

# Measuring and Training Creativity Competencies: Validation of a New Test

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In 2 studies with a total of over 300 participants, the Epstein Creativity Competencies Inventory for Individuals (ECCI-i) was shown to be a reliable measuring instrument. In the first of these studies, the test was also shown to be a valid predictor of 2 measures of creative expression. The test is derived from empirical research on the creative process in individuals, which suggests that creative expression can be accelerated through the strengthening of any of 4 measurable, trainable competencies: capturing (preserving new ideas as they occur), challenging (taking on difficult tasks), broadening (seeking knowledge and skills outside one's current areas of expertise), and surrounding (seeking out new stimuli or combinations of stimuli). In the second study, training such competencies improved test scores and led to a significant increase in creative output.

Previous investigations by Epstein (e.g., 1991, 1996a, 1999) have shown that creative expression in individuals is both orderly and predictable and that it can be successfully modeled in the laboratory moment-to-moment in time. He has proposed a formal theory of creative expression in individuals—Generativity Theory—that holds that novel behavior is the orderly result of dynamic interactions among previously established behaviors.

In early studies, Epstein showed that complex, novel, “spontaneous performances” could be engineered in pigeons. In one such study, pigeons with minimal training were shown to be capable of solving Köhler's classic box-and-banana problem (Epstein, Kirshnit, Lanza, &

Rubin, 1984). Subsequent studies with both impaired and normal children and adults led to refinement of the theory, to the development of a graphical technique for displaying novel, ongoing behavior in individual subjects, and to the development of a formal, predictive model of generative processes (Epstein, 1996a, 1999, 2005).

Generativity Theory suggests, among other things, that creative potential in individuals is universal and perhaps limitless. Because creative expression tends to be discouraged in our culture, however, such expression is relatively rare. This is true, in part, because creative expression depends on the mastery of certain competencies (or skill sets), which only a handful of people in our society—people who tend to resist socialization—ever learn. Epstein (1996b, 2000) has developed tests that measure four essential competencies—capturing, challenging, broadening, and surrounding—that individuals need in order to be able to express their creativity (Table 1), as well as eight competencies that teachers, managers, and others need to stimulate creative expression in others. He has also developed games and exercises that teach such competencies (Epstein, 1996b, 2000).

A competencies approach to understanding creative expression complements and supplements existing approaches, which have typically focused on topics such as personality differences, creativity styles, the level or degree of creativeness, or environmental determinants

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TABLE 1  
Four Core Competencies of Creative Expression

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<b>Capturing</b>	– Preserves new ideas as they occur, finds places and times where new ideas can be observed easily, uses dreams and daydreams as sources of ideas Sample item: “I always keep a recording device by my bed at night.”
<b>Challenging</b>	– Takes on difficult tasks, sets open-ended goals, manages fear and stress associated with failure effectively Sample item: “When I set goals for myself, I make sure they’re open-ended.”
<b>Broadening</b>	– Seeks training, experience, and knowledge outside current areas of expertise Sample item: “I often read books from outside my specialty.”
<b>Surrounding</b>	– Changes physical and social environments regularly, seeks out unusual stimuli or combinations of stimuli Sample item: “I redecorate or rearrange my work environment regularly.”

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of creative expression. Identifying measurable and trainable competencies that predict the rate and nature of creative expression provides additional insights into the creative process—insights with substantial practical value.

## CREATIVITY TESTS

Many creativity-related tests have been developed over the years, including personality tests that contain various sorts of creativeness scales (e.g., Costa & McCrae, 1980; Khatena & Torrance, 1976; Myers & McCaulley, 1985; Taylor & Fish, 1979), tests that measure the different styles with which people express creativity (e.g., Basadur, Wakabayashi, & Graen, 1990; Kirton, 1976; Kumar, Kemmler, & Holman, 1997), tests that measure divergent thinking, (e.g., Auzmendi, Villa, & Abedi, 1996; Guilford, 1968; Meeker & Meeker, 2000; Runco, 1994; Torrance, 1998), tests that measure how suitable various environments are for creative expression (e.g., Amabile & Grysiewicz, 1989; Walberg & Anderson, 1968), tests that measure creative achievement (e.g., Ludwig, 1992; Richards, Kinney, Benet, & Merzel, 1988), and so on.

Although all of these approaches to creativity testing have merit, we believe that a competencies approach to such testing has some attractive features that deserve serious consideration:

1. *The labeling problem.* By measuring competencies associated with creative expression, we avoid labeling people *creative*, *noncreative*, or something in between. Negative labeling is sometimes demoralizing, especially when labels imply that characteristics cannot be changed. When it comes to creativity, labels can be especially troublesome,

leading some people to believe that they are naturally or inherently creative and others to believe that they have little or no creative potential. A competency score, we believe, is less intimidating than a label, particularly when the competencies have been identified as trainable. Needless to say, when creative ability is not viewed as a fixed trait, but rather as a flexible characteristic that can be improved through experience, labeling someone’s current level has less potential to do harm.

2. *Human potential.* Because all of the skill sets we are measuring can be improved through training, ECCI-i scores give people a snapshot of their current abilities, with the promise that both their scores and their abilities can be improved. Even low competency scores can, thus, be viewed with at least some optimism. In that sense, a competencies approach, we believe, consistently emphasizes human potential.
3. *Predictive value.* A long history of competency testing and related research has demonstrated the value of such tests in areas such as sales, management, and leadership. In particular, well designed competency tests—and especially those that pinpoint specific behaviors—are excellent predictors of behavior (Boyatzis, 1982; Smith & Smith, 2005; Spencer & Spencer, 1993; Wood & Payne, 1998).

Epstein (1996a, 1996b) has suggested that creative expression depends largely on the mastery of one or more of four core competencies, each of which derives from various aspects of Generativity Theory and research:

1. *Capturing.* Because generative mechanisms appear to be universal, or, in other words, because behavior always varies and is virtually always novel in some sense, one of the most powerful ways to increase creative output is through the mastery of diverse skills that allow one to pay attention to and to preserve new ideas—in other words, to capture the new ideas that are already occurring on an ongoing basis. It is not surprising that artists, writers, and other people who are labeled *creative* often jot down ideas compulsively in notebooks and on sketchpads, keep recording devices by their beds, make deliberate use of dream states as a source of ideas, and so on. Salvador Dali took great pride in his ability to capture ideas from the hypnagogic state—the fertile dream-like state between waking and sleeping (Dali, 1976; Mavromatis, 1987).

2. *Challenging*. Because new behaviors appear to be the result of interconnections among previously established behaviors, situations that cause different behaviors to compete should provide a fertile ground for novelty. One of the simplest ways to produce such competition is through extinction (the termination of reinforcement), which causes previously effective behaviors to recur both simultaneously and sequentially—a phenomenon that Epstein (1983, 1985) called “extinction-induced resurgence.” Thus, people can increase the frequency of new ideas simply by putting themselves into difficult situations—situations in which they are likely to be ineffective. Situations in which we speak of “challenge” or “problem solving” are precisely these kinds of situations; the more difficult the challenge or problem, the more likely it is that multiple behaviors will compete and that new ideas will emerge.

While behaviors are competing, people often report feeling “frustrated” or “confused”—the by-products, perhaps, of a competition among behavioral repertoires. Thus, the skill set associated with this competency includes stress management techniques that allow people to handle difficult situations more calmly than they normally might. Again, it’s no surprise that many of the famous people we consider to be creative report long periods of frustration and suffering from which important ideas eventually emerge.

3. *Broadening*. Unless essential behaviors are established beforehand, they will fail to emerge in situations where they are required to appear as components of novel behaviors. Moreover, the more diverse the initial behavioral repertoire, the more interesting the possible interconnections that can occur. Therefore, one way to produce more novelty—and, indeed, more interesting novelty—in behavior is for people to acquire knowledge, information, and skills well outside their current areas of expertise—in other words, to broaden their knowledge and skills. Edwin Land’s invention of instant photography—an incredible breakthrough in its day—was possible because he was one of the few people in the world who had extensive knowledge of several disparate technical disciplines (plastics, polarization chemistry, viscous liquids, and microscopic crystals), all of which were required for the instant photography process (McElheny, 1998).
4. *Surrounding*. Behaviors can also be made to compete when an organism is exposed to several stimuli simultaneously or to a single ambiguous or novel stimulus, and the process of competition is orderly, as it is in extinction-induced resurgence

(Epstein, 1996a). Thus, the fourth core creativity competency involves behaviors that surround the individual with unusual social or environmental stimuli or unusual combinations of such stimuli. In a practical sense, this means doing simple things like putting unusual objects on one’s desk, rearranging furniture, or bringing together unusual combinations of people on teams or at social gatherings.

In the current investigation, a paper-and-pencil test that measures the four core competencies of creativity expression in individuals—the Epstein Creativity Competencies Inventory for Individuals (ECCI-i)—was evaluated in several respects in two studies, the first involving business people in the Philadelphia, Pennsylvania, area, and the second involving employees of the city of Brea, California.

## STUDY 1: PHILADELPHIA

### Methods

*Structure of the ECCI-i*. Items on the test are exemplars of typical behaviors within each of the four core competency areas. Thus, items in the *surrounding* category include statements such as *I rearrange the items in my work area regularly* and *I often seek a change of scenery*. Overall, the ECCI-i has 28 items, evenly divided among the four competency subscales (Table 1). Answers were recorded on a 5-point Likert-type scale labeled *agree* and *disagree* at the extremes.

In order to give the experimenters a quick measure of the consistency with which subjects responded on each subscale, two dummy items—positive or negative variants on another item—were included for each subscale, which allowed for the computation of an individual’s Internal Consistency Score (ICS), a correlation of scores on dummy pairs. (For example, the dummy variant for the item *I always record my new ideas as they occur to me* was the reverse-scored item *I only record new ideas when I’m ready to use them*.) Responses on dummy items were used only to compute a subject’s ICS; they were not used to tabulate subscale or total scores.

Because the ICS can be computed immediately after a subject takes a test, it has a practical use when the test is administered in a training or evaluation context—especially when it is administered by computer: A low ICS suggests that an individual misunderstood questions or was responding dishonestly or at random. Therefore, subjects with a low ICS can be asked to retake the test; none were asked to do so in the present studies, however. Because a low ICS suggests that an individual’s scores are inaccurate, it can also be used to eliminate subjects from some statistical analyses. In the following,

we present validity data in two formats: showing all subjects and showing “best” subjects—that is, subjects with an ICS exceeding a certain value. We also describe a conservative rationale for selecting a reasonable ICS *cutoff*—that is, an ICS value below which subjects can reasonably be eliminated from an analysis.

**Participants.** Participants were business people who attended creativity training seminars in the Philadelphia area. In all cases, the test was administered before any training began. In all, 208 racially and ethnically diverse subjects (157 Whites, 14 Blacks, 10 Asian, and 17 Hispanic) were tested. One hundred thirty-six were women and 72 were men, with a mean age of 41.

**Procedure.** Subjects were administered the test in a paper-and-pencil format. Answers were recorded on a form that was later scanned into a computer database for analysis. One hundred eighty of the 208 individuals who took the ECCI-i also provided a simple self-rating of creative expression by replying to the question *How frequently do you express your creativity?* on a 10-point scale; this question was posed before subjects took the test itself so that their response would not be affected by the test items. In addition, 60 subjects evaluated a colleague or subordinate who was attending the same seminar by replying to the question *How frequently does \_\_\_\_\_ express his or her creativity?* on a 10-point scale. Again, this question was asked before subjects took the test itself.

## Results

**Adverse impact.** The United States Equal Employment Opportunity Commission (EEOC) places restrictions on the possible adverse impact of tests that might be used in hiring, firing, or promotions. Specifically, the EEOC requires that such tests not distinguish groups by race, ethnicity, or gender by more than 20%. This requirement was satisfied by the results of the Philadelphia study. Total scores among racial and ethnic groups did not differ by more than 4%, and women outscored men by only 2%. Moreover, neither the racial/ethnic differences ( $F = 0.28$ ,  $p = 0.89$ ) nor the gender difference ( $t = -1.1$ ,  $p = 0.28$ ) was statistically significant.

**Reliability and validity.** Reliability was estimated by computing Cronbach’s alpha (the average intercorrelation of items), which proved to be 0.67 for all 208 subjects. Validity was estimated in two ways. First, for 180 subjects, subscale scores were employed in a linear regression to predict how frequently subjects said they

expressed their own creativity (self rating). Subscale scores proved to be a moderately good predictor of the self rating ( $r = 0.32$ ,  $p < 0.01$ ), with *challenging* the most predictive of the four competencies ( $\beta = 0.17$ ,  $p < 0.05$ ). Second, for 60 subjects, subscale scores were employed in a linear regression to predict the creativity ratings provided by colleagues or supervisors (other ratings). Subscale scores were marginally predictive of other ratings ( $r = 0.29$ ,  $p < 0.05$ ).

Eliminating subjects with relatively low ICS provides a way to assess the validity of the instrument using the subjects who responded most consistently on each of the subscales of the test. To determine a reasonable cutoff point for the ICS, we looked at how both reliability and validity scores varied as the cutoff point was raised. Reliability peaked with an ICS of 0.6, and validity peaked with an ICS of 0.7. (Note that as more subjects are eliminated, it becomes more difficult to achieve statistical significance; the improvement in the consistency of scores is offset by the decrease in the number of subjects.) A conservative choice for the cutoff, we believe, is the lower of these two values: 0.6. With this value, we’re left with only 41 subjects; however, subscale scores were now much better predictors of self ratings of creative expression ( $r = 0.49$ ,  $p < 0.01$ ). Presumably, if each subject with a low ICS had been asked to retake the test, our validity measures would have been higher from the outset. Unfortunately, with an ICS cutoff of 0.6, too few subjects were available to reach statistical significance in an attempt to predict the other rating ( $n = 15$ ,  $r = 0.14$ ,  $p = 0.61$ ).

## STUDY 2: BREA

### Methods

**Participants.** One hundred seventy-three employees—nearly half of the employees in this city of 35,000 people in Orange County, California—took part in this study, which was encouraged by the city manager as an attempt to involve more staff in finding solutions to city problems. Employees from every city department (Parks & Recreation, Police, Human Resources, Sanitation, etc.) participated. Seventy-four members of the initial group (44 women and 30 men, with a mean age of 45) also took part in an 8-month follow-up. Of those 74, 60 were White, 2 were Black, 5 were Asian, and 6 were Hispanic, with one choosing the “Other” designation.

**Procedure.** Initially, during a 1-week baseline period, the managers of five city departments kept a log of the number of new ideas suggested to them by department employees. Then, over a period of several months, employees and managers were invited to attend

creativity training seminars, some conducted by outside trainers and others by appropriately-trained members of the city's Human Resources department. Before the start of each session, participants took the ECCI-i online. Sessions lasted a half day and consisted of games and exercises developed by the first author to strengthen four core competencies of creative expression (Epstein, 1996b, 2000). At the start of each session, the instructor reviewed and discussed the participants' scores on the ECCI-i.

Approximately 8 months after the training session, 74 of the initial 173 participants took the ECCI-i again online, and, for a 1-week period, the five department managers again kept a log of the number of ideas that were suggested to them by department employees.

## Results

**Adverse impact.** EEOC guidelines were met once again, with no racial or ethnic group outscoring another by more than 10% and men outscoring women by 3.7%. Once again, neither the racial/ethnic differences ( $F = 0.60$ ,  $p = 0.62$ ) nor the gender difference ( $t = 0.73$ ,  $p = 0.47$ ) was statistically significant.

**Reliability.** Cronbach's alpha for this full data set ( $N = 173$ ) was 0.84, substantially higher than in the previous data set.

**Outcomes of training.** Scores on the ECCI-i approximately 8 months after training for the subset of employees who took both the pretest and the follow-up test ( $n = 74$ ) were somewhat higher than on the pretest ( $\bar{x}_1 = 67$ ,  $\bar{x}_2 = 71$ ), and the difference was significant at the .05 level. More important, the rate at which new ideas were expressed by employees to managers increased 55% over this period—from 1.46 per employee per week (92 ideas expressed by 63 employees during the baseline observation period) to 2.26 per employee per week (122 ideas expressed by 54 employees during the follow-up observation period). City officials attributed many positive changes directly to this brief testing and training program, including more than \$600,000 in new revenues and about \$3.5 million in innovative expenditure reductions over an 8-month period, involving only a handful of job terminations (Getting Creative, 2005).

## DISCUSSION AND CONCLUSION

Although the results of this investigation are generally positive, it suffers from flaws that are relatively common in research in real working environments. In the

Philadelphia study, for example, the large number of people with ICS under 0.6 (167 out of 208) was surprising. Participants may have been rushed in some training sessions, or perhaps instructions were unclear. It is also possible that errors were introduced when paper scoring forms were scanned in to the computer. In the Brea study, only 74 of the original 173 trainees chose to take the follow-up test 8 months after the training sessions. By this time, some of the trainees may have no longer been employed by the city (mainly because of normal job turnover), and some probably now had higher workloads due to downsizing and the redistribution of assignments. We don't know why nearly 100 individuals failed to take the follow-up test, and we also don't know whether there was any self-selection involved—that is, whether the people who responded to an invitation to take the follow-up test generally learned more from, or felt more favorable toward, the creativity training they had.

In our 8-month follow-up test in Brea, a small but marginally significant increase in ECCI-i scores was observed. We failed, however, to administer the test shortly after the completion of training, and hence we were unable to compare our follow-up scores to post-training scores, which would presumably have been much higher than the follow-up scores. This makes it difficult to interpret the significance of the magnitude of the follow-up scores. This study is also limited in that the increase in test scores, as well as the increase in the number of new ideas expressed to managers, may well have been due to factors other than the relatively brief creativity training that we provided. Without a control group, it is impossible to demonstrate, with any degree of confidence, a causal link between our intervention and the improvement we observed. It is notable, however, that the city manager, the director of human resources, and other city officials attributed a number of positive changes in the city to a change in culture brought about by the creativity training; specifically, employees seemed more willing to share new ideas, and managers seemed more willing to hear them.

In the early stages of the development of psychometric tests, it is common for investigators to use factor analytic techniques either to discover or to establish the integrity of subscales. For competency tests such as the ECCI-i, we believe that a factor analysis is inappropriate and have, thus, refrained from employing it in this investigation. Factor analysis is appropriate where the factors under consideration are entirely or largely hypothetical; indeed, the fact that responses on clusters of items covary is sometimes the only basis for describing a factor. In contrast, the competencies we are measuring were well defined based on research and principles established before the competency test was developed. They can be described and trained independently of one another, and

the utility of each competency can also be established independently. Moreover, scores on items that represent various behavioral exemplars within a competency need not covary; even though they may all be cases of capturing or broadening, specific skills within each category may be learned and mastered separately. Generalization from one behavior to another within a competency area is not presumed to occur, even though such behaviors can be described under a single principle. Once shown to have value, competencies become the bedrock of the competency test, rather than the end point of a factor analysis.

We tentatively conclude from this investigation that:

1. The ECCI-i accurately measures relatively stable creativity competencies.
2. Competency scores on the ECCI-i predict how frequently people express creativity, as indicated by their own assessment, as well as by the assessments of coworkers and supervisors.
3. The test does not discriminate against people by gender, race, or ethnic group.
4. Creativity competencies can be trained.
5. Strengthening creativity competencies appears to lead to a measurable increase in creative expression in an organizational setting.

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