Correlates of Creativity: An Association Between Creativity, Personality, and Intelligence

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ABSTRACT

The present study aimed to explore the association between creativity, intelligence, and personality. Sixty dextral healthy volunteers in the age range of 20-40 years were recruited for the study and administered tests for fluid intelligence (Raven's Standard Progressive Matrices), personality (Big Five NEO-FFI), and divergent thinking (Wallach & Kogan Creativity Test). Findings revealed that intelligence and openness to experience were significantly and positively correlated with fluency, flexibility, and originality dimensions of creativity. The multiple regression analysis suggested openness and fluid intelligence as significant predictors for creativity which entails that individuals who are more open to new experiences continue integrating new and diverse information to their subsisting repertoire of experiences, when intelligently assimilated with contextual and emotional stimuli could provide more varied and novel responses to divergent thinking tasks.

Keywords: divergent thinking, fluid intelligence, creativity, openness to experience, personality

Introduction

The traditional cognitive models of creativity, at the face value, make creativity synonymous to intelligence, with both cognitive processes requiring formation of associations between concepts and an amalgamation of convergent and divergent thinking (DT) styles (Guilford, 1968; Mednick, 1962; Policastro, 1995; Wallas, 1926; Weisberg, 1989). However, this idea was first refuted by Terman's longitudinal study of gifted children revealing that of the entire 757 genius children studied, only three were conspicuously creative by midlife (Terman, 1917). Richards (1976) administered three types of IQ tests along with two divergent thinking (DT) tasks to almost 500 naval officers (Richards, 1976). The mean correlation between the battery of creativity tests and IQ tests was r= 0.27. Studies further reiterated a varied and low correlation between creativity and intelligence (Batey & Furnham, 2006; Getzels & Jackson, 1962; J. C. Kaufman, Cole, & Baer, 2009; Kim, 2005; Runco, 2014; Sawyer, 2011; Wallach & Kogan, 1965b; Weisberg, 2006). Subsequently, Silvia et al. (2008), found DT to be substantially related to a higher-order intelligence factor and posited that when intelligence is modeled as a higher-order latent variable, it has a much stronger relationship to creativity ($\beta = .43$) than the typical effect found in previous studies (Silvia et al., 2008). The correlation coefficients linking intelligence with total creativity were high for all- fluency, originality and flexibility. Benedek et al. (2012) also found intelligence to be related to divergent thinking, specifically to ideational originality inferring that cognitive inhibition specifically drives the fluency and flexibility of idea generation (i.e. the quantitative aspect of ideation), while intelligence has a positive effect on the originality of ideas (i.e. the qualitative aspect of ideation) (Benedek, Franz, Heene, & Neubauer, 2012).

This was a unique aspect, as previous studies have asserted fluency as a component of intellectual ability (Hargreaves, 1927; Thurstone, 1938). Authors explained their findings in line with the

Geneplore model (Finke, Ward, & Smith, 1992), which posits inhibition as being more related to the ‘‘generation’ stage and intelligence contributing to the ‘exploration’ stage. Further, intelligence’s necessary role in creativity has been reiterated by Threshold Theory (Runco & Albert, 1986) and triangular theory (Guilford, 1968). Threshold theory suggests that a minimum level of general intelligence is necessary but not enough precondition for creative work and the relationship is linear up to a certain level (IQ of 120) after which it becomes random.

Fluid intelligence (the innate ability to reason and solve novel problems, independent of acquired experience) (Sawyer, 2011) has been consistently associated with performance on divergent thinking tests (Batey, Chamorro-Premuzic, & Furnham, 2009; Beaty & Silvia, 2013; Benedek, Jauk, et al., 2014; Silvia, Beaty, & Nusbaum, 2013). Divergent thinking ability has been consistently proven to be an indicator of creative potential (Runco & Acar, 2012), and also has ecological validity for real-life creative accomplishment (Benedek, Borovnjak, Neubauer, & Kruse-Weber, 2014; Plucker, 1999).

Along with intelligence, researchers have consistently associated certain personality traits to be associated with increased creative potential/achievement (Furnham & Bachtiar, 2008; Gelade, 2002; Shi, Wang, Yang, Zhang, & Xu, 2017). Feist (1998) conducted the first meta-analytic review exploring the associations between creativity and personality and found that creative people are more open to new experiences, less conscientious, more self-accepting, hostile, and impulsive (large effect sizes over 0.8 on creativity) (Feist, 1998). In subsequent studies, Openness and Extraversion were consistently positively associated with creativity (Batey, Furnham, & Safiullina, 2010; Chamorro-Premuzic & Reichenbacher, 2008; Feist, 1998; Feist & Barron, 2003; Furnham, Crump, Batey, & Chamorro-Premuzic, 2009; King, Walker, & Broyles, 1996; Silvia et al., 2008) along with low Conscientiousness and high Neuroticism (Batey & Furnham, 2006; J. C.

Kaufman et al., 2009; Silvia, Kaufman, Reiter-Palmon, & Wigert, 2011). It has been hypothesized that individuals with high extraversion, openness and low conscientiousness would provide more fluent, varied and unique responses to divergent thinking tests (Batey et al., 2009; Batey & Furnham, 2006; Hughes, Furnham, & Batey, 2013) and rate themselves higher on self- rated creativity tests.

The present study aimed to explore intelligence and personality as predictors of creativity. It was hypothesized that fluid intelligence would be positively and significantly related to DT fluency and originality. Existing research has demonstrated significant positive relationships of creativity with extraversion, openness and negative relationship with conscientiousness. It was hypothesized that these personality traits will be significantly related to creativity. The current research is modeled after Furnham & Bachtiar (2008) study of intelligence and personality as predictors of creativity (Furnham & Bachtiar, 2008) and responds to the need for using fluid intelligence measure in predicting creativity and rating the DT tests for originality along with the widely used measure of fluency.

Methodology

Sample

60 right-handed (screened using Edinburgh Handedness Inventory) (Oldfield, 1971) healthy participants (46 males and 14 females) in the age range of 20-40 years (29.3 ± 5.39 years with 16.27 ± 0.73 years of education) were recruited for the study. Individuals with any medical, psychiatric or neurological disorders were excluded from the study using M.I.N.I. 6.0 (Sheehan et al., 1998). Written informed consent and socio-demographic details were obtained from all the

participants in a socio-demographic datasheet and the study was approved by the Institute Ethics Committee.

Measures

Raven's Standard Progressive Matrices (SPM) (Raven, 1938) was used to assess intelligence. It consists of 60 problems presented in the form of 5 sets containing12 each. These problems involve completing a pattern or figure with a part missing by choosing the correct missing piece from among six alternatives.

Big Five personality traits were assessed using the short personality inventory (Costa & McCrae, 1992). The 60-item scale is a self-report version of the NEO-PI-R and assesses the five major dimensions of personality, namely Neuroticism (NEO-N) (low Emotional Stability), Extraversion (NEO-E), Openness to Experience (NEO-O), Agreeableness (NEO-A), and Conscientiousness (NEO-C). There is wide agreement among personality researchers that these five personality factors are representative of cross-cultural individual differences in normal behavior and studies have replicated this taxonomy in a diversity of sample (Chamorro-Premuzic, Furnham, & Moutafi, 2004).

Wallach & Kogan Creativity Test (1965) (WKC; Paramesh, 1972): The test originally developed in 1965 (Wallach & Kogan, 1965a) was standardized on the Indian population by Paramesh in 1972 (Paramesh, 1972). It comprises of 5 subtests- 3 verbal and 2 visual. The verbal subtests are - Instances (e.g. name all round things you can think of); Alternate Uses (e.g. what are the different ways in which one can use a newspaper); Similarities (e.g. what are the similarities between a potato & carrot). The visual subtests are- Pattern meanings & Line meanings. There are three types of scores- the number of responses (fluency), uniqueness of response (originality), and the number

of categories used in responding for a single item (flexibility) were determined for each subject. Inter score reliability is 86 % for verbal and 92% for visual subtests.

Results

Intercorrelation between creativity subtests (Instances, Alternative uses, Line meaning, and Pattern drawing) for each type of score (Fluency, Originality, and Flexibility) are presented in Table 1, 2, and 3. All creativity subtests were strongly and significantly intercorrelated suggesting that a valid composite score could be generated for fluency, originality, and flexibility. The scale reliability (Cronbach's α) for each type of score was also acceptably high ($\alpha > 0.7$) designating the internal validity of the measures (Bland & Altman, 1997).

Table 4 shows the intercorrelation between composite creativity subtests scores for each type of score (fluency, originality, and flexibility), personality (NEO-FFI), and intelligence (SPM). Fluency (FLU), Originality (ORI), and Flexibility (FLE) were strongly and significantly intercorrelated *($r = .939$ - $.958$; $p < 0.01$)*. Intelligence was found to be significantly correlated with FLU *($r = .367$; $p < 0.01$)*, ORI *($r = .318$; $p < 0.05$)*, and FLE *($r = .339$; $p < 0.01$)*, but not correlated with any other measure of the personality. NEO-O was significantly correlated with FLU *($r = .312$; $p < 0.05$)*, ORI *($r = .311$; $p < 0.05$)*, and FLE *($r = .349$; $p < 0.01$)*, however, other personality measures were not significantly correlated with any type of creativity score.

Multiple regression analysis of three types of creativity scores (as dependent variables) and personality, intelligence, age, and gender (as independent variables) was then performed and is presented in Table 5. Standardized β coefficients and t-values for all the predictors were calculated in the regression analysis.

The first regression analysis showed that NEO-FFI accounted for 9.6% of the variance in the fluency scores *($F_{(5,54)} = 2.26$; Adj $R^2 = .096$)*, 10.3% in the originality scores *($F_{(5,54)} = 2.354$; Adj $R^2 = .103$)*, and 17.7% in the flexibility scores *($F_{(5,54)} = 3.533$; $p < 0.01$; Adj $R^2 = .177$)*. NEO-O was the only significant predictor for Fluency *($\beta = .353$; $t = 2.794$; $p < 0.01$)*, Originality *($\beta = .357$; $t = 2.838$; $p < 0.01$)*, and Flexibility (*$\beta = .403$; $t = 3.337$; $p < 0.01$)* among all the other personality measures.

When Intelligence added to the model, the variance accounted 18.6% for fluency *($F_{(6,53)} = 3.254$; $p < 0.01$; Adj $R^2 = .186$)*, 16.6% for originality *($F_{(6,53)} = 2.951$; $p < 0.05$; Adj $R^2 = .166$)*, and 24.5 % for flexibility *($F_{(6,53)} = 4.182$; $p < 0.01$; Adj $R^2 = .245$)*. Intelligence was the significant predictor in this model for Fluency *($\beta = .323$; $t = 2.641$; $p < 0.05$)*, Originality *($\beta = .278$; $t = 2.248$; $p < 0.05$)*, and Flexibility (*$\beta = .285$; $t = 2.418$; $p < 0.05$).*

Both age and gender were not found significant predictors when added to the model.

Discussion

The current study aimed at exploring intelligence and personality as predictors of creativity. Results indicated fluid intelligence as a significant predictor of fluency, flexibility, and originality aspects of creativity. While most previous studies have found a positive relationship between DT fluency and creativity, our study findings support emerging evidence indicating a positive association between intelligence and creativity, when latter is assessed in terms of the creative quality of generated ideas rather than by ideational fluency (Nusbaum, Silvia, & Beaty, 2014). It is well known that divergent thinking is initially dominated by the retrieval of common, known ideas which are readily accessible whereas original and unique ideas occur at later stages in the ideation process (Beaty & Silvia, 2012; Benedek, Mühlmann, Jauk, & Neubauer, 2013; Gilhooly,

Fioratou, Anthony, & Wynn, 2007). Fluid intelligence is suggested to evaluate the originality of ideas by overcoming the readily accessible yet uncreative ideas and supporting the generation of new and more creative ideas (Benedek, Jauk, et al., 2014; Kleinmintz et al., 2018).

Another explanation for the relationship between creativity and intelligence may reside in the contribution of neural efficiency to enhanced performance on timed DT tests (Eysenck & Barrett, 1985; Jensen, 1993). Batey et al. (2009) assert that at the initial stage, the speed of retrieval of information from memory will provide more ideas in a short period of time. And at the later stage, it would facilitate the rapid manipulation of existing concepts to produce innovative solutions or original products (Batey et al., 2009). Lastly, a rich store of knowledge that is effectively organized will be required in order to combine ideas to produce responses to the DT test items. In the current study, we found that fluid intelligence when measured by SPM was significantly and positively correlated with all three dimensions of creativity- fluency, flexibility, and originality.

With respect to personality, the current study found openness to experience as a significant predictor of creativity, corroborating the findings from existing literature (Benedek, Borovnjak, et al., 2014; Carson, Peterson, & Higgins, 2005; Dollinger, Urban, & James, 2004; Feist, 1998; Fink & Woschnjak, 2011; King et al., 1996; McCrae, 1987; Miller & Tal, 2007). Openness to experience, one of the Big Five factor has been a subject of fundamental research in creativity as it predicts creativity in a wide range of domains (e.g. arts, sciences, and humanities) (Feist, 1998) and levels of analysis (e.g. creative thinking styles, hobbies, and accomplishments) (Feist & Barron, 2003; King et al., 1996; Silvia et al., 2008). It was also positively and significantly correlated with fluency, flexibility and originality dimensions of creativity.

Deconstructing openness to experience as a trait, DeYoung at el. (2007) proposed that it has two primary aspects—openness (an imaginative, creative, and aesthetic aspect) and intellect (thinking

and reasoning aspect) (DeYoung, Quilty, & Peterson, 2007). Openness/Intellect represents the capacity to process abstract and perceptual information flexibly and efficiently and includes four major dimensions namely cognitive ability, intellectual engagement, affective engagement and aesthetic interest (S. B. Kaufman, 2013). Explicit cognitive ability comprises traditional measures of intelligence (i.e. IQ tests), including fluid reasoning, mental rotation, verbal analogical reasoning, and working memory. Intellectual engagement refers to the drive to engage in ideas, rational thought, and the search for truth. Affective engagement involves a preference for using emotions, intuitions and empathy to make decisions while aesthetic engagement involves a preference for aesthetics, fantasy, and emotional absorption in artistic and cultural stimuli. Thus, both these models involve an intellectual and an imaginative/aesthetic component.

Openness/Intellect has been consistently and positively associated with intelligence (DeYoung, Peterson, & Higgins, 2005), a faculty that appears to be associated with the prefrontal cortex and with functions such as abstract reasoning, working memory and decision making (Gray, Chabris, & Braver, 2003). Thus, a higher degree of Openness/Intellect in creative artists suggests an increased tendency to expose themselves to diverse perceptual experiences and a larger capacity to assimilate these experiences intellectually and emotionally in their creative potential. This vastness and richness of input create a corresponding richness of output, as individuals who score high on activity tend to have many diverse experiences that may be used as a substrate for divergent thinking and creative activity.

Incorporating these aspects into the present study, it can be postulated that fluid intelligence or abstract reasoning provides the basic cognitive substrate which further influences domain-specific cognitive abilities (e.g. capacities for speed of information processing, focused attention, verbal and visual fluency, visuospatial working memory and auditory learning and memory). These

cognitive substrates then interact with the environment wherein components of affective (basic temperament and emotional interactions in interpersonal relationships) and aesthetic engagement (external beautiful objects as well as subjective mental representations) further shape them. These thinking styles could take shape of distinctive patterns that define an individual's personality- in this case, components of explicit cognitive ability; intellectual engagement; affective engagement; and aesthetic engagement which together constitute openness to experience.

Taken together, our results suggest that individuals who are more open to new experiences would continue adding new and diverse information to their existing repertoire of experiences, which when intelligently assimilated with contextual and emotional stimuli could provide more varied and novel responses on divergent thinking tasks.

The study aimed at exploring predictors of creativity in adult health participants. However, a small sample size, few female participants and cross-sectional assessments are limitations of this study. Future larger cohort longitudinal studies could explore and compare fluid intelligence, crystallized intelligence, cognitive styles, personality development, and their association with creative potential and achievement.

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Conflict of interest

None

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Table 1. Descriptive statistics and intercorrelation of creativity subtests for fluency scores

Variables	Scores		Instances	Alternate uses	Line meaning	Pattern drawing
	Mean	SD				
Instances	25.47	11.33		.840**	.565**	.558**
Alternate uses	16.55	8.08			.539**	.553**
Line meaning	11.72	7.06				.860**
Pattern drawing	11.97	7.67				

Note. Cronbach's α = .868

**p < 0.01.

Table 2. Descriptive statistics and intercorrelation of creativity subtests for originality scores

Variables	Scores		Instances	Alternate uses	Line meaning	Pattern drawing
	Mean	SD				
Instances	11.6	7.92		.841**	.641**	.489**
Alternate uses	9.98	6.57			.493**	.365**
Line meaning	7.98	6.01				.825**
Pattern drawing	8.8	6.92				

Note. Cronbach's α = .858

**p < 0.01.

Table 3. Descriptive statistics and intercorrelation of creativity subtests for flexibility scores

Variables	Scores		Instances	Alternate uses	Line meaning	Pattern drawing
	Mean	SD				
Instances	13.47	5.73		.751**	.553**	.512**
Alternate uses	9.25	3.62			.618**	.612**
Line meaning	8.95	4.47				.807**
Pattern drawing	10.07	5.75				

Note. Cronbach's $\alpha = .861$

**$p < 0.01$.

Table 4. Descriptive statistics and inter-correlation between three types of creativity scores (fluency, originality, and flexibility), personality (NEO-FFI), and intelligence (SPM)

Variables	Scores		Fluency	Originality	Flexibility	NEO-N	NEO-E	NEO-O	NEO-A	NEO-C	SPM
	Mean	SD									
Fluency	65.7	29.44		.957**	.958**	.068	-.201	.312*	-.144	-.180	.367**
Originality	38.37	23.09			.939**	.123	-.191	.311*	-.171	-.176	.318*
Flexibility	41.73	16.71				.044	-.242	.349**	-.205	-.224	.339**
NEO-N	21.27	8.37					-.330*	-.025	-.203	-.383**	.025
NEO-E	29.43	6.54						.083	.246	.582**	-.125
NEO-O	29.45	6.79							.172	.006	.171
NEO-A	28.83	5.04								.348**	.118
NEO-C	31.92	6.82									-.136
SPM	86.75	14.46									

* $p < 0.05$. ** $p < 0.01$.

Table 5. Standardised β coefficient and t-values for the predictors of the multiple regressions

		Fluency		Originality		Flexibility	
		β	t	β	t	β	t
1	NEO-N	-.027	-.201	.04	.293	-.084	-.646
	NEO-E	-.183	-1.181	-.159	-1.031	-.216	-1.462
	NEO-O	.353	2.794**	.357	2.838**	.403	3.337**
	NEO-A	-.154	-1.147	-.184	-1.368	-.219	-1.701
	NEO-C	-.032	-.197	-.006	-.037	-.057	-.366
	F (5,54)	2.26		2.354		3.533**	
	Adj R^2	.096		.103		.177	
2	SPM	.323	2.641*	.278	2.248*	.285	2.418*
	F (6,53)	3.254**		2.951*		4.182**	
	Adj R^2	.186		.166		.245	
3	Age	-.059	-.435	-.068	-.488	-.063	-.473
	Gender	.215	1.640	.190	1.422	.149	1.164
	F (8,51)	2.983**		2.632*		3.414**	
	Adj R^2	.212		.181		.247	

* $p < 0.05$. ** $p < 0.01$.