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Intelligence in childhood and creative achievements in middle-age: The necessary condition approach

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ABSTRACT

This paper explores longitudinal links between intelligence measured at age 11 (N = 1594) and 13 (N = 255) and creative achievement as tested forty years later (at age 52). Using a dataset from the most recent (fifth: 2015) follow-up to the Warsaw Study (Firkowska et al., 1978), we examined the hypothesis that intelligence forms a necessary-yet-not-sufficient condition for creative achievement. Although the links between intelligence and creativity as estimated with the use of linear (correlations) and nonlinear (segmented regression) analytical methods were generally ambiguous, the recently developed Necessary Condition Analysis (NCA, Dul, 2016a) presented a much clearer pattern demonstrating that high creative middle-age achievement was unlikely with low intelligence in childhood. The strength of the NCA effect size was moderated by the domain of creativity, being higher for cognitively demanding domains (science, inventions, humor, architecture, or writing) than for artistic or everyday domains (cooking, dance, music, visual arts or theatre).

1. Introduction

What role does intelligence play for creative behavior and achievement? Is creativity impossible without a certain level of intelligence (Schubert, 1973), or might these two constructs be orthogonal (Batey, Chamorro-Premuzic, & Furnham, 2010)? Should intelligence be perceived as a necessary-yet-not-sufficient condition of creative accomplishments (Karwowski, Dul et al., 2016)? Or should creative achievement be seen as simply the effective application of intelligence or specific abilities to a certain domain (Robertson, Smeets, Lubinski, & Benbow, 2010)?

These questions intrigue scholars and laypeople alike for good reasons. Both Luis Alvarez [1911–1988] and William Shockley [1910–1989] achieved the highest honor a physicist may ever dream of – the Nobel Prize. Yet their award was not the only thing they had in common; both were not deemed to be sufficiently intelligent to be included in the seminal Terman studies of profoundly gifted kids (Shurkin, 1992). Obviously, however, anecdotes are not data and the long-standing question of the relationship between intelligence and creativity requires more than rhetorically convincing analysis. As correlational studies are unable to fully untangle these links, longitudinal investigations (Plucker, 1999; Runco, Millar, Acar, & Cramond, 2010) are necessary to enhance our understanding of this long-standing issue. This article is built on top of one such longitudinal project with the hope of contributing to our understanding of the intelligence-creativity link.

This paper focuses on three specific aspects of the contemporary creativity-intelligence debate. First, it explores the relationship between intelligence and creative achievement. Instead of analyzing creative potential, we are interested in observable, lifetime creative accomplishments so that we can examine the extent to which they may be related to intelligence. Second, this article utilizes a large, longitudinal dataset, with intelligence being measured in childhood (age 11 and 13) and creative achievement in middle-age (age 52). Finally, we complement the typically used correlation- or regression-based analytical models with a new method of analysis (Dul, 2016a) only recently introduced to the field of psychology (Karwowski, Dul et al., 2016): the Necessary Condition Analysis (NCA). NCA may serve as an excellent tool to test the classic assumption that although there is little creativity with very low intelligence (Guilford, 1967; Schubert, 1973), high intelligence does not guarantee creative accomplishment (Jauk, Benedek, & Neubauer, 2014). Therefore, unlike average-based

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regression-like analyses (including latent variable models – see Silvia, 2008a, 2008b), the NCA allows researchers to quantify the pattern of the relationship between cognitive ability and creative achievement.

1.1. Creativity-intelligence links: Findings and challenges

1.1.1. Defining creativity and crucial clarifications

After nearly seven decades of in-depth research across multiple disciplines (Guilford, 1950; Kaufman & Beghetto, 2009), the creativity literature has seen convergence on some core issues. For example, a basic definition of creativity has emerged: the capacity to produce ideas and products that are both original and useful or task appropriate (Kaufman, 2016; Plucker, Beghetto, & Dow, 2004).

However, several topics in creativity are still actively debated and explored. The relationship between creativity and intelligence and the role played by intelligence in creativity is one such continuing research question. Although studied from the very beginning of any scientific studies of creativity or intelligence (Galton, 1869), and engaging both creativity (Avitia & Kaufman, 2014) and intelligence (Kell, Lubinski, & Benbow, 2013) scholars, the exact pattern of this relationship and plausible theoretical mechanisms of the links between intelligence and creativity are still up for debate. Plucker and Renzulli (1999, see also Plucker & Esping, 2014, Plucker & Makel, 2010) proposed that the question is not whether intelligence and creativity are connected, but instead the nature of that relationship. The way the question is approached can depend on whether creativity is being placed in an intelligence framework or vice versa (Kaufman & Plucker, 2011; Plucker, Esping, Kaufman, & Avitia, 2015). One consideration if addressing the relationship from a creativity orientation is to distinguish between creative potential from creative achievement. Creative potential is often conceptualized as a multifaceted mix of cognitive processes and personality traits that can include divergent thinking (Baer, 2014), imagination (Beghetto, 2014), openness to experience (Silvia et al., 2014), self-assessments (Kaufman, 2012), or curiosity (Karwowski, 2012). These constructs are theoretically relevant to creative thinking and predictive of observed creative behavior. Creative achievement, in contrast, applies to observable and socially recognized artifacts or accomplishments across different domains. It can encompass both early and mid-career markers (getting a poem or scholarly article published, receiving a patent, or discovering a scientific theorem) as well as prestigious prizes for truly outstanding performance (such as a Pulitzer or Nobel Prize).

The vast majority of past studies, as we will review, focus on creative potential, which is typically measured as divergent thinking ability. If creative achievement is included it is nearly always self-reported and at lower levels (with some exceptions, which we will discuss). However, when people talk about the benefits of creativity, they often mean actual achievement (Forgeard & Kaufman, 2016).

1.1.2. The links between intelligence and creative ability

Kim's (2005) meta-analysis summarizes many of the initial studies on the topic, finding a weak ($r = 0.17$) and highly heterogeneous (range between -0.46 and 0.76) relationship between intelligence and creative potential. Two issues, however, are important when discussing the studies included in her paper. First, although the links between intelligence and creativity seem initially meager, the latent variables method reveals a stronger relationship (Silvia, 2015). One classic work (Cropley, 1966) found that when the intelligence and creativity tasks were first factor-analyzed, the resulting factors were much more highly correlated ($r = 0.51$) than were the specific tasks. Hence, data analysis does indeed matter.

The second issue is related to possible nonlinear links between intelligence and creativity. For decades, scholars have debated the "threshold hypothesis," which claims that intelligence and creativity are positively related up until a particular level (or threshold) of IQ, which is usually 120 (Getzels & Jackson, 1962). After this point, the two constructs are less related (Karwowski & Gralewski, 2013). The evidence is mixed. Some studies support the threshold hypothesis (Cho, Nijenhuis, Vianen, Kim, & Lee, 2010), yet others do not (Preckel, Holling, & Wiese, 2006; see also Karwowski, Dul et al., 2016, for a broader discussion). However, different and unsystematic strategies have been used to test the threshold (see Karwowski & Gralewski, 2013). Some researchers treated significant correlations below a certain IQ point and a lack of significant correlations above this point as being proof of the hypothesis. This empirical strategy is not ideal given the restriction of range for intelligence scores in the high end of its distribution (see Robertson et al., 2010). The vast majority of studies, even on samples of gifted students (Runco & Albert, 1986), were too statistically underpowered to properly correct for the restriction range problem (see Kell, Lubinski, Benbow, & Steiger, 2013 or Robertson et al., 2010, for exceptions).

Interestingly, neuroscientific studies also provide plausible arguments for nonlinear links between creativity and intelligence. For example, Jung and colleagues (Jung et al., 2009) found differing links between creative potential and markers of neuronal integrity in participants with higher versus lower IQs. In the same vein, Jauk, Neubauer, Dunst, Fink, and Benedek (2015) demonstrated links between ideational fluency and higher regional gray matter volume only in participants with lower IQs; this relationship was not found in those with higher IQs.

In comparison with earlier endeavors, contemporary studies on intelligence-creative ability relationship have been characterized by three distinctive characteristics. First, the vast majority of these works are conceptually located within the Cattell-Horn-Carroll (CHC) theoretical framework (McGrew, 2009; Schneider & Flanagan, 2015). In other words, creative ability is conceptualized as a part of intelligence. Although some studies have focused on *Gf,* or fluid intelligence (e.g., Batey, Furnham, & Safiullina, 2010), recent investigations have followed the CHC model's placement of creativity, which is in *Glr*, or long-term storage and retrieval (Avitia & Kaufman, 2014; Silvia, Beaty, & Nusbaum, 2013, see also Kaufman, 2015). One of *Glr*'s subcomponents is fluency, defined in the CHC model as the ability to quickly recall a large number of things; the connection with divergent thinking is certainly straightforward (Kaufman, Kaufman, & Lichtenberger, 2011; Silvia et al., 2013). Second, these studies are less focused on static, correlational evidence of the link between creativity and intelligence, but rather emphasize and test different cognitive mechanisms that may be responsible for both constructs (Benedek, Jauk, Sommer, Arendasy, & Neubauer, 2014; Pan & Yu, 2016; Preckel, Wermer, & Spinath, 2011). Third, more advanced techniques are used to study and analyze associations between creative ability and intelligence. These include advances in behavioral and neuropsychological measurements (Haier & Jung, 2008; Jaarsveld et al., 2015) as well as new statistical developments including structural equation modelling (Benedek, Franz, Heene, & Neubauer, 2012; Benedek et al., 2014; Silvia & Beaty, 2012), the Odds Ratio method (Park, Lubinski, & Benbow, 2008; see also Lubinski, 2016), and the application of segmented regression analysis (Jauk, Benedek, Dunst, & Neubauer, 2013), a technique that enables the discovery of the exact value of the threshold rather than testing an arbitrary point (see also Mourgues et al., 2015). Another new analytical approach is the Necessary Condition Analysis (NCA; Karwowski, Dul et al., 2016), which will be applied in this study.

NCA looks for necessary-but-not-sufficient conditions with a ceiling approach as opposed to an "average" based (e.g., correlational or regression) approach. The necessary condition is operationalized as a situation in which there are no values characterized by high scores on one variable (e.g., creativity) and low on the other (e.g., intelligence). The presence of enough people with tremendous creative achievements yet very low IQs would negate an argument for the necessary condition. To demonstrate the NCA, a scatterplot that shows the association between intelligence and creativity should have an empty upper-left corner and all cases should be located below the ceiling (Karwowski, Dul et al., 2016). This "empty zone" above the ceiling may not always