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Correlates of domain-general and domain-specific components of creativity

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Authors

Chen, C
Himsel, A
Kasof, J
[et al.](#)

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Peer reviewed

CHUANSHENG CHEN
AMY HIMSEL
JOSEPH KASOF
ELLEN GREENBERGER
JULIA DMITRIEVA

Boundless Creativity: Evidence for the Domain Generality of Individual Differences in Creativity

ABSTRACT This study investigated correlates of domain-general and domain-specific components of creativity. 158 college students completed a questionnaire that assessed their motivational and personality traits (i.e., intrinsic and extrinsic motivation, creative personality, and originality in word association) as well as intellectual abilities (SAT verbal and quantitative scores). Under two different instruction conditions (standard instruction or explicit “be creative” instruction), students also took a battery of multi-item, product-based tests of creativity in three domains (artistic, verbal, and mathematical creativity). Factor analyses showed evidence of domain-generality of creativity. Furthermore, results from structural equation models showed that motivational and personality traits and intellectual abilities were associated with the domain-general component of creativity. Only one variable (SAT quantitative score) was found to be associated with the domain-specific component of mathematical creativity under the explicit “be creative” instruction condition. These results affirm the domain-generality of creativity and challenge researchers to identify correlates of domain-specific components of creativity.

INTRODUCTION The debate on the domain-generality vs. domain-specificity of creativity has intensified over the past two decades and is reaching a new height with the publication of a volume mainly devoted to this issue (Sternberg, Grigorenko, & Singer, 2004). Both sides of the debate have accumulated theoretical and empirical evidence to support their arguments. Domain-generality of creativity has been supported by evidence such as the power of tests of creative thinking (e.g., Torrance Tests

of Creative Thinking [TTCT]) to predict subsequent creative achievement (Plucker, 1999a; Sternberg, 1989) and the reliability and validity of self and others' (e.g., teachers') ratings of an individual's general creativity (e.g., Creative Personality Scale) (e.g., Plucker, 1999b).

The key evidence for domain-specificity derives from the low correlations among ratings of creative performance in different domains (e.g., poetry, mathematics, and drawings) (Baer, 1991, 1994a; Conti, Coon, & Amabile, 1996; Kaufman & Baer, 2004; Han, 2003; Han & Marvin, 2002; Runco, 1989; Ruscio, Whitney, & Amabile, 1998) or even within the domain of verbal creativity (e.g., poetry vs. story, Baer, 1994a; painting vs. drawing, Conti et al., 1996); low correlations between creativity in specific domains and creativity assessed with measures such as TTCT (Diakidoy & Spanoudis, 2002) and Wallace-Kogan Creative Thinking Test (Han, 2003; Han & Marvin, 2002); a lack of transfer of learning of creativity skills across domains (Baer, 1994b, 1996); and the small number of geniuses who excel in multiple domains (Baer, 2004; Sternberg & Lubart, 1995).

The evidence for both sides of the debate, however, has serious weaknesses. For example, when arguing against the domain-generality of creativity, Baer (1998) questioned the relevance and significance of self-report indices of creativity. He believed that response-bias in self-reports may have resulted in the appearance of domain-generality. The explanatory power of TTCT and other divergent thinking tests has also been challenged (Amabile, 1983; Diakidoy & Spanoudis, 2002; Han, 2003; Han & Marvin, 2002; Hocevar & Bachelor, 1989). Research is needed to explore new correlates that may better account for the domain-general components of creativity. One such set of variables involves the trait forms of intrinsic and extrinsic motivation. Research has shown that creative performance in various domains is promoted by state intrinsic motivation (Amabile, 1996) although the effects of state extrinsic motivation are less well understood (Eisenberger & Shanock, 2003). Additionally, in several different domains creative behavior has been associated with stable individual differences in intrinsic and extrinsic motivational orientations in schoolwork and employment (Amabile, Hill, Hennessey, & Tighe, 1994; Kaufman, 2002) and with need for cognition, which Cacioppo and Petty (1982) define as trait intrinsic motivation to engage in effortful cognitive processing (Dollinger, 2003; Tierney, Farmer, & Graen, 1999). In the present study,

we measured these types of trait motivational orientation. Creative performance in different domains has also been associated with the Creative Personality Scale (e.g., Gough, 1979; Kaduson & Schaefer, 1991; Koestner, Walker, & Fichman, 1999) and with measures of originality in word associations (e.g., Gough, 1976; MacKinnon, 1962; Upmanyu, Bhardwaj, & Singh, 1996). Hence, we also included measures of these individual differences. Finally, because creativity, intellectual ability, and academic performance are closely related (Kuncel, Hezlett, & Ones, 2004), we included students' SAT scores as potential correlates.

The arguments for domain-specificity also have weaknesses. The most fundamental weakness is that they rely almost exclusively on the absence of good evidence in favor of domain-generalty, rather than on direct evidence either for domain-specificity or against domain-generalty. Reliance on the absence of good evidence for domain-generalty is problematic because such an absence may be due to reasons other than domain-specificity.

One alternative reason is that evidence from previous research had methodological problems, thus failing to generate good evidence for domain-generalty. For example, the low correlations among creativity scores from different domains can be explained by the poor psychometric properties of existing creativity tests, most of which consist of a single item (i.e., single task). According to measurement theories (Nunnally, 1978), when a construct is difficult to measure without error, it is recommended that measures include as many alternative indicators as possible in order to increase internal consistency. It would be informative to ask what would the results have been if creativity tests had included more items.

Based on existing data summarized by Baer (1998), inter-domain correlations (based on one item in each domain) were typically around .20 (e.g., $r = .18$ in Runco, 1989; $r = .23$ in Baer, 1991; $r = .19$ in Baer, 1994a; $r = .37$ in Sternberg & Lubart, 1995; also see Conti et al., 1996, and Ruscio et al., 1998, for modest inter-domain correlations). Baer interpreted this modest magnitude of correlation as evidence for a lack of domain-generalty and hence as evidence for domain-specificity. But if those studies had included more items, say, 10 items, an average inter-item correlation of .20 would have generated a Cronbach alpha of .70 (assuming that the actual association between items were similar to that of the studies summarized by Baer). If the number of items was 16 and the inter-item

correlations were averaged at .20, Cronbach alpha would have reached .80. Such a level of internal consistency would likely have been interpreted as evidence for domain-generalizability. It is instructive to consider that most achievement tests have 40-50 items.

The above discussion suggests that a lack of strong evidence for domain-generalizability may be due mainly to a lack of multiple-item tests, an issue that was explored in the current study. It should also be pointed out that creativity researchers typically report data from every single item of a creativity test. Although such a practice is understandable given the frequently labor-intensive nature of data collection, one should keep in mind that most other areas of research endorse a process of systematic elimination of items that are not correlated with the total test score.

A rigorous examination of the domain-generalizability of creativity requires as many valid and reliable test items as practically possible. In the present study, we used eight tests — most of which had multiple items — to examine creativity in three domains (artistic, verbal, and mathematical). After establishing the factor structure of creativity, structural equation models were used to test whether the correlates were associated with the domain-general vs. domain-specific components of creativity.

Finally, test instruction may influence the way domain-general and domain-specific components of creativity are revealed. In some creativity studies, research participants were explicitly asked to “be creative,” whereas in other studies they were only told to complete a task and might not even be aware that creativity was being measured. Previous research (e.g., Chen et al., 2005; Harrington, 1975) has found that the explicit “be creative” instruction (EI) greatly increased creative performance. More relevant to the present study, there is some evidence that, as compared to the standard condition (SI), the EI condition results in creativity scores that are more closely associated with other measures of creativity. Harrington (1975) and Katz and Poag (1979) found that test scores obtained under the EI condition were more closely associated with the scores on the creative personality and ability scales than they were under the SI condition. Similarly, Chand and Runco (1993) reported that divergent thinking test scores obtained under the EI condition, but not those under the SI condition, were related to self-reports of creative activities and accomplishment. These

results suggest that domain-generalty may be better revealed under the EI condition than under the SI condition. This is perhaps due to the fact that the explicit “be creative” instruction helps to direct research participants’ attention to the creativity dimension of the criteria that will be used in performance evaluation.

METHOD
Participants Participants were 158 (72% females) undergraduate students enrolled in a large public university in Southern California. This was a subsample of a larger study (Chen et al., 2005). This subsample was given a complete battery of eight creativity tests and asked to complete a questionnaire that included measures of motivation and personality traits (to be described below). The mean age of the sample was 21.66 yrs. (s.d. = 3.79 yrs.). The sample was ethnically diverse: 30% European Americans, 40% Asian Americans/Pacific Islanders, and 30% other ethnic background (including Mexican Americans, African Americans, bi-ethnic or multi-ethnic students). More than half of the participants’ fathers (59%) and 46% of their mothers had a four-year college education or post-graduate degrees.

Procedures After obtaining informed consent, all students completed a questionnaire that included demographic information, their SAT scores, a creative personality scale, a word association test, and two measures of motivation orientation. Participants were then randomly assigned to either the explicit “be creative” instruction (EI) condition or the standard instruction (SI) condition to complete the creativity tasks. Under the EI condition, participants were explicitly asked to be creative and imaginative (but still appropriate) in their responses. For example, the specific instruction for the EI condition for drawing was titled “Drawing Creatively” and included the instruction: “This task involves drawing creatively. We want you to create drawings that are highly creative, imaginative. That is, please create drawings that are both original (novel, uncommon) and also appropriate (artistically effective) . . . And remember: Be as creative and imaginative as you can be!”

For verbal tasks, students were asked to write a creative story and poems with assigned titles and to write creative titles for photographs. For example, poetry instruction included: “We want you to be as creative as you can possibly be in writing a poem. That is, we want you to write a poem that is both highly *original* (unusual, uncommon, non-ordinary) and highly *appropriate* (sensible, poetically effective, beautifully written).” For the chair design and mathematical creativity tasks, the

following sentence was used (in upper case) “Try to be as creative (original) as you can in solving the problem.”

Under the standard condition, all references to the word “creativity” or related words (e.g., original, uncommon, etc.) were removed. For example, “Drawing Creatively” was replaced with “Visual Imagery” and “Writing Creative Poetry” with “The Poetry of Your Mind.” Students completed these tasks in their classrooms for extra course credits.

Measures of
Creativity

Participants created original products in the verbal, artistic, and mathematical domains, and these products were subsequently assessed for level of creativity.

Verbal creativity. Each participant was asked to create two poems, one story, and two titles. The poetry task was adapted from that introduced by Amabile and used extensively in previous creativity studies (e.g., Amabile, 1996). Participants were asked to write poems in which line 1 consisted of one noun, line 2 consisted of two adjectives that modified the noun, line 3 consisted of three verbs that were related to the noun, lines 4 and 5 could have any number of words of any grammatical type as long as they were related to the noun, and line 6 repeated the noun in line 1. As in previous research by other investigators, participants were given the first lines of each poem. Within each instructional condition, participants were randomly assigned either two commonplace titles (“Hope” and “Sunshine”) or two unusual titles (“Ear” and “Window”). These title words were selected from a list of 100 words that are deemed to have universal meanings (Osgood, May, & Miron, 1975, p. 72). Participants were allowed 6 minutes to write each poem.

For the story task, participants were given 15 minutes to write a story with the title “Beyond the Edge” (from Sternberg & Lubart, 1992). Story writing tasks have been used in many previous creativity studies (e.g., Amabile, Hennessey, & Grossman, 1986; Koestner, Walker, & Fichman, 1999; Moneta & Siu, 2002; Sternberg & Lubart, 1995).

For the final verbal creativity task, participants were asked to create titles for art photographs. Although title-writing tasks have been employed in a few previous creativity studies (e.g., Eisenberger & Rhoades, 2001), the use of photographs as stimuli for such tasks is original to our study. Two photographs featured commonplace photographic subject matter (Ansel Adams’s realistic landscapes of a dead tree on a hilly pasture, “Tree, Sierra Foothills, CA, 1938,” and of a stream running through a field of tall grass, “Bear Track Cove, Alaska, 1948,”

in De Cook, 1972, pp. 43 and 48, respectively), and two photographs featured unusual imagery (photomontages of a hanging door suspended within a boulder and a human face superimposed upon a large rock; Uelsmann, 1992, pp. 65 and 111). Participants who were assigned commonplace titles for the poetry tasks were asked to create titles for the two photographs that featured commonplace images, whereas the participants who had received unusual poetry titles were asked to create titles for the two photographs of unusual imagery. Photographs were presented in counterbalanced order. Participants had 3 minutes to title each photograph.

Artistic creativity. To measure artistic creativity, two types of tasks were used which required only minimal technical skill. The drawing task was adapted from tasks used in many previous creativity studies (e.g., Chen et al., 2002; Getzels & Cskszentmihalyi, 1976; Sobel & Rothenberg, 1980; Sternberg & Lubart, 1995). Participants were given 10 minutes to create eight small drawings with the following titles (four geometric shapes and four non-geometric titles): circle, rectangle, triangle, oval, contrast, person, motion, and dream. For the design task, participants were given 8 minutes to design a chair by using two triangles, two ovals, two rectangles, and three lines (participants were allowed to use just eight of the nine components if they so desired) of any size or length. This task was designed for the present study.

Mathematical creativity. To measure creativity in mathematics, two tasks were adapted from Haylock's (1987) measures of the originality and flexibility in solutions to ambiguous mathematical problems. On each type of task, participants were given guidelines that defined appropriateness and, within these parameters, were asked to generate multiple responses, which varied greatly in originality. For the "Cutting Rectangles Task," participants were asked to partition rectangles by drawing straight lines. Participants had 6 minutes to work on four rectangles, of which two were to be segmented into four component rectangles and two were to be segmented into nine component rectangles. On the "Nine-Dot Areas Task," participants were given a 2" by 2" space (demarcated by nine dots) and asked to partition the space into segments of 2 square inches by drawing straight lines and connecting the dots. Participants had 6 minutes to work on three "Nine-Dot Areas Tasks."

We used three methods to assess the creativity of different types of original products. Before presenting products for assessment, we removed each product from its original test

packet, typed each poem, story, and title, and grouped products together with other participants' products of the same type. Judges and coders were trained undergraduate research assistants, both for reasons of economy and because previous research has found that judgments made by undergraduates were reliable and valid (e.g., highly correlated with judgments made by experts; Amabile, 1996, pp. 72-73; also see Sternberg & Lubart, 1995). Different sets of judges were used for tests in the different domains or sub-domains (i.e., geometric drawings, nongeometric drawings, chair design, story writing, poem and title writing, and mathematical creativity).

Consensual assessment technique. Poems, drawings, and stories were judged following Amabile's (1982) consensual assessment technique. Although we gathered ratings on multiple dimensions (e.g., creativity, liking, technical quality), the present study focuses only on the creativity dimension. Judges were instructed to employ their own subjective understanding of creativity, rate each product relative to the others, and use the entire 5-point rating scale, which ranged from 1 (*not at all creative*) to 5 (*highly creative*). For each task, products were arranged into a different random order before they were rated by judges. The number of judges ranged from 6 to 8 per task. Inter-rater reliability (Cronbach alpha) ranged from .72 to .97 and averaged .89.

Sorting method. For the title writing and chair design tasks, we developed a sorting method to measure creativity. For each task, after the products were randomly shuffled, judges were first asked to sort the products into three approximately equal piles that represented low, medium, and high creativity, and then were asked to further divide the low creativity and the high creativity piles each into two smaller piles, such that products were eventually sorted into five levels that approximated a normal distribution. Several previous studies have employed similar methods of pre-normalizing judges' assessments of creativity (e.g., Getzels & Csikszentmihalyi, 1976). Inter-rater reliability (Cronbach alpha) ranged from .75 to .88, with a mean of .82.

Coding method. To measure mathematical creativity, we developed simple objective coding schemes based on Haylock (1987). Undergraduate research assistants were trained to use these schemes in coding products. On the Cutting Rectangles Task, products that featured only vertical lines or only horizontal lines were coded as low creativity, products that featured vertical and horizontal lines of different lengths (resulting in

rectangles of varying size) were coded as medium creativity, and products that featured more complex configurations (e.g., three-dimensional or imbedded rectangles) were coded as high creativity. For the Nine-Dot Areas Task, we coded creativity according to how small of a unit participants used to generate the 2-square-inch segments, assigning higher creativity to products that featured smaller units. For example, products that featured large segments (e.g., a segment half the size of the 4-square-inch space) were coded as low in creativity, whereas products that featured the smallest possible unit (a unit of one-sixteenth of the larger space created by drawing straight lines across all nine dots) were coded as most highly creative. All products were coded independently by two coders, yielding an initial agreement rate of >85%; inter-coder disagreements were examined and resolved during meetings with the authors. The validity of these coding schemes is supported by Chen et al.'s (2005) finding that explicit instruction to be creative significantly increased mathematical creativity, as measured by these coding schemes.

Measures of
Motivational
Orientation,
Creative Personality,
and Word
Associations

Motivational orientation. Two scales were used to assess motivational orientation: the Work Preference Inventory (Amabile et al., 1994) and the Need for Cognition scale (Cacioppo, Petty, & Kao, 1984). From the Work Preference Inventory, separate scores were calculated for intrinsic and extrinsic orientations. The intrinsic motivation scale had 15 items. A sample item is "Curiosity is the driving force behind much of what I do." The extrinsic motivation scale also had 15 items. A sample item is "I am strongly motivated by the grades I can earn." Participants responded to a 6-point Likert scale, ranging from -3 (*strongly disagree*) to +3 (*strongly agree*). The Cronbach α was .70 for the intrinsic motivation scale and .77 for the extrinsic motivation scale. The 18-item Need for Cognition scale (Cacioppo, Petty, & Kao, 1984) was used to measure the intrinsic motivation to engage in effortful cognitive processing. Sample items include "I really enjoy a task that involves coming up with new solutions to problems." Participants responded to a 6-point Likert scale, ranging from -3 (*strongly disagree*) to +3 (*strongly agree*). Cronbach α for this scale was .88.

Creative Personality Scale. The Creative Personality Scale of the Adjective Checklist (Gough, 1979) included 30 adjectives, 18 of which are considered to be positively indicative of creativity (e.g., inventive, original, unconventional) and 12 of which are coded negatively (e.g., conservative, cautious,

interests narrow). This scale has been linked to creative performance (Gough, 1979; Kaduson & Schaefer, 1991; Koestner, Walker, & Fichman, 1999). Cronbach α of the scale was .66.

Word Association Test. We used 41 stimulus words (e.g., Anger, Chair, Egg, Food, House, Life, Moon, Woman). These words often appear in daily language, and most of them are included in the list of 100 words that have similar semantic differential meanings world-wide (Osgood, May, & Miron, 1975). An originality score was created in the following way. We first assigned a number to each word-association based on how many participants in the study gave the same response to the same stimulus word. The frequency number or score was then standardized within each stimulus word across all subjects. The standardized score was then reversed to reflect originality: That is, a response used by few subjects got a high originality score. Finally, the originality scores were averaged across all stimulus words to create a total score. Cronbach α of this scale was .76.

RESULTS Factor Analyses of the Creativity Tests

The scores from the eight tests of creativity were submitted to a principal component analysis (see Table 1 for the means and standard deviations and other descriptive statistics of these and other key variables used in the present study). Three factors were extracted for both the standard instruction (SI) condition and the explicit “be creative” instruction (EI) condition. For the SI condition, the first factor accounted for 25% of the variance, the second, 18%, and the third, 14%, yielding a total of 57% of the variance. The corresponding numbers for the EI condition were 31%, 16%, and 13%, yielding a total of 59% explained variance. After varimax rotations, the loadings of the tests on the factors generally corresponded to the three domains of artistic, verbal, and mathematical creativity (see Table 2). Given this evidence, summary scores were created for the three domains of creativity.

The three summary scores were again submitted to a factor analysis to see whether they loaded on a single second-order factor of *overall creativity*. For both conditions, only one factor was extracted. It accounted for 45% of the variance for the SI condition and 52% of the variance for the EI condition. The loadings of artistic, verbal, and mathematical creativity on this one factor were respectively .74, .79, and .41 for the SI condition and .81, .70, and .65 for the EI condition.

Another way of examining the domain-generality of creativity is to conduct reliability analyses at the item level. As discussed in the introduction, we anticipated that, with a moderate number of items, there might be a satisfactory level of internal consistency among creativity test items. Using all 21 items (four geometric drawings, four non-geometric drawings, one chair design, one story writing, two poems, two titles of photographs,

TABLE 1. Means and Standard Deviations of the Major Variables.

	Means	SD	Actual range	Possible range
<i>Creativity Measures</i>				
Geometric drawings	2.45	.88	1.33 - 4.20	1 - 5
Nongeometric drawings	2.74	.49	1.62 - 3.97	1 - 5
Chair design	2.99	.97	1.00 - 5.00	1 - 5
Story writing	3.20	.62	1.13 - 4.88	1 - 5
Poem writing	3.22	.60	1.91 - 4.65	1 - 5
Title writing	3.03	.55	1.72 - 4.12	1 - 5
Cutting rectangles	1.85	.86	0.00 - 4.50	0 - 5
Nine-dot areas	2.06	1.36	0.00 - 5.00	0 - 5
<i>Correlates</i>				
Intrinsic motivation	20.75	9.57	-4.00 - 45.00	-45 - 45
Extrinsic motivation	5.46	12.16	-37.00 - 31.00	-45 - 45
NFC	0.84	0.92	-2.00 - 2.83	-3 - 3
CPS	5.15	4.16	-5.00 - 15.00	-12 - 18
Word association	-0.01	0.32	-0.78 - 1.01	NA ¹
SAT-V	548.01	98.44	310 - 780	200 - 800
SAT-Q	586.17	91.09	360 - 800	200 - 800

Notes: NFC = Need for cognition; CPS = Creative Personality Scale; SAT-V = SAT Verbal scores; SAT-Q = SAT quantitative scores.

¹ These were standardized scores that had no limits to the possible range. The absolute possible range for the raw scores ranged from -6478 (when every of 158 subjects picked the same word for each of the 41 target word) to 41 (when no one but the individual subject picked the same word for each of the 41 target words).

TABLE 2. Factor Analysis of the Creativity Measures.

	The SI Condition			The EI Condition		
	Factor 1 (Math)	Factor 2 (Artistic)	Factor 3 (Verbal)	Factor 1 (Artistic)	Factor 2 (Math)	Factor 3 (Verbal)
Geometric drawings	.025	.792	.054	.879	.020	.077
Nongeometric drawings	.212	.769	-.026	.768	.179	.207
Chair design	-.206	.500	.474	.467	.409	.133
Story writing	-.059	-.065	.848	-.029	.264	.690
Poem writing	.364	.136	.645	.207	-.033	.572
Title writing	.383	.221	.211	.150	-.037	.780
Cutting rectangles	.851	.050	-.009	.192	.806	.031
Nine-dot areas	.710	-.017	-.016	.036	.813	.046

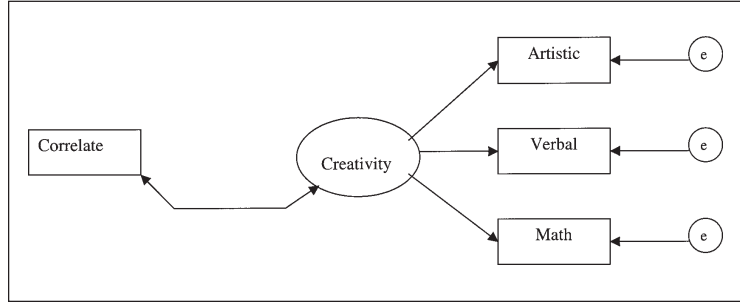
Notes: SI = Standard Instruction; EI = Explicit “Be Creative” Instruction. Factor loadings greater than .40 are in bold.

four rectangles for the cutting task, and three nine-dot area tasks), Cronbach a was .83 for the whole sample (.73 for the SI condition and .82 for the EI condition). These results provide clear evidence for a domain-general component of creativity.

Correlates of
Domain-General vs.
Domain-Specific
Components of
Creativity: Structural
Equation Models

Given that about half of the variance of the three summary scores was shared (i.e., domain-general) and the other half contributed by a combination of domain-specific components and measurement errors (see second-order factor analysis above), we proceeded to examine the associations between motivation and personality factors and the domain-specific vs. domain-general components of creativity. Structural equation models are ideal for these analyses because they simultaneously evaluate the covariance structure among the three domains of creativity (with a latent construct of domain-general creativity) and their associations with a potential correlate (see Figure 1). The model depicted in Figure 1 was used to test all seven correlates (intrinsic motivation, extrinsic motivation, need for cognition, creativity personality scale, originality in word association, SAT-verbal score, and SAT-quantitative score). The null hypothesis for this model is that each correlate was associated only with the domain-general component of creativity (i.e., the latent construct of creativity). The error

FIGURE 1. Structural Equation Models Used to Assess Correlates of Domain-General and Domain-Specific Components of Creativity.



terms (e) for each domain of creativity include both measurement errors and domain-specific aspects of creativity. In the null hypothesis, the covariance between the correlate and the domain-specific aspects of creativity was set to zero (i.e., no association between the correlate and domain-specific aspects of creativity in this model that simultaneously takes into account the association between the correlate and the domain-general component of creativity).

When the model does not fit the data, the null hypothesis should be rejected. In that case, one should examine the residuals to find out whether there is a potential covariance between the correlate and a particular domain of creativity. The model should be re-tested after the addition of a covariance between the correlate and the error term (which, as indicated earlier, includes the domain-specific component of creativity as well as measurement error).

Before we show the results from the structural equation models, it is helpful to show the bivariate correlations between the correlates and creativity (see Table 3). Clearly, all correlations were in the expected directions, although not all reached the conventional significance level. Most importantly, 11 out of the 14 correlations for the total creativity score were significant and 1 was marginally significant. That number of significant correlations was greater than that for each of the domains (four for artistic creativity, seven for verbal creativity, and five for mathematical creativity). These results appear to indicate that the total score (a proxy of the domain-general component of creativity) had a more consistent association with the correlates than did the domain-specific scores. It is not clear, however, whether there were correlates that were associated with domain-specific components after the domain-

TABLE 3. Correlates of Creativity.

	The SI Condition				The EI Condition			
	Artistic	Verbal	Math	Total	Artistic	Verbal	Math	Total
Intrinsic motivation	.26*	.37**	.15	.36**	.19+	.10	.24*	.25*
Extrinsic motivation	-.21+	-.18	-.29*	-.35**	-.31**	-.07	-.03	-.13
NFC	.19+	.26*	.19+	.32**	.22*	.16	.35**	.36**
CPS	.20+	.22+	.03	.21+	.10	.24*	.18*	.24*
Word association	.15	.25*	.21+	.27*	.13	.28*	.00	.11
SAT-V	.23+	.29*	.18	.31*	.28*	.19	.20	.32**
SAT-Q	.25+	.29*	.10	.27*	.18	.12	.35**	.38**

Notes: SI = Standard Instruction; EI = Explicit “Be Creative” Instruction; NFC = Need for cognition; CPS = Creative Personality Scale; SAT-V = SAT Verbal scores; SAT-Q = SAT quantitative scores.

+ $p < .10$, * $p < .05$, ** $p < .01$.

general components are taken into consideration (or partialled out in traditional correlational analyses). Structural equation models tested this in a systematic manner.

Tables 4 and 5 present the results of the structural equation models. As shown in Table 4, six of the seven models for the SI condition fit the data very well (non-significant chi-square, fit indices about .90 or higher). All standardized residuals were small. Only one model (the one involving extrinsic motivation) had less than adequate fit according to some of the indices (e.g., NNFI) but not others (e.g., chi-square). However, a close examination of the standardized residuals did not show any evidence that extrinsic motivation was a domain-specific correlate. In sum, all seven correlates were correlated (at least marginally) with the domain-general component of creativity, and none of them was correlated with any domain-specific component of creativity.

Similar results were found with the EI condition, but with one important exception. As shown in Table 5, six of the seven initial models fit the data very well and each correlate was significantly or marginally associated with the domain-general component of creativity. None of the residuals for these six

TABLE 4. Summary of SEM: The Standard Instruction (SI) Condition.

	Fit Indices					Correlation with the latent construct of creativity	Standardized Residuals				
	χ^2	df	N	p	NFI		NNFI	CFI	Artistic creativity	Verbal creativity	Math creativity
Intrinsic motivation	.281	2	73	.869	.987	1.318	1.000	.60*	.00	-.01	.02
Extrinsic motivation	3.789	2	73	.150	.793	.565	.855	-.54*	.02	.05	-.10
NFC	1.084	2	73	.581	.936	1.251	1.000	.48*	-.01	-.01	.08
CPS	.323	2	73	.851	.977	1.611	1.000	.41+	.02	-.01	-.03
Word association	1.609	2	72	.447	.893	1.129	1.000	.40+	.03	.01	-.11
SAT-V	.620	2	57	.733	.966	1.330	1.000	.45+	.04	.01	-.05
SAT-Q	1.940	2	57	.389	.896	1.015	1.000	.41+	.08	.02	-.10

Notes: NFI = Bentler-Bonnet Normed Fit Index; NNFI = Bentler-Bonnet Nonnormed Fit Index; CFI = Comparative Fit Index; NFC = Need for cognition; CPS = Creative Personality Scale; SAT-V = SAT Verbal scores; SAT-Q = SAT quantitative scores.

+ $p < .10$, * $p < .05$, ** $p < .01$.

TABLE 5. Summary of SEM : The Explicit “Be Creative” Instruction (EI) Condition.

	Fit Indices					Correlation with the latent construct of creativity	Standardized Residuals				
	χ^2	df	N	p	NFI		NNFI	CFI	Artistic creativity	Verbal creativity	Math creativity
Intrinsic motivation	1.642	2	79	.440	.935	1.060	1.000	.30*	-.02	-.03	.11
Extrinsic motivation	.888	2	79	.642	.969	1.147	1.000	-.33**	.00	.03	.08
NFC	4.040	2	79	.133	.870	.757	.919	.45**	-.05	-.05	.11
CPS	2.865	2	79	.239	.882	.859	.953	.23+	-.07	.08	.07
Word association	4.930	2	78	.085	.814	.571	.857	.37*	.07	-.07	.10
SAT-V	2.888	2	63	.238	.868	.832	.944	.38*	-.09	.00	.16
SAT-Q	7.611	2	64	.020	.675	.030	.678	.23	-.01	-.03	.32
SAT-Q (modified) ^a	.092	1	64	.762	.996	1.31	1.00	.19	.00	.11	.00

Notes: NFI = Bentler-Bonnet Normed Fit Index; NNFI = Bentler-Bonnet Nonnormed Fit Index; CFI = Comparative Fit Index; NFC = Need for cognition; CPS = Creative Personality Scale; SAT-V = SAT Verbal scores; SAT-Q = SAT quantitative scores.

^a In this modified model, SAT-Q and the error term for mathematical creativity were allowed to correlate. The correlation between them was .33, $p < .05$.

+ $p < .10$, * $p < .05$, ** $p < .01$.

models was substantial. For the SAT-quantitative score, however, the model did not fit (i.e., a significant chi-square and poor fit indices). An examination of the residuals showed that the SAT-quantitative score had a unique association with mathematical creativity with a standardized residual of .32. A modified model (with the addition of a covariance term between SAT-quantitative score and the error term of mathematical creativity) was re-run and the results showed a very good fit between the model and the data.

DISCUSSION Whether creativity is domain-general or domain-specific has been debated for some time. Few prior studies have found strong evidence for domain generality. The “splitters” (borrowing the terminology from a parallel debate about the domain-specificity of intelligence) have interpreted a lack of evidence for domain-generality as proof of domain specificity. However, a lack of evidence for domain-generality could have been due to measurement problems and poor choices of correlates for domain-general components of creativity. With improved measurement of creativity in multiple domains and the inclusion of variables that have been found to be consistently related to creativity in various domains, the present study found clear evidence of domain-generality and little evidence of domain-specificity. This is the first study to our knowledge that provides reasonable psychometric evidence (Plucker, 2004) for domain-generality of creativity.

We hasten to point out that there is still much room for improvement in the measurement of creativity. More and better items are needed for each domain. A much-improved battery of creativity tests might better distinguish the domain-general and domain-specific components of creativity and better identify the correlates for each. Future research should include new domains and new potential correlates of domain-specific components of creativity.

A better measure of creativity may also improve the factor structure. Although our results generally agreed with existing conceptions of the three domains, we had two tests whose loadings can be improved. For example, chair design loaded at a modest level of between .40 and .50 across two factors, one of which differed across the two conditions. Title writing also failed to have adequate loading on verbal creativity under the standard condition. Future researchers need to improve on these tests and perhaps include new domains of creativity (e.g., scientific creativity, musical creativity). A more comprehensive

test of creativity would likely involve a multi-level (items, subdomains, domains, and domain-general) factor structure involving first-, second-, and even third-order factors of creativity. A large sample will also be needed to test such a model directly with confirmatory factor analysis. It is clear from this study, however, that when the number of test items is adequate (half a dozen for each domain), a reasonable level of internal consistency of the overall creativity test can be achieved.

Finally, instruction condition should also be considered when studying the domain-specificity of creativity. Consistent with our hypothesis, the degree of domain-generality of creativity was affected by the instruction condition. The EI condition resulted in 6-7% more shared variance among the various tests (first principal component, 31% -25% = 6%) and among the three domains (52% -45% = 7%) than the SI condition. These results shed further light on the effects of the explicit "be creative" instruction on the testing of creativity. The explicit "be creative" instruction not only elicits more creative responses (e.g., Chen et al., 2005; Harrington, 1975), but also increases the domain-general component of creative performance. Future research should investigate the mechanisms (e.g., goal-setting function, Locke & Latham, 1990) involved in the instruction effects.

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Chuansheng Chen, Department of Psychology and Social Behavior, 3340 Social Ecology II, University of California, Irvine, Irvine, CA 92697-7085, Tel: 949-824-4184, Fax: 949-824-3002, E-mail: cschen@uci.edu