In a follow-up to a previously published study (Epstein, Schmidt, & Warfel, 2008), an ethnically-diverse sample of 13,578 people in 47 countries (mainly the United States and Canada) took an online test that measures 4 trainable competencies that have been shown to enhance creative expression in individuals. The new study confirmed that the test has high internal-consistency reliability and reasonably strong predictive validity. Competency scores were good predictors of self-reported frequency of creative expression and moderately good predictors of life satisfaction and professional success. Scores were also substantially higher for people who had had creativity training, and more training was associated with higher scores. Small but statistically significant differences in scores were found for gender (women outscoring men) and race/ethnicity. Of the 4 competencies examined, capturing (preserves new ideas as they occur) proved to be the best predictor of self-reported creative expression, followed by challenging (takes on difficult tasks), broadening (expands one’s skills and knowledge), and surrounding (arranges stimulating physical and social environments).

Research begun by Epstein in the late 1970s led to the development of Generativity Theory (Epstein, 1985, 1991, 1996a, 1999), a formal theory of creative expression in individuals. The theory and related research suggest that new behavior emerges as previously established behaviors become interconnected and that the process of interconnection is both orderly and predictable. In the laboratory, equations and a computer model derived from the theory have been used to predict novel human and animal behavior moment-to-moment in time.

The theory suggests that creative expression can be accelerated and directed in various ways by altering the number and nature of available repertoires of behavior and by arranging conditions under which interconnections are likely to occur (Epstein, 1999, 2005). Epstein has shown, moreover, that people can be deliberate about both acquiring relevant repertoires and arranging conditions under which interesting interconnections will occur. He has identified four basic competencies—the core competencies of creative expression—that give people control over this process and thus allow people to increase their creative output, sometimes dramatically so. 1 The four core competencies are: capturing (preserves new ideas as they occur, finds

1Competency refers to a functionally-related set of skills that may or may not have been previously expressed. In that sense, the competency domain is far larger than the performance domain. Although the ideal way to measure competence is to sample behavior (McClelland, 1973), test questions that pinpoint behavior can be excellent predictors of such behavior (Boyatzis, 1982; Epstein et al., 2008; Smith & Smith, 2005; Spencer & Spencer, 1993; Wood & Payne, 1998). A test item such as “I’m good at recording my new ideas” would be deficient in this regard, whereas an item such as “I always keep a recording device by my bed at night” (an item from the ECCI-i) does a far better job of pinpointing behavior.
The four core competencies of creative expression. The challenging (takes on difficult tasks, sets open-ended goals, manages fear and stress associated with failure effectively), broadening (seeks training, experience, and knowledge outside current areas of expertise), and surrounding (changes physical and social environments regularly and seeks out unusual stimuli or combinations of stimuli).

Creative expression is also affected by factors such as personality traits that are not generally trainable (e.g., Muñoz-Doyague, González-Alvarez, & Nieto, 2008; Prabhu, Sutton, & Sauser, 2008), as well as by work climate and other variables typically under the control of managers or leaders (e.g., Hunter, Bedell, & Mumford, 2007). In that regard, Epstein has also identified eight competencies that leaders need to elicit creativity in others and has developed tests that measure the strength of both the core and managerial competencies (Epstein, 1999; Epstein et al., 2008). In addition, he has developed games and exercises that strengthen these competencies (Epstein, 1996b, 2000, 2011). He has also suggested that focusing on measurable, trainable competencies is an especially practical way of boosting creativity (Epstein, 1996b, 1999, 2000, 2011).

Epstein et al. (2008) conducted two studies demonstrating that a test designed to measure the four core competencies of creative expression—the Epstein Creativity Competencies Inventory for Individuals (ECCI-i)—was both a reliable and valid measuring instrument. The first study involved a racially and ethnically diverse group of 208 business people in Philadelphia, Pennsylvania, and the second, 173 employees of the government of the city of Brea, California. All tests were administered in a classroom environment in written format. The second study also found that 8 months after people had participated in a half-day workshop to strengthen the core competencies, they were on average expressing 55% more new ideas to supervisors than they had before training.

The present study again examines the validity and reliability of the ECCI-i, this time with a large sample of subjects obtained over the Internet. In addition, this study seeks through regression analysis to determine which creativity competencies best predict desirable outcomes related to creative expression.

METHODS

Test Design

The ECCI-i is a 28-item, Likert-scale inventory (5 points labeled agree and disagree at the extremes) that assesses the four core competencies of creative expression. The test includes seven items per competency, one of which (for each competency) is a dummy item that can be used to assess consistency of responding as soon as an individual completes the test (Epstein et al., 2008). If the Internal Consistency Score (ICS)—a correlation (Spearman’s rho) of scores on the dummy pairs—is low, that suggests the individual was not reading the test carefully or did not understand test items. In that case, he or she can be asked to retake the test. In the present study, the ICS was not used for this purpose.

Items in each of the four competency areas were related to that specific competency. A typical item in the capturing category, for example, was, “I always keep a recording device by my bed at night.” In the challenging category, a typical item was, “I sometimes try to solve problems that, in principle, have no solution.” In the broadening category, a typical item was, “I often read books from outside my specialty.” And in the surrounding category, a typical item was, “I redecorate or rearrange my work environment regularly.”

Subjects were informed that they were taking a test that “measures four types of skills that help people express their creativity.” They were also asked basic demographic questions, along with three criterion questions, each answered on a 10-point Likert scale: “How frequently do you currently express your creativity?” (scale from rarely to frequently), “How satisfied are you with your life?” (scale from not at all to extremely satisfied), and “How much success have you had in your professional life?” (scale from low to high). These questions were administered before the start of the test itself, so that responses would not be affected by the test items. E-mail addresses were also collected, but to preserve subject confidentiality, the e-mail addresses were stored separately from test results and could not be used to identify test takers.

Subjects

Participants were 13,578 people who took the ECCI-i at the Web site http://MyCreativitySkills.com between May 29, 2007 and October 31, 2009. Participants were not actively recruited. People presumably found the test through search engines or through links to the test posted at a variety of different websites, including http://PBS.org, http://CNBC.com, and http://PsychologyToday.com. When people took the test more than once, data from only the first test administration were used in this study.

Forty-two point one percent of the subjects were men, and 57.9% were women. The mean age was 36.7 years, with an age range from 9 to 85. The sample was racially and ethnically diverse (73.4% White, 0.6% American Indian, 8.6% Asian, 6.0% Black, 5.0% Hispanic, and 4.7% other, with 1.6% unknown) as well
as diverse in educational background (4.6% no degree, 22.7% high school, 8.3% associates, 38.6% college, 20.0% Masters, and 5.3% Doctorate, with 0.5% unknown). Ninety-one point six percent of the subjects were located in the United States or Canada; 5.4% were from 45 other countries; and 3.0% were from unknown locations.

Procedure
After completing the test, the test taker clicked on a “Submit” button, which produced a detailed report defining the four core competencies and showing his or her total score and score in each competency area.

RESULTS

Adverse Impact
The United States Equal Employment Opportunity Commission (EEOC) provides statistical standards that must be upheld by tests that could be used to hire, fire, or promote employees (US EEOC, 2007, 2010). The EEOC requires that these tests not distinguish groups by race, ethnicity, or gender by 20% or more. This standard was met in the previous study (Epstein et al., 2008), as well as in this study. Scores for women differed from scores for men by only 1.8%, and the maximum difference between any two racial or ethnic groups was 4.6%.

Reliability and Validity
Internal-consistency reliability was moderate: Cronbach’s alpha was 0.85, and the Guttman split-half measure was 0.84. In addition, the average ICS was 0.87. Test–retest reliability was not measured (see Discussion).

The predictive validity of the test is suggested by significant positive correlations between total scores and a number of self-reported variables. Most important, test scores were good predictors of the subjects’ estimates of how frequently they expressed creativity (Spearman’s $\rho = 0.52^{**}$). Test scores were also associated with both life satisfaction ($\rho = 0.25^{***}$) and professional success ($\rho = 0.26^{***}$). In addition, test scores were substantially higher among people who had had creativity training (Mann-Whitney $U = 1.3E + 07^{***}$, $M_{Yes} = 64.8$, $M_{No} = 58.8$) and were positively correlated with the number of training hours ($\rho = 0.22^{**}$).

Demographic Differences
Small but significant effects were found for age ($\rho = 0.05^{**}$) and education ($\rho = 0.07^{**}$). Kruskal-Wallis $\chi^2 = 81.5^{**}$, $M_{None} = 59.1$, $M_{HighSchool} = 58.8$, $M_{Associates} = 60.7$, $M_{Bachelors} = 60.1$, $M_{Masters} = 61.9$, $M_{Doctorate} = 62.3$), as well as for race and ethnicity ($\chi^2 = 19^{**}$, $M_{Whites} = 60.3$, $M_{Blacks} = 60.2$, $M_{Hispanics} = 60.0$, $M_{Asian} = 59.5$, $M_{AmerInd} = 61.5$, $M_{Other} = 62.1$).

Women outscored men on three of the four competencies (capturing: $U = 21,343,370^{**}$, $M_{Males} = 53.0$, $M_{Females} = 54.6$; broadening: $U = 21,424,260^{**}$, $M_{Males} = 73.8$, $M_{Females} = 75.2$; surrounding: $U = 19,019,204^{**}$, $M_{Males} = 51.9$, $M_{Females} = 57.2$), as well as on total score ($U = 2.1E + 07^{***}$, $M_{Males} = 59.7$, $M_{Females} = 60.8$), and men outscored women in one competency area (challenging: $U = 18,828,772^{**}$, $M_{Males} = 60.2$, $M_{Females} = 55.6$).

Competency Differences
Generally speaking, subjects scored relatively high on only the broadening competency ($M = 74.6$), which suggests that people see value in extending their knowledge and skills into new areas. Scores in the other three competencies were low (capturing: $M = 53.9$; challenging: $M = 57.6$; surrounding: $M = 55.2$), as was the average total score ($M = 60.3$; Figure 1).

Regressions and Factor Analysis
The relative value of the four competencies was determined using linear regressions. All four of the

![FIGURE 1](image-url)
competencies proved to be predictive in the regression models. Capturing was the most predictive competency when predicting self-reported frequency of creative expression (capturing: $\beta = 0.31^{***}$; challenging: $\beta = 0.15^{***}$; surrounding: $\beta = 0.15^{***}$; broadening: $\beta = 0.05^{***}$), but challenging was most important when predicting both life satisfaction (challenging: $\beta = 0.22^{***}$; surrounding: $\beta = 0.15^{***}$; capturing: $\beta = -0.03^{*}$) and professional success (challenging: $\beta = 0.21^{***}$; surrounding: $\beta = 0.12^{***}$; broadening: $\beta = 0.05^{***}$; capturing: $\beta = -0.03^{**}$).

A factor analysis yielded five interpretable components closely related to the four core competencies of creative expression: (a) expanding knowledge, (b) seeking inspiration from new or unusual stimuli, (c) creating a stimulating environment, (d) seeking challenge, and (e) recording solutions to difficult problems (Table 1).

## DISCUSSION

Although the results of this study support the conclusions drawn by Epstein et al. (2008), that study involved face-to-face contact with subjects, whereas this study was conducted on the Internet. Although Internet-based research is rapid and economical, it is also limited in some respects. Subjects in this study were self-selected, and self-selection can bias a sample. In this study, for example, 63.9% of the subjects had at least a college degree; in the general population in the United States, only about 27% of adults have completed their college education (US Census Bureau, 2010). In Internet research, one also cannot be certain of the accuracy of demographic information or even of the integrity of test results, although some studies suggest that subjects might be more honest, on average, when taking a computer-administered test than when taking a person-administered test (Kaplan & Saccuzzo, 2009).

Moreover, because the identities of our subjects were unknown, there was no way to measure concurrent validity or test-retest reliability. Future studies will ask subjects if they would be willing to take additional tests; that will allow us to conduct various kinds of follow-up research, at least with a self-selected subset of our sample. These limitations aside, converting the survey to an online format allowed for its rapid administration across a large, demographically-diverse sample of people worldwide.

One of the more notable findings in this study concerned gender differences, with women outscoring men in three of the four competency areas, and particularly on the surrounding competency. This is consistent with the finding that, on average, women may be more aware than men of the effects that physical and social surroundings have on behavior (Flaherty & Richman, 1989; Wilson & Stokes, 1983). Men outscored women substantially in only one competency area—challenging—which is consistent with the finding that, on average, men may be more prone to risk-taking and challenge-seeking than women (e.g., Gerard, Fischbeck, Gengler, & Weinberg, 2007).

This study also suggests that capturing—preserving new ideas as they occur—has special value in increasing creative expression. Of the four competencies, it was by far the best predictor of self-reported creative output. Elsewhere, Epstein has noted that teaching people strategies for preserving their new ideas can dramatically increase creative expression, sometimes increasing the volume of new ideas by a factor of 10 or more (Epstein, 2000). On the other hand, and as one might expect, capturing was a poor predictor of self-reported life satisfaction and professional success. These variables were best predicted by the challenging competency, suggesting that some degree of challenge-seeking is important for satisfaction and success in life (cf. Friedman & Martin, 2011).

Finally, the fact that the test scores in this study were generally low suggests that a vast reservoir of untapped creative potential could easily be released through creativity competency training and, in particular, simply by teaching people to be more conscientious about paying

### TABLE 1

**Factor Analysis: Rotated Component Matrix**

<table>
<thead>
<tr>
<th>Item</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
<th>Component 5</th>
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Notes. Extraction Method was Principal Component Analysis. Rotation Method was Varimax with Kaiser Normalization. Factor loadings under 0.30 are not shown.
attention to and recording their new ideas. Other studies have long shown that various kinds of creativity training, and especially training that improves problem-solving skills, has the potential to enhance creative expression (Epstein, 2011; Ma, 2006; Torrance, 1987); this study now joins the Epstein et al. (2008) study in suggesting that creativity competency training may also be valuable in this regard.

REFERENCES


