



Intelligence, general knowledge and personality as predictors of creativity

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ABSTRACT

This study sought to examine the contribution of fluid intelligence, general knowledge and Big Five personality traits in predicting four indices of creativity: Divergent Thinking (DT) fluency, Rated DT, Creative Achievement and Self-Rated creativity and a combined Total Creativity variable. When creativity was assessed by DT test, the consistent predictor was fluid intelligence. When creativity was assessed in terms of achievement or self-rating, personality variables were consistently predictive.

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Creativity is an important individual difference construct, yet has received little academic attention in comparison to allied areas like intelligence. In part, the scarcity of studies may be linked to the difficulties in defining and measuring the creativity dependent variable (Batey, & Furnham, 2006). Creativity may be defined in relation to the concepts of novelty and utility (Mumford, 2003; Plucker, Beghetto, & Dow, 2004). One of the most popular methods of examining creativity utilises the multi-trait multi-method approach (Batey, & Furnham, 2008; Furnham, Batey, Anand, & Manfield, 2008) whereby several predictor variables are analysed in relation to different operationalisations of the dependent variable. This study examined four different measures of creativity and a total creativity score; Divergent Thinking (DT) Fluency, Rated DT, an inventory of creative achievement (Batey, 2007), a self-rating of creativity (Batey, 2007) and a total creativity composite, in relation to fluid intelligence (*gf*), crystallised intelligence (*gc*) as measured by a test of general knowledge (GK) and the Five Factor model of personality.

Studies that have examined the relationship of creativity to intelligence have tended to find modest correlations (Batey, & Furnham, 2006; Kim, 2006). When creativity has been assessed by means of DT Fluency, positive correlations have been observed with measures of *gf* (Batey, Chamorro-Premuzic, & Furnham, 2009; Furnham et al., 2008) and GK (Batey et al., 2009). When DT responses are rated by judges, positive relationships to *gf* (Furnham, Crump, Batey, & Chamorro-Premuzic, 2009) and a latent general factor of

intelligence have been reported (Silvia, 2008). Studies that have examined the relationship between intellect and creative achievement inventories have found no significant relationships (Carson, Peterson, & Higgins, 2005; Furnham, & Bachtiar, 2008; Furnham et al., 2008). Similarly no significant relationships between intellect and self-rated creativity have been reported (Furnham, & Bachtiar, 2008; Furnham et al., 2008).

The growing body of research examining the links between personality and creativity has begun to yield relatively consistent findings (Batey, & Furnham, 2006). Meta-analytical studies have shown that Neuroticism, Extraversion and Openness are positively related to creativity, whilst Agreeableness and Conscientiousness are negatively related (Feist, 1998). DT Fluency has been demonstrated to be related to Extraversion and Openness (positively) and Agreeableness (negatively) (Batey et al., 2009; Chamorro-Premuzic, & Reichenbacher, 2008; Furnham, & Bachtiar, 2008; Furnham et al., 2008). Rated DT has been found to be allied to Neuroticism and Agreeableness (negatively) and also to Extraversion and Openness (Furnham et al., 2009). Extraversion and Openness have been shown to be positively related to creativity when assessed using inventories of creative achievement (Carson et al., 2005; Furnham, & Bachtiar, 2008; Furnham et al., 2008). Self-rated creativity has been shown to be predicted by Emotional Stability and Openness (Furnham et al., 2008) as well as Extraversion (Furnham, & Bachtiar, 2008). It is difficult to hypothesise how the Total Creativity aggregate score will relate to some personality variables. This is because Neuroticism has been demonstrated to be both positively and negatively related to different measures of creativity. However, it may be proposed that there will be significant positive relationships to Extraversion and Openness, and negative associations with Agreeableness and Conscientiousness.

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In this study of the how *gf*, General Knowledge and Personality predict individual differences in creativity as assessed by four different indices and a total creativity score, it was hypothesised that:

H1a. DT Fluency will be positively and significantly related to *gf* and General Knowledge.

H1b. Rated DT will be positively and significantly related to *gf*.

H1c. Self-rated creative achievement will not be related to either *gf* or General Knowledge.

H1d. Self-rated creativity will not be related to either *gf* or General Knowledge.

H1e. Total Creativity will be positively and significantly related to both *gf* and General Knowledge.

H2a. DT Fluency will be positively and significantly related to Extraversion, Openness and negatively related to Agreeableness.

H2b. Rated DT will be positively and significantly related to Neuroticism, Extraversion and Openness, but negatively related to Agreeableness.

H2c. Self-rated creative achievement will be positively and significantly related to Extraversion and Openness.

H2d. Self-rated creativity will be positively and significantly related to Extraversion and Openness, but negatively related to Neuroticism.

H2e. Total Creativity will be positively and significantly related to Extraversion and Openness, but negatively related to Agreeableness and Conscientiousness.

1. Method

1.1. Participants

A total of 100 (25 male and 75 female) undergraduate psychology students from a UK-based university took part in this study. Ages ranged from 18 to 46 (mean = 19.66, SD = 3.91). All participants possessed excellent English language skills and had a minimum IELTS English language proficiency score of 7.5.

1.2. Materials

1.2.1. Measures of creativity

- Divergent Thinking Fluency* (DT Fluency) was assessed by a variant of Guilford's (1967) Alternate Uses test. Participants had 3 min per item to name as many uses as possible uses for a brick, wooden pencil and wire coat hanger. DT Fluency was assessed by counting the number of responses. DT Fluency has been used in recent studies of DT (Furnham, & Bachtar, 2008).
- Rated Creativity* (Rated DT) was assessed using the same three DT items used for DT Fluency. The DT responses were rated using a variant of the Consensual Assessment Technique (Amabile, 1982). Responses on the Alternate Uses test were rated by an independent judge on a five point likert-type scale. Rated DT has been used in recent studies (Silvia, 2008).
- Creative Achievement* was assessed by the *Biographical Inventory of Creative Behaviours* (BICB; Batey, 2007). This is an assessment of everyday creative achievement. Participants were required to indicate, from a list of 34 activities (e.g. Written a short story, Produced your own website, Designed and planted a garden, Composed a piece of music, etc.) those in which they had been actively involved over the past 12 months. The BICB demonstrated adequate reliability ($\alpha=0.78$) and has been in recent investigations (Batey, & Furnham, 2008).

d) *Self-rating of creativity* (Batey, 2007) was measured on a 10-point Likert-type scale. The rating for creativity was embedded within 10 other ratings of personal attributes (e.g. intelligent, wise, etc.). The internal consistency of the self-ratings scale (11 items) was $\alpha=0.66$. This self-rating scale has been used in recent studies (Furnham et al., 2008).

e) *Total Creativity* was measured by taking the sum of the four creativity measures when z-scored. This allowed an examination of a more comprehensive measure of creativity. The use of a total creativity score has been popular (Batey, & Furnham, 2008).

1.2.2. Intelligence

(a) *Fluid intelligence* (*gf*) was measured with the *Raven's Advanced Progressive Matrices set II* (Raven, Raven, & Court, 1998). The matrices were administered in 30 min.

(b) *Crystallised intelligence* (*gc*) was assessed with a General Knowledge Questionnaire (GK; (Irwing, Cammock, & Lynn, 2001) that consisted of 81 questions in 12 knowledge domains. The questionnaire was administered in 15 min.

1.2.3. Personality

Big Five Personality Traits were assessed with the *Ten-Item Personality Inventory* (Gosling, Rentfrow, & Swann, 2003). The test has been extensively validated (Gosling et al., 2003).

1.3. Procedure

Half of the sample completed the timed tests first (DT tests, Raven's and GK test) followed by the non-timed measures (BICB, self-rating of creativity and Personality Inventory). The other half of the sample completed the non-timed measures first, followed by the timed tests. The study was approved by the Universities' ethics committee and all participants provided informed consent.

2. Results

2.1. Descriptive statistics and correlations

Means, standard deviations and Pearson correlations for all variables in this study are presented in Table 1.

DT Fluency was found to be positively and significantly related to *gf* and GK partially confirming H1a. Rated DT was demonstrated to be positively and significantly related to *gf*, partially confirming H1b. Self-reported creative achievements and self-rated creativity were found to be unrelated to *gf* or GK partially confirming H1c and H1d. Total creativity demonstrated positive and significant relations to *gf*, partially confirming H1e.

Neither DT fluency nor Rated DT were found to possess significant relationships to any of the personality variables, failing to confirm H2a and H2b. Self-reported creative achievement was found to be positively and significantly related to Openness, partially confirming H2c. Self-rated creativity demonstrated positive and significant relationships to Extraversion and Openness and negative relationships to Neuroticism, partially confirming H2d. Total creativity was found to be related to Openness only, partially confirming H2e.

2.2. Multiple regressions

To examine the extent to which demographics, intelligence and personality could predict variance in creativity, a series of enter method multiple hierarchical regressions were performed. Therefore, gender, age, fluid intelligence, general knowledge and Big Five personality traits were regressed onto each of the five different creativity dependent variables. Data were entered in three blocks: demographics, intellectual variables followed by personality variables. The results of those analyses are presented in Table 2.

Table 1
Descriptive statistics and Pearson inter-correlations for all measures.

	M (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13
Gender		.00	.12	-.08	-.06	-.14	-.05	.19	.23*	-.06	-.30**	-.19	-.20*	.05
1. Age	19.66 (3.91)		.09	.06	-.13	-.12	-.04	.13	.39**	-.07	.11	.07	.07	.19
2. DT Fluency	12.86 (6.26)			.79**	.21*	.15	.78**	.27**	.23*	-.10	.01	.16	.07	-.02
3. Rated DT	2.56 (1.21)				.14	.22*	.78**	.26**	.08	-.08	.04	.19	.11	-.12
4. BICB	10.92 (5.11)					.31**	.60**	.17	.10	-.14	-.02	.33**	-.09	.00
5. SR Creativity	6.07(2.09)						.61**	.11	-.14	-.20*	.09	.46**	.04	-.13
6. Total Creativity	.00 (2.76)							.29**	.10	-.19	.04	.42**	.04	-.10
7. Ravens	26.43 (5.52)								.22*	-.19	.11	.03	.06	.07
8. GK	22.64 (11.14)									-.01	-.01	.10	-.09	.23*
9. Neuroticism	7.16 (2.90)										.06	-.20*	-.31**	-.19
10. Extraversion	9.16 (2.75)											.22*	.15	.13
11. Openness	10.28 (2.19)												.09	-.13
12. Agreeable.	9.45 (2.01)													.09
13. Consc.	9.58 (2.84)													

Note. N = 100. Gender coded 1 = male, 2 = female.

DT = Divergent Thinking BICB = Biographical Inventory of Creative Behaviours SR Creativity = Self-Rated Creativity Ravens = Ravens Advanced Progressive Matrices, GK = General Knowledge, Agreeable. = Agreeableness, Consc. = Conscientiousness.

** p < .01.

* p < .05.

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Neither DT fluency nor Rated DT were found to possess significant associations to any of the personality variables, failing to confirm H2a and H2b. Self-reported creative achievement was found to be positively and significantly related to Openness, partially confirming H2c. Self-rated creativity demonstrated positive and significant relationships to Openness, partially confirming H2d. Total creativity was found to be related to Openness only, partially confirming H2e.

3. Discussion

This study sought to systematically examine the relationships between fluid intelligence, general knowledge and personality with four different measures of creativity and a Total creativity score.

When creativity was assessed as DT Fluency, there was strong support that this aspect of creativity is related to fluid intelligence, which is in line with the extant research (Batey et al., 2009; Furnham et al., 2008). It may be contended that this consistent relationship is observed, because of the way that DT Fluency is scored (by counting the number of responses). Given that the DT test used in this study took only three minutes, it is likely that those participants who could produce voluminous responses may have called, in part, on their ability to quickly process information and record their ideas. These

Table 2
Standardized β coefficients and *t* values for the predictors of the multiple regressions.

		DT Fluency		Rated DT		BICB		Self-rated creativity		Total creativity	
		β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	<i>B</i>	<i>t</i>
1	Age	.09	.84	.06	.62	-.13	-1.30	-.12	-1.23	-.04	-.38
	Gender	.12	1.24	-.08	-.76	-.05	-.54	-.14	-1.42	-.05	-.53
	<i>F</i> (2,97)	1.12		.48		1.01		1.76		.21	
	Adj. <i>R</i> ²	.02		-.01		.00		.02		-.02	
2	Age	-.02	-.16	.01	.04	-.23	-2.09*	-.10	-.96	-.12	-1.17
	Gender	.04	.39	-.14	-1.40	-.13	-1.26	-.15	-1.45	-.14	-1.37
	<i>Gf</i>	.22	2.21*	.28	2.72**	.18	1.78	.17	1.66	.31	3.07**
	GK	.18	1.67	.05	.49	.18	1.60	-.11	-.94	.11	1.02
	<i>F</i> (4,95)	2.82*		2.30		2.19		1.71		3.01*	
Adj. <i>R</i> ²	.07		.05		.05		.03		.08		
3	Age	-.02	-.16	.02	.16	-.22	-2.10*	-.10	-1.04	-.12	-1.16
	Gender	.08	.75	-.11	-.97	-.12	-1.13	-.07	-.70	-.08	-.76
	<i>Gf</i>	.21	1.97*	.27	2.58*	.18	1.81	.14	1.43	.29	2.99**
	GK	.18	1.59	.06	.55	.11	.98	-.16	-1.54	.07	.66
	N	-.01	-.11	.00	.03	-.09	-.88	-.13	-1.32	-.09	-.83
	E	-.02	-.16	-.05	-.44	-.10	-1.00	-.01	-.13	-.07	-.66
	O	.14	1.31	.14	1.31	.33	3.23**	.44	4.51**	.38	3.87**
	A	.08	.76	.08	.74	-.15	-1.51	-.07	-.73	-.02	-.23
	C	-.06	-.58	-.14	-1.26	.06	.62	-.04	-.45	-.06	-.65
	<i>F</i> (9, 90)	1.61*		1.58		2.77		4.14**		3.83**	
Adj. <i>R</i> ²	.05		.05		.14		.22		.21		

Note: BICB = Biographical Inventory of Creative Behaviours, *Gf* = fluid intelligence, GK = General Knowledge, N = Neuroticism, E = Extraversion, O = Openness to Experiences, A = Agreeableness, C = Conscientiousness.

** p < .01.

* p < .05.

skills are likely to rely in part upon fluid intelligence (Carroll, 1993). No relationship was observed between DT Fluency and GK. This result was surprising given the findings of Batey et al. (2009). However, the failure to find a significant relationship is likely to be a reflection of the small sample size and restricted range of ability of the participants, rather than disconfirmation of a relationship between GK and DT.

The results of the correlational and regression analyses failed to demonstrate any significant relationships between DT Fluency and personality. This finding is in opposition to previous research in the area (Batey et al., 2009; Furnham & Bachtari, 2008; Furnham et al., 2008). First, these findings need to be interpreted in the light of the relatively small number of participants, which would suppress the chances of revealing more marginal relationships. Were this study to be replicated with more participants it is likely that significant relationships would be observed with Openness. Second, this study used a very short measure of personality, utilising only ten items. Though the scale has been carefully validated, the reliability of the scales are in the range of $\alpha = .40$ to $.73$ (Gosling et al., 2003). These low reliabilities may have resulted in the failure to observe significant relationships.

Creativity in this study was also operationalised as Rated DT. Rated DT was found to be positively and significantly related to *gf*. These findings are aligned to those found for DT Fluency. This demonstrates that irregardless as to how verbal DT is assessed, *gf* is part of the explanation as to how people produce ideas in response to DT test items. Akin to the findings for DT Fluency, no relationships were observed between Rated DT and personality. Similar to the suggestion posited with regards to DT Fluency, the confirmation of the null hypothesis may be a result of the unreliability of the measure of personality, in conjunction with the small sample size.

When creativity was assessed using a measure of Self-Reported Creative Achievement (BICB: Batey, 2007) a different pattern of results emerged in contrast to the DT variables. Creative Achievement was, as hypothesised, unrelated to *gf* or GK, but demonstrated positive and significant relationships to Openness. It has been suggested that everyday creative accomplishment is not reliant upon intellect (Batey, & Furnham, 2006). Insofar as an abundance of *gf* or GK will not confer significant advantage in assisting an individual to write a short story, compose a piece of music, etc. However, if the achievements were to be rated for originality or quality (which was not the case for a self-report measure like the BICB) it is possible that intellect would be predictive of the level or quality of the accomplishment. The role of Openness in predicting creative achievement has been repeatedly demonstrated (Batey, & Furnham, 2006; King, Walker, & Broyles, 1996; Soldz, & Vaillant, 1999).

The assessment of creativity by a self-rating, revealed a similar pattern of results to those observed for self-reported creative achievement. No relationships were observed with regards to intellect, but positive and significant relationships were demonstrated between Openness and self-rated creativity. This suggests that self-rated creativity is perceived by respondents to be related to non-cognitive traits (Openness) rather than intellectual traits (*gf* or GK).

Finally, when creativity was assessed by a Total Creativity score, both *gf* and Openness were found to be predictive. Essentially, this result can be considered to reflect the finding that the DT variables

showed consistent relationships to *gf* whilst, the self-reported creativity measures were found to be significantly related to Openness. When both DT and self-reported measures are combined into a Total Creativity score it is not surprising to find that both *gf* and Openness are significant predictors.

Before considering the implications of the this study, it is important to note that care should be taken when generalising from the results, because the student sample was small and the measure of personality was very brief. However, the study did demonstrate that when creativity is assessed by a performance measure like DT, that intellectual variables (primarily *gf*) are most heavily involved. However, when creativity is assessed by self-report measures (creative achievement and self-rating), cognitive variables are unrelated, whilst personality variables explain the most variance.

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