Creativity Research Journal
2006, Vol. 18, No. 1, 3–14

Can We Trust Creativity Tests? A Review of the Torrance Tests of Creative Thinking (TTCT)

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ABSTRACT: Dr. E. Paul Torrance, "Father of Creativity," is best known for developing the Torrance Tests of Creative Thinking (TTCT). The TTCT was developed by Torrance in 1966. It has been renormed 4 times: in 1974, 1984, 1990, and 1998. There are 2 forms (A and B) of the TTCT-Verbal and 2 forms (A and B) of the TTCT-Figural. However, in the scope of this review, only the TTCT-Figural was examined. The TTCT has been translated into more than 35 languages (Millar, 2002). It has become highly recommended in the educational field and is even used in the corporate world. It is the most widely used test of creativity (Davis, 1997) and is the most referenced of all creativity tests (Lissitz & Willhoft, 1985). Basic information is presented, including purposes, content area, norms, reliability, and validity. Strengths and weaknesses of the TTCT, including use of the TTCT in identifying gifted learners and suggestions for further development and improvement, are provided and discussed.

"E. Paul Torrance was an international leader in creativity research and was best known for developing the Torrance Tests of Creative Thinking (TTCT), which are used in the business world and in education to assess individuals' capacity for creativity" ("E. Paul Torrance, 87," 2003, p. B13).

Torrance (1966, p. 6) defined creativity as

> a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results.

The TTCT does not entirely operationalize Torrance's definition of creativity (Chase, 1985); however, Torrance neither concluded that his tests assess all dimensions of creativity, nor did he suggest that they should be used alone as a basis for decisions (Treffinger, 1985). Torrance (1974) stated that showing a high degree of these abilities on the TTCT does not guarantee a person's chances of behaving creatively. According to Torrance (Torrance, 1990, 1998; Torrance & Ball, 1984), creative motivation and skills as well as creative abilities are necessary for adult creative achievement to occur.

The TTCT-Verbal and the TTCT-Figural are two versions of the TTCT. The TTCT-Verbal has two parallel forms, A and B, and consists of five activities: ask-and-guess, product improvement, unusual uses, unusual questions, and just suppose. The stimulus for each task includes a picture to which people respond in writing (Torrance, 1966, 1974). The TTCT-Figural has two parallel forms, A and B, and consists of three activities: picture construction, picture completion, and repeated figures of lines or circles. For the purposes of this article, only the TTCT-Figural will be discussed. Ten minutes are required to complete each activity. In Activity I, the subject constructs a picture using a pear or jellybean shape provided on the page as a stimulus. The stimulus must be an integral part of the picture construction. Activity II requires the subject to use 10 incomplete figures to make an object or picture. The

This is a version of a paper presented at the 8th Asian-Pacific Conference on Giftedness held in Daejeon, Korea, July 26–30, 2004.

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last activity, Activity III, is composed of three pages of lines or circles that the subject is to use as a part of his or her picture (Torrance, 1966, 1974, 1990, 1998; Torrance & Ball, 1984).

Torrance (1966) recommended the creation of a game-like, thinking, or problem-solving atmosphere, avoiding the threatening situation associated with testing. His intent was to set the tone so that the expectation that examinees would enjoy the activities was created. Examinees should be encouraged to "have fun" and should experience a psychological climate that is as comfortable and stimulating as possible. Thus, according to the administration of the TTCT in the manual (Ball & Torrance, 1984), administrators of the tests should invite the examinees to enjoy the activities and view the tests as a series of fun activities, thereby reducing test anxiety.

The TTCT can be administered as an individual or group test from the kindergarten level through the graduate level and beyond. It requires 30 min of working time, so speed is important, and artistic quality is not required to receive credit (Chase, 1985). Scholastic Testing Service, Inc., holds the copyright for the TTCT and has provided a 1998 norms manual for the test.

Purpose

The TTCT was part of a long-term research program emphasizing classroom experiences that stimulate creativity (Swartz, 1988). Torrance is readily identified with his eponymous tests of creativity, but assessment of creativity was not one of Torrance's goals. Torrance's main focus was in understanding and nurturing qualities that help people express their creativity. The tests were not designed to simply measure creativity, but instead to serve as tools for its enhancement (Hébert, Cramond, Neumeister, Millar, & Silvian, 2002). Torrance (1966, 1974) suggested the following uses for the tests:

1. To understand the human mind and its functioning and development.
2. To discover effective bases for individualizing instruction.
3. To provide clues for remedial and psychotherapeutic programs.
4. To evaluate the effects of educational programs, materials, curricula, and teaching procedures.
5. To be aware of latent potentialities.

In other words, although the tests have been used mostly for assessment in the identification of gifted children, Torrance originally planned to use them as a basis for individualizing instruction for different students based on the test scores (Torrance, 1966, 1974). The test may yield a composite score (the Creativity Index[CI]), but Torrance discouraged interpretation of scores as a static measure of a person's ability and, instead, argued for using the profile of strengths as a means to understand and nurture a person's creativity (Hébert et al., 2002; Torrance, 1966, 1974, 1979). Thus, the purposes of the TTCT are for research and experimentation, for general use, for instructional planning, and for determining possible strengths of students.

Content Areas

Guilford (1956, 1959, 1960, 1986) considered creative thinking as involving divergent thinking, which emphasizes fluency, flexibility, originality, and elaboration. Guilford, however, noted that creative thinking is not the same as divergent thinking, because creativity requires sensitivity to problems as well as redefinition abilities, which include transformations of thought, reinterpretations, and freedom from functional fixedness in driving unique solutions. Although there have been several revisions of the TTCT-Figural manual, the test itself has remained unchanged. The first edition in 1966 measured fluency, flexibility, originality, and elaboration, which were taken from the divergent-thinking factors found in Guilford's (1959) Structure of the Intellect Model (Baer, 1997; Torrance, 1966). The second edition measured the same four scoring variables as that of 1966 (Torrance, 1974).

The stimuli of the TTCT of 1984 are identical to those of 1966 and 1974, but the scoring procedures were changed in the third edition, the TTCT of 1984. Chase (1985) criticized earlier editions of the TTCT because of a lack of empirical basis for the scoring decisions caused by the subjectivity of scoring. However, the scoring system has been improved since the 1984 edition, because Torrance (Ball & Torrance, 1984) enhanced the scoring of the TTCT by designing a streamlined scoring system. The TTCT-Figural manual has presented a simplification of the scoring procedures

and has also provided a detailed scoring workbook (Ball & Torrance, 1984) in addition to the Norms-Technical Manual.

Two norm-referenced measures of creative potential, abstractness of titles and resistance to premature closure, were added to fluency, originality, and elaboration; the measure of flexibility (scored by the variety of categories of relevant responses) was eliminated because it correlated very highly with fluency (Hébert et al., 2002). The five subscales are listed as follows, with descriptions of each subscale and information about scoring and the content measured (Torrance & Ball, 1984; Torrance, 1990):

- Fluency: The number of relevant ideas; shows an ability to produce a number of figural images.
- Originality: The number of statistically infrequent ideas; shows an ability to produce uncommon or unique responses. The scoring procedure counts the most common responses as 0 and all other legitimate responses as 1. The originality lists have been prepared for each item on the basis of normative data, which are readily memorized by scorers.
- Elaboration: The number of added ideas; demonstrates the subject's ability to develop and elaborate on ideas.
- Abstractness of Titles: The degree beyond labeling; based on the idea that creativity requires an abstraction of thought. It measures the degree a title moves beyond concrete labeling of the pictures drawn.
- Resistance to Premature Closure: The degree of psychological openness; based on the belief that creative behavior requires a person to consider a variety of information when processing information and to keep an "open mind."

Thirteen criterion-referenced measures, which Torrance called creative strengths, also were added to the scoring (Torrance, 1990; Torrance & Ball, 1984). The creative strengths are emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines or circles, unusual visualization, internal visualization, extending or breaking boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy.

To get a CI, the standard scores of each of five variables are used according to the TTCT Norms-Technical Manual (Torrance, 1998). Raw scores are converted into standard scores with means of 100 and standard deviations of 20. The standard scores of each subscale can be ranged as follows: fluency, 40–154; originality, 40–160; elaboration, 40–160; Abstractness of titles, 40–160; resistance to premature closure, 40–160. The standard scores for each of the five norm-referenced measures are averaged to produce an overall indicator of creative potential. For the frequency of creative strength, a + or ++ is awarded on the basis of the scoring guide. The number of +s is added (range for Creative Strengths: 0–26) to the averaged standard scores to yield a Creative Index (Torrance, 1998).

Torrance added these subscales based on information that was unavailable when he originally developed the TTCT in 1966, because of his concern that the norm-referenced score was not measuring the breadth of creativity manifestations he had observed (Hébert et al., 2002; Torrance, 1979). He used continued research to expand his test, including studies of the creative giants, personality studies of creative people, creativity training guides, his own studies, and other literature in the field. Torrance (1979, 1988, 1994; Torrance & Ball, 1984) also provided evidence to show that the new subscales were valid predictors of creative achievement and that they improved the test's validity. Content and construct validity of the scoring variables have been studied in a factor-analytic study (Mourad, 1976), a comparative study (Rungsinan, 1977), a developmental study (Ali-el-din, 1978; 1982), and Torrance's *The Search for Satori and Creativity* (1979). According to Johnson and Fishkin (1999), the TTCT's revised scoring system addresses essential constructs of creative behaviors reflective of Torrance's (1988) definition of creativity. Therefore, Torrance showed that the TTCT is not only a divergent thinking test but also a creativity test as of the 1984 revisions.

Norms

The 1998 TTCT manual provides norms generated in the summer of 1997 and includes both grade-related (kindergarten through Grade 12) and age-related norms (ages 6 through 19). Samples included 55,600 kindergarten through 12th-grade students from the central (3.6%), northeast (11.4%), southeast (15.2%),

and western (57.6%) regions in the United States and other areas, including Canada (2.2%; Torrance, 1998). These groupings are used by the National Assessment of Educational Progress, the U.S. Department of Commerce, and the National Education Association. The central region was somewhat undersampled, and the western region was oversampled. Although the TTCT has been used in more than 35 countries for research purposes, there have been fewer authorized versions for which the developers have developed (or been developing) country norms. Among those are Brazil, France, Italy, Portugal, Saudi Arabia (and the Arabic countries), Slovenia, Taiwan, Turkey, and Korea (under development). In each of these countries, the norms were developed by the local author (J. Kauffman, vice president of Scholastic Testing Service, Inc., personal communication, January 25, 2005). In addition, norms for many other countries either have been either or are being developed for research purposes.

Reliability

According to the TTCT-Figural Manual of 1998, the reliability estimates of the creative index from Kuder–Richardson 21 using 99th percentile scores as the estimates of the number of items ranged between .89 and .94. The TTCT-Figural Manual of 1990 states that the interrater reliability among the scorers for Scholastic Testing Service, Inc., was greater than .90. Samples included 88,355 kindergarten through 12th-grade students in the United States from the south (41.4%), northeast (28.5%), north central (5.1%), and west (5.1%), as well as some students from Canada (Torrance, 1990).

According to the TTCT manuals of 1966 and 1974, the test–retest reliability coefficients have ranged from .50 to .93, which is not so high. Torrance (1974) indicated that motivational conditions affect the measurement of creative functioning, which could explain the low test–retest reliability. Treffinger (1985) concluded that, given the complexity of creative thinking, the TTCT can be seen as having reasonable reliability for group and research applications.

Validity

The preliminary studies were conducted examining the predictive validity of the TTCT including elementary education majors (Torrance, Tan, & Allman, 1970), seventh-grade students (Cropley, 1971), and economically disadvantaged elementary school Black children (Witt, 1971), which increased the TTCT's credibility as a predictor of creative productivity (Hébert et al., 2002). However, four points of data that were collected from two elementary schools and a high school provide the major body of longitudinal research on the TTCT. Beginning in 1958 and continuing through 1964, all students enrolled in grades 1–6 in two elementary schools took the TTCT each year. Beginning in 1959, all students enrolled in grades 7–12 of the University of Minnesota High School also took the TTCT.

The results of the follow-up of 46 high school students at a 7-year interval are as follows (Torrance, 1969, 1972). Three of the TTCT subscales (fluency, flexibility, and originality) correlated significantly (at the .01 level) with both quantity and quality of creative achievements, and the significant correlations ranged from $r = .39$ to .48. IQ (Iowa Test of Basic Skills, Lorge-Thorndike, or the Stanford-Binet Intelligence Scale) correlated ($r = .37$) with quality of creative achievements. The three TTCT subscale scores were better predictors of creative achievement than IQ, high school achievement, or peer nominations.

The results of the follow-up of 236 high school students at the 12-year interval indicated that all of the creativity predictors (fluency, flexibility, inventive level, elaboration, originality, and IQ [only for quality]) were found to be significant (at the .01 level), except IQ for quantity of creative achievements ($r = .06$, $p > .05$) and creativeness of aspiration ($r = .18$, $p \leq .05$) for girls (Torrance, 1972).

The results of the follow-up of 211 elementary school students at the 22-year interval are as follows (Torrance, 1980, 1981a, 1981b). The criteria used were number of high school creative achievements, number of post–high school creative achievements, number of creative style of life achievements, quality of highest creative achievements, and creativeness of future career image. The judges' interrater reliabilities obtained using Cronbach's alpha were .81 (Torrance, 1981b). Pearson product–moment correlation coefficients calculated between the CI from elementary school TTCT scores and each of the five criteria was significant (at the .001 level). A multiple correlation coefficient of .63 was obtained for the five criteria entered into a stepwise multiple regression equation (Torrance, 1981b).

The results of the follow-up of 99 elementary school students at the 40-year interval are as follows (Torrance, 2002). The predictors included IQ, fluency, flexibility, originality, elaboration, creative strengths, whether respondents had a mentor in 1980, and whether respondents had a mentor in 1998. The criteria used were number of publicly recognized creative achievements and quality of public achievements. The judges' interrater reliabilities obtained using Cronbach's alpha ranged from .78 to .88. IQ was a significant predictor of quantity ($r = .44$, $p \leq .01$) and quality ($r = .46$, $p \leq .01$) of creative achievements for females but not for males. Originality was a significant predictor of quality of creative achievements for both males ($r = .32$, $p \leq .05$) and females ($r = .40$, $p \leq .01$). Creative strengths was a significant predictor of quality for males ($r = .45$, $p \leq .01$), and both quality ($r = .41$, $p \leq .01$) and quantity ($r = .29$, $p \leq .05$) were significant predictors of quality for females. Having had a mentor in 1980 was a significant predictor of quantity ($r = .41$, $p \leq .01$) and quality ($r = .50$, $p \leq .01$) of creative achievements for females but not for males. Having had a mentor in 1998 was a significant predictor for both males ($r = .36$, $p \leq .05$) and females ($r = .40$, $p \leq .01$) for quality of creative achievements but not for quantity. Quantity and quality of creative achievements were highly correlated for both males ($r = .90$, $p \leq .01$) and for females ($r = .81$, $p \leq .01$). This showed the link between quantity of ideas and the production of quality of ideas (Hébert et al., 2002).

Torrance and Wu's (1981) study and Yamada and Tam's (1996) reanalysis and Plucker's (1999) reanalysis of Torrance's data concluded that the Creative Index was the best predictor for adult creative achievement. Plucker (1999) found that the standardized path coefficient from the TTCT to adult creative achievement was .60, whereas the standardized path coefficient from IQ scores (the Stanford-Binet Intelligence Scale, Wechsler Intelligence Scale for Children, or California Test of Mental Maturity) was .19.

In terms of concurrent validity, Gonzales and Campos (1997) studied the correlations between TTCT and the Spatial Test of Primary Mental Abilities (PMA) and the Gordon Test of Visual Imagery Control. The results indicated that imagery was significantly correlated with various aspects of creative thinking. Among those with IQ > 120, the correlation between originality and PMA was .36 ($p < .001$) and the correlation between originality and scores on the Gordon test was .30 ($p < .01$). The correlation between resistance to premature closure and PMA was .33 ($p < .001$), and resistance to premature closure and the Gordon test was .26 ($p < .01$).

In terms of construct validity, studies on the TTCT have shown conflicting results regarding its dimensionality (Chase, 1985; Clapham, 1998; Dixon, 1979; Heausler & Thompson, 1988; Hocevar, 1979a, 1979b; Hocevar & Michael, 1979; Runco & Mraz, 1992; Treffinger, 1985). Guilford (1959, 1962) conceptualized divergent thinking as multidimensional, and many researchers have hypothesized that creativity consists of several independent psychological factors. Torrance (1966, 1974) also encouraged the use of individual scale scores and warned that using a single score may be misleading.

However, Hocevar (1979a, 1979b) argued that the TTCT and Guilford's divergent thinking tests measure only fluency. Dixon (1979) was concerned that originality scores of the TTCT depended heavily on fluency scores. Abernathy Tannehill (1998) also considered the significant correlation between fluency and originality as the sign that the subscores of the TTCT may not measure independent constructs.

Hocevar and Michael (1979) found that the heterotrait–monomethod coefficients were too high compared with monotrait–heteromethod coefficients based on multitrait–multimethod analyses using the TTCT and Guilford tests, which suggests that these two tests lack discriminant validity. Runco and Mraz (1992) also criticized the lack of discriminant validity of the TTCT in a study including several other divergent thinking tests.

Heausler and Thompson (1988) concluded that the correlations among the subscales were so high that each subscale could not provide meaningfully different information. Chase (1985) suggested that the correlation coefficients among fluency, flexibility, and originality were so high (.74 to .80) that one single score could be appropriate for the three subscores. Thus, Treffinger (1985) warned that interpretations of TTCT subscores as if they were independent should be avoided. Hassan (1986) also concluded that there was no justification for considering creativity as composed of the distinct traits recommended by Torrance.

There are not many studies that have analyzed factor structures of the TTCT. One study modeled two components through a principal component analysis

and concluded that the scores of the TTCT primarily reflect one general factor (Heausler & Thompson, 1988). Clapham (1998) also concluded that there is only one general factor for the TTCT. Further, the result of a principal component analysis indicated that resistance to premature closure explained the highest amount of the variance in the CI.

Contrary to the research cited here, the results of confirmatory analyses (Kim, in press; Kim & Cramond, 2004) based on 500 sixth graders indicated that a two-factor model fits significantly better than a single-factor model. This study examined the possibility of a two-factor model based on Kirton's (1976, 1978, 1989) Adaptor–Innovator (A–I) Theory. According to Kirton (1978), innovators prefer to create change by threatening the paradigm, whereas adaptors prefer to create change by working within the existing paradigm. Factor innovative is loaded by fluency, originality, and resistance to premature closure, whereas factor adaptive is loaded by elaboration, abstractness of titles, and creative strengths. The factor models with and without creative strengths also were analyzed, because creative strengths had different procedures from the other subscales in scoring. However, this subscale is too important to be excluded from full explanations of the scores of the TTCT (E. P. Torrance, personal communication, October 30, 2002). The factor models without creative strengths fit better than those with creative strengths. This indicates that creative strengths might represent a separate factor. However, more indicators of the TTCT would be needed to test this model.

The high (.844) correlation between fluency and originality also was noted in Kim and Cramond's study (2004), as criticized by several researchers before. However, Torrance and Safter (1999) argued that the person who produces a large number of alternatives is more likely to produce original ones. Simonton (1990) also concluded that a person's originality is a function of the number of ideas formulated. Several longitudinal studies of the TTCT also have shown a link between the quantity of ideas and the quality of ideas that are produced (Hébert et al., 2002), as mentioned in the validity section.

Other studies (Kim, 2004a; Kim, Cramond, & Bandalos, 2004, in press) based on 3,000 kindergarteners, third graders, and sixth graders support a two-factor structure. In addition, the results of the multiple group analyses indicated that the latent structure of the TTCT showed more differences across grade-level groups than across gender groups. These findings are consistent with Torrance's conclusion (1977) that the TTCT-Figural was fair in terms of gender. These results also indicate that when TTCT scores are compared among different grade levels, more caution may be needed for interpretation.

Merits

Positive features of the TTCT include the wealth of information available on it, the short time needed for administration, and the ease of its administration (Swartz, 1988). It has fewer limitations and cautions to apply, and it is more researched and analyzed than any other creativity instrument (Johnson & Fishkin, 1999; Swartz, 1988; Treffinger, 1985). The TTCT-Figural has had 25 years of extensive development and evaluation (Millar, 2002). It has one of the largest norming samples, with valuable longitudinal validations (Davis, 1997) and high predictive validity over a very wide age range (Cropley, 2000). The standardized administration, scoring procedures and norms, and the development and evaluation (Davis & Rimm, 1994) have made the TTCT especially useful for identifying gifted and talented students. The TTCT-Figural can be fair in terms of gender, race, and community status, as well as for persons with a different language background, socioeconomic status, and culture (Cramond, 1993; Torrance, 1977). Torrance (1971; Torrance & Torrance, 1972) found that in most situations there are no statistically significant differences in performance on the TTCT because of race or socioeconomic status; in some cases, the TTCT favors Black children and children of low socioeconomic backgrounds.

Use in Identifying Gifted Learners

The most extensive use of the TTCT-Figural is for identification of children for gifted programs. The TTCT is a helpful addition to the assessment repertoire, because most measures for gifted identification are heavily driven by verbal and quantitative content (Torrance, 1977), largely measuring achievement and aptitude in those specific areas. Even teacher recommendation focuses more on the student's classroom performance than other kinds of potential. For these

reasons, the TTCT-Figural is valuable in that it allows another perspective on the student's ability that is vastly different from other aptitude and achievement tests. It also may be less biased for those who speak English as a second language (Torrance, 1977), because the test is not based on a student's ability to use the English language.

As an alternative to standardized testing, expert opinions are highly recommended for identifying gifted students by Baer (1993, 1994). Cramond (1994b), however, pointed out that experts might have failed to identify Van Gogh, Einstein, and Edison as gifted when they were children either because of a vested interest in the status quo or because of the children's lack of production in the field of their future success. Experts may find the child who is already succeeding in a field but are hard pressed to discover latent potential. Furthermore, such opinions are costly, and true experts are rare, especially in rural areas.

In practical situations, teacher nomination is one of the most common methods for identifying gifted students. However, teachers tend to prefer gifted children who are low in creativity to those who are highly creative (Anderson, 1961). Research has shown that teachers are apt to identify students who are achievers and teacher pleasers as gifted rather than creative students who may be disruptive or unconventional (Davis & Rimm, 1994; Oliphant, 1986; Rimm & Davis, 1976; Ritchie, 1980; Robinson, 1980). Even worse, energetic and unconventional students can be seen as having Attention Deficit Hyperactivity Disorder (ADHD) by their teachers (Cramond, 1994a). As a result of scholastic expectations and the needs of creatively gifted children, the potential of creatively gifted students may be overlooked by teachers who view them as "troublemakers" rather than successful young scholars.

Getzels and Jackson (1958) found that highly creative adolescents are estranged from their teachers and peers. Children with high IQs were rated by their teachers as more desirable, better understood, more ambitious, and more studious than children with high creativity (Torrance, 1962). Drews (1961) found that the studious achievers attained the highest teacher grades, whereas the creative intellectuals attained the lowest among three types of gifted high school students: social leaders, studious achievers, and creative intellectuals. In Whitmore's study (1980), when informed that children they had not recommended might be gifted, teachers usually volunteered information about the child's lack of the expected characteristics. Reasons included immature social and emotional behavior, lack of striving to achieve, and less productivity than other classmates.

Identification based on IQ scores may appear like an obvious way to identify gifted students in an educational system that favors conformity, but such a limited selection criteria risks allowing creatively gifted children to go unnoticed, thus leaving their needs unmet. Torrance (1962) was concerned that a great deal of creative talent goes unrecognized. Torrance (1960, 1962, 2002) concluded that if we identify gifted children only on the basis of IQ and scholastic aptitude tests, we are eliminating approximately 70% of the top 20% of creative students from consideration. According to Barron and Mackinnon's (Barron, 1961; Macckinnon, 1961, 1978) threshold theory, creativity and IQ are moderately related, but the relationship disappears for people with an IQ above 120. Walberg and Herbig (1991; Walberg, 1988) concluded that the very brightest, as identified by estimated IQ, are not necessarily the most creative.

To balance the risk of missing creative students that comes from identifying students by IQ only, an additional form of selection may be called for. The TTCT-Figural may be a less biased and more efficient method than expert opinions, which may be inaccessible, subjective, and expensive. It may also be less subjective and biased than teacher recommendations. Furthermore, the TTCT should be used to add highly creative students who may remain unnoticed in other ways, rather than to eliminate students who otherwise qualify for gifted education services (Torrance, 2002).

The TTCT is not usually used by itself to make high-stakes decisions on admission to gifted programs. As an example, according to the Georgia Department of Education (1998; Krisel & Cowan, 1997), to be eligible for gifted programs (a) a student must score either at the 99th percentile (for kindergarteners–2nd graders) or the 96th percentile (for 3rd –12th graders) on the composite or full-scale score of a standardized intelligence test and meet the achievement criteria or (b) qualify through a multiple-criteria assessment process by meeting the criteria in three of the following four areas: intelligence, achievement, creativity, and motivation. This indicates that creativity is one—not the only—criterion used to identify a gifted student. Because Torrance's purposes for developing the TTCT were for inclusion of students rather than exclusion of

students for individualizing instructional programs (Treffinger, 1985), the TTCT should be used for including students for gifted programs. An example of the merits of an inclusive system can be found in Georgia, where many school systems use the TTCT for their creativity measure in the selection of students for gifted programs (a student must score at the 90th percentile on the TTCT). Since Georgia adopted the multiple criteria selection process, more minority, disadvantaged, and other at-risk students have been placed in gifted programs than when Georgia merely used IQ scores (Williams, 2000).

Suggestions for Further Development

The TTCT-Figural appears to display adequate reliability and validity (Treffinger, 1985; Cooper, 1991) for the purposes of the test. However, reliability and validity information for the latest addition of TTCT-Figural (Torrance, 1998) have not been provided. This information is needed, because the new norm group may provide different reliability and validity than the 1990 norm group. This is an issue, because without reliability and validity, use of a test violates American Psychological Association standards of practice, particularly when a test is used as an instrument for making a decision for admission to a program.

Besides a lack of reliability and validity information in the latest version of the TTCT for the norm groups, demographic characteristics such as gender, race, community status, and speakers of English as second language were not outlined (e.g., Torrance, 1990, 1998). This omission could stem from the conclusion that the TTCT is fair in terms of race, socioeconomic status, and culture (Cramond, 1993; Torrance, 1971, 1977; Torrance & Torrance, 1972). However, such demographic information should be included at different time periods for each version of the TTCT, because latent structures could vary across different groups for each CI. This information could lead to a greater understanding of the TTCT, other creativity tests, the nature of creativity, and, ultimately, how to encourage creativity.

It is probable that the originality scores also would change among various demographics over time. The author questions the credibility of originality scores from 1998, which used the same lists as in 1984. It appears likely that the frequency of different responses would have changed between 1984 and the present. In addition, these responses may differ across cultures. The fact that one of Torrance's associates, Richard Johnson, found that originality is culture specific (Millar, 1995) supports this opinion. Saeki, Fan, and Van Dusen (2001) also noticed this difference among cultural groups when comparing Japanese and American responses. The experiences of the TTCT scorers also have confirmed that there might be cultural differences in the originality lists (Kim, 2004b). These studies suggested the creation and use of independent criteria for each group. The statistical frequency of various responses will vary among people from different cultures, which would bring misleading results if the TTCT-Figural were used in different cultures without adequate norm groups for each population and, subsequently, their own originality lists.

Some studies (Kwon, 1997; Kwon, Gotez, & Zellner, 1998) explored the development of a computer-based TTCT-Figural. Goff (2001) developed a brief version of the TTCT on compact disk, which is encouraging further development of the TTCT. Use of computer scoring would provide efficient and easy-to-understand interpretations of test results, especially when one considers the amount of time required for scoring the TTCT. It appears wise to carefully experiment with appropriate applications of the computer and Internet for future testing. In the computer-based TTCT studies (Kwon, 1997; Kwon, Gotez, & Zellner, 1998), the TTCT was interpreted in terms of time of response so that time-related information useful for understanding the creative thinking processes could be gathered; however, computer-based scoring was not conducted. Using a mouse to respond to the stimuli was reported to be more difficult and time-consuming compared with the paper-and-pencil TTCT. Further developments of the TTCT could include the use of a drawing pad instead of a mouse (Kwon, 1997; Kwon et al., 1998). In addition, computer-based versions of the TTCT should be studied to determine whether they yield equivalent scores as well as equal levels of reliability and validity as the original.

Torrance (1974) demonstrated that a variety of motivational procedures affect creative functioning, furthering the measurement of the abilities involved in creative thinking. For instance, rewarding creative behavior (Torrance, 1965a), stress and mental health (Torrance, 1965b), and teaching procedures and envi-

ronmental conditions (1966, 1974) can influence TTCT scores. Other researchers also concluded that motivation (Bamber, 1973; Halpin & Halpin, 1973), fatigue (Johnson & Fishkin, 1999), and testing conditions (Bamber, 1973; Callahan, 1991; Halpin & Halpin, 1973), as well as exposure to diverse information (Clapham, 2000–2001), influence TTCT scores. At the same time, however, these effects may be related to test reliability, depending on administration differences. Some studies (Iscoe & Pierce-Jones, 1964; Wallach & Kogan, 1965) indicated that creativity measures are influenced when creativity tests are administered as serious tests rather than as fun activities, especially for children in kindergarten or in the early grades. To address these issues, Torrance (1987) suggested using a warm-up activity before administration of the TTCT to arouse the incubation processes and increase motivation, thereby enabling creative energy. The use of a standardized warm-up activity that meets Torrance's criteria could enhance the test and minimize fluctuations caused by motivational factors. Guidelines for a specific activity included in the manual and treated as a part of the test would increase the likelihood that administrators would follow Torrance's suggestions.

Conclusion

Both Torrance (Treffinger, 1985) and Cropley (2000) suggested that, considering the multidimensional nature of the creativity concept, assessments should be based on several tests, rather than relying on a single score. A minimum of two measures to assess children's potential for creative behavior was recommended by Johnson and Fishkin (1999). I also recommend using at least two measures; that is, the TTCT and another indicator (e.g., products, performance, rating scales, or recommendations).

Torrance's research into creativity as a measure of intelligence shattered the theory that IQ tests alone can measure real intelligence (Powell, 2003; Shearer, 2003). The TTCT provided a physical measure and groundwork for the idea that creative levels can be scaled and then increased through practice—a premise that was previously only conceptual (Childs, 2003). The TTCT can provide useful insights into creativity as long as the tests are used with sensitivity and good judgment by qualified professionals (Treffinger, 1985; Swartz, 1988), because variations in testing procedures can affect scores (Swartz, 1988). To ensure qualified scorers, there are ongoing TTCT Scoring Trainings by the Torrance Center for Creativity and Talent Development at The University of Georgia and Scholastic Testing Service, Inc.

In conclusion, the TTCT appears to be a good measure, not only for identifying and educating the gifted but also for discovering and encouraging everyday life creativity in the general population. When used appropriately, the TTCT is an important part of Torrance's legacy and dream: to nurture and enhance creativity among students.

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