
Reliability, Validity, and Factor Structure of the Creative Achievement Questionnaire

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ABSTRACT: The Creative Achievement Questionnaire (CAQ) is a new self-report measure of creative achievement that assesses achievement across 10 domains of creativity. It was designed to be objective, empirically valid, and easy to administer and score. Study 1 established test–retest reliability ($r = .81, p < .0001$) and internal consistency reliability ($\alpha = .96$) in a sample of 117 undergraduate students. Study 2 established predictive validity of the CAQ against artist ratings of a creative product, a collage ($r = .59, p < .0001, n = 39$). Study 3 ($n = 86$) established convergent validity with other measures of creative potential, including divergent thinking tests ($r = .47, p < .0001$), the Creative Personality Scale (Gough, 1979; $r = .33, p = .004$), Intellect (Goldberg, 1992; $r = .51, p < .0001$), and Openness to Experience (Costa & McCrae, 1992; $r = .33, p = .002$). Study 4 established discriminant validity between the CAQ and both IQ and self-serving bias. Study 5 examined the factor structure of the CAQ. A three-factor solution identified Expressive, Scientific, and Performance factors of creative achievement. A two-factor solution identified an Arts factor and a Science factor.

Creative achievement may be defined as the sum of creative products generated by an individual in the course of his or her lifetime. A *creative product*, according to Barron's (1955) criteria, must be both original and functional or adapted in some pragmatic way to reality. A creative product—be it a new poem, musical

composition, medical cure, or weapon of mass destruction—is therefore both novel and useful. Barron also suggested that creative products are generally characterized by “elegance” or “esthetic fit” (Barron, 1969, p.20).

Creative achievement appears to be facilitated by a confluence of varying intrapersonal and interpersonal factors (Amabile, 1996; Eysenck, 1995; Ludwig, 1995; Simonton, 1994). Relevant *intrapersonal* factors may include cognitive abilities (e.g., intelligence, capacity for divergent thinking, imagination), personality traits (e.g., confidence, nonconformity), intrinsic motivation, and talent (Amabile, 1983; Eysenck, 1995; Fink, Ward, & Smith, 1992). Relevant *interpersonal* factors may include familial resources (e.g., ability to provide practical support), societal factors (e.g., opportunity for interaction with experts in the chosen field of creativity), and cultural considerations, such as sufficient political or economic stability (Csikszentmihalyi, 1988; Ludwig, 1995; Simonton, 1975).

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The intrapersonal factors necessary for creative achievement appear to be normally distributed in the population, when considered as single entities. However, creative achievement itself appears to result from the simultaneous high-end occurrence of many individual traits and, as such, is probably characterized by a non-Gaussian, inverted “J” distribution. In principle, therefore, only a minority of individuals within any population will exhibit high levels of creative achievement (Eysenck, 1995). By accurately identifying and then studying these relatively rare individuals, it may be possible to learn more about the biological, psychological, social, and cultural factors that underlie and influence individual creative output. Such research cannot progress without accurate measurement of creative achievement across a variety of domains. This article presents an instrument to measure creative achievement, the Creative Achievement Questionnaire (CAQ), that is time-efficient, easy to administer and score, objective, and empirically valid.

Previously Existing Measures of Creative Achievement

Creativity researchers have measured achievement using a variety of methods, depending upon the purpose of the individual investigation being conducted. These methods, described in detail below, include using verifiable accomplishments or honors as markers for eminence (e.g. Colangelo, Kerr, Hallowell, Huesman, & Gaeth, 1992; Ellis, 1926; Simonton, 1980), ratings of existing creative products by experts or nonexperts (e.g. Ludwig, 1992; MacKinnon, 1962; Richards, Kinney, Benet, & Merzel, 1988), and self-report inventories of achievement (e.g. Hocevar, 1989; Holland & Nichols, 1964; Torrance, 1972).

Markers of Eminence

First, achievement has been measured using a single honor or award as an indicator of eminence. For example, Ellis (1926) used entry in the *Dictionary of National Biography* as a measure of eminence in an early study of 1,030 British luminaries. Researchers have also used counts of a domain-specific marker of eminence to measure achievement. For instance, Colangelo and colleagues (1992) used the number of patents acquired as a marker for eminence among

well-known inventors, and Simonton (1980) counted the number of times a musical composition had been recorded as a measure of eminence among deceased composers.

Ratings by Experts and Nonexperts

Another method of measuring creative achievement is the use of expert ratings as a criterion for eminence. MacKinnon (1962), for example, asked five professors of architecture to nominate the living architects who had had the most influence on the field in his study of architectural creativity.

Beside the ratings of experts in a domain, nonexpert ratings of creativity in eminent individuals have also been used as a criterion for achievement. For example, Ludwig (1992) developed the Creative Achievement Scale (CAS) to distinguish levels of creativity among 1,006 deceased luminaries in 19 different professions. Nonexpert raters who were trained to use the CAS judged the eminent achievers based on information available in biographical sources.

Rating scales have also been devised to measure everyday creativity in the general population. For example, Richards and her colleagues (1988) composed the Lifetime Creativity Scales to measure creative achievement and interest levels in unselected samples of individuals. They included measurement of both “peak” accomplishments and overall involvement in and appreciation for creative endeavors in the scale. Using this method, information on creativity was collected during open-ended interviews with participants. A rater then evaluated the creativity-relevant interview material on a 6-point scale ranging from 1 (xxx) to 6 (xxx).

Self-Report Inventories

Hocevar and Bachelor (1989) have suggested that the self-report inventory is the most easily defended method of assessing both creative achievement and creative talent. Most such inventories are checklists that ask the participant to check off achievements in various areas of creative endeavor.

Torrance (1972) devised a checklist intended to measure the quantity and quality of post-high school achievements in a longitudinal study of the predictive ability of divergent thinking tests administered to school children. Respondents listed how many times

they had accomplished each of 15 activities, yielding a quantitative score. They were also asked to list their three most important creative achievements. These achievements were rated on a 10-point scale ranging from 1 (xxx) to 10 (xxx) by trained experimenters, yielding a qualitative score.

Holland and Nichols (1964) devised a checklist based on accomplishments elicited from students in their freshman year of college. The accomplishments spanned six domains of achievement: leadership, science, dramatic arts, literature, music, and art. Each item on the checklist was categorized as common or rare. Two subscales were tallied from each domain.

Hocevar (1979) compiled the most extensive checklist to date, the Creative Behavior Inventory, composed of 90 items spanning the domains of literature, music, crafts, art, math/science, and performing arts. Participants responded to each item on a 4-point scale ranging from 1 (xxx) to 4 (xxx).

Problems With the Existing Measures

Several problems with the existing measures of creative achievement are apparent. First, many techniques apply only to deceased or socially eminent creators. These populations may provide very valuable information regarding the characteristics of highly creative achievers; however, access to deceased luminaries is limited to biographical information, and access to living luminaries is limited by their small number. Second, many measures rely on subjective ratings from either expert or nonexpert judges. Generally, more than one skilled rater is required to establish validity. The process of training and compensating raters may be both lengthy and costly, making measures that require subjective ratings less than ideal.

Creative achievement inventories provide an inexpensive and easily administered alternative. However, the inventories available to date either fail to discriminate among levels of achievement or intermingle achievement items with items addressing attitudes and other associated constructs. This confounds the assessment of actual achievement with cognitive ability, motivation, and personality.

Development of the CAQ

The CAQ is based on five assumptions:

1. Creative achievement is best assessed in a domain-specific manner. Achievement in one area of creative endeavor (painting, architecture, or scientific discovery) does not necessarily imply creative excellence in all areas (Ward, Smith, & Finke, 1999). However, many individuals boast accomplishments in more than one domain of endeavor. The CAQ was therefore designed to identify specific domains of achievement as well as to provide an indicator of total accomplishment across multiple domains.

2. Creative achievement implies exposure to, and acquisition of knowledge and skill in, the appropriate domain of endeavor (Ludwig, 1995). The CAQ was therefore designed to provide an indicator of training in domains of creative accomplishment.

3. Recognition by experts in the domain is the most valid and practical criterion for judgment of accomplishment (Hennessey & Amabile, 1988; Ludwig, 1995). The CAQ was therefore based upon public acclaim ranked by field "experts."

4. Recognition of an achievement by a broad range of experts rather than a narrow range implies greater accomplishment. The CAQ was therefore designed to give more weight to national than to local awards and acclaim.

5. Fewer individuals attain higher levels of achievement. The CAQ was therefore designed so that the levels of achievement acknowledged by the fewest individuals received the most weight.

Nine separate domains of creative achievement in the arts and sciences were selected for inclusion in the CAQ, based on a review of areas of accomplishment listed in previous research (Colangelo et al., 1992; Hocevar, 1979; MacKinnon, 1962; Taylor & Ellison, 1967; Torrance, 1972). A tenth area of accomplishment, *Culinary*, was added to reflect the wide acceptance of culinary endeavors as an art form. Indicators for achievement in each of the 10 domains were also drawn from previous research. These indicators were then submitted to two domain-expert professionals for rank-ordering by level of achievement, with the lowest level appearing first on the list. List contents were additionally modified on the basis of feedback from the expert raters. The surviving items on each list were rank-ordered and assigned ascending weights from 0 to 7 points.

To ensure that items earning four points in one domain were roughly equivalent in level to items earning

four points in another domain, randomly selected items from theoretically similar levels of achievement in different domains were compared by expert raters. Raters were asked questions such as, "Composing an original piece of music is most similar in achievement level to a) sketching out an invention, b) creating original computer software, or c) building a prototype of an invention?" Items were reworded on the basis of the raters' feedback. Finally, all items were reassessed and reweighted based on frequency counts for each item after administration to a sample of gifted university students ($N = 120$), so that the less frequently chosen items were granted more weight. A total of 22 out of 96 items were reweighted by one or two points based on frequency counts for individual items.

Description of the CAQ

The resulting instrument, the CAQ, is a self-report checklist consisting of 96 items, divided into three parts. Appendix 1 contains the CAQ and its scoring guidelines. Part One lists 13 different areas of talent, including the 10 domains of artistic and scientific creativity assessed later in the instrument, and three additional domains: individual sports, team sports, and entrepreneurial ventures. The research participant is instructed to place a checkmark next to the areas in which he or she has more self-perceived talent or ability than the average person. Part Two lists concrete achievements in the 10 standard domains of artistic and scientific endeavor (visual arts, music, dance, creative writing, architectural design, humor, theater and film, culinary arts, inventions, and scientific inquiry). The participant is asked to place a checkmark next to the items describing his or her accomplishments. Each domain includes eight ranked questions weighted with a score from 0 to 7. Each domain consists of a "no achievement" item with a weight of 0 points ("I have no training or recognized talent in this area"), a "training" item with a weight of one point ("I have taken lessons in this area"), and six additional items of ascending achievement ("I have won a national prize in the fields of science or medicine"). On selected items, participants also indicate how many times each achievement has been earned. Part Two yields a separate domain score for each of the 10 domains of assessed creative achievement as well as a Total Creative Achievement score. In addition, space is provided for

participants to write in other achievements they have earned that were not listed in the scored portion of the questionnaire. Although these additional achievements are not scored, they may provide useful information to researchers. Part Three consists of three questions asking the participant to indicate how others perceive him or her, relative to creative characteristics. Part Three allows each researcher to append any additional questions regarding creativity that might be of interest to his or her line of inquiry.

Study 1: Reliability and Internal Consistency of the CAQ

Method

Participants. Participants included 117 undergraduate students (66 male and 51 female, M age = 20.1, $SD = 1.6$ years) enrolled in a Theories of Personality psychology course at Harvard College. Students were given course credit for participating in the study.

Procedure. A computerized version of the CAQ was administered to students in a computer lab. Students were allowed to take the test at their leisure, within the first two weeks of the semester (Time 1). Later in the semester, students were again given the opportunity to retake the CAQ for additional course credit (Time 2). A total of 53 students (32 males and 21 females) retook the test. The number of days between first and second test administration ranged from 14 to 122 days, and the $M = 51$ days ($SD = 13$).

Results

Test-retest reliability. The mean CAQ score of all participants in the study was 14.4 ($SD = 11.4$, minimum score = 0, maximum score = 47). The mean CAQ score at Time 1 for the 53 students who participated in both trials was 16.7 ($SD = 11.6$, minimum score = 1, maximum = 47). Mean CAQ score at Time 2 was 14.2 ($SD = 10.6$, minimum = 0, maximum = 54). Mean number of days between test times 1 and 2 was 51.3 ($SD = 12.6$, minimum = 14, maximum = 120). The correlation coefficient between scores at Time 1 and Time 2 was .81 ($p < .0001$), consistent with standard levels of

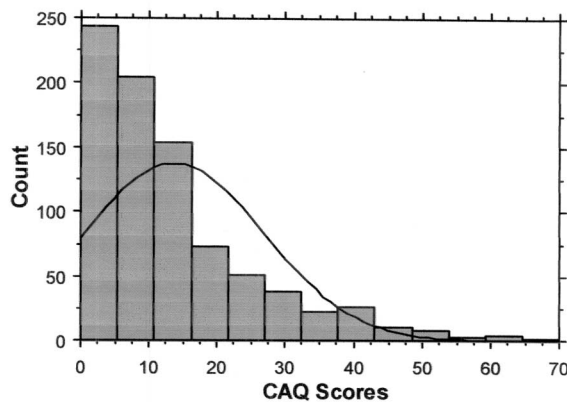


Figure 1. Distribution of Creative Achievement Questionnaire (CAQ) scores.

acceptance for reliability (Hocevar & Bachelor, 1989; see Figure 1).

Internal consistency. The 96 items on the CAQ were tested across the Time 1 scores of the 117 participants to examine internal consistency. The internal consistency rating for the CAQ as a whole was $\alpha = .96$, indicating strong internal reliability. Split half reliabilities for the two halves of the CAQ were $\alpha = .92$ (48 items of the first half) and $\alpha = .91$ (48 items of the second half). Internal consistency ratings for each of the 10 domains are presented in Table 1.

Discussion

The test-retest results indicated good reliability over time. The internal consistency analyses indicated

Table 1. Internal Consistency Reliability for the 10 Domains of the Creative Achievement Questionnaire (CAQ)

Domain	α
Visual arts	.77
Music	.82
Creative writing	.77
Dance	.86
Drama	.70
Architecture	.82
Humor	.85
Scientific discovery	.80
Invention	.87
Culinary	.80
Total CAQ	.96

good internal consistency for the instrument as a whole. In addition, all domain scores demonstrated internal consistency above the .70 minimum standard for research instruments (Hocevar & Bachelor, 1989).

**Study 2:
Criterion and Predictive Validity
of the CAQ**

Colangelo et al. (1992, p. 158) suggested that “the best predictor of future creative behavior may be past creative behavior.” In consequence, we hypothesized that past creative achievements, measured by the CAQ, would predict the creativity of a new product, rated by judges familiar with the product’s domain. We tested this expectation by asking students to complete the CAQ and to create a collage under controlled conditions. The collage allows for creative expression but minimizes individual differences in technical ability (Amabile, 1996). We employed the Consensual Assessment Technique (CAT), as described in Amabile (1982), to evaluate the collages. Amabile (1982) also suggested that expert raters judge the product for aesthetic appeal, as well as for creativity. Acquisition of this additional judgment allows the researcher to control for personal preferences of the rater(s). We hypothesized that CAQ scores would positively predict experts’ creativity ratings of the product.

Method

Participants. Participants included 39 undergraduate students (23 males and 16 females, M age = 20.1, $SD = 1.5$ years), solicited through posters on campus and paid for participation. The sample included students majoring in 19 different subjects. None were art majors.

Procedure. Participants were tested in small groups in a room with a large flat working surface. Each participant was given a large manila envelope containing a white poster board (14 in. \times 11 in.), a bag containing over 200 pieces of paper in a variety of sizes, shapes, and colors; a glue stick; and a questionnaire containing the CAQ. The pieces of paper were identical for each participant. Participants were instructed to remove the poster, the bag of colored paper, and the glue stick from the envelope, and to “make a

collage.” No other instructions or rules were presented. Participants had 18 min to complete the project. When time was up, the experimenter collected the posters and the unused paper. Participants then removed the questionnaire from the envelope and filled it out at their leisure. The experimenter collected the questionnaires and answered any questions.

Scoring. Five local artists, blind to CAQ scores, were selected to evaluate the collages. All artists had taken art courses, shown their work publicly, and sold at least one piece of work. They were requested to evaluate the collages for creativity on a 5-point scale ranging from 1 (*least creative*) to 5 (*most creative*). The artists were also asked to evaluate the collages for aesthetic appeal on a separate score sheet. This second evaluation allowed the artists to separate personal preference from objective creativity scores. The scores of all five artists were then summed to provide a Creative Evaluation score.

Results

The zero-order correlation between CAQ scores and the Creative Evaluation score was .59 ($p < .0001$; Spearman’s $\rho = .57, p = .0005$; see Table 2). When aesthetic appeal was controlled, the correlation between CAQ scores and Creative Evaluation scores rose to .65 ($p < .0001$). Interrater reliability (Spearman-Brown formula; Rosenthal & Rosnow, 1991) among the 5 artists was $R = .71$. The mean correlation among the artists was .32.

Discussion

Despite the relatively low mean correlation between individual artists’ ratings for the collages, the effective

reliability of the artists’ ratings was adequate. Other studies using the CAT procedure, reviewed by Amabile (1996), reveal similar low to moderate mean correlations between individual judges. The correlation between the Creative Evaluation score (sum of artists’ ratings) and the CAQ was strong and positive, exceeding that reported in 95% of social science research reports (Hemphill, 2003). This result suggests that, as Colangelo and colleagues (1992) stated, past creative behavior is a good indicator of future creative behavior. The results also support the CAQ’s validity as a predictor of creative production ability.

**Study 3:
Convergent Validity of the CAQ**

The measurement of creativity can be divided into three main categories: achievement inventories and creative product evaluations (discussed previously), personality tests, and cognitive tests (Amabile, 1996). Among these categories, we would expect—and, indeed, researchers have found—significant correlations, despite their different approaches to the topic of creativity (e.g., Gough, 1979; McCrae, 1987; Torrance, 1974).

Several personality tests have been associated with creativity measurement. Gough (1979) developed the Creative Personality Scale (CPS) from items on the Adjective Check List (Gough & Heilbrun, 1965) that predicted high levels of creativity across multiple studies in diverse domains of creativity. Respondents to the CPS describe themselves by checking off 18 positively scored and 12 negatively scored items. Goldberg’s (1992) adjective markers for the Big Five trait factor structure assess the dimension of Intellect and include such descriptors as *creative*, *complex*, and *imaginative*.

Table 2. Correlation of Artists’ Ratings of Collages With the Creative Achievement Questionnaire (CAQ)

	Artist 1	Artist 2	Artist 3	Artist 4	Artist 5	All Artists
Artist 2	.34*					
Artist 3	.23	.37*				
Artist 4	.51**	.36*	.23			
Artist 5	.50**	.06	.20	.45**		
All artists	.76***	.64***	.49**	.80***	.67***	
CAQ	.32*	.47**	.32*	.39*	.48**	.59***

Note. All Artists = Creative Evaluation Score.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Respondents rate how well each of 100 adjectives describes themselves on a 9-point scale ranging from 1(xxx) to 9 (xxx). The dimension of Openness to Experience (Costa & McCrae, 1992), part of the Five-Factor questionnaire-based model of personality, is similar to Goldberg's intellect. It contains 40 items ("I am intrigued by the patterns I find in art and nature") measured on a 5-point scale ranging from 1 (xxx) to 5 (xxx). Openness to experience has been associated with a variety of other creativity measures (McCrae, 1987).

Divergent thinking tests have also been used as a measure of the potential for creative ideation (Runco, 1991). Divergent thinking refers to the cognitive ability associated with activation of associational networks. Divergent thinking tests assess the ability to generate many possible answers to a problem, rather than a single "correct" answer (an ability represented by convergent thinking, Guilford, 1967). Divergent thinking tests include tasks such as listing items that conform to a stated set of criteria, listing similarities between two disparate items, listing alternate uses for a common object, and listing the consequences of a hypothetical situation. Three aspects of divergent thinking are generally assessed: fluency (number of responses generated), originality (unusualness of responses, based on the statistical infrequency within the sample of each response), and flexibility (the number of different categories of response and number of category changes). Although divergent thinking tasks have recently been criticized as measures of general creative ability (see Baer, 1993), there is a substantial literature demonstrating the tests' positive correlation with other measures of creativity (Barron & Harrington, 1981).

Because measures of divergent thinking, creative personality traits, and creative achievement are all pur-

ported measures of creativity, we presumed they would be significantly correlated. Because creative achievement is a confluence of many individual factors, however—including personality traits and divergent thinking styles—we presumed that these correlations would be moderate.

Method

Participants. Participants included 86 graduate and undergraduate students (33 males and 53 females) from Harvard University, with a mean age of 20.68 years (SD 3.29, minimum = 16, maximum = 35). Participants were recruited from sign-up sheets posted on campus advertising a study on creativity and personality. All were paid to participate.

Procedure. Participants were given a questionnaire booklet containing the CAQ, the NEO-FFI Openness to Experience Scale (Costa & McCrae, 1992), the 30-item CPS (Gough, 1979), and the Big Five Intellect Adjectives (Goldberg, 1992). After completing the booklet, participants were administered a set of four divergent thinking tests, each timed for 3 min (Torrance, 1968), including an Alternate Uses and a Consequences task. Divergent thinking tests were scored for fluency, originality, and flexibility. Fluency, originality, and flexibility scales were also z-scored and summed to produce a total Divergent Thinking score.

Results and Discussion

Correlations between the CAQ, personality measures, and the divergent thinking tests are presented in Table 3. Results indicate that the CAQ is substantially and significantly correlated with other measures

Table 3. Correlations of the CAQ With Other Creativity Measures

	CPS	Openness	Intellect	Diverg	Fluency	Orig	Flexibility
Openness	.42***						
Intellect	.51***	.37**					
Diverg	.29*	.34*	.39***				
Fluency	.10	.20	.31**	.86***			
Orig	.32**	.30**	.36**	.86***	.59***		
Flexibility	.34**	.37**	.35**	.87***	.62***	.63***	
CAQ	.33**	.33**	.51***	.47***	.38***	.46***	.37***

Note. CPS = Creative Personality Scale, Diverg = Total Divergent Thinking Score, Orig = Originality.

* $p < .05$. ** $p < .01$. *** $p < .001$.

of creativity, including three measures of creative personality and all facets of divergent thinking. Correlations between the CAQ and the related variables were within the accepted limits for convergent validity.

Study 4: Discriminant Validity of the CAQ

Two major variables threaten to confound measures such as the CAQ: IQ and self-enhancing bias. Creativity is theoretically related to IQ below the level of IQ 120; however, some researchers believe that above IQ 120 the correlation between IQ and creativity appears diminished or absent (Guilford, 1967), although this attenuation of relationship was not evident in our recent study of creative achievement at Harvard (Carson, Peterson, & Higgins, 2003). This *threshold* theory suggests that a certain level of IQ is necessary but not sufficient for high creative functioning. Sternberg and O'Hara (1999) have pointed out that individuals with low or even average intelligence are not well-represented among lists of creative achievers. Some researchers, such as Weisberg (1993), have argued that creative thinking is no different than ordinary problem solving, and as such is a matter of intelligence rather than a special thought process. To determine that the CAQ was not merely a measure of IQ or intelligence, we tested it against IQ scores in two samples of students with mean IQ levels above the purported threshold.

A second potential confounding variable is self-enhancing bias. Whenever a self-report measure is administered, there is a chance that responders will answer the questions in such a way as to enhance their own image on the test. To determine the extent to which participants were likely to self-enhance in this way, we administered the Marlowe-Crowne Social Desirability Scale (MCSD; Crowne & Marlowe, 1960), a measure of the tendency of responders to tailor their responses to appear socially acceptable. The MCSD is a 33-item self-report measure that assesses the tendency to ascribe to oneself positive characteristics considered rare in the general population, as well as the tendency to deny possessing negative characteristics.

Method

Participants. The 117 students from Study 1 were offered additional course credit to complete the MCSD and the Vocabulary and Block Design subtests of the Wechsler Adult Intelligence Test-Revised (WAIS-R; Wechsler, 1981). Previous research has shown that a composite score derived from these two subtests correlates .91 with the full-scale WAIS-R (Brooker & Cyr, 1986). In addition, the 86 students from Study 3 were given the WAIS-R subtests as part of another unrelated study (Peterson & Carson, 2000). A total of 115 students (63 male and 52 female, M age = 20.1 years) completed the MCSD, while a total of 184 students (94 males and 90 females, M age = 20.3) completed the WAIS-R tests. All students had previously completed the CAQ.

Procedure. Students completed a computerized version of the MCSD at their leisure in a computer lab. The WAIS-R subtests were administered by appointment by one of four experimenters trained in WAIS-R administration.

Results

Self-enhancing bias. The mean MCSD score for the sample was 12.0 ($SD = 5.9$, minimum = 1, maximum = 30). The correlation between the CAQ and the Marlowe Crowne was $r = -.05$ ($p = .58$; Spearman's $\rho = .10$, $p = .28$), indicating that the students in this sample were not particularly interested in self-enhancement in the testing procedure.

IQ. The mean IQ score for the total sample was 129.40 ($SD = 10.93$), well above the suggested threshold for correlation with creativity. The zero-order correlation between the CAQ and the IQ score was .14 ($p = .06$).

Discussion

The correlation between MCSD scores and CAQ scores did not approach significance in this study, despite several extremely high individual scores on the MCSD. This result suggests that the CAQ is resistant to self-enhancing bias. The correlation between IQ scores and CAQ scores did approach significance,

however, indicating a weak but positive relationship. This weak correlation between IQ and the CAQ suggests that the CAQ is not measuring, and is easily discriminated from, IQ. The discriminant validity of the CAQ relative to IQ and self-enhancing bias is supported by the results of this study.

Study 5: Factor Structure of the CAQ

Although highly creative individuals in the arts and highly creative individuals in the sciences may share more distinctive qualities with one another than they share with less creative individuals in their own field (Vernon, 1989), there is evidence that artists display different personality traits (Feist, 1999) and even different types of psychopathology (Ludwig, 1995) than creative scientists. In addition, it has been suggested that achievement in the various domains of art, as opposed to science, may be related to different types of intelligence (Gardner, 1983, 1993). Given these potential differences among domains of creativity, we wished to determine if art domains and science domains might compose separate factors of creativity if we subjected the 10 domains of the CAQ to exploratory factor analysis. We also wished to examine the distribution of CAQ scores in a large sample.

Method

Participants. Participants included 249 students (mean CAQ score = 15.1, $SD = 12.2$) from Harvard University, 287 members of a community sample (mean CAQ score = 13.5, $SD = 14.7$) in Toronto, Canada, and 311 students (mean CAQ score = 13.1, $SD = 13.0$) from the University of Toronto ($N = 847$). This total includes participants from Studies 1 through 4. Harvard students and University of Toronto students either received course credit or were paid for participation. The Toronto community sample participants were recruited through posters and advertisements and were paid for participation.

Procedure. All participants took either the computerized version ($n = 707$) or filled out a paper-and-pencil version of the CAQ in a university lab ($n = 140$). Both versions were identical in wording.

The CAQ scores for the Harvard and University of Toronto students and the Toronto community sample participants were combined.

Results

The 10 CAQ domain scores of the 847 participants were subjected to a principal components analysis, with varimax rotation. The initial principal components analysis of the 10 CAQ domains yielded a four-factor solution as the best fit for the data, accounting for 54.3% of the variance. However, a three-factor solution, accounting for 43.8% of the variance, was indicated by the scree plot, and appeared more easily interpretable after varimax rotation. The initial eigenvalue for the first factor of the three-factor solution, which accounted for 15% of the variance after rotation, was 1.94. The eigenvalue for the second factor (14.7% of the variance after rotation) was 1.33, and the eigenvalue of the third factor (14.1% of the variance after rotation) was 1.11. Table 4 presents the CAQ domains and their loadings on the three derived factors. Loadings with an absolute value of .40 or above were considered significant to the factor.

In the three-factor solution, Factor 1 included visual arts, writing, and humor and was interpreted as “expressive” achievement. Factor 2 included dance, drama, and music and was interpreted as “performance” achievement. Factor 3 included invention, scientific discovery, and culinary arts and was interpreted as “scientific” achievement. Architecture did not

Table 4. *Creative Achievement Questionnaire (CAQ) Domain Loadings Onto Three Factors Derived From Principal Components Analysis*

Domain	Factor1	Factor2	Factor3	Dimension
Visual arts	-.71	.15	.03	Expressive
Writing	.66	.28	.08	Expressive
Humor	.63	.20	.11	Expressive
Dance	-.12	.79	-.05	Performance
Drama	.31	.65	-.09	Performance
Music	.14	.48	.18	Performance
Invention	.13	.04	.80	Scientific
Science	-.11	.12	.72	Scientific
Culinary	.06	-.01	.41	Scientific
Architecture	.03	.21	.03	(no loading)

Note. Boldface indicates XXXXX XXXXX.

achieve an adequate loading on any factor to be included in the three-factor solution.

In addition to the three-factor solution, which provided the better fit for the data in terms of explained variance, we decided to force a two-factor solution to see if it would yield the standard arts/science dichotomy. The two-factor solution accounted for only 33.5% of the variance. However, the varimax rotation of the principle components analysis did yield an interpretable solution (see Table 5). Factor 1 included drama, humor, music, visual arts, and creative writing and was interpreted as “Arts.” Factor 2 included invention, scientific discovery, and culinary arts and was interpreted as “Science.” Neither architecture nor dance achieved an adequate loading on either factor to be included in the two-factor solution.

Discussion

In the two-factor solution, architecture and dance were excluded due to failure to achieve a .40 loading on either factor. Architecture may have been under-endorsed in this sample, contributing to this failure (only 42 of the 538 participants endorsed any of the items in the architecture domain). It may well be that the current sample was too young to measure achievement in the architectural domain. Although dance technically failed to meet the .40 cutoff, a good case could be made to include it in the Arts factor (Factor 1). Dance approaches the target cutoff and is universally considered an art form.

Table 5. *Creative Achievement Questionnaire (CAQ) Domain Loadings Onto Two Factors Derived From Principal Components Analysis*

Domain	Factor 1	Factor 2	Dimension
Drama	.68	-.10	Arts
Writing	.67	.09	Arts
Humor	.58	.13	Arts
Music	.49	.01	Arts
Visual arts	.43	.13	Arts
Dance	.38	.04	Arts
Invention	.02	.82	Science
Science	-.07	.74	Science
Culinary	.07	.41	Science
Architecture	.17	.23	(not included)

Note. Boldface indicates XXXXX XXXXX.

The three-factor solution, interpreted as expressive, performance, and scientific dimensions of creative achievement, provides the best fit for the data from the CAQ. However, some researchers may find it useful to employ the arts versus science dichotomy of the two-factor solution. Individual factor scores can be calculated by summing the scores of the domains included on each factor. Factor scores may prove valuable to researchers interested in individual differences between artists and scientists or between performers and artists/writers in the arts.

Discussion and Conclusion

Achievements in the arts and sciences provide inspiration, give comfort, decrease suffering, and improve the quality of human life. They are well worth assessing accurately and investigating in detail. The CAQ is reliable and valid and can provide a criterion by which to efficiently measure and study the varied components of creativity. The CAQ achieved good test-retest reliability when administered to participants on two different occasions. It had high overall internal and domain-specific consistency. It served as a surprisingly accurate predictor of actual laboratory creative performance and was characterized by solid convergent validity, when compared to other standard measures of creativity, including divergent thinking tests and personality scales. Finally, the CAQ demonstrated good discriminant validity when tested against IQ, indicating its separability from intelligence (above the hypothesized IQ threshold for genuine creativity) and proved unrelated to a measure of self-enhancement, indicating that self-report scores on the CAQ were not inflated due to a desire to enhance personal image.

The framework of the CAQ allows researchers to examine the creative achievement of individuals within a specific domain of endeavor. It facilitates the comparison of individuals who achieve in different domains or in different dimensions of achievement (arts vs. science). Finally, the CAQ allows researchers to examine individuals who display versatility across several domains to those who excel in only one creative field. It can be used to test both individual differences and group differences in creative achievement (see Carson, Peterson, & Higgins, 1993). The CAQ is also

easy to administer and to score. In consequence, we hope that it will prove useful in variety of settings.

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Appendix
Creative Achievement Questionnaire
Shelley Carson
Harvard University

I. Place a check mark beside the areas in which you feel you have more talent, ability, or training than the average person.

- visual arts (painting, sculpture)
- music
- dance
- individual sports (tennis, golf)
- team sports
- architectural design
- entrepreneurial ventures
- creative writing
- humor
- inventions
- scientific inquiry
- theater and film
- culinary arts

II. Place a check mark beside sentences that apply to you. Next to sentences with an asterisk (*), write the number of times this sentence applies to you.

- A. Visual Arts (painting, sculpture)
- 0. I have no training or recognized talent in this area. (Skip to Music).
 - 1. I have taken lessons in this area.
 - 2. People have commented on my talent in this area.
 - 3. I have won a prize or prizes at a juried art show.
 - 4. I have had a showing of my work in a gallery.
 - 5. I have sold a piece of my work.
 - 6. My work has been critiqued in local publications.
 - * 7. My work has been critiqued in national publications.

B. Music

- 0. I have no training or recognized talent in this area (Skip to Dance).
- 1. I play one or more musical instruments proficiently.
- 2. I have played with a recognized orchestra or band.
- 3. I have composed an original piece of music.
- 4. My musical talent has been critiqued in a local publication.
- 5. My composition has been recorded.
- 6. Recordings of my composition have been sold publicly.
- * 7. My compositions have been critiqued in a national publication.

C. Dance

- 0. I have no training or recognized talent in this area (Skip to Architecture)
- 1. I have danced with a recognized dance company.
- 2. I have choreographed an original dance number.
- 3. My choreography has been performed publicly.
- 4. My dance abilities have been critiqued in a local publication.
- 5. I have choreographed dance professionally.
- 6. My choreography has been recognized by a local publication.

- *__7. My choreography has been recognized by a national publication.

D. Architectural Design

- __0. I do not have training or recognized talent in this area (Skip to Writing).
 __1. I have designed an original structure.
 __2. A structure designed by me has been constructed.
 __3. I have sold an original architectural design.
 __4. A structure that I have designed and sold has been built professionally.
 __5. My architectural design has won an award or awards.
 __6. My architectural design has been recognized in a local publication.
 *__7. My architectural design has been recognized in a national publication.

E. Creative Writing

- __0. I do not have training or recognized talent in this area (Skip to Humor).
 __1. I have written an original short work (poem or short story).
 __2. My work has won an award or prize.
 __3. I have written an original long work (epic, novel, or play).
 __4. I have sold my work to a publisher.
 __5. My work has been printed and sold publicly.
 __6. My work has been reviewed in local publications.
 *__7. My work has been reviewed in national publications.

F. Humor

- __0. I do not have recognized talent in this area (Skip to Inventions).
 __1. People have often commented on my original sense of humor.
 __2. I have created jokes that are now regularly repeated by others.
 __3. I have written jokes for other people.
 __4. I have written a joke or cartoon that has been published.
 __5. I have worked as a professional comedian.
 __6. I have worked as a professional comedy writer.
 __7. My humor has been recognized in a national publication.

G. Inventions

- __0. I do not have recognized talent in this area.
 __1. I regularly find novel uses for household objects.
 __2. I have sketched out an invention and worked on its design flaws.
 __3. I have created original software for a computer.
 __4. I have built a prototype of one of my designed inventions.
 __5. I have sold one of my inventions to people I know.
 *__6. I have received a patent for one of my inventions.
 *__7. I have sold one of my inventions to a manufacturing firm.

H. Scientific Discovery

- __0. I do not have training or recognized ability in this field (Skip to Theater)
 __1. I often think about ways that scientific problems could be solved.
 __2. I have won a prize at a science fair or other local competition.
 __3. I have received a scholarship based on my work in science or medicine.
 __4. I have been author or coauthor of a study published in a scientific journal.
 *__5. I have won a national prize in the field of science or medicine.
 *__6. I have received a grant to pursue my work in science or medicine.
 __7. My work has been cited by other scientists in national publications.

I. Theater and Film

- __0. I do not have training or recognized ability in this field.
 __1. I have performed in theater or film.
 __2. My acting abilities have been recognized in a local publication.
 __3. I have directed or produced a theater or film production.
 __4. I have won an award or prize for acting in theater or film.
 __5. I have been paid to act in theater or film.
 __6. I have been paid to direct a theater or film production.
 *__7. My theatrical work has been recognized in a national publication.

J. Culinary Arts

- 0. I do not have training or experience in this field.
- 1. I often experiment with recipes.
- 2. My recipes have been published in a local cookook.
- 3. My recipes have been used in restaurants or other public venues.
- 4. I have been asked to prepare food for celebrities or dignitaries.
- 5. My recipes have won a prize or award.
- 6. I have received a degree in culinary arts.
- *7. My recipes have been published nationally.

K. Please list other creative achievements not mentioned above.

**Scoring of the Creative Achievement
Questionnaire**

- 1 Each checkmarked item receives the number of points represented by the question number adjacent to the checkmark.
- 2 If an item is marked by an asterisk, multiply the number of times the item has been achieved by the number of the question to determine points for that item.
- 3 Sum the total number of points within each domain to determine the domain score.
- 4 Sum all ten domain scores to determine the total CAQ score.