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The interrelationship between speeded and unspeeded divergent thinking and reasoning, and the role of mental speed

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ABSTRACT

The relationship between intelligence and creativity is still subject to substantial debate in the research literature. In the present study, we focused on core dimensions of both constructs, that is divergent thinking and reasoning. We hypothesized their relationship to depend both on the speededness of test tasks and on the subject's mental speed, positing that with increasing speededness of the tasks, mental speed would have a stronger impact on task outcomes. We disentangled the effects of task speededness and mental speed experimentally, testing 261 participants (mean age 14.48 years) with 12 divergent thinking and 12 reasoning tasks, 6 of each under power conditions, 6 time-constrained. In addition, we assessed mental speed with 6 tasks. We analyzed the data through structural equation modeling. Results confirmed our expectations: test speededness contributed significantly to mental speed variance in divergent thinking task performance. Divergent thinking assessed under time constraints was fully explained by divergent thinking assessed under power conditions and by mental speed. Divergent thinking and reasoning showed no correlation when controlling for mental speed. Our findings suggest that the correlations between divergent thinking and reasoning are mainly the result of variance both constructs share with mental speed, and that timed versus untimed test-taking plays a minor role.

1. Introduction

How much intelligence is needed to be creative? Is one construct a predictor of the other, and can intelligence and creativity be separated at all? There is no generally accepted definition for either construct. But most experts agree that the key aspects of intelligence are the capacities for information processing, problem-solving, and abstract reasoning (Snyderman & Rothman, 1987), while creativity relies on the ability to generate both novel and adaptive (useful, appropriate) solutions to problems (e.g., Amabile, 1996; Sternberg & Lubart, 1999). Creativity can therefore be understood as “a specific capacity to not only solve problems but to solve them originally and adaptively” (Feist & Barron, 2003, p. 63).

The study of the relation between intelligence and creativity has a long history and is still under vigorous debate (for an overview, see Batey & Furnham, 2006). According to Sternberg and O'Hara (1999), conceptualizations of the relationship between intelligence and creativity range from proposals of distinct psychological constructs to partially overlapping constructs such as “creative intelligence” (Lubart, 2003), and in some cases are simply different labels for the same thing. The psychometric approach frequently conceptualizes creativity as a subset of intelligence. Correspondingly, the prevalent models of intellect generally include creativity constructs as lower-order factors of general intelligence (e.g., Carroll, 1993: broad retrieval ability or idea production; Jäger, 1984: divergent thinking; Vernon, 1950: creative abilities). These models would, however, be challenged if it were shown that intelligence and creativity are unrelated or that their relation is

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mainly due to another common cause (e.g., long-term memory or elementary cognitive processes like mental speed). And if it were shown that the correlation between intelligence and creativity can be traced back to shared variance with mental speed, this would lead to a fundamental discussion about the hierarchical level of intelligence, creativity, and mental speed and the nature of their common cause. The investigation of the strength and particularly the nature of the relationship between intelligence and creativity are therefore of high theoretical interest. But also in applied fields of ability assessment, insights into the intelligence-creativity relationship will be important in helping to explain (and not just describe) individual differences.

1.1. Divergent thinking as an indicator of creative potential

Divergent thinking (DT), also denoted as divergent production or fluency (Carroll, 1993), can most generally be described as the ability to generate diverse and numerous ideas (Runco, 1991). Guilford (1950) was one of the first to see DT as a major component of creativity. Together with his associates he differentiated four main aspects of DT: (a) fluency of thinking or the ability to produce a large number of ideas or solutions to a given problem in a short period of time (consisting of word, ideational, expressional, and associational fluency); (b) flexibility of thinking or the ability to consider a variety of approaches to a solution (consisting of spontaneous and adaptive flexibility); (c) originality of thinking or the ability to produce unusual ideas different from those of most other people; and (d) elaboration of thinking or the ability to think through the details of an idea (consisting of figural and semantic elaboration) (Batey & Furnham, 2006). In the 1960s, Mednick suggested an associative basis for individual differences in divergent thinking performance (Mednick, 1962). This conception is still prominent (Kauman, 2009) and suggests that the knowledge base of less creative people is smaller and organized in steeper associative hierarchies than the one of creative people. Creative people, on the other hand, are assumed to have a qualitatively and quantitatively richer knowledge base with flat associative hierarchies. Therefore they have access to a larger pool of associations and show a higher likelihood for creative combinations (that is, a new combination of beforehand conceptually distant mental elements).

Within the psychometric study of creativity, DT tests are well established as measures of creative potential (Barron & Harrington, 1981; Kim, 2008; Silvia et al., 2008). DT tests assess the ability to generate multiple alternative solutions and require individuals to produce several responses to a specific prompt within a certain time period (Plucker & Renzulli, 1999). The responses are usually scored quantitatively for fluency (number of responses), but sometimes also for flexibility (number of different categories covered by the responses), originality (statistical infrequency of the responses), or elaboration (amount of details given). Psychometric properties of DT tests are satisfactory. They show good concurrent validity with other creativity tests (Plucker, 1999), good criterion validity with non-test indices of creativity (e.g., real-life criteria, other-ratings; Barron & Harrington, 1981), and sufficient reliability (for an overview, see Cropley, 2000). Importantly, almost all of the existing tests of DT include tasks from semantic and figural content areas only, and neglect the numerical content area, which is well established in intelligence research (Marshalek, Lohman, & Snow, 1983). In this study, we used DT tests covering all of the aforementioned content domains.

1.2. Findings on the relationship between divergent thinking and intelligence

In their comprehensive review, Batey and Furnham (2006) concluded that creativity and intelligence are modestly correlated with correlations in the area of $r = .20$ to $r = .40$. This range also holds for the correlation of divergent thinking and intelligence for samples as diverse as regular or gifted students, architects, or air force officers (see also Furnham & Nederstrom, 2010). In other words, the strength of the correlation seems to be the same across the entire ability range. Accordingly, recent research does not support the so-called threshold theory, which states that creativity and intelligence show a curvilinear relationship, that is, decreasing correlations with increasing levels of intelligence (Kim, 2005; Preckel, Holling, & Wiese, 2006; Sligh, Conners, & Roskos-Ewoldsen, 2005).

It is important to note that the *nature* of the relation between intelligence and creativity is not very well understood (see Section 1.3 below). Since most of the available studies do not control for possible confounds, one cannot exclude the possibility that a third variable might explain the intelligence–creativity correlation (e.g., openness to experience, which is positively related to both creativity and intelligence; Silvia, 2008). Moreover, research results are inconsistent. There are several studies documenting that divergent thinking test scores as indicators of creative potential and also creative achievements or creativity test scores are *not* related to psychometric intelligence (e.g., Cropley, 1968; Feist & Barron, 2003; Furnham & Bachtiar, 2008; Guilford, 1950; Helson & Crutchfield, 1971; Rossmann & Horn, 1972; Torrance, 1977; Vartanian, Martindale, & Matthews, 2009).

1.2.1. The influence of task speededness. This heterogeneity of findings on the relationship between creativity and intelligence can be traced back in part to the different time allocations used in assessing creativity and intelligence. Wallach and Kogan (1965) showed that the intelligence–creativity relationship is strongly dependent on the degree of speededness of test tasks. Speededness refers to the extent to which time available to complete test tasks is constrained. According to Nunnally and Bernstein (1994), time constrains introduce speededness into a test when less than 90% of a sample completes all items. While substantial correlations were found under speeded conditions, essentially no intelligence–creativity relationship was observable under unspeeded conditions. The authors stressed the importance of unspeeded assessment conditions in creating a non-evaluative, game-like environment, which they consider a necessary condition for creativity assessment (Kogan, 2008). It is important to note that with increasing speededness of the tasks, mental speed is likely to become more influential on task outcomes because faster processing of information is advantageous when time is limited. For reasoning ability, Wilhelm and Schulze (2002) demonstrated the influence of test speededness on construct validity and the contribution of mental speed. In their study, they found that the variance of speeded reasoning could be