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Diverse Perspectives of Creativity Testing: Controversial Issues When Used for Inclusion Into Gifted Programs

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Abstract

Although it is important to include creative potential in the criteria for gifted programs, a review of the literature reveals creativity testing for this purpose to be a controversial topic. As creativity is a complex, multifaceted construct difficult to measure and operationalize, instruments purporting to measure creative abilities may lead to inaccurate assessments. The purpose of this article is to present and clarify some of the many conflicting perspectives of creativity testing in order for educators involved in gifted programs to make informed decisions about their use. Suggestions for measurement selection and alternative methods of assessing creative potential are offered.

Keywords

creativity, creativity testing, gifted programs

More than a decade ago, the U.S. Department of Education recognized that intelligence takes many forms, and their definition of giftedness included children with "high performance capability in intellectual, creative, and/or artistic areas" (U.S. Department of Education, 1993). Many school districts have incorporated creative potential, in addition to academic achievement, in their identification procedures for gifted programs. This is to be applauded as achievement tests do not measure creativity, and many

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hidden talents are rarely identified by typical classroom practices (Jarosewich, Pfeiffer, & Morris, 2002; Mann, 2006). Mann (2006) made a distinction between academic achievement and creative ability. He argued that restricting the search to the academically gifted "who perform well on timed standards-based assessments denies opportunities to the creatively talented that goes undiscovered because of lower levels of classroom achievement or limited educational experiences" (p. 247). Mann posited that although accuracy and a high level of procedural knowledge are important, without understanding and creative ability, they are of little use.

Clearly, innovative thinking should be included in the identification processes for gifted programs. To this end, many school districts have incorporated tests purported to measure creative potential. However, creativity testing for inclusion into gifted programs is a complex and controversial topic. Although researchers have made enormous strides in learning about the cognitive processes of innovation as well as the creative personality, psychometric testing for creative potential is inherently problematic due to the multifaceted complexity of creativity as well as the difficulty of operationalizing this construct. Opponents argue that measurement attempts may lead educators to assess students' creative potential in ways that are inaccurate (Hunsaker & Callahan, 1995; Piirto, 2004).

The purpose of this article is to present the many diverse perspectives and challenges of measuring creative abilities. They are offered to clarify some of the issues so that educators can make more informed decisions regarding the use and appropriateness of creativity tests. This article will begin with a review of the theoretical frameworks of creativity used to develop the first creativity assessments, followed by a brief review of subsequent creativity tests. Second, an overview of reliability and validity issues of the more popular creativity assessments will be presented. The third section will offer opposing views of creativity tests. The fourth section will present a summary of the various lenses researchers have used to study creativity and creative behavior. This is included to better understand the complex, multifaceted nature of creativity as well as to better understand some of the reasons underlying the testing controversy. Finally, implications for practice will be offered.

Theoretical Framework of Early Creativity Tests

Prompted by the Russians' launch of Sputnik, Guilford's (1950) presidential address to the American Psychological Association attempted to instill a patriotic zeal in the psychological community and challenged psychologists to explore the field of creativity. Considering the economic value of new ideas, he questioned why we did not produce more innovative thinkers and felt that much could be done to encourage creative development. However what was needed were tests to measure factors crucial to creative performance. Psychologists and educators heeded the call. For the last half century, much of the creativity research has focused on identifying the characteristics of eminently creative people in the arts and sciences and developing instruments for detecting potentially creative individuals.

Guilford's Divergent Thinking Theory of Creativity

A student of Tichner and influenced by Spearman, Guilford felt intelligence was too complicated to be categorized by a few mental abilities or one general "g" factor. According to Guilford (1967), every mental task included three ingredients: an operation (e.g., cognition, memory), a product (e.g., relations, implications), and a content (e.g., figural, semantic). His structure of intellect (SOI) model theorized that, through various combinations, there are 120 independent components of intelligence.

Unlike other models of intelligence, the SOI model included creative abilities with a focus on divergent production. Divergent production, considered an operation that could be combined with a product and content in 24 different combinations, was referred to as divergent thinking (Guilford, 1950, 1959).

Guilford (1950, 1959, 1967) construed creativity as a form of problem solving and created tests that searched for numerous novel answers to problems. He determined a number of factors involved in creative problem solving, including fluency (the ability to generate numerous responses), sensitivity to problems (the ability to recognize problems), flexibility (shifts in approaches to produce numerous ideas), originality (the ability to produce unusual ideas), and elaboration (to embellish ideas).

Researchers were enthused about the concept of ideational fluency, hoping that tests of divergent thinking would be more helpful than tests of academic skills to identify creative individuals. As distinguished people from the arts and sciences mentioned the free flow of ideas as part of the creative process, it was reasonable to use a component of idea fluency to measure creativity. It made sense to think that creative abilities could be enhanced by thinking of many different ideas. This theory became so prevalent that it was considered synonymous with creativity and became the foundation on which many succeeding creativity tests were based (Baer, 1993; Sternberg & Lubart, 1996; Weiner, 2000). In fact, Piirto (2004) argued that creativity tests should actually be called divergent production tests.

The SOI has undergone many modifications over the years. Meeker, a student of Guilford, reduced his original 120 cognitive abilities down to 26 and produced a commercial learning abilities test (SOI-LA), which has become a popular instrument used by many testing firms and consulting psychologists (Meeker & Meeker, 1985). The 26 subtests are each between 3 and 15 min in length. Of the 26 subtests, 3 assess dimensions of creative thinking and include a drawing test, a word test, and a symbolic relations test.

The drawing test has small rectangles with instructions to make something different in each square. Scoring is based on fluency, flexibility (set change), transformation (the ability to revise something into a new form), and originality. Points are given if each square has been filled. Transformation is scored if two or more squares are used in a drawing. Flexibility is scored if different ideas are produced in each box.

The word subtest requires the testee to write a story about a previously drawn picture. The story is assessed on fluency (word count) and originality (e. g., uniqueness of

words, theme, pun, humor, moral, poetry). The symbolic relations subtest assesses the ability to make relationships between letters and numbers and is scored for fluency, flexibility, and originality.

Subsequent Assessments

It is beyond the scope of this article to do a comprehensive review of creativity tests. However, a limited number will be included here to demonstrate the diverse theoretical perspectives of researchers when it comes to measuring innovative thinking and creative behavior. The tests presented here were chosen based on their popularity (cited in at least three sources), contributions to the field, targeted population, and availability of objective reviews (e.g., Mental Measurement Yearbook. For more extensive lists, see Center for Creative Learning, 2010; Cropley, 2000; Hocevar & Bachelor, 1989; Starko, 1995).

Torrance Tests of Creative Thinking (TTCT)

Many of Guilford's tests were expanded on by Torrance (Sternberg & O'Hara, 1999), whose seminal and prolific work has had a major influence on the field of creativity research. Torrance (1966) included Guilford's measures of fluency, flexibility, originality, and elaboration and added three figural subtests (e.g., how many different things can be drawn from an egg-shaped figure?) and seven verbal subtests (e.g., pictures for the participant to write about, an object such as a toy elephant for the participant to think about improving, and "just suppose" [e.g., clouds have strings that hang down to earth] questions on which the participant is asked to elaborate). Each subtest has a 5- or 10-min time limit. The scoring has gone through several iterations and in 1984, Torrance added scoring for Abstractness of Titles and Resistance to Premature Closure as well as 13 criterion referenced measures such as humor and fantasy (Ball & Torrance, 1984; Kim, 2006). The measure of flexibility was also eliminated at this time as it correlated so highly with fluency scores.

The TTCT became so popular that it was used in 75% of all published creativity studies using elementary schoolchildren and 40% of all published creativity studies using college students and adults (Baer, 1993). In addition, it has been translated into more than 35 languages (Millar, 2002). Although the TTCT has been the most widely used instrument of creative potential, assessment was not Torrance's primary goal. His purpose in developing the tests was for research, individualizing instruction, and understanding the components of creative thinking to nurture the creative ability of all students (Haensly & Torrance, 1990; Kim, 2006).

Wallach–Kogan Creativity Test (WKCT)

The WKCT (Wallach & Kogan, 1965) is similar to the TTCT in that it focuses on divergent thinking and assesses both visual and verbal content. It includes three verbal subtests—Instances (e.g., name all the round things you can think of), Alternative Uses

(e.g., for a newspaper), and Similarities (e.g., How are a cat and mouse similar?)—and two figural subtests—Pattern Meanings and Line Meanings (interpreting abstract patterns and lines). It is scored for fluency (number of ideas) and uniqueness (ideas not offered by others in the group being tested).

Wallach and Kogan's (1965) major contribution was their belief that standardized test procedures were not conducive to creative performance and their insistence on a more relaxed and game-like atmosphere. The test is meant to be given individually and no time limits are imposed. The test is not available from a publisher as it was reproduced in its entirety during development.

Remote Association Test (RAT)

Although Guilford (1950, 1959) argued that the key to innovation was divergent thinking, Mednick (1962)[1] created the RAT, which was loosely modeled after convergent thinking intelligence tests (Sternberg & O'Hara, 1999). Mednick posited that "any ability or tendency which serves to bring . . . mutually remote ideas into contiguity will facilitate a creative solution" (p. 222). In any given problem, the subject searches for a combination of elements and makes associations that will satisfy the given criteria. Mednick used the term *associative hierarchy* to describe the frequency of responses to certain words. For instance, if given the word "foot," most people would respond with the word "shoe" as opposed to "soldier." Less creative people, Mednick argued, would come up with stereotypical words that were reproduced frequently. More creative people would generate a larger number (thus, less frequently used words) of associations. Consistent responses with low frequency words would imply less adherence to the usual, a certain imaginative freedom, and therefore a more creative individual.

The RAT offers a series of three disparate words, and testees are asked to find a fourth word that links these words to form a new associative combination. For example:

wire heel ball

Another example:

electric high wheel

The task is to discover a word related to all three words. (The associative word for the first example is *high*. The associative word for the second example is *chair*.)

Creativity Assessment Packet (CAP)

The CAP by Williams (1980) was designed to measure the creativity of students in Grades 3 to 12. It includes the following three components: Exercise in Divergent Thinking, Exercise in Divergent Feeling, and the Williams Scale. The Exercise in Divergent thinking is a drawing test in which students are asked to work on 12 incomplete drawings and create a title. The end product is scored on fluency, originality, flexibility, and

elaboration. Titles are awarded points based on length, complexity, and humor. (This is similar to the TTCT picture completion task.) The Exercise in Divergent Feeling is a 50-item survey in which students rate themselves along a 4-point scale for characteristics such as curiosity, imagination, and risk taking. The Williams Scale is a 48-item rating instrument, completed by teachers or parents, that assesses the same creative traits as the other two components.

Khatena–Torrance Creative Perceptions Inventory (KTCPI)

First published in 1976 (Khatena & Torrance), the KTCPI is intended for individuals aged 10 to adult. The first part of this inventory includes a self-rating scale (What Kind of Person Are You?) designed to assess an individual's tendency to function creativity. It contains 50 forced-choice items requiring the testee to choose between pairs of characteristics representing high and low creativity (e.g., I give my whole attention to what I do/I am respectful and polite) and is scored on acceptance of authority, self-confidence, inquisitiveness, awareness of others, and imagination. The second part of this inventory is another 50-item self-rating personality scale (Something About Myself) designed as an autobiographical screening device (e.g., I have composed a dance, song, or musical piece) and is scored on environmental sensitivity, initiative, self-strength, intellectuality, individuality, and artistry.

The Creativity Checklist (CCh)

The CCh is intended for grades kindergarten to graduate school and is meant to identify the extent of creative behavior observed by others (Johnson, 1979). It was an attempt to focus not on cognitive abilities but to assess the creative personality within a social context. The author developed a checklist of eight behaviors (fluency, flexibility, skill, resourcefulness, ingenuity, independence, preference for complexity, and positive self-referencing) believed to be characteristic of the creative person. Items are scored on a scale from "never" to "consistently."

Scales for Rating the Behavioral Characteristics of Superior Students (SRBCSS)

Teacher reports can provide valuable information when included in assessments of creativity and can increase the validity of the identification process. The SRBCSS (Renzulli, Smith, White, Callahan, & Hartman, 1976) is a 96-item teacher rating scale covering a more expansive definition of giftedness that includes the following 10 characteristics: creativity, motivation, artistic, musical, dramatics, communication (precision), communication (expressive), planning, leadership, and learning. Four new scales were added in 2003 for Reading, Math, Science, and Technology. Intended for Grades K-12 students, the items are rated on a 6-point Likert-type scale from "never" to "always."

Torrance Checklist of Creative Positives (TCCP)

Torrance (1973) was aware that poverty can influence creative achievement, which propelled him to develop an extensive, nontest, unbiased checklist of indicators of creative ability that included criteria such as being able to express emotions (e.g., through writing or role-playing), perseverance (particularly in problem solving), expressive speech using metaphors and newly invented words, and the ability to improvise with commonplace materials. His checklist was meant to encourage creatively gifted, disadvantaged children.

Creative Product Analysis Matrix (CPAM)

Some researchers believe that creative people and processes can only be identified through their products, which themselves must be judged as creative. The CPAM is a scale developed to understand the characteristics of creative products across disciplines (Besemer & O'Quin, 1987). The authors proposed that groups of related attributes cluster along three dimensions for assessing creative products: novelty (original and surprising), resolution (valuable, useful, and solves a need or problem), and elaboration and synthesis (the product is well crafted, attractive, and elegant). Raters assess the dimensions using a 43-item, semantic-differential rating scale (e.g., elegant–inelegant and logical–illogical). Reliabilities of the three dimensions ranged from .69 to .87. This scale is also referred to as the Creative Product Semantic Scale (Cropley, 2000) and the Creative Product Assessment Matrix (Starko, 1995).

Student Product Assessment Form (SPAF)

The SPAF was developed by Reis and Renzulli (1991) to guide qualitative assessment of all types of student products. Raters use a 1 to 5 Likert-type scale to rate products (e.g., a solar collector, a book on skunks, and a documentary film) on different traits. It is scored on the following nine factors: Statement of Purpose (clearly defined the topic), Problem Focusing (clearly represents a specific problem), Level of Resources (using more advanced or complex materials), Diversity of Resources (resources beyond what is typically used), Appropriateness of Resources, Logic and Transition (does the product reflect and clearly present a logical sequence of steps?), Action Orientation (the purpose of the project is directed toward some action), Audience, and Overall Assessment (e.g., originality, quality, effort, and care).

Assessment Summary

It is clear that researchers hold various perspectives on creativity, on operationalizing its constructs, and on methods of measurement. Tests can focus on cognitive abilities, observable behavior, personalities, motivation, or products. Table 1 represents examples of tests attempting to measure diverse aspects of creativity. It is interesting to note the absence of measurements looking at the creative environment. We tend to overlook

Table 1. Creativity Characteristics and Test Examples

Measure	Characteristics	Sample tests
Process	Problem solving	CAP
Cognitive process	Divergent thinking	Paper and pencil
	Restructuring information	Self-rating survey
	Low cortical arousal	Objective item rating
	Making associations	RAT
		Paper and pencil
		SOI
		Paper and pencil
		TTCT
		Paper and pencil
		WKCT
		Paper and pencil
Person	Confident	CAP
Personality	Curious	Paper and pencil
	Resourceful	Self-rating survey
	Risk-taker	Objective item rating
	Expressive	CCh
	Tolerance for ambiguity	Objective checklistK
	Less inhibited	TCPI
	Self-accepting	Self-rating scale
	Self-aware	Autobiographical
	Unconstrained by stereotypes	SRBCSS
	Open to subconscious experiences	Objective checklist
		TCCP
		Objective checklist
Product	Novel	CPAM
Artifacts	Original	Objective rubric
	Socially useful	SPAF
	Well crafted	Objective rubric
	Sensitivity to gaps in knowledge	
Passion	Love of the process	KTCPI
Motivation	Perseverance	Self-rating scale
	Sustained effort	Autobiographical
		SRBCSS
		Objective checklist
		TCCP
		Objective checklist
Press	Supportive community	None available
Environment	Available resources	
	Function of time, place, culture	

Note: CAP = Creativity Assessment Packet; RAT = Remote Association Test; SOI = Structure of Intellect; TTCT = Torrance Tests of Creative Thinking; WKCT = Wallach–Kogan Creativity Test; CCh = The Creativity Checklist; KTCPI = Khatena–Torrance Creative Perceptions Inventory; SRBCSS = Scales for Rating the Behavioral Characteristics of Superior Students; TCCP = Torrance Checklist of Creative Positives; CPAM = Creative Product Analysis Matrix; SPAF = Student Product Assessment Form.

the importance of having available resources and support for developing creative potential. It is much easier to view creativity as a dichotomous variable, as something one either does or does not have. The next section will cover the reliability and validity of creativity tests.

Technical Information and Issues With Specific Assessments

Reliability of Creativity Tests

Early studies in the Torrance (1966) testing manual reported test–retest (1 week to 8 months) reliabilities ranging from .34 to .97. Other studies reported by Crockenberg (1972) showed nonsignificant reliabilities (–.29 to .33) when tested over a 2-year period. Low reliabilities were also reported by Wodtke (1964) and Cropley and Clapson (1971) who argued that the higher scores reported by Torrance frequently involved total scores rather than subscores, inflating the test–retest reliabilities.

However, reliability for the TTCT has improved over the years. More recent test–retest reliabilities of the TTCT were reported in the .60 to .80 range (Haensly & Torrance, 1990). In an overview of a number of various paper-and-pencil creativity tests, Cropley (2000) reported test–retest reliabilities to be in the .60 to .75 range.

In general, the test–retest reliabilities of the SOI figural subtests were low (.36 to .60 for the figural subtests and .27 to .55 for the word subtests) for a 2- to 4-week interval. For such a short interval, higher coefficients would be expected (Clarizio & Mehrens, 1985). For the SOI-LA, test–retest coefficients for the 26 subtests ranged between .35 and .88 with the divergent production coefficient being .65 (Cummings, 1989).

Kogan and Pankove (1972) found stability of scores for fifth graders when retested 5 and 7 years later using the WKCT. The KTCPI reported test–retest reliabilities on college students from .71 to .98 for periods up to 6 weeks (Callahan, 2005). For the SRBCSS, the test–retest reliability (3-month interval) was .91 for the Motivation subtest and .79 for the Creativity subtest (Jarosewich et al., 2002). The CAP reported reliabilities over 10 months to be in the .60s (Cropley, 2000).

Predictive Validity of Creativity Tests

There is some evidence to support the predictive validity of the TTCT. Between 1958 and 1964, Torrance gave almost 400 very able elementary school students (mean IQ of 118) his creativity test. In a follow-up study, 12 years later, approximately half completed questionnaires on quantity and quality of creative achievement and creative aspirations. The correlations between the criteria and the test subscales were between .27 and .45 and increased to .51 when the scores were combined (Torrance, 1969). Torrance argued that the creativity predictors (fluency, flexibility, elaboration, and originality) were better predictors of quantity and quality of creative achievement than intelligence test scores.

Torrance collected data (quantity and quality of creative achievement) in 1980, 22 years after the initial testing, and again in 1998, 40 years after the testing. Torrance (2002) reported coefficients between .38 and .58. Although low, he posited that these were adequate for predictive validity because motivation, life events, and opportunities were also factors that affected adult creative achievement.

Plucker (2000) used structural equation modeling (SEM) on the data Torrance collected in 1980 (n = 212, IQ M = 121) and found that composite verbal (but not figural) divergent thinking scores accounted for slightly under half the variance of creativity scores and concluded that divergent thinking tests were better cognitive predictors of creative achievement than intelligence test scores. Cramond, Mathews-Morgan, Bandalos, and Zuo (2005) also used SEM on Torrance's longitudinal data collected in 1998 (n = 80) and concluded that the creativity index, a combined TTCT score, was predictive of future creative production, explaining 23% of the variance in creative production. These authors also reported mediating factors such as gender and having a mentor.

Kogan and Pankove (1972, 1974) gave 5th graders (n = 162) the WKCT test and retested them (n = 101) 5 years later and again when they were high school seniors (n = 68). A self-assessed inventory of extracurricular activities and accomplishments was also administered. The divergent thinking tests given in the 5th grade did correlate to overall nonacademic accomplishment in the 10th grade but not when the students were seniors. The authors mentioned a number of mediating factors that affected correlation scores such as school size, individual versus group administration, general anxiety levels, and a high attrition rate.

Regarding the KTPCI, Schraw (2005) wrote that, although the test may provide useful indices about personality characteristics associated with creativity, one of the weaknesses of the test was a lack of predictive validity. There was also a lack of evidence for predictive validity for the SRBCSS (Jarosewich et al., 2002).

Content Validity of Creativity Tests

In an analysis of creativity tests, Cooper (1991) questioned the content validity of five of the six tests reviewed. She suggested that the items may be measuring analytical or critical thinking skills rather than other dimensions of creativity such as spatial or verbal talent. Regarding the SOI-LA, Cooper questioned the independence of the subtests as well as the fluency scoring for the word test, questioning whether 100 senseless words should get a higher score than 50 meaningful words. She also criticized the SOI-LA drawing test for its small rectangles and the writing tests for its narrow writing spaces. Both caused visual crowding and were too restrictive, which may inhibit creativity. Although not questions of content validity per se, they can affect scoring or hide the characteristics one is seeking to measure. Many researchers opposed the theoretical foundation of the SOI. Correlations between SOI types of tests and other measures of creativity are generally low, most likely because the materials on Guilford's tests have little resemblance to the types of tasks used to assess creativity (Sternberg & Grigorenko, 2000).

Regarding the RAT, some questioned whether this assessment measured creative ability or simply verbal proficiency (Treffinger, 2002). The RAT also assumed that

people have similar cultural and linguistic backgrounds, making the validity of this test questionable (Baer, 1993). However, the RAT did correlate highly (.70) with instructor's ratings of creativity in a university design course (Cropley, 2000).

Construct Validity of Creativity Tests

As for the SOI and SOI-LA, Cummings (1989) noted the many researchers who have questioned the theoretical adequacy of the SOI model. Clarizio and Mehrens (1985) posited that Guilford sliced the intellectual pie too thin and, even though Meeker reduced the original 120 factors down to 26, they concluded that the SOI model lacked adequate norms and had severe psychometric limitations. The SOI-LA was also severely criticized for lack of justification regarding scale development and interpretation, lack of adequate population norms, and high correlations between subtests (Coffman, 1985; Leton, 1985). Coffman (1985) wrote, "The reviewer looks in vain for what everybody seems to be saying is there—and finds nothing" (p. 1486).

The CAP has been severely criticized for its vague operational definitions; problematic scoring; and ambiguity concerning instrument construction, norms, validity, and reliability (Cooper, 1991; Damarin, 1985; Rosen, 1985). Rosen also felt the focus of the test was too narrow. Cooper noted that the drawing task begins by directing students to work fast, which might work against students who are more reflective.

Callahan (2005) and Bolton (1998) wrote that the validity of the KTPCI is difficult to interpret due to the lack of a theoretical framework for the creativity construct. Exactly what is being measured is somewhat ambiguous. Both authors also questioned the validity of self-report measures and believed that items requiring considerable reflection are a tenuous assessment strategy. Bolton also mentioned the issue of social desirability bias. Both authors concluded that the KTPCI should be limited to research purposes and not to identify gifted students.

The manual for the SRBCSS does not mention the developmental theory that guided test construction nor does it mention any quantitative method in scale construction (Jarosewich et al., 2002). The reviewers advised caution in using the scale, perhaps utilizing it for nomination but not elimination for a gifted program. There was also a lack of evidence to support the use of the CCh as an evaluation instrument, as validity data were inadequate and normative data were not reported (Dwinell, 1985; White Hawthorne, 1985).

Discriminant Validity of Creativity Tests

Creativity tests and intelligence tests appear to measure different cognitive processes. To establish discriminant validity between creativity and intelligence, there must be a low degree of correlation between the creativity subtest scores and traditional IQ scores. Researchers have reported some discriminant validity for both the TTCT (Crockenberg, 1972; Plucker, 2000) as well as the WKCT (Cropley, 1968; Cropley & Maslany, 1969; McKinney & Forman, 2006) because the within-trait correlations between the various subtests were somewhat higher than test–IQ correlations.

Regarding subscore correlations, even though Torrance deleted flexibility from the scoring because it correlated so highly with fluency, there were still concerns regarding the discriminant validity between the subtests. Kim (2006) reported a high correlation (.88) on the TTCT between fluency and originality and noted that those who produced a large number of responses were also more likely to produce original ones. Chase (1985) also questioned the subtest correlations of the TTCT and suggested that a single score might be satisfactory. The high correlation between number of responses and originality was also noted by Kogan and Pankove (1974) using the WKCT.

Using factor analysis on the scores of children, Heausler and Thompson (1988) similarly found that the correlations between the subscales of the TTCT were too high to offer meaningfully different information, and suggested that the scores reflected one general creativity factor. Using principal components analysis on scores of college students, Clapham (1998) also found that the subscores had little discriminant validity and concluded that one general creativity factor adequately represented the TTCT subscores. Although these researchers argued for one factor, Kim, Cramond, and Bandalos (2006) found that their factor analysis of the TTCT figural tests supported a two-factor model.

Generalizability

Although Torrance tested students with a range of abilities, it might be argued that the two Minnesota schools Torrance drew from for his longitudinal study were atypical (Millar, 2002; Plucker, 2000). They were considered progressive and creative places, the teachers were mainly doctoral students, one of the schools was on the university campus and the university administered the program, most of the students came from professional families and many were children of professors, acceleration was common throughout the schools, and the average IQ was more than 130. Clearly, these were not typical elementary schools. A similar criticism of using brighter students for creativity testing (Crockenberg, 1972; Wodtke, 1964) was directed at the WKCT when the research was restricted to college students at Duke University. Those high in idea production also had reasonably high IQs.

Some (Baer, 1993; Plucker, 2000) criticized Torrance's 12-year study using the TTCT as having a linguistic bias: The more one wrote, the higher the divergent thinking score. Because all three criterion variables involved writing answers, it is possible that students' test answers (e.g., list interesting and unusual uses for cardboard boxes) as well as their questionnaire answers (e.g., report quantity of creative achievement, quality of creative achievement, and aspirations) reflected a particular kind of writing ability and not necessarily real-world creative achievement.[2]

Statistical Assumptions

Piirto (2004) opposed the assumption of a normal curve for creativity scores and wrote that creativity is too amorphous a construct to be normally distributed. Plucker (2000) similarly wrote that scores on creativity tests are often nonnormally distributed, which violates the assumptions of many statistical procedures.

Alternative Views Regarding Creativity Tests

Creativity testing is a controversial and complex issue, and a distinction needs to be made between the tests themselves and testing for creative potential. Creativity tests have demonstrated a fair degree of reliability and validity; have merit in expanding, exploring, and helping to identify cognitive creative processes and behaviors; and can offer a piece of information regarding creative potential for some students. However, there are philosophical, theoretical, and data-driven arguments opposing the tests.

Predictive Validity

As for their predictive validity, a number of researchers have questioned the ability of creativity tests to accurately predict future accomplishments (Han, 2003; Hocevar, 1978; Policastro & Gardner, 1999; Treffinger, Renzulli, & Feldhusen, 1971; Wallach, 1976). In an overview of numerous creativity tests and checklists, Cropley (2000) reported relatively low predictive validity (coefficients around .50) and suggested this might be because the test tasks do not resemble real-life creative behavior. Addressing the discrepancy between the conditions of creativity testing and criterion measures of creative innovation, Wallach (1976) wrote,

> The greater the conceptual distance between the test and the performance to be predicted, the less reason there is to believe that the test will tell you what you really want to know. It will tell you about the person's response tendencies in situations that resemble the test rather than in situations that resemble the criterion . . . The premise that tests reflect the potential for achievement is false. (p. 57)

Csikszentmihalyi (1988, 1999), in his longitudinal study of art students, noted that some of the most potentially creative people ended up pursuing ordinary occupations whereas others, who demonstrated no outstanding potential, persevered and produced major creative achievements. Feist (2004) similarly argued that early childhood talent is by no means a sufficient condition or predictor of adult creative achievement. Even Torrance (1995) noted that there were students who had scored only moderately on his tests but had made substantial creative achievements in scientific fields.

Content Validity

Two decades ago, Sternberg (1985) wrote, "Many investigators of creativity would question whether creativity tests . . . measure anything even coming close to creativity" (p. 608). One of the problems that has plagued the field of creativity testing has been establishing definitions and criteria. As talent may manifest in a variety of ways, there is a lack of consensus pertaining to the skills and knowledge necessary for creative achievement (Cropley, 1972; Eisenberg, 2006; Hunsaker & Callahan, 1995; Treffinger et al., 1971).

Whereas some (Chen et al., 2005; Chen, Himsel, Kasof, Greenberger, & Dmitrieva, 2006) argue for a domain-general characteristic, others believe creativity to be domain relevant (Dow & Mayer, 2004; Kaufman & Baer, 2004; Rostan, 1998; Runco & Nemiro, 2003; Sternberg, 2006a; Sternberg & Lubart, 1995) and possibly even task specific within a domain (Baer, 1998, 2003; Rostan, 2005). Even in very young children, creative performance in one domain was quite independent of creative performance in another, and in some instances, there was even a negative relationship (Han, 2003). Perhaps there are some characteristics of the creative personality (e.g., being inquisitive, unconventional, and willing to take risks) and cognitive processes (e.g., seeing gaps in the existing knowledge and problem finding) that are found across domains, but each domain has its own unique set of skills and rules of accomplishment (Kaufman, Cole, & Baer, 2009; Piirto, 2004; Plucker, 2005; Sternberg, 2006b). Hu and Adey (2002) argued that a general creativity test will not do for assessing scientific creativity. Hunsaker and Callahan (1995) wrote that, although "single instruments may measure some aspect of creativity . . . no instrument is satisfactory as a total measure of the construct" (p. 113). Treffinger (2002) similarly wrote, "No single instrument or analytical procedure can capture the complex and multidimensional nature of creativity effectively and comprehensively" (p. 62). As it is difficult to agree on criteria, it is unlikely general creativity tests will ever have content validity (Cropley, 1992; Michael & Wright, 1989; Russ, 2003).

Divergent Thinking

Although creativity tests measure a number of components within the larger construct of creativity, some researchers have begun to question whether divergent thinking is a necessary component for creative thinking (Baer, 1993; Crockenberg, 1972; Michael & Wright, 1989; Piirto, 2004; Wallach, 1976). Both Treffinger et al. (1971) and Eisenberg (2006) cautioned against confusing concurrent validity with predictive validity. It is one thing to uncover distinguishing characteristics of eminent individuals and quite another to conclude that these traits will identify individuals with creative potential and that this potential will manifest in the future.

Weisberg (1986) noted that the most creative scientists did not have the best performances on divergent thinking tests. He used Darwin's notebooks concerning the development of his theory of evolution and Watson's research on the structure of the DNA molecule as examples illustrating that nothing similar to divergent thinking was used in these processes of discovery. Conversely, divergent thinkers may not necessarily exhibit creative talents. Han (2003) found that the most divergent thinker, who scored three standard deviations above the mean, did not demonstrate any creative ability in any of the criterion areas tested (art, math, and language). Runco (2002) similarly found that students who gave the most diverse ideas did not give the most original ones. In addition, links between talent and ideational fluency are tenuous, and for some kinds of talent (dramatics and music), no links were found at all (Cropley, 1992; Hocevar & Bachelor, 1989; Wallach, 1976).

Fluctuations in Creative Production

Testing conditions (Hattie, 1980) as well as instructions (Chen et al., 2005; Chen et al., 2006; Niu & Sternberg, 2003) affect test scores. What test takers think is being asked for has an effect on task perception, strategies used, and performance (Runco, Illies, & Eisenman, 2005). Lissitz and Willhoft (1985) found that modest manipulations in the form of experimenter comments (e.g., "be practical and reasonable" and "be weird or illogical") could affect creativity test performance of college students by as much as one standard deviation using the TTCT.

Perhaps a more important issue than reliability is the *merit* of a single score at one point in time. Numerous biographical and empirical studies have demonstrated that creative output (whether in product development or scientific breakthroughs) is not linear but vacillates in frequency. Guilford (1950) and Torrance (1995) were aware that the creative fluctuations in performance and motivation would result in low test–retest reliabilities. Others (Rostan, Pariser, & Gruber, 2002) also mentioned that skills, ability, interest, and motivation may or may not be present in any student at any one point in time. If creative output is sporadic and sensitive to external variables, then scores at a single point in time are rather meaningless. Clearly, there are opposing perspectives regarding creativity tests. To better understand the reasons for these diverse views, and to help in making better informed decisions regarding the assessment of creative potential, a brief review of the different lenses researchers have used to study creativity will be presented.

The Lenses of Creativity Research

Creativity cannot be studied as a purely individual phenomenon (Csikszentmihalyi, 1999). External variables such as social, cultural, and economic factors must be considered when explaining why, when, where, and how new ideas are created. Although there is no single agreed-on definition, theory, or perspective, researchers have generally investigated creativity through one of the following four lenses: the creative person, the creative product, the creative environment (often called "press" for the purpose of alliteration), and the creative process (Brown, 1989; Cropley, 2000; Taylor, 1988). Included here is an often overlooked fifth element: passion. A brief review of these concepts is necessary to understand the difficulty in assessing and measuring creative abilities as well as to better understand the controversy surrounding creativity testing.

The Creative Person

When referring to the creative personality, researchers have noted that exceptionally creative people are confident in their abilities and have a general lack of cognitive and behavioral inhibition (Eysenck, 1997; Feist, 1999; Martindale, 1989). They are independent, resourceful, spontaneous, unconventional, open to different experiences, and willing to take risks (Bull, Montgomery, & Baloche, 1995; Cassandro & Simonton, 2010; Eysenck, 1997; Feist, 1999; Feldman, 1999; Maslow, 1959; Rogers, 1959). Creators

also have a tolerance for ambiguity, an ability to accept conflict and tension (Bull et al., 1995; Feist, 1999; Feldman, 1999; Fromm, 1959), and a lack of concern over traditional gender roles (Weiner, 2000).

Maslow (1959, 1976) wrote that the characteristics of his self-actualizing participants and the characteristics of highly creative individuals were one and the same. Creative, self-actualizing individuals seek to expand themselves by gaining knowledge, wisdom, and a better understanding of the grand scheme of things by integrating emotions, motivations, and behaviors. With more integration, people become less afraid of what others say or demand, have a healthier self-esteem, and are less afraid of their own impulses, emotions, and thoughts (Cloninger, 2004; Kashdan & Fincham, 2002; Yau, 1991). Creativity then is not something one *does* as much as it is something one *is*. Creativity is not simply a cognitive or personality characteristic but an essence of being that represents pure human potential. In their case study of an exceptionally talented 7-year-old, Kokot and Colman (1997) wrote, "She seems to have a sense of oneness with all things in the world. She cannot say, 'This is me, this is my work.' She *is* the work" (p. 219).

The Creative Process

Some (Cawelti, Rappaport, & Wood, 1992; Kokot & Colman, 1997) have classified the process of creating into five categories: cognitive-developmental (creativity develops through stages), gestalt (restructuring), psychoanalytical (exploring the subconscious), associationist (making connections), and humanistic (when individuals holistically integrate all their experiences). The humanistic process was discussed in the previous section, and the other processes will be discussed briefly in the following section.

Cognitive. Some researchers (Csikszentmihalyi, 1990; Mumford, Baughman, & Sager, 2003; Parnes, 1967; Sternberg & Lubart, 2003) believe creative thought to be a form of complex problem solving and problem finding. Creative problems are those in which the solution cannot be reached through the rote application of experience or knowledge. A new alternative is generated by reorganizing the existing knowledge structure. How people encode, discover, construct, and define problems in the process of combining and reorganizing existing knowledge is what leads to creative thinking and new understandings.

Gestalt. Some researchers (Ansburg & Dominowski, 2000; Grossman & Wiseman, 1993; Runco, 1996) have emphasized the transformational or restructuring abilities of the creative process. Creative transformation requires a shift in perception. For instance, in Dunker's (1945) classic Candle Problem, one is given a candle, a box of tacks, some matches, and a corkboard. The problem is to attach a lighted candle to the upright board without dripping wax on the table. Most people first try to attach the candle to the wall by using the wax as some type of adhesive or using the tacks to catch the dripping wax (Lemons, 2001). To successfully solve the problem, participants need to change their perception of the box, from something that holds tacks to an object that can be used as a platform (Dominowski & Dallob, 1996). This restructuring of ideas, which may occur

by adding information or relaxing constraints, is the cognitive process leading to the production of a new form (Ansburg & Dominowski, 2000; Knoblich, Ohlsson, Haider, & Rhenius, 1999; Mumford et al., 2003).

Psychoanalytical. Participants who reported high levels of creative activities often used their dreams in creative pursuits (Pagel & Kwiatkowski, 2003). Dreams are a cognitive mental activity and can be an important tool in the creative process (Herrmann, 1991; Kumar, Holman, & Rudegeair, 1991; Martindale, 1989; Mattimore, 1994). In explaining why, Bindeman (1998) wrote, "The primivity of the unconscious, because it possesses a reckless honesty and courage, can provide us with thoughts and images beyond the grasp of the conscious mind" (p. 76).

Associationist. Daydreams also help creative processes. Researchers (Eysenck, 1997; Runco, 2002; Simonton, 2000) have found that a larger number of associative connections become more accessible when in a state of low cortical arousal. Cortical arousal or activation can be viewed as a continuum, from sleep through wakefulness to tension. Looking at electroencephalogram activity, Martindale (1989) found that highly creative individuals were in a state of low cortical arousal while taking a creativity test and high cortical arousal while taking an intelligence test. The less creative group showed high arousal when taking both tests. It is interesting to note that the high-creative group was less aroused during the creativity test than when their baseline recordings were taken.

The Creative Product

Novelty (or statistical infrequency) is frequently cited as a distinctive characteristic of creative products (Amabile, 1995; Eysenck, 1997; Nickerson, 1999; Runco, 1993). The product should also show originality (Kasof, 1995; Runco, 1993) and sensitivity to gaps in existing knowledge (Tardif & Sternberg, 1988) as well as some form of utility or social usefulness (Eysenck, 1997; Nickerson, 1999). In one survey, scientists and inventors were rated as more creative than artists and musicians because of the social contribution of their inventions (Yue, 2003). If the product fits the needs of society, it is more likely to be recognized and accepted.

The Creative Press (Environment)

One does not create in isolation. The popular image of the lone genius or solitary artist is a myth (Montuori & Purser, 1995; Weisberg, 1986). Creators work within a social milieu or community and are in touch with the beliefs and ideas of others (Dewey, Steinberg, & Coulson, 1998; Gruber & Wallace, 1999). Creative acts require a considerable amount of training, collaboration, dialogue, and listening to the ideas of others (Montuori & Purser, 1995). Had Beethoven been born on a deserted island, he might have done terrific bird imitations, but it is unlikely he ever would have composed the *Ninth Symphony.*

Many posit that creativity is influenced by the constantly changing cultural, social, economic, and political zeitgeist of the period (Amabile, 1995; Csikszentmihalyi, 1988, 1999; Eysenck, 1997; Montuori & Purser, 1995; Seitz, 2003; Simonton, 1997). Creativity is a function of evaluations and judgments made by people who are guided by the trends and traditions of a particular time and place. It is "constructed through an interaction between producer and audience" (Csikszentmihalyi & Rich, 1997, p. 45). Weisberg (1986) wrote, "It is a mistake to look for genius either in an individual or in an individual's work. Rather, genius is a characteristic that society bestows upon an individual" (p. 88). Scott Joplin's opera *Treemonisha* was performed only once in 1911 and not even reviewed, but in 1976 it won a Pulitzer Prize (Jason & Jones, 2002). What is considered creative then depends more on the reaction of the society than an attribute of the individual (Csikszentmihalyi, 1999; Montuori & Purser, 1995; Seitz, 2003).

Creativity has historically been viewed as a fixed ability, a subtopic of either cognitive or social-personality psychology, and has focused on the following four different characteristics: the person, the process, the product of creating, and the press (environment). There is a fifth element, difficult to measure but one that researchers are beginning to recognize, and that is passion.

Passion

Passion is the factor that intrinsically motivates individuals to pursue creative endeavors (Amabile, 1998, 2001; Collins & Amabile, 1999; Cropley, 1997; Csikszentmihalyi, 1999; Runco, 1993). Some (Feist, 1999; Hayes, 1989; Sternberg, 2002) believe it is *the* variable that distinguishes creative from noncreative people. When asked how he maintained his regime of 10-hr workdays, author John Irving replied, "The unspoken factor is love" (Amabile, 2001, p. 335). Jung similarly wrote, "The creative mind plays with the object it loves" (Read, Fordham, Adler, & McGuire, 1971, p. 123).

Some (Amabile, 2001; Maddux & Gosselin, 2003) have suggested that, although creative skills are important, they may be overrated. It is motivation that determines what an individual will do and how it will be done. Others (Cawelti et al., 1992; Cropley, 1997; Sternberg, 2002, 2006a) concurred that creative people differ in an astounding number of ways except for one key attribute, and that is their motivation to be creative. Author John Irving said that those of his students who did go somewhere with their writing were not necessarily particularly talented but simply the ones more compelled by the craft (Amabile, 2001). Csikszentmihalyi (1999) similarly noted that

> in our longitudinal study of artists, it became increasingly clear that some of the potentially most creative persons stopped doing art . . . while others who seemed to lack creative personal attributes persevered and . . . produced important achievements. (p. 313)

In a survey of creativity researchers (Runco, Nemiro, & Walberg, 1998), motivation was rated as the most important variable for creative achievement. Perseverance was

listed second. Perhaps, as Runco (2002) suggested, motivation is necessary for sustained effort, which can lead to collecting a great deal of information and influencing creative thinking. Creativity then can be viewed as a combination of the creative product, press, person, process, and passion. With such a complex construct, it is not surprising that there are opposing perspectives regarding the benefits and uses of creativity tests.

Creativity Tests: An Oxymoron?

Creativity tests appear to be antithetical to what is known about the act of creating. First, there needs to be intrinsic motivation (Amabile, 1998, 2001; Collins & Amabile, 1999; Cropley, 1997; Csikszentmihalyi, 1999; Runco, 1993; Torrance, 1995). In essence, "All creative work is a matter of passion" (Weiner, 2000, p. 209). What test makers think may be interesting and motivating activities may not be viewed as such by the testees. In short, a low creativity test score may not necessarily reflect low creative potential or ability.

Second, there needs to be autonomy, a sense that one's actions are one's own. Deci and Ryan (1987) wrote that people need to "experience themselves as initiators of their own behavior" (p. 1025). For creativity to manifest, an individual must perceive the freedom to think, feel, be, and express whatever is within (Rogers, 1959). Individuals are more motivated when they choose their own tasks because then it becomes more meaningful (Fasco, 2001; Rostan, 2005). Children and adults become aware that certain kinds of behavior are preferred, leading to conformist as opposed to original behavior. Creativity tests then may suppress the very element they are designed to measure (Cropley, 1997; Wallach, 1976). The expectations of the experimenter might also persuade an individual to stay with a task he or she might otherwise leave, leading to a discrepancy between those who score high on a test and those who are creative when there is no external pressure to produce (Crockenberg, 1972).

A third issue is that the elements within creativity tests are defined and dealt with in general terms, separate from the content in which the skills might operate. Skills manifested on a creativity test (e.g., producing as many different pictures as possible using circles) do not necessarily transfer to other problems in other domains. These generalized, abstract exercises often lack inherent interest because the problems are not meaningful to the solver (Houtz, 1994; Treffinger et al., 1971), the tasks are not anchored to real-world creativity (Brown, 1989; Cropley, 2000), and the activities do not require a synthesis of information (Cooper, 1991).

A fourth issue regarding testing is that many creativity tests are timed, to standardize procedures and control variables. As the number of items produced is fundamental, children who work slowly and deliberately may be penalized (Chase, 1985). As more unusual ideas tend to come later in the sequence of ideas (Hattie, 1980; Parnes, 1961; Wallach, 1976), individuals need an incubation period and time to reflect to produce novel ideas and make abstract connections. Torrance (1969) found higher creativity test scores when children were allowed 24 hr, compared with when they had only 5 min.

That time can be such a subjective variable was demonstrated by Cropley and Maslany (1969) who, using the WKCT, reported testing times in a group of undergraduate students to vary between 75 min to over 6 hr.

Guilford (1971) argued that too much time on a test makes it too inefficient and criticized the WKCT untimed tests because when the examinees "are given liberal time on a test . . . some of them will use that time to invent strategies that may unduly facilitate their performance" (p. 79). To discredit an item because it promotes the very thing one is trying to discover only serves to perpetuate the narrow, either-you-have-it-or-you-don't perspective, and if you have it, then you have it on demand. Guilford summarily dismissed the time factor because it was too inefficient, but lack of time to pursue ideas was one of the major obstacles to creativity, cited by both university students as well as "research and development" individuals within organizations (Alencar, Fleith, & Martinez, 2003; Amabile, 1987).

A fifth issue is the atmosphere during testing. Standardization annihilates creativity. Most creativity tests are administered in a test-like atmosphere using a booklet form with numbered spaces for responses similar to standardized achievement tests. A test-like situation, by its rigid nature, can seem intimidating and oppressive. Creativity tests given under relaxed conditions produced higher scores than when the same tests were given under more rigid conditions (Crockenberg, 1972; Torrance, 1969; Treffinger et al., 1971). However, "a test is still a test, even when it is called a 'game.' And surely even . . . children are not all deceived by the ruse" (Guilford, 1971, p. 81).

To summarize, creativity tests do not take into account intrinsic motivation, autonomy, the accumulation of knowledge, the time needed for original ideas to sprout, the climate of the culture, or differences in skills required for various domains. Their constructs are not anchored to real-world problems or creative behavior. Testing may suppress the very elements being investigated and modest manipulations of the environment can affect scores. In short, scoring well on a creativity test does not guarantee that a person will behave creatively, and low scores do not necessarily reflect low creative ability or potential.

Selecting Creativity Instruments

The purpose of this article was to present and clarify some of the many conflicting perspectives of creativity testing, in order for those involved in gifted programs to make informed decisions about their use. Offering gifted children challenging and stimulating educational programs is warranted, and creative potential is certainly an important facet to include in the identification process for gifted programs. Educators, program coordinators, counselors, and administrators need to be reminded of the many challenges of assessing the multifaceted construct of creativity. There is no single instrument that can accurately measure creative potential and any assessment needs to include multiple sources of information. If creativity assessment is to include test instruments, there are a number of issues to consider.

It is helpful to understand the differences between measurement and assessment. Measurement is defined as any instrument or testing procedure through which quantitative data can be obtained and analyzed statistically (Treffinger, Young, Selby, & Shepardson, 2002). Assessment is a matter of "taking stock" or gathering information from a number of sources (which may include measurement instruments) and synthesizing it in a meaningful way.

First, there are numerous perspectives and measurement instruments claiming to measure creative potential. But the instruments are not interchangeable and each has a specific purpose and focus as well as limitations. Instruments might focus on creative behavior, cognitive processes, previous performance, personality traits, self-efficacy, motivation, or any combination of these. Tests can be self-report/autobiographical measures, objective observation rating scales or checklists, or standardized tests providing quantitative data for statistical analysis.

Second, creativity is a multifaceted phenomenon with widely diverse characteristics across numerous domains that extend beyond the traditional fields of the visual and performing arts. Students may be, for example, exceptionally talented at fixing mechanical gadgets, interpersonal relationships, building complex Lego models, or creating computer games. Before deciding if an instrument is to be included in assessment, educators must first develop a definitive idea of what they believe creativity to be, including a clear idea of what they want to measure and why this characteristic is considered important and appropriate for the intended program. These decisions will guide assessment procedures and tools used.

Third, if including a measurement instrument in the assessment, the instrument needs to be appropriate and relevant for the characteristics of creativity being assessed. Are the characteristics that the test purports to measure in alignment with the characteristics deemed important for the targeted population or program? What is the focus of the program? For example, is it important for students to be able to draw many different pictures in small boxes or write humorous stories with a moral, if the focus of the program is math or music?

Educators must then look into the reliability (stability) and validity (appropriateness) of the instrument and consider all available data (e.g., independent reviews) concerning the test. Are the norms or the population the instrument was tested on similar to the population intended to take the test?

Finally, be aware that any testing instrument has limitations and that no single instrument can measure the multiple facets associated with the complex construct of creativity. It is important to use multiple sources of data. Also remember that characteristics are not static, so tests may or may not offer an accurate piece of information at any one point in time. As Treffinger et al. (2002) wrote, "What does not appear at one time, in one area, or with one assessment tool, may appear at another time, in another context, or with other tools" (p. xiii). He advised that test results alone should not be used for exclusionary purposes. Multiple perspectives and sources of information need to be included in creativity assessments.

In addition to paper-and-pencil tests, alternative forms of measurement might be considered. Educators might identify talent by observing students in settings and through assessments that allow them to display their interests and abilities. As an example, for their final project, my undergraduates chose their own medium in conveying concepts covered in class. They have made complex Lego® models, Lincoln log dioramas, posters, quilts, videos, and masks in relaying their understanding of the material, while demonstrating a high degree of creative thinking and behavior.

Some researchers (Cramond et al., 2005; Kim, 2006; Piirto, 2004) have noted that teachers often preferred and were more familiar with the bright, well-behaved, teacher-pleasing students (and hence more likely to recommend them for gifted program) and tended to overlook the exceptionally creative students who may be unconventional or disruptive. Creative characteristics may manifest in negative ways. Although aberrant behavior might well indicate a psychological disturbance, it might also be indicative of high creativity that needs a direction. In one study, comparing creativity test scores with behavior commonly viewed as negative, the authors found that the children who were assessed as more disruptive and impulsive had higher scores on fluency and flexibility (Brandau et al., 2007). Millar (2002) interviewed a father (one of Torrance's longitudinal study participants) who refused the school's recommendation to medicate his son, who was diagnosed with attention-deficit hyperactivity disorder. Instead, the father encouraged his son to pursue his passion for computers and the boy became a corporate computer consultant while still in high school.

Mercogliano (2003) recounted a similar story of one troubled young boy with severe behavioral issues who found his passion in Indians and their artifacts. While making an authentic Indian drum, this boy's behavior radically changed for the better and his schoolwork improved considerably. Observing students in their own element can offer information about their creative potential and abilities.

Conclusion

We cannot view creativity from a deterministic lens, subject to the strict rules of scientific inquiry and fostered through the application of confirmed causal principles (Eisenberg, 2006). Creative behavior involves complex cognitive, environmental, and personality variables. As Harrington (1990) wrote, "Creativity does not 'reside' in any single cognitive or personality process, does not 'occur' at any single point in time, does not 'happen' at any particular place, and is not the product of a single individual" (p. 150).

Finding gifts in students who do not necessarily score well on intelligence tests is certainly challenging, but our understanding and search of talent must be broader in scope. Creativity is a multifaceted trait that requires looking at students from diverse points of view. It would benefit students if educators were to investigate and include nontest measures and multiple methodologies when assessing creative potential for decisions regarding entrance into gifted programs.

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Notes

1. Although Mednick is often cited as developing the first remote association tests, Galton, a hundred years previous to Mednick, did word association experiments using a chronometer to record the time needed to produce the associations. These lab experiments led to Galton's invention of word association tests (Shultz & Schultz, 1992).
2. Cooper (1991) posited that creativity test makers would create tests from the metacognition of their own creative processes. Because Torrance began his college career as an English major, it is understandable that his writing skills and love of words would exert an influence on the tests he devised.

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