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Exploring the relationships between analogical, analytical, and creative thinking

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ABSTRACT

The purpose of this research study was to examine the relationships between analogical, analytical, and creative thinking and other relevant issues through a carefully constructed and self-designed instrument. Participants were 287 six-graders living in an urban area of Taiwan. Major findings are shown as follows. Whereas three factors with larger-than-one eigenvalues were extracted, the *g* factor can be considered existing in the present study because the variance explained by the first principal factor was much larger than those explained by the other two. The two types of novel analogies were significantly and negatively correlated with each other. Analogical thinking straddles both the fields of analytical and creative thinking. Of the four analogy subscales, the traditional analogical-verbal section was most capable of predicting analytical thinking, creative thinking, and academic achievements. Discussions of the findings were presented in the context of the existing literature.

1. Introduction

Not merely a type of figurative language, analogy is currently considered the core of cognition (Gentner & Kurtz, 2006; Hofstadter, 2001). Analogy is ubiquitous but not many people notice its existence, much less its subtlety. Employing prior experiences in problem solving, learning through comparison (Gentner & Smith, 2012), and the case method in business (Gavetti & Rivkin, 2004) are all important instances of analogy. Gentner, Brem, Ferguson, Wolff, Markman, and Forbus (1997) also pointed out the usefulness of analogy in scientific inventions. Because of analogy's importance and ubiquity, it is edifying to find out the relationships between analogical thinking and other kinds of thinking. However, there is a paucity of research that addresses this issue. The present study aimed to explore its relationships with analytical and creative thinking and relevant questions to add to the insufficient literature in this field.

1.1. What is analogy?

Analogy is a process of establishing correspondences between concepts from different fields of knowledge (Doumas, Hummel, Sandhofer, 2008; Gentner & Smith, 2012). Technically, analogical thinking involves mapping two domains or situations and bringing across inferences from the more familiar domain to the less familiar domain. Mapping requires aligning two domains based on their commonalities. The two domains are referred to as analogs. Of the two domains, the

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more familiar or concrete one is also called the base or source, while the less familiar or more abstract one is the target or topic. In general, bases help us explain or better understand targets, for inferences are drawn from bases to address targets (Gentner, 2010; Gentner & Smith, 2012). Moreover, it is the relational or structural similarity that analogical thinking depends on. Matching surface or obvious properties is not necessary for analogy. Analogical thinking can thus be succinctly defined as "the ability to perceive and use relational similarity (Gentner & Colhoun, 2010, p. 35).

Analogies differ tremendously in their content, appearance, and usage (Gentner & Smith, 2012). Nonetheless, most of them follow some principles. The principle of one-to-one correspondence denotes that each element in the base is mapped to one and only one element in the target. The connectivity principle suggests that if two predicates or relations are matched, their arguments also correspond with each other (Gentner, 2010). The systematicity principle indicates people's tendency to choose large, deeply interconnected systems during merge processes, rather than isolated coincidental matches. In other words, when more than one possible interpretation is derived from a certain analogy, the more systematic interpretation is favored. "Our desire for systematicity reflects an implicit preference for analogies that are highly informative and have inferential power" (Gentner & Smith, 2012, p. 132).

1.2. Analogy and analytical thinking

Traditional intelligence tests are mainly assessments of analytical thinking abilities (Sternberg, 2003a). From the fact that analogy items are frequently used in the IQ test, we can assume that analogical and analytical thinking are closely related. The standard structure of the analogy test items in the multiple-choice format is A:B = C:D (e.g., Glove is to hand as sock is to foot). According to Sternberg (2002, 2006), analytical thinking involves abilities to (1) take apart a problem and understand its parts, (2) explain the functioning of a system, the reasons why something happens, or the procedures of solving a problem, (3) compare and contrast two or more things, or (4) evaluate and critique the characteristics of something. Obviously, comparison is integral to analytical thinking. On the other hand, comparison is also a signature mechanism in the analogical thinking because during comparison a process of alignment occurs between two represented situations, whereby the common relational structure is made more salient (Gentner, 2010).

1.3. Analogy and creative thinking

Analogical thinking is a key process in problem solving and scientific discoveries (Gentner & Smith, 2012). Gentner et al. (1997) made a good use of the works of Kepler to illuminate the processes whereby analogy brings about creativity and changes in knowledge. They continued to argue that distant analogies Kepler used many times could develop a new framework in a certain domain or even form a new domain (e.g., the new science of astrophysics formed by Kepler). In contrast, local or close analogies could be used to fill in a framework in a rather well agreed-on field. As implied in the description above, the more distant the analogies, the more creative the outcomes.

Analogical thinking is the pivot of many theories of creativity. Mednick's (1962) associative theory is an exemplar, which points out that creativity entails a particular sort of response, bringing together apparently irrelevant or remote ideas. As described earlier, analogy is a process of establishing correspondences between concepts from different domains. "Bringing together" can be seen as establishing correspondences or mapping and "irrelevant or remote ideas" can be viewed as concepts coming from different domains. In other words, Mednick's associative theory refers to transcending surface similarities and identifying a common relational system between two seemingly different domains. Likewise, Koestler (1978) proposed the term bisociation—"perceiving a situation or event in two mutually exclusive associative contexts" (p. 130). This term was coined to distinguish the inflexible thinking fixed on a single plane from the creative thinking operating on more than one plane. The highest level of creative achievement is represented by "the endeavor to bridge the gap between the two planes" (p. 146). "To bridge the gap" can be regarded as establishing a common relational structure through mapping and "two planes" as two domains or analogs. Furthermore, analogy is the mainstay of Gordon's (1961) synectics, which includes four kinds of analogical methods (i.e., direct, personal, fantasy, and symbolic analogy) applied in problem solving.

1.4. Creative and analytical thinking

Creativity and intelligence, which is primarily measured by analytical thinking abilities, are in general regarded as different constructs with a small amount of overlap (Kaufman & Plucker, 2011; Kim, Cramond, & VanTassel-Baska, 2010). According to his own research findings, Cropley (1968) contended that creativity and intelligence are two independent psychological constructs. Torrance (1980) noted low correlations between creativity and intelligence scores. Similarly, Renzulli (1986) makes distinction between schoolhouse giftedness and creative/productive giftedness, based on high intellectual and creative abilities, respectively. As pointed out in Batey and Furnham's (2006) literature review, IQ can just explain less than 10% of the variance in creativity scores. In a meta-analysis on the relationship between creativity and intelligence conducted by Kim (2005), an average weighted effect size of $r = .174$ was proposed. However, several creativity researchers, like Silvia and Beaty (2012) and Nusbaum and Silvia (2011), argued that the relationship between creativity and cognitive abilities was underestimated and needed to be revisited. If the argument that overlap between creativity and intelligence is minor is correct, an exploratory factor analysis (EFA) on the test scores concerning both analytical and creative abilities may not result in a predominant first factor (a *g* factor).