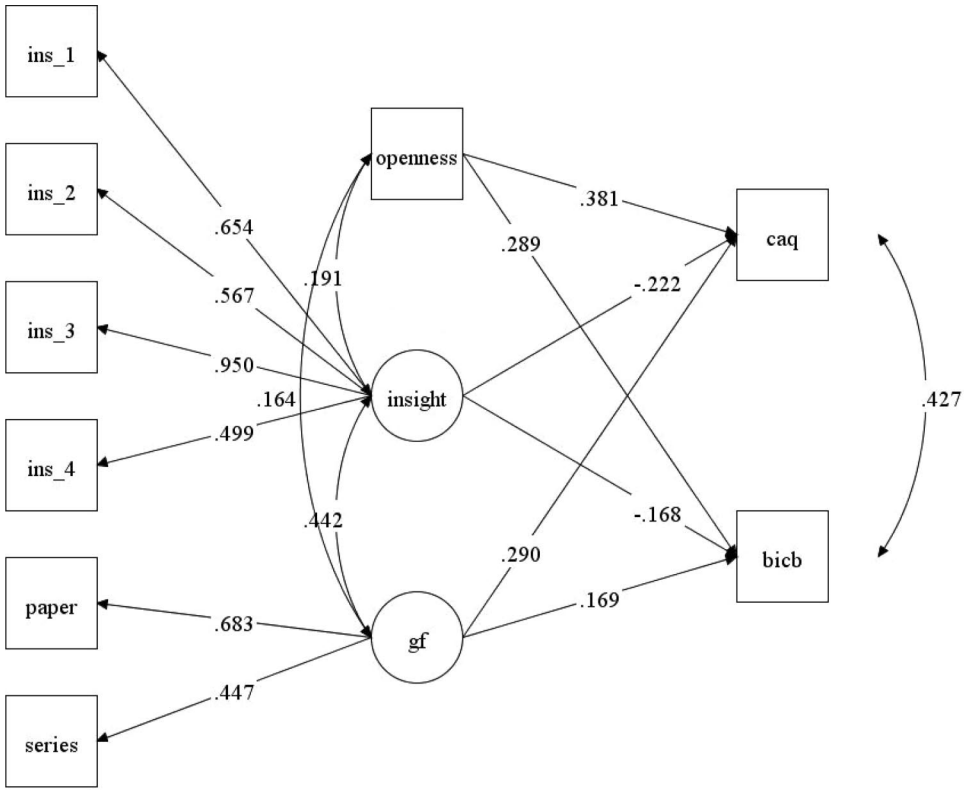

Figure 1. A depiction of the structural equation model from Study 2.

The null effect of insight raises the question of whether insight problems are valid measures of real-world creativity. Given insight's long tradition in creativity research, one would expect at least a modest relation between problem solving and creative achievement. Indeed, other cognitive tasks assumed to measure creative potential predict creative behavior outside of laboratory settings. For example, performance on divergent thinking tasks predicts both quantity of creative achievements (Torrance, 1988) and quality of creative performance (Beaty et al., 2013). Insight problems and divergent thinking task are markedly different, however, in the extent to which they recruit underlying cognitive processes: insight problem solving involves unconscious, associative processes (Bowden et al., 2005), whereas divergent thinking involves controlled, strategic processes (Gilhooly et al., 2007). If insight is unrelated to creative achievement, the notion that unconscious processes contribute to creativity seems somewhat problematic.

Regarding intelligence, our findings are closely aligned with a recent study of creative behavior. Jauk et al. (2014) examined the role of intelligence in everyday creative activities and significant creative accomplishments. They administered the Inventory of Creative Activities and Achievements (ICAA), a newly developed questionnaire with two subscales—one for activities, one for accomplishments—along with several measures of intelligence. Using structural equation models, Jauk and colleagues found that intelligence moderated the relationship between activities and accomplishments, which suggests that intelligence plays a key role in translating minor creative expressions into major creative products. The present study and the results of Jauk et al. (2014) support the notion that cognitive control is central to the creative process.

Table 6
Summary of Regression Effects: Study 2

	CAQ			BICB		
	β	*p*	95% CI	β	*p*	95% CI
Insight	−.22	.171	−.531, .098	−.16	.319	−.427, .141
Openness	.38	<.001	.199, .452	.28	<.001	.103, .330
Gf	.29	.047	−.003, .568	.16	.249	−.104, .391

Strengths, Limitations, and Future Directions

Our study explored the role of several classic insight problems in real-world creativity. Future research should further examine how well other measures of insight relate to creativity outside of the lab. The Remote Associates Test (RAT), for example, is one of the most commonly used assessments in the creativity literature. Although the RAT and the problems used in our study both measure insight, perhaps performance on the RAT relates differently to creative achievement. Investigating the role of RAT performance in achievement measures is important in determining the role of unconscious thought in creative behavior. Another area for future research is to explore whether insight predicts other facets of creativity, such as creative self-concepts. Although insight is an interesting phenomenon that connects with many longstanding problems in creativity research, its role in predicting real-world creative outcomes appears unclear.

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