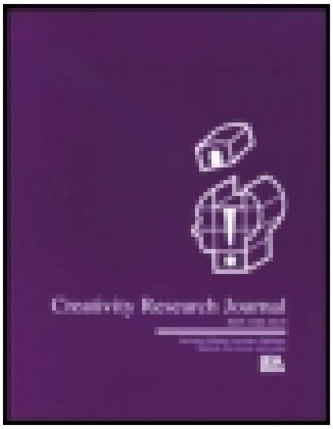

Creativity Research Journal
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/hcrj20

Divergent thinking is not a general trait: A multidomain training experiment

John Baer [a]

[a] Rider College , 12 N. Clinton Ave., Wenonah, NJ, 08090

Published online: 02 Nov 2009.

Creativity Research Journal
Volume 7 (1) 35–46 (1994)

Divergent Thinking is not a General Trait: A Multidomain Training Experiment

John Baer
Rider College

ABSTRACT: Twenty-one second-grade subjects received divergent-thinking training and 20 matched subjects received training in solving mathematical word problems. All subjects were then given five tasks: telling stories, writing stories, writing poems, writing mathematical word problems, and making collages. Experts evaluated the creativity of each product. The divergent-thinking groups scored significantly higher than controls on the story-telling, story-writing, and poetry-writing tasks. The lack of correlations among scores on the five tasks, however, suggests that several task-specific factors, rather than one general factor, led to observed group differences. This is consistent with previous research using subjects untrained in divergent thinking in showing that divergent thinking is not a general trait.

An important and controversial issue in creativity research and theory is whether creativity is (a) a general capacity that influences an individual's performance across many domains, or (b) a widely diverse collection of skills and knowledge, each contributing to creative performance in only a single domain (Bamberger, 1990). The former assumption—that general creativity-relevant traits, skills, attitudes, or habits of thought exist—has guided much research and theory in creativity (e.g., Amabile, 1983; Darley, Glucksberg, & Kinchla, 1986; Kogan, 1983; Perkins, 1981; Tardif & Sternberg, 1988; Torrance & Presbury, 1984). This monolithic view has recently been challenged, however, by a number of writers (Gardner, 1988; Gruber & Davis, 1988; Runco, 1987; Tardif & Sternberg, 1988; Winner, 1982).

Among creativity theorists who argue for domain specificity, there is a tendency to focus on creativity of the highest order (e.g., Gruber & Davis, 1988). In contrast, those who view creativity as a more general trait tend to see creativity as a continuum, with genius at one end and everyday problem solving at the other (e.g., Amabile, 1983; Richards, 1990; Richards & Kinney, 1990). Because genius is hard to find, researchers in this camp typically run studies that compare what might be termed the "garden variety" creative performances of ordinary

This material is based on work supported under a National Science Foundation Graduate Fellowship.

A version of this article was presented at the meeting of the American Psychological Association in Washington, DC, in August of 1992. It was the winner of the 1992 Daniel E. Berlyne Award which was sponsored by Division 10 of the APA.

Correspondence and requests for reprints should be sent to John Baer, 12 N. Clinton Ave., Wenonah, NJ 08090.

subjects under different experimentally controlled conditions.

In a series of studies (Baer, 1989, 1991), some of the techniques of the "continuum" school of creativity (especially those of Amabile, 1983) were adapted for use in testing the question of the generality of creative performance of ordinary subjects in various domains. Subjects ranging in age from 7 years old to 40 years old were asked to produce poems, stories, collages, equations, and mathematical word problems. These products were judged by experts in their respective fields of creativity. If general-purpose, domain-transcending creative-thinking processes, distinct from those skills measured by standard aptitude or achievement tests, make substantial contributions to creative performance on different tasks, and if there are individual differences in how well subjects employ these thinking skills, then subjects who perform more creatively than their peers on one task should, on average and other things being equal, tend to perform more creatively on other tasks in different domains. Conversely, low creativity on one task should be predictive of low creativity on other tasks.

The results of these studies have consistently favored a task-specific view of the skills underlying creative performance. Analyses of the expert ratings of the products made by subjects of all ages have indicated that creative performance on one task is not predictive of creative performance on other tasks, including those that might normally be considered to fall into the same domain, such as the writing of poetry and stories. Creative performance on any of the tasks used in these studies has predicted *only* performance on the same task at later testing dates. Scores on divergent-thinking tests have also not reliably predicted creative performance on any of the tasks. These results argue strongly against the existence of a general creative capacity (and against the importance of divergent thinking, a prime candidate for such a general creativity-relevant skill). They also argue against the view of general domains such as that proposed by Gardner (1983, 1988). Creativity-relevant skills appear to be quite narrowly applicable, perhaps of use only on specific tasks.

The claim that general creative-thinking skills do not exist is a strong one, with wide implications. One set of implications centers around the divergent-production theory of creativity (Guilford, 1950, 1956, 1967; Guilford & Hoepfner, 1971). Divergent thinking (as it is now more commonly called) and creativity have become almost synonymous in much research in, assessment of, and theorizing about creativity (Kagan, 1988; Kogan, 1983; McCrae, Arenberg, & Costa, 1987; Rose & Lin, 1984; Runco, 1986; Torrance, 1972, 1984, 1990; Torrance & Presbury, 1984; Treffinger, 1986; Wallach, 1970). Although Guilford posited 16 divergent-production factors in his structure-of-the-intellect model, distinctions among different kinds of divergent thinking have largely been ignored in many theories of creativity, and divergent thinking is typically thought of as a single, all-purpose, creativity-relevant skill. This has been especially true in divergent-thinking/creativity testing, in which only a single creativity score is often reported (Kagan, 1988; Treffinger, 1986; Williams, 1980). Moreover, even in cases where the distinction between different types of divergent thinking has been retained in the form of subtests, there are often methods for summing the several subtest scores into a total creativity score (Heausler & Thompson, 1988; Thorndike, 1972; Torrance, 1990).

Divergent thinking is also central to a variety of creativity-training programs, most of which include divergent thinking as a major component (Baer, 1988; Covington, Crutchfield, Davies, & Olton, 1974; Crabbe, 1985; Feldhusen, Treffinger, & Bahlke, 1970; Gordon, 1961; Gourley, 1981; Hoomes, 1986; Isaksen & Parnes, 1985; Micklus & Micklus, 1986; Myers & Torrance, 1964; National Talent Network, 1989; Olton & Crutchfield, 1969; Osborn, 1963; Parnes, 1985; Parnes & Noller, 1973, 1974; Perkins, 1981; Rose & Lin, 1984). These programs make diverse claims for their success in promoting creative thinking. Denying the existence, or at least the importance, of general creative-thinking skills would appear not only to contradict the most common divergent-thinking theories of creativity, but also to question the foundation of creativity-training programs that teach divergent thinking.

If there are no general skills (like divergent thinking) influencing creative performance across domains, how can the apparent success of many creativity-training programs that teach divergent thinking be explained? One might respond to this question by pointing out that it is not clear that these programs *are* successful in improving general creative importance. Most of the studies that claim to show positive effects of training in divergent thinking on creative performance have used the Torrance Tests of Creative Thinking (TTCT; Torrance, 1974, 1990) as their criterion measure (Rose & Lin, 1984; Torrance & Presbury, 1984). These studies therefore only show that training in divergent thinking produces higher divergent-thinking test scores. They tell us nothing about the validity of the divergent-thinking model. But there have also been evaluations of creativity-training programs that have not relied on Torrance Tests or other tests of divergent thinking (Baer, 1988; Mansfield, Busse, & Krepelka, 1978; Olton & Crutchfield, 1969). The results have been mixed, but generally positive. Still, the programs that were most successful have been criticized for claiming to improve general creative-thinking ability based on test results that show only that students improved in the specific kind of problem solving taught in the course (Mansfield et al., 1978; Mayer, 1983). How might these claims be reconciled with the absence of effects of divergent thinking, or of any general creative-thinking skill, in studies of subjects without divergent-thinking training?

There are at least two interpretations of the positive effects of divergent-thinking training (if they exist) that can be reconciled with both (a) the evidence against general creativity-relevant skills and (b) the failure of divergent-thinking test scores to predict creative performance in untrained subjects. Under one such interpretation, increases in creativity following training in divergent thinking are not due to increased divergent-thinking skill, but to an increased awareness of when to apply such skill. Divergent thinking may play an important role in creative performance *if* one knows when to use it, but because most people have not had explicit training in when to apply such skill, they simply do not produce it at appropriate times. By separating competence from performance, a revised divergent-thinking theory of creativity could then predict that training in divergent thinking would produce both (a) gains in creative performance across domains and (b) an increase in correlations among an individual's creative performance ratings, even though the levels of creative performance of untrained subjects would show no effects of different levels of divergent-thinking skill.

A second possible interpretation is that training in divergent thinking is actually training in many diverse skills, which may influence creative performance on different tasks. Divergent-thinking training must have some context, whether one is brainstorming unusual uses for discarded boxes, imagining a variety of pictures that could be made using a given shape, or elaborating on the design of a device for catching mice—all things one might routinely do as part of training in divergent thinking. The creativity-enhancing effects of such training might result not from increased proficiency in some general skill (presumably divergent thinking) but from practicing many different skills (e.g., use of humor in telling a story, use of alliteration in composing poetry, use of contrasting colors in designing a graphic representation) while doing various divergent-thinking exercises, with each skill applicable to only a narrow range of tasks.

The research reported below was designed to test the effects of training in divergent thinking on creative performance in several domains and to allow interpretation of any observed effects of such training.

Table 1.
Mean Test Scores.

Test	Total Group	Control	Experimental
Pretraining			
Reading Achievement[a]	74.6 (41) [19.5]	70.6 (20) [21.3]	78.4 (21) [17.3]
Math Achievement[b]	67.4 (41) [20.6]	64.7 (20) [22.3]	69.9 (21) [19.0]
Story-Telling[c]	2.63 (36) [0.83]	2.57 (19) [0.84]	2.71 (17) [0.84]
Collage[c]	2.71 (38) [0.79]	2.94 (20) [0.78]	2.46 (18) [0.75]
Posttraining			
Story-Telling[c]	3.13 (40) [0.83]	2.86 (20) [0.82]	3.40 (20) [0.77]
Story-Writing[c]	2.78 (41) [0.98]	2.35 (20) [0.77]	3.20 (21) [0.99]
Poetry[c]	2.69 (39) [1.04]	2.16 (20) [0.77]	3.26 (19) [0.98]
Word Problem[c]	2.93 (41) [0.85]	3.04 (20) [0.74]	2.82 (21) [0.97]
Collage[c]	3.04 (41) [0.66]	2.96 (20) [0.76]	3.12 (21) [0.75]

Note: n of each group appears in parentheses following the mean score. Standard deviations appear in brackets beneath mean scores.
[a]Percentile scores, CAT (Reading Comprehension).
[b]Percentile scores, CAT (Total Math).
[c]1–5 scale.

Method

Subjects

Forty-one second-grade students—the entire second grade of a small suburban elementary school in southern New Jersey—served as subjects. Thirty-eight of the students had been subjects in a study (Baer, 1991) six months earlier. The three subjects who had not taken part in that study had entered the school in the intervening six months. In the earlier investigation, subjects made collages and told stories that went with a picture book (tasks which are described more fully later in this article). As part of that study they also took the TTCT, but this test was not part of the present experiment. In the previous study students were tested, but received no training.

At the beginning of the year the students had been divided into two self-contained classes. One class was randomly chosen as the experimental group, the other as the control group. According to the principal of the school, assignment of students to these two classes had been done "semirandomly"; that is, initial assignment was made randomly by sex (to assure a roughly equal number of boys and girls in each class), and then minor adjustments were made to balance the number of students receiving special education services. There were 11 girls and 9 boys in the control group and 12 girls and 9 boys in the experimental group. California Achievement Tests (CATs) were given two weeks prior to the beginning of training. CAT scores for both groups were above average in both reading and mathematics, although there was a wide range of achievement. The experimental group scored somewhat higher in both Reading Comprehension and Total Math (the two subtests used in this study to partial out variance attributable to general academic skill and knowledge), but the differences were insignificant ($p > .20$) in both cases. Mean scores and standard deviations appear in Table 1.

Tests

There were five creative-performance tasks. Two were variations of tests the same students (except for the three new students) had taken six months previously: story-telling and collage-making. These tests have been used and validated extensively by Amabile (1983) and Hennessey and Amabile (1988). The other three tasks were new to these students, but had been used in several previous studies (Baer, 1989, 1991).

In the collage-making test, subjects were given a 14" × 22" piece of white tagboard, a bottle of glue, and a set of over one hundred precut construction paper designs (e.g., hearts, butterflies, squares, circles, and triangles) and asked to make an "interesting, silly design." The materials each student received were identical. There was no time limit, but most students finished in less than 40 minutes. The collages were later rated for creativity by art educators.

In the story-telling test, subjects were shown the picture book, *A Boy, a Dog, a Frog, and a Friend* (Mayer & Mayer, 1971). After looking through it to become familiar with the story, they were instructed to "tell the story in [their] own words by saying one thing about each page" while looking at the book's pictures. These stories were later transcribed and given to experts to rate for creativity.

In the poetry-writing test, subjects were asked to write an original poem. The form, style, and length of the poem were not specified. They were offered "The Wind" as a possible topic, but were not constrained as in previous studies (Baer, 1989, 1991). Pilot testing with second-graders at a different school had suggested that students found it easiest to start writing with these instructions, in comparison to either topic-constrained ("Write a poem about the wind") or totally free ("Write a poem about anything that you wish") instructions.

In the story-writing test, students were given a line drawing of a girl and a boy dancing or jumping near what might be interpreted as the remains of a picnic lunch. They were asked to write an original story *in which the boy and the girl played* some part.

In the word-problem-creating test, subjects were asked to write an interesting and original math word problem. They were not asked to solve the problem, but were instructed to make sure all necessary information was included so that the problem could be solved by someone else.

Expert raters judged each product on a 1.00-to-5.00 scale. There were five raters each for the story-telling, story-writing, poetry, and word-problem tests, and 14 raters for the collage-making test. The raters for all but the collage-making tests were a mix of elementary-school teachers, specialists in gifted education, writers (for the story-writing and poetry-writing tests), and mathematics professors (for the word-problem-creating test). The collages were judged by art educators. In all cases the raters were experts in the domains in which they served as raters, and in no case did they know the students whose papers they were rating. All raters worked independently, and all were paid for their work.

The raters for the poetry-writing, story-telling, and story-writing tests were given the following instructions:

> There is only one criterion in rating these tests: creativity. I realize that creativity doesn't exist in a vacuum, and to some extent creativity probably overlaps other criteria one might apply—aesthetic appeal, organization, richness of imagery, sophistication of expression, novelty of

> word choice, appropriateness of word choice, and possibly even correctness of grammar, for example—but I ask you to rate the poems [stories] solely on the basis of your thoughtful-but-subjective opinions of their creativity. The point is, you are the expert, and you needn't defend your choices or articulate a definition of creativity. What creativity means to you can remain a mystery—what I want you to do is use that mysterious expert sense to rate the poems [stories] for creativity.

Raters for the word-problem-creating tests were given the same instructions, except that the words "aesthetic appeal, organization, richness of imagery, sophistication of expression, novelty of word choice, appropriateness of word choice, and possibly even correctness of grammar" were replaced by "degree of difficulty, novelty, aesthetic appeal, usefulness in teaching a concept, appropriateness, and precision." Similarly, for the collage-making test, the words "aesthetic appeal, organization, richness of imagery, sophistication of expression, novelty of word choice, appropriateness of word choice, and possibly even correctness of grammar" were replaced by "aesthetic appeal, organization, use of color, novelty, complexity, balance, symmetry, technical goodness, neatness, or detail."

All alpha coefficient interrater reliabilities were very good. For the story-telling test, alpha was .85; for the story-writing test, .92; for the poetry-writing test, .88; for the word-problem-creating test, .88; and for the collage-making test, .87.

Procedure

The experimenter taught each class for approximately one hour, four days each week, for four weeks. Testing took place in the two weeks immediately following the four weeks of instruction, and was also conducted by the experimenter. All instruction and testing took place in the morning. The classroom teachers were not directly involved in this instruction and testing. Some days they remained in the classroom to work at their desks, but most days they left the room to work elsewhere in the school.

Training. The control group's instruction came exclusively from two volumes of the *Real Math* program (Willoughby, Bereiter, Hilton, & Rubinstein, 1981). At each grade level this program includes a "Thinking Story Book" consisting of 20 extended stories involving mathematical and logical problem solving. Each of the stories is followed by a set of shorter word problems of the same kind. *Measuring Bowser* (Willoughby, Bereiter, Hilton, Rubinstein, Anderson, & Scardamalia, 1981) is the second-grade level book in the "Thinking Story Book" series; *Bargains Galore* (Willoughby, Bereiter, Hilton, Rubinstein, & Scardamalia, 1981) is the third-grade level book of the series. Eight lessons from each set were used.

As an example from this set, Lesson 2 of *Bargains Galore* is "Swing Low, Sweet Willy." Willy talks his father into helping him build a backyard swing, but Willy has to plan the swing and buy all the materials himself. Students are asked, as a group, to help Willy figure out how to solve problems he encounters, such as how to measure the height of the branch he plans to use for the swing. The teacher (in this case the experimenter) reads the story until there is a problem for Willy to solve, then the story is put aside temporarily as the class figures ways to solve the problem. Many of the problems have no single right answer, as in the example given, although many others involve mathematical problem solving with quantitative answers. For example, in the problem set that follows "Swing Low, Sweet Willy," problem 6 asks, "If Willy were 12 years old, he would be twice as old as Wendy. How old is Wendy?"

The exercises used in the experimental group's training came from four sources. These are *CPS for Kids: A Resource Book for Teaching Creative Problem-Solving to Children* (Eberle & Stanish, 1980); *TAP: A Talents Unlimited Demonstration Project* (Mobile County Public Schools, 1974); *OM-AHA!: Problems to Develop Creative Thinking Skills* (Micklus, 1986); and *Project Implode* (Bella Vista Elementary School, 1965). All of the activities used were divergent-thinking training exercises, varying in length from a few minutes (in which case several were used in one class period) to one hour.

As an example of the divergent-thinking exercises, consider "Put an Alligator in the Refrigerator," from *CPS for Kids* (Eberle & Stanish, 1980). Students were read a scenario in which a pet alligator had become ill. The veterinarian was called and said the alligator's temperature must be lowered quickly, and that the alligator should be put in the refrigerator to accomplish this. The task was to think of as many ways as possible to put an alligator into a refrigerator. Students worked on this as a group. A second task was to think of a name for the alligator that no one else in the class would think of, which was later to be shared with the group. The directions encouraged students to think of as many possible solutions as possible, and to come up with the most unusual names they could imagine. Brainstorming rules applied in these exercises: That is, the goal was to produce a large quantity of ideas, not (necessarily) ideas of high quality; there was to be no judgment of ideas as good or bad; unusual ideas were welcome; and adapting or modifying previously suggested ideas was encouraged. The general direction was to "think of many, varied, unusual ideas for . . . [whichever problem]."

Tests. The tests were not identified as tests; however, students were instructed to work alone. Except for the story-telling test, which was tape recorded, students worked in their regular classrooms. Students were told that if they needed help with spelling a word they should raise their hand and the experimenter would come to them and write it out for them on scrap paper. This was a standard classroom procedure followed all year by the regular teachers in both classes. The experimenter typed all stories, poems, and word problems before sending them to raters.

The group tests were administered on four consecutive days; the story-telling test was given individually the following week. There were no time limits imposed on the students, but none took more than one hour to complete any one of the tests.

Students who were absent on the day of testing were not retested, as their performance could not be validly compared to that of students who did not learn of the task in advance. This affected only the poetry-writing task: Two students in the experimental group did not write poems. All students completed the story-telling task, but the voice of one student in the experimental group was too soft to be understood on tape. The number of subjects in each condition for each task appear in Table 1.

Results

The divergent-thinking group had significantly higher creativity scores on three of the tasks: story-telling, $F(1, 39) = 4.55$, $p < .05$, story-writing, $F(1, 40) = 9.50$, $p < .005$, and poetry-writing $F(1, 38) = 15.32$, $p < .0005$. The divergent-thinking group scored slightly higher on the collage-making test and slightly lower on the word-problem-creating test. These results are summarized in Table 1.

Table 2.
Comparison of Mean Residual Scores.

Test	Control	Experimental
Posttraining		
Story-Telling	2.90	3.36
Story-Writing	2.44	3.10
Poetry	2.19	3.22
Word Problem	3.10	2.77
Collage	2.97	3.11
Pretraining		
Story-Telling	2.60	2.67
Collage	2.92	2.47

Note: Variance attributable to reading and math achievement test scores was removed. All scores were computed as deviation scores and then added to the original total group mean.

Regression equations were used to partial out variance attributable to reading achievement and math achievement, as measured by the CATs. Between-group comparisons using these results followed exactly the same pattern as the raw score comparisons, with the divergent-thinking group scoring significantly higher on the same three tasks: story-telling, $F(1, 39) = 4.19$, $p < .05$, story-writing, $F(1, 40) = 7.70$, $p < .01$, and poetry-writing $F(1, 38) = 13.28$, $p < .001$. The mean residual test scores are listed in Table 2.

A reanalysis of the results of previous testing of the 38 students who had taken part in the earlier experiment was conducted to see if the difference in story-telling creativity could be attributed to differences that preceded training. The differences in scores of the two groups on pretraining story-telling creativity, both before and after variance attributable to reading and math achievement had been partialled out, were negligible. The control group scored higher on collage-making (difference in mean raw scores: $F[1, 37] = 3.74$, $p < .10$; difference in mean residual scores: $F[1, 37] = 3.29$, $p < .10$). These results are included in Tables 1 and 2.

Because divergent-thinking training had a significant effect on three of the four tasks for which such an effect was predicted, correlations among test scores of the experimental group were analyzed. The effects of skills that preceded training, especially skills such as those measured by standard achievement tests, are not of interest to this analysis; therefore, only partial correlations among creativity test scores (with variance attributable to reading and math achievement removed) are reported in Table 3.

There are a total of 10 correlations among the five creativity tests. They are scattered in what appears to be a random pattern centered around zero. Five are positive and five are negative; none approach significance (the largest has a p value greater than .35); and none account for more than 4% of the total variance of the two tests involved. This is similar to the kind of results found in previous experiments involving subjects untrained in divergent thinking (Baer, 1989, 1991).

Discussion

The results indicate that, although training in divergent thinking influences creativity on a variety of tasks, these effects are not due to a single factor such as a general divergent-thinking skill. On three tests—poetry-writing, story-writing, and story-telling—the group trained in divergent thinking scored higher than the control group by considerable (and statistically significant) margins. The nearly random pattern of partial correlations (with variance attributable to reading and math achievement removed) among the various tests for the experimental group follows the same pattern observed previously with untrained groups (Baer, 1989, 1991), suggesting that many factors, rather than one, are involved in the success of the training.

Table 3.
Partial Correlations among Creativity Tests[a] (Experimental Group).

Test	Story-Writing	Poetry	Word Problem	Collage
Story-Telling	−.20	.13	.19	−.05
Story-Writing		.10	−.05	.01
Poetry			.04	−.11
Word Problem				−.18

[a]Correlations of scores after variance attributable to standardized test scores (reading achievement and math achievement) was removed.

The interpretation of the results of the other two tests is less straightforward, although not in ways that cast doubt on the overall interpretation of the pattern of results. On the word-problem-creating test, the divergent-thinking group scored slightly lower than the control group, but the control group had four weeks of training in *solving* mathematical word problems. Although there is no way to directly assess the impact of this training on subjects' creativity in *writing* mathematical word problems, it is likely that greater skill in solving such problems would facilitate creation of interesting new problems.

The divergent-thinking group did slightly better than the control group on the collage-making task, reversing a somewhat poorer performance than the control group on this task in testing six months prior to training. Thus divergent-thinking training may have also had an impact, although a smaller one, on this test.

The tests on which the most significant differences between the groups appear—poetry-writing, story-writing, and story-telling—were tasks that were largely verbal in nature. Group differences were not due to any explicit training in verbal skills. Both groups received training that was highly interactive and verbal; however, the divergent-thinking training influenced creative performance in ways that the training in solving word problems did not. It is important to note that the effects of the divergent-thinking training, although concentrated to some extent in what might be termed the verbal domain, were not attributable to a single verbal factor, because creativity scores on those tasks were not correlated with one another.

Although divergent thinking does not appear to be either a single skill or a distinct set of skills widely applicable within broad cognitive domains (such as those proposed by Gardner, 1983, 1988), what is commonly referred to as divergent thinking may describe a large constellation of skills, each influencing creative performance on different tasks. Unfortunately, this study cannot determine the nature of such skills, nor speak to what kinds of training led to which effects. It can only claim that no single factor was at work in improving the creative performance of trained subjects.

This experiment adds to the evidence that single-factor theories of creativity are inadequate, whether the single factor is divergent thinking or some other broadly applicable skill or trait. Even theories that include several different kinds of divergent thinking do not adequately fit the results of this and prior studies (Baer, 1989, 1991) of creative performance. Nor does a theory in which divergent-thinking competence and performance are separated, with divergent thinking having an effect only among those who have learned how and when to apply it, fit the evidence gathered in the present study.

A distinction must be made between theories of divergent thinking and training based on those theories. This experiment supports claims made by such programs that they can improve creative performance across task domains. This may have to do with practicing a variety of skills, as suggested above, although the exact nature of those skills, and the mechanisms by which they influence creative performance, remain unknown.

It would certainly be easier if one all-purpose approach, or even a few very general strategies, could be made to yield creative solutions in every field, and that is perhaps one reason why previous attempts to understand creativity have focused on general traits, attitudes, and skills. It appears, however, that there is a diversity of creative-thinking skills and heuristics, and this diversity makes creativity a mystery that will in all likelihood yield its secrets to psychologists only in piecemeal fashion. The search reported above for general factors that influence creative performance, as well as the effort to revise (and thereby revive) the most widely followed general theory of creativity (the divergent-thinking theory), point in the same direction: away from a divergent-thinking theory, or from any single-factor theory, of creativity. A potentially very productive area for future research would be experiments designed to isolate which kinds of divergent-thinking training lead to enhanced creative performance in particular tasks. It may be, for example, that what is useful is the particular content that is used in training. That is, the more similar the content used in training to the content of the task used as a test, the greater the influence on creative performance. There may also be certain kinds of cognitive tasks, such as listing possible uses for some object (a common divergent-thinking exercise), that influence certain kinds of task performance. Such research could improve both our understanding of the kinds of knowledge and cognitive processes important in different kinds of creative thinking and our ability to target training to the kinds of tasks that matter to us.

REFERENCES

Amabile, T. M. (1983). *The social psychology of creativity*. New York: Springer-Verlag.

Baer, J. (1988). Long-term effects of creativity training with middle school students. *Journal of Early Adolescence*, *8*, 183–193.

Baer, J. (1989). *Generality of creativity across performance domains in eighth-grade students' creative products*. Unpublished master's thesis, Rutgers, the State University of New Jersey, New Brunswick, NJ.

Baer, J. (1991). Generality of creativity across performance domains. *Creativity Research Journal*, *4*, 23–39.

Bamberger, J. (1990). Current views on creativity research. *Contemporary Psychology*, *35*, 434–435.

Bella Vista Elementary School. (1965). *Project Implode*. Salt Lake City, UT: Author.

Covington, M. V., Crutchfield, R. S., Davies, L. B., & Olton, R. M. (1974). *The productive thinking program*. Columbus, OH: Merrill.

Crabbe, A. B. (1985). Future problem solving. In A. L. Costa (Ed.), *Developing minds: A resource book for teaching thinking* (pp. 217–219). Alexandria, VA: Association for Supervision and Curriculum Development.

Darley, J. M., Glucksberg, S., & Kinchla, R. A. (1986). *Psychology* (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Eberle, B., & Stanish, B. (1980). *CPS for kids: A resource book for teaching creative problem-solving to children*. Buffalo, NY: DOK Publishers.

Feldhusen, J. F., Treffinger, D. J., & Bahlke, S. J. (1970). Developing creative thinking: The Purdue creativity program. *Journal of Creative Behavior*, *4*, 85–90.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic Books.

Gardner, H. (1988). Creative lives and creative works: A synthetic scientific approach. In R. J. Sternberg (Ed.), *The nature of creativity* (pp. 298–321). Cambridge: Cambridge University Press.

Gordon, W. J. J. (1961). *Synectics*. New York: Harper & Row.
Gourley, T. J. (1981). Adapting the varsity sports model to nonpsychomotor gifted students. *Gifted Child Quarterly*, *25*, 164–166.
Gruber, H. E., & Davis, S. N. (1988). Inching our way up Mount Olympus: The evolving-systems approach to creative thinking. In R. J. Sternberg (Ed.), *The nature of creativity* (pp. 243–270). Cambridge: Cambridge University Press.
Guilford, J. P. (1950). Creativity. *American Psychologist*, *14*, 205–208.
Guilford, J. P. (1956). The structure of intellect. *Psychological Bulletin*, *53*, 267–293.
Guilford, J. P. (1967). *The nature of human intelligence*. New York: McGraw-Hill.
Guilford, J. P., & Hoepfner, R. (1971). *The analysis of intelligence*. New York: McGraw-Hill.
Heausler, N. L., & Thompson, B. (1988). Structure of the Torrance Tests of Creative Thinking. *Educational and Psychological Measurement*, *48*, 463–468.
Hennessey, B. A., & Amabile, T. M. (1988). Storytelling: A method for assessing children's creativity. *Journal of Creative Behavior*, *22*, 235–246.
Hoomes, E. W. (1986). Future problem solving: Preparing students for a world community. *Gifted Education International*, *4*, 16–20.
Isaksen, S. G., & Parnes, S. J. (1985). Curriculum planning for creative behavior and problem solving. *Journal of Creative Behavior*, *19*, 1–28.
Kagan, D. M. (1988). Measurements of divergent and complex thinking. *Educational and Psychological Measurement*, *48*, 873–884.
Kogan, N. (1983). Stylistic variation in childhood and adolescence: Creativity, metaphor, and cognitive styles. In P. H. Mussen (Ed.), *Handbook of child psychology: Vol 3: Cognitive development* (4th ed., pp. 628–706). New York: Wiley.
Mansfield, R. S., Busse, T. V., & Krepelka, E. J. (1978). The effectiveness of creativity training. *Review of Educational Research*, *48*, 517–536.
Mayer, R. E. (1983). *Thinking, problem solving, cognition*. New York: Freeman.
Mayer, M., & Mayer, M. (1971). *A boy, a dog, a frog, and a friend*. New York: Dial Books.
McCrae, R. R., Arenberg, D., & Costa, P. T., Jr. (1987). Declines in divergent thinking with age: Cross-sectional, longitudinal, and cross-sequential analyses. *Psychology and Aging*, *2*, 1–8.
Micklus, C. S. (1986). *OM-AHA!: Problems to develop creative thinking skills*. Glassboro, NJ: Creative Competitions.
Micklus, C. S., & Micklus, C. (1986). *OM program handbook*. Glassboro, NJ: Creative Competitions.
Mobile County Public Schools. (1974). *TAP: A Talents Unlimited demonstration project*. Mobile, AL: Author.
Myers, R. E., & Torrance, E. P. (1964). *Invitations to thinking and doing*. Boston: Ginn.
National Talent Network. (1989). Gifted programs from the National Talent Network. Sewell, NJ: Author.
Olton, R. M., & Crutchfield, R. S. (1969). Developing skills of productive thinking. In P. Mussen, J. Langer, & M. Covington (Eds.), *Trends and issues in developmental psychology* (pp. 68–91). New York: Holt, Rinehart & Winston.
Osborn, A. F. (1963). *Applied imagination*. New York: Scribner's.
Parnes, S. J. (1985). Creative problem solving. In A. L. Costa (Ed.), *Developing minds: A resource book for teaching thinking* (pp. 230–232). Alexandria, VA: Association for Supervision and Curriculum Development.
Parnes, S. J., & Noller, R. B. (1973). *Toward supersanity*. Buffalo, NY: DOK Publishers.
Parnes, S. J., & Noller, R. B. (1974). *Toward supersanity: Research supplement*. Buffalo, NY: DOK Publishers.
Perkins, D. N. (1981). *The mind's best work*. Cambridge, MA: Harvard University Press.
Richards, R. (1990). Everyday creativity, eminent creativity, and health: "Afterview" for *CRJ* issues on creativity and health. *Creativity Research Journal*, *3*, 300–326.
Richards, R., & Kinney, D. K. (1990). Mood swings and creativity. *Creativity Research Journal*, *3*, 202–217.
Rose, L. H., & Lin, H. (1984). A meta-analysis of long-term creativity training programs. *Journal of Creative Behavior*, *18*, 11–22.
Runco, M. A. (1986). Divergent thinking and creative performance in gifted and nongifted children. *Educational and Psychological Measurement*, *46*, 375–384.
Runco, M. A. (1987). The generality of creative performance in gifted and nongifted children. *Gifted Child Quarterly*, *31*, 121–125.
Tardif, T. Z., & Sternberg, R. J. (1988). What do we know about creativity? In R. J. Sternberg (Ed.), *The nature of creativity* (pp. 429–440). Cambridge: Cambridge University Press.

Thorndike, R. L. (1972). Review of the Torrance Tests of Creative Thinking. In O. K. Buros (Ed.), *The seventh mental measurements yearbook* (pp. 838–839). Highland Park, NJ: Gryphon Press.

Torrance, E. P. (1972). Predictive validity of the Torrance Tests of Creative Thinking. *Journal of Creative Behavior*, *6*, 236–252.

Torrance, E. P. (1974). *The Torrance Tests of Creative Thinking: Norms-technical manual.* Bensenville, IL: Scholastic Testing Service.

Torrance, E. P. (1984). The role of creativity in identification of the gifted and talented. *Gifted Child Quarterly*, *28*, 153–156.

Torrance, E. P. (1990). *The Torrance Tests of Creative Thinking: Norms-technical manual.* Bensenville, IL: Scholastic Testing Service.

Torrance, E. P., & Presbury, J. (1984). The criteria of success used in 242 recent experimental studies of creativity. *Creative Child and Adult Quarterly*, *9*, 238–243.

Treffinger, D. J. (1986). Research on creativity. *Gifted Child Quarterly*, *30*, 15–19.

Wallach, M. A. (1970). Creativity. In P. H. Mussen (Ed.), *Carmichael's handbook of child psychology* (Vol. 1, 3rd ed., pp. 1211–1272). New York: Wiley.

Williams, F. (1980). *Creativity assessment packet manual.* Buffalo, NY: DOK Publishers.

Willoughby, S., Bereiter, C., Hilton, P., & Rubinstein, J. (1981). *Real Math.* LaSalle, IL: Open Court.

Willoughby, S., Bereiter, C., Hilton, P., Rubinstein, J., Anderson, V., & Scardamalia, M. (1981). *Measuring Bowser.* LaSalle, IL: Open Court.

Willoughby, S., Bereiter, C., Hilton, P., Rubinstein, J., & Scardamalia, M. (1981). *Bargains Galore.* LaSalle, IL: Open Court.

Winner, E. (1982). *Invented worlds: The psychology of the arts.* Cambridge, MA: Harvard University Press.