



FACTOR ANALYSES CREATIVITY

Factor analyses are used to study patterns and relationships among many variables, with the goal of discovering the nature of such variables, their dependence and independence, even though some variables may not be measured directly. Factor analyses have been used to study patterns and relationships among the variables that characterize intelligence and creativity in individuals. Researchers using factor analyses have most often concluded that creativity and intelligence are separate constructs and that typical intelligence tests do not measure creativity. Therefore, creativity tests, such as the Paul Torrance's Torrance Tests of Creative Thinking (TTCT), were developed and have been widely used as a measure of creative potential. Factor analyses of the results of these tests most often indicate creativity itself has two or more dimensions usually modeled with Michael Kirton's *adaptor-innovator theory of creativity*. This entry describes multifactor, single-factor, and two-factor models, as well as additional research.

Multifactor Model

J. P. Guilford, a prominent early researcher in the field of creativity, based his research on creative thinking on factor analyses. His theory of intelligence and creativity dominated the factor analytical approach regarding creativity in the 1960s and 1970s. Seeking the underlying factors in the ability to answer test questions with alternate solutions,

he described the overall factor of divergent production as a creative operation.

Guilford's *structure of intellect model* has three dimensions: operation, content, and product. The first dimension, operation, has five categories: cognition, memory, divergent production, convergent production, and evaluation. The second dimension, content, has four categories: figural, symbolic, semantic, and behavioral. The third dimension, product, has six categories: units, classes, relations, systems, transformations, and implications. The intersection of these dimensions provides 120 hypothetical three-dimensional intellectual factors.

Creative problem-solving ability consists of a number of factors: sensitivity to problems (the ability to recognize problems), fluency (the ability to produce many ideas), flexibility (the ability to shift in approaches), and originality (the ability to produce novel or uncommon answers). The operation factor of divergent production is the most important to creative problem-solving ability. Divergent production can be combined with a product and a content category in 24 separate ways that combine into and define divergent thinking. Guilford's concepts of fluency, flexibility, and originality became the basis of TTCT, one of the best known and widely used measures of creativity.

Guilford concluded that intelligence is not unitary but a cluster of specific intellectual abilities. Divergent production is one operation of intellect, which makes creativity a subset of intelligence. However, creative abilities are not measured by conventional intelligence tests that require convergent operations to

produce a single correct answer to multiple-choice questions. Guilford subjected the scores of numerous people on intelligence tests to a factor analysis and found zero correlation between most of the factors of intelligence and reaffirmed that intelligence is a composite of many distinct factors.

Many researchers have come to the conclusion that creativity consists of several psychological factors because of Guilford's proposition that divergent thinking consists of distinct factors including fluency, flexibility, and originality. Similarly, Torrance discouraged the use of composite TTCT scores and warned that using a single score is misleading because each subscale score has an independent meaning.

Single-Factor Models

Several factor analytic studies have concluded that creativity is one dimensional within divergent thinking tests, which are the most commonly used estimate of creative potential. Several researchers have concluded that Torrance's TTCT and Guilford's divergent thinking tests measure only one dimension rather than several independent dimensions. Most researchers concluded that only fluency measures truly represent divergent thinking and that flexibility and elaboration scores have more in common with convergent thinking. Another researcher, however, noted that resistance to premature closure explained the highest amount of the variance in the creativity index (a general indicator of creative potential) of the TTCT. Several other researchers also concluded that the scores of the TTCT primarily reflected one general factor.

Two-Factor Models

Recently, however, a two-factor model of creativity, based on Kirton's adaptor-innovator theory, has been found to be a better fit than are one-dimensional models. Using the TTCT, Kyung Hee Kim and her colleagues found that the two-factor model provided a much better fit than did a model that assumes one general factor. Michael Kirton's adaptor-innovator theory postulates that some creativity is merely adaptation of previous experiences and some creativity is truly innovative. The factor measuring "innovative" creativity was measured by combining fluency and originality scores

on the TTCT, and the factor measuring "adaptive" creativity was measured by combining elaboration and abstractness of titles scores; however, resistance to premature closure was also used in both adaptive and innovative factors. The double loading by resistance to premature closure is consistent with Torrance's theory that creative people keep their minds open long enough to make mental leaps, whereas less creative individuals tend to leap to conclusions prematurely. In addition, Kirton postulated that innovators prefer to create change by threatening the paradigm, but adaptors prefer to create change by working within existing paradigms. Further, Torrance and others have found that innovators are significantly more fluent and original. Other researchers have also found that innovators gravitate toward creativity that was original, transformational, and expressive, whereas adaptors are linked to creative endeavors that were logical, adequate, and well crafted. This two-factor approach supports the informal classification of the two types of people found by the scoring experiences of the TTCT: one type produces quick and novel responses and scores better on fluency and originality, whereas the other type gives detailed responses, which indicates greater depth of thought, and scores better on elaboration and abstractness of titles.

Creativity researchers have emphasized that creativity consists of two separate elements, originality and adaptiveness. Originality is not a sufficient indicator of creativity because social value, aesthetic appeal, and appropriateness are also necessary. By itself, originality may be characterized as bizarre and inappropriate work or behavior. Thus, the original idea or product must prove adaptive in some sense. The recipients of that idea or product, rather than the originator, judge an original idea or product as adaptive.

The main elements of innovative factors are fluency and originality, according to Kim and her colleagues' factor model. Fluency, the number of ideas generated, is thought to be related to originality because many researchers have reported high correlations between fluency and originality. Some researchers have concluded that a person's originality is a function of the number of ideas formulated (e.g., the more ideas are generated, the more likely original ideas are generated). However, Torrance concluded that even though fluency may

increase the chance that original ideas will be produced, there is no guarantee that this will occur.

Additional Research

Several factor analyses done on divergent thinking tests other than the TTCT have yielded more than one factor and contradict the idea that creativity is one-dimensional within divergent thinking tests. A researcher factor-analyzed a modified version of the Remote Associates Test and a battery of tests of creativity and yielded a two-factor model in which fluency and originality loaded on Factor 1 and other creativity indexes loaded on Factor 2. Another researcher factor-analyzed the Creative Product Semantic Scale and yielded a three-factor model with Resolution, Novelty, and Elaboration and Synthesis. Another researcher factor-analyzed the TTCT-Figural and Verbal and two creative interest inventories, How Do You Think? and How Creative Are You?, and yielded a three-factor model with Interests and Attitudes, Verbal Divergent Thinking, and Figural Divergent Thinking. Several researchers factor-analyzed 30 measures of the Torrance Tests of Creative Thinking and yielded seven different factors.

Several factor-analysis studies support Guilford's conclusion of creativity as a separate factor from intelligence. He concluded that the correlations between divergent thinking tests and intelligence tests scores are generally quite low. Although above average intelligence is necessary for doing well in divergent thinking tests, high intelligence is not necessary. Two researchers factor-analyzed 11 divergent tests, 4 nondivergent tests, and 2 IQ tests and found that creativity and intelligence are separate factors. A researcher factor-analyzed the Lorge-Thorndike Intelligence Tests and five creativity tests including Jacob Getzels and Philip Jackson's Uses tests, the Word Association Test, the Make-up Problems test, and Torrance's Circles Test and Incomplete Figures Task and yielded a three-factor model with Verbal Intelligence, Reasoning, and Creativity. Another researcher factor-analyzed and yielded a three-factor model with Intelligence, Verbal Creativity, and Figural Creativity. Two researchers factor-analyzed the TTCT-Figural and Verbal, the Picture Interpretation Test, the Metropolitan Readiness Tests, and the California Test of Mental Maturity and yielded a

four-factor model with Intelligence, Academic Achievement, Figural Creativity, and Verbal Creativity. Thus, all these factor analyses have identified creativity and intelligence as separate factors. In addition, Kim's meta-analysis in 2005 indicated that the relationship between creativity test scores and IQ ($r = .17$) is negligible, which also supports the underlying belief that creativity and intelligence are separate constructs.

Several researchers, however, factor-analyzed Getzels and Jackson's data of 1962 and did not find any evidence that creativity is a separate factor from intelligence. One limitation is that Michael Wallach and Nathan Kogan concluded that creativity is distinct from intelligence but that the distinction only emerges if creativity tests are administered under untimed and gamelike conditions. Two researchers factor-analyzed Wallach and Kogan's data of 1965 and yielded a three-factor model with General Intelligence, Verbal Creativity, and Visual Creativity and confirmed that creativity and intelligence are distinct under untimed and gamelike conditions. Another researcher factor-analyzed 10 Wallach and Kogan tests using an unrotated principal component solution and yielded a single general component. Later, however, Kogan yielded a three-factor model with Creativity and two of Intelligence when he used rotated promax factor analysis. Two researchers factor-analyzed seven different data sets including Wallach and Kogan's data of 1965, Thomas Ward's data of 1968, Arthur Cropley's data of 1968, Richard Murphy's two data sets of 1973, creative achievement data and creative ability data, and J. A. Hattie's two data sets of 1980, gamelike situation data and testlike situation data, and confirmed creativity and intelligence as distinct. Kim's meta-analysis in 2005 found that the mean correlation coefficient between the Wallach-Kogan divergent thinking measures and IQ tests was statistically significantly ($p < .001$) lower than those between other creativity tests (e.g., the Guilford Tests, the Torrance Tests of Creative Thinking) and IQ tests. This may confirm that creativity factor is distinct from intelligence only when creativity tests are administered under untimed and gamelike conditions.

Kyung Hee Kim

See also Creativity, Definition; History of Creativity

Further Readings

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FAMILY ACHIEVEMENT

For centuries, people have recognized a connection between family life and achievement. Many psychologists and researchers have been fascinated with studying this link and finding out just which family characteristics coincide with individuals who achieve greatness. Although traditional research points to the dysfunctional family roots that lead to eminence, more recent research on happy and strong families demonstrates there is also reason to believe a functional and supportive family life encourages both individual and

family achievement. This entry discusses family qualities and achievement levels and enhancing family achievement and strengths.

Family Qualities and Achievement Levels

Family Demographic Correlates

For more than 30 years, Nick Stinnett, John DeFrain, Sylvia Asay, and several of their colleagues have studied more than 24,000 family members in the United States and 27 other countries around the world to find out which family characteristics make for a strong family unit and happy, successful family members. From completing such extensive work, they have learned that although demographic variables sometimes correlate with family well-being, family strengths largely have to do with the ways families function and not the internal structure of the family. Included in the strong families these researchers have worked with are two-parent families, single-parent families, stepfamilies, extended families, families with gay and lesbian members, families who have faced crises, parents who grew up in happy families, and parents who grew up in troubled families, among other demographic compositions. The authors also note that although each family has distinctive strengths and each culture has unique family strengths, considerable similarities exist between families and between cultures when it comes to family strengths and their development.

In their studies of happy families, Barbara Kerr and her colleagues have found likewise and have stated that no religion, class, or race holds a monopoly on family happiness. Though results from their work with happy family members indicate these families tend to have more members than the average U.S. family and that they tend to have both a father and mother present in the home, the families from the study were quite diverse. Of the 27 participating families, 4 had experienced divorce, 2 had endured an affair and a temporary separation, 1 included a mother with terminal cancer, 1 included an openly gay father who shared the household with the mother, and 1 had both a stepfather and father living in the same house with the mother and children.

However, although nearly any family structure can have strong and successful family members,