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ABSTRACT

Intended to provide teachers with information about research in creativity, the book reviews practical considerations involved in the education of gifted and talented children. The first section analyzes difficulties and issues in defining creativity, including a review of models of creative thinking. The second chapter briefly reviews standardized instruments for evaluating creativity, while the third, the major focus of the book discusses approaches to stimulating and developing the creative thinking process. In addition to a review of general approaches, such as word association training and brainstorming, nine teacher guides are presented on such activities as personal analogy and divergent production of symbolic relations. Five programs and curricula designed to develop creativity, including the Productive Thinking Program and the Purdue Creative Thinking Program, are considered. The fourth and fifth chapters provide information on evaluating the effectiveness of the teaching approaches. (CI)

DEVELOPING CREATIVITY IN THE GIFTED AND TALENTED

Carolyn M. Callahan

What Research and Experience Say to the Teacher of Exceptional Children

THE COUNCIL FOR EXCEPTIONAL CHILDREN

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Contents

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- Discrimination Learning
  Alice H. Hayden
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  Edward L. Meyen
- Social Acceptance and Peer Relationship
  Maynard C. Reynolds
- Instructional Technology
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Preface

It would be a waste of time to survey any group of classroom teachers and ask whether or not they consider the development of creative thinking abilities to be a goal in their classroom. Nearly every teacher, regardless of training, philosophy, age, or sex would agree that creativity is a desired outcome of instruction. However, it is unlikely that there would be such agreement in response to questions such as: What is creativity? How do you recognize creativity? What do you do to enhance creative thinking abilities? How do you measure increased creativity? Within the usual classroom for gifted children these issues become even more critical because the development of creativity is a stated goal of nearly every program for gifted children. In some programs it becomes a primary goal around which all teaching and planning is focused; in other programs it is a secondary goal supplementing content oriented goals.

Given the considerable emphasis on these creative thinking goals, the teacher of the gifted child will be called on to make judgments about the creative abilities of the children in these classes, to select or develop the most effective ways to enhance the creativity of gifted children, and to evaluate the effectiveness of their instruction in attaining these goals. Faced with this formidable task and the voluminous literature in the area of creativity, the teacher is often at a loss to decide which tests to select, which teaching strategies will be effective, or which of the proposed curricula is most worthwhile. The purpose of this book is to provide teachers with information about the research that has been done in the area of creativity and the development of creative thinking skills so that they may begin to make informed judgments about, and select appropriate teaching strategies and materials for, achieving their goals.

The book will be divided into four major sections. First, a consideration of the definitions of creativity and their relation to giftedness

will be offered as a basis for the discussions to follow. Next, a brief consideration of means of identifying creative children will be presented. These first two chapters will be relatively brief and used as an orientation for Chapter 3, the major focus of the book. Within each of these divisions an attempt will be made to summarize major ideas and research findings. In addition, reference will be made to more complete descriptions and basic sources of information for those who wish to pursue a particular topic in more depth. These sources will be found in inserts labeled *Basic Reference*. The third chapter also contains specific lesson plans that exemplify some of the techniques described, labeled *Teacher Guide*. These additional sources should set a teacher on the way to designing a curriculum to meet specific needs and objectives.

The final section of the book is designed to provide ideas for evaluating the effectiveness of the program you decide to implement. A program is only good if those who use it are comfortable with it and are reasonably sure that desired effects are achieved.

1 Defining Creativity

The problem of defining creativity has received attention in nearly every attempt to examine the process, to identify potential, or to design strategies for its improvement. The complex thinking process called creativity has thus been defined and redefined hundreds of times from many different viewpoints. There have been so many widely diverse definitions of creativity that one author has concluded that there is an extremely low probability that a new one can be found. It might be said that creativity within the field of defining creativity now seems impossible (Baer, Rowbury, & Goetz, 1976).

PROBLEMS IN DEFINING CREATIVITY

All the various definitions of creativity seem to have stemmed from disagreements relating to the following questions: Are creativity and giftedness independent phenomena? Are gifted persons necessarily creative? Is artistic creativity the same as scientific creativity or problem solving creativity? Do we measure creativity against the individual's past performances and experiences or against societal norms? Can the creative process be broken down into component skills that can be learned? The research in the area of creativity has not provided any firm answers to the questions posed here, but the definition of creativity adopted by various researchers has greatly influenced the development of teaching strategies.

Artistic Versus Scientific Creativity

The first issue to be considered here is the question of artistic versus scientific creativity or problem solving creativity. Whether or not the strategies employed in the creation of paintings, sculpture, musical compositions, or other artistic products are the same as those employed by the scientist, the political leader, or other problem solvers

is not entirely clear. However, task analyses used to assess various intellectual processes indicated much commonality in these strategies and have resulted in the formulation of several models of creative thinking based on the assumption that such commonality exists. (See, for example, Guilford's model described briefly in this book and more completely in the Basic Reference on the Structure of the Intellect.) The Structure of Intellect model and the research done in the various strategies that will be discussed later also suggest that, within the process we call creativity, there are several specific skills that can be identified and modified to increase creative production.

Intelligence and Creativity

Whether or not the intellectually gifted person is necessarily creative is another question still open to investigation. Early studies by Getzels and Jackson (1962) first suggested only a slight overlap of intelligence and creativity. Even though this relationship has been generally supported by later research (Dellas & Gaier, 1976), some questions about the generalizability of the research findings still exist. Furthermore, as Renzulli (1977) has suggested, our final evaluation of adults as "gifted" is nearly synonomous with an evaluation of them as "creative." That is, the society in general labels as gifted those individuals who make a unique contribution to their field of study or practice. It would thus seem that even though students who are identified as gifted using IQ as the criterion of giftedness may not have the highest scores on tests of creativity, there exists a close relationship between these two characteristics in those who ultimately produce the most valuable contributions to society. To go one step further in this line of reasoning would be to conclude that our responsibility to encourage the development of creative thinking and problem solving in the intellectually gifted is of primary importance.

Standards for Judging Creativity: Individual or Societal

The task of defining creativity in children is further confused by the lack of agreement about the standard against which a response will be judged. A response (be it a composition, solution to a problem, oil painting, or simple pun) might be judged creative relative to the norms of the population of which the individual is a part—classroom, school, community, or nation—or it might be judged relative to the individual's past experience and behavior. Both of these approaches have been used in the identification of creative potential and products. With young children in particular it would seem most reasonable to use the latter comparison. Most teaching materials have been oriented in that direction with an underlying assumption that if the concept of inventiveness (in the sense of surpassing one's own previous ideas and conceptions) is taught first, subsequent attempts to orient the child toward surpassing societal norms will be

easier. With highly gifted individuals, comparisons with societal norms may even tend to restrict the boundaries and limit the direction of creativity rather than provide reasonable guidelines for comparison.

A Proposed Definition

One definition of creativity that avoids locking us into one perspective, but is still very useful in allowing us to both explore some of the unanswered research questions and to assess the usefulness of various tactics used in the development of creative thinking, is offered by Jones (1972):

> Creativity is a combination of the flexibility, originality, and sensitivity to ideas which enables the learner to break away from usual sequences of thought into different and productive sequences, the result of which gives satisfaction to himself and possibly to others. (p. 7)

MODELS OF CREATIVE THINKING

The orientation of researchers in defining and studying creativity revolves around models that stress either the creative process itself, the products of the creative process, or the personality of the creator. Although the product models have generated more research and study of the processes of identifying creative potential and developing creative thinking, each orientation has resulted in the development of particular notions about the appropriate means of identifying and fostering creative thinking in gifted children.

The Process Orientation

The two theorists who contributed most to the idea that the process of creativity is greatly affected by the environment are Carl Rogers and Abraham Maslow. Their orientations led to the study of classroom environment and its effect on creative thinking.

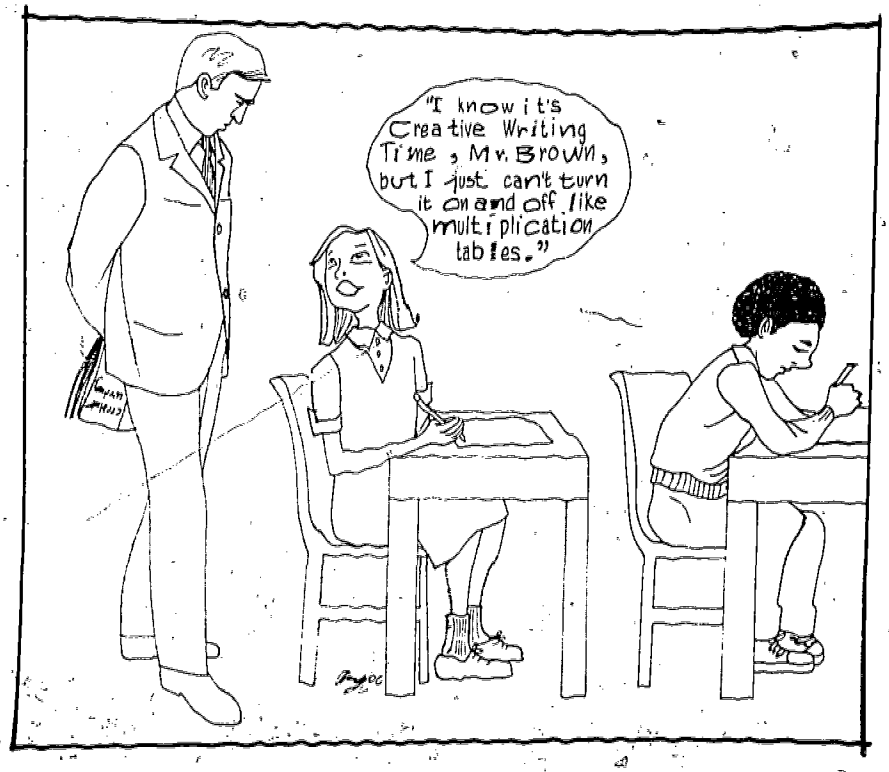
Rogers (1962), one of the theorists to speak of the universality of creativity, defined the creative process as the production of novel ideas or products as a result of the interaction between individuals and their environments. He carefully made no distinction between "good" creativity and "bad" creativity, leaving that distinction to the individual to make in terms of his or her experience. It is Rogers' belief that the ability to be creative in this relative sense is an attribute of *every* individual, but that it is often buried beneath layers of psychological defenses. The conditions that provide for the emergence of this ability from beneath those defenses are psychological safety and freedom. Psychological safety is established by accepting the individual as being of unconditional worth, providing a climate in which external evaluation is absent, and providing empathetic understanding. Psychological freedom allows the individual complete freedom of symbolic expression.

A. H. Maslow added another dimension to this basic theory of creativity. *Secondary creativity*, as defined by Maslow (1968), is the type of creativity that results when one person works with and "stands on the shoulders" of others and consciously proceeds cautiously to conclusions. *Primary creativity* is the creativeness that is the heritage of *every* human being and springs forth from the unconscious. This creativeness is found in all healthy children, but is buried, as Rogers claimed, beneath defenses that develop over the years. Maslow also distinguishes between special talent creativeness and self actualizing creativeness. *Special talent creativeness* is the type of creativeness displayed by musicians or artists, whereas *self actualizing creativeness* involves a tendency to do *anything* creatively. Self actualizing creativity involves a special kind of perception that allows the person to see "the fresh, the raw, the concrete, the ideographic, as well as the generic, the abstract, the rubicized, the categorized and the classified" (Maslow, 1968, p. 137). Inherent to this creativeness is the ability to express ideas and intuitive feelings without dreading the reactions such expression might bring, as well as a spontaneous, effortless, easy, and free manner of acting without the hindrances of stereotypes, cliches, or preconceived notions of what one should see, feel, or do. As Maslow sees the human being, these attributes are all fundamental characteristics lost in the process of enculturation and are only recaptured by the self actualizing person who is able to dig beneath the layers of defenses and recover them.

The Stages of the Creative Process

The creative process has also been studied through case studies of creative individuals and autobiographical descriptions they have given of the creative process. These data suggest that creativity can be explained as a series of chronologically ordered stages. Each stage is crucial, and makes a unique contribution, to the overall process. These stages have been described in many sources and are summarized by Wallas (1976) as: preparation, incubation, illumination, and verification. These stages suggest certain interventions that might have a positive impact on the overall success of the creator. The stage that seems most open to input is the preparation stage. Because this is the stage where the individual must define the problem, gather information or data relevant to the problem, and formulate approaches to the solution, it would appear that any training that allows the individual to be open and flexible in this process would aid his or her progress. Similarly, the stage of incubation suggests that the student may need time to "let the problem lie" before a solution or idea is produced. This suggests that a teacher must allow time for students to incubate ideas. Further, the student and the teacher must not always demand immediate solutions to problems or immediate products.

The notions that developed as part of the process approach to crea-



tivity suggest an open, free environment which is structured so that creative behavior can occur without threat and with reinforcement. Conditions that seem to contribute to such an environment have been researched and will be discussed in the third chapter of this book.

The Personality Orientation

Other researchers have approached the study of creativity, its definition, identification, and development through the study of creative persons and their personalities. These studies have led to composite descriptions of creative individuals in the fields of architecture, mathematics, and science. Many of the personality traits identified suggest that these characteristics are closely related to the process of creativity. That is, it would appear that many of the personality traits that have been found in creative individuals relate to the characteristics of Maslow's self actualized person and to the stages of the creative process.

Among the traits that have been identified as characteristic of creative individuals are: openness to experience, internal locus of evaluation, ability to toy with ideas, willingness to take risks, preference for complexity, tolerance for ambiguity, a positive self image, and the ability to become absorbed in a task (Guilford, 1959; MacKinnon, 1970; Roe, 1952). Certainly the preparatory stage of the creative

process calls on the individual to be open to new experiences and ideas, to toy with ideas, and to feel free to seek out new ideas in unfamiliar areas. The incubation stage requires a tolerance for ambiguity. The verification stage is likely to require an evaluation of the worth of the project and willingness to take risks in presenting the ideas to others. The personality orientation led to the development of several tests of creative ability, but did not have a great impact on the area of the development of creative thinking abilities.

The Product Orientation

The product models served as a basis for the majority of the techniques and programs aimed at the measurement and development of creativity. These models focused on the production of new and original solutions to problems or unusual and novel creations. The most popular model has been J. P. Guilford's Structure of the Intellect (SOI) model.

Guilford's Structure of the Intellect Model

Guilford's Structure of the Intellect model was originally derived from an analysis of data collected on thousands of subjects all of whom took hundreds of tests of mental abilities. The analysis revealed that the thinking processes people used (at least as assessed by these tests) could be categorized according to the content area in which thinking occurred, the complexity of the product produced, and the mental operation used in the process. For example, if a person is asked to recall his or her phone number, he or she uses the *operation* of memory to produce a simple *unit* of *symbolic* information. The operation is memory, the content is symbolic, and the product is a unit. Mental tasks were thus categorized according to these three dimensions, with each task assigned some level within the dimension.

Divergent Production. As a result of this process, Guilford identified one mental operation which he labeled *divergent production* and which he considered to be one of the basic operations involved in creative thinking. This mental operation was defined as the ability to produce many, varied responses or solutions to a given task or question. He further broke divergent production down into more specific components: fluency, flexibility, originality, and elaboration. *Fluency* is the ability to produce several ideas or solutions to a given problem, *flexibility* is the ability to produce ideas or solutions to a problem that come from many categories of possible solutions, *originality* is the ability to produce unique or novel solutions to a problem, and *elaboration* is the ability to add detail to a given idea in order to produce a new idea.

A simple example will illustrate these abilities. Suppose we pose the following question: If you want a drink of water, what are all the

ways you can think of to transport water to your mouth? It is readily apparent that there are many answers to this question—glass, coffee cup, tea cup, paper cup, etc. The more answers produced, the more fluent the person is. If the individual chooses answers from many categories by saying, "glass, cup, using hands to form a cup, hose, bending head under faucet, making a fountain, etc.," then he or she is said to be flexible. If the solutions are novel or unique then the person is said to be original. Finally, the skill with which the person builds on a given idea, such as describing the construction of a water fountain in detail, is called elaboration.

Evaluation. Evaluation, another thinking operation described by Guilford, has been emphasized in some of the creativity development programs. This particular process implies the ability to make judgments about the worth or value of a response according to some criteria.

The development of evaluative skills in the creative individual would include the ability to evaluate products according to existing criteria and standards as well as the ability to create new criteria and standards for his or her own unique products (self evaluation). Developing evaluative skills in creative individuals is necessary for two important reasons. First, the creative individual will need to

assess the direction in which he or she is proceeding in completing a task—be it a mathematical or scientific problem, an artistic creation, a poem, or any other creative product. Evaluating the effectiveness of the process and learning from past errors are crucial in the development of new ideas. Secondly, the creative person by virtue of the creative process will often be using ideas, incorporating materials, and producing products for which no existing criteria are applicable. For example, until the first impressionist painted, there were no standards for judging impressionistic art. Pioneers in any new endeavors will be responsible for creating criteria for success as well as the successful product.

The combination of divergent production and evaluation as part of the creative problem solving process is particularly important if the level of instruction in this area is to go beyond simple exercises into the realm of real problems and creative production.

It should be emphasized here that many other thinking skills, such as memory and convergent production, play a role in creative thinking and problem solving. The point made by Guilford is that divergent production and evaluation appear to play a major role in creative thinking and are not developed in most educational programs.

The divergent production and evaluation operations are employed across several content areas (verbal, figural, symbolic, and behavioral) to produce products with varying degrees of complexity. The assessment of these operations formed the basis for many of the measures of creativity discussed in Chapter 2. Furthermore, the development of these skills has formed the basis for the vast majority of programs designed to increase creative thinking skills. Such programs have generally focused on increasing the thinking skills described in the divergent production process. The result is an attempt to construct activities that span all possible combinations of levels of complexity and types of content.

BASIC REFERENCE on the Structure of the Intellect Model

Any teacher of the gifted who is interested in exploring a model that will draw attention to the need to develop the higher level thinking skills of these children (creativity included) should consult the following reference.

Guilford, J. P. The three faces of intellect. In W. B. Barbe & J. S. Renzulli (Eds.), *Psychology and education of the gifted.* New York: Irvington, 1976.

2 The Assessment of Creativity

The measurement of creativity or creative thinking abilities is still in a very primitive stage of development. Unlike areas of reading achievement or mathematics achievement, creativity represents such a nebulous concept that it has been difficult to define the concept in such a way that we can examine a child to determine whether or not that child is creative or has the potential to be creative.

STANDARDIZED INSTRUMENTS

Those instruments that have been developed to date are based primarily on either the product or personality approaches to creativity discussed in Chapter 1. The tests focusing on products have generally incorporated the notions of creativity outlined by Guilford. The best known and most widely investigated tests of this type are the Torrance Tests of Creative Thinking (Torrance, 1966).

Torrance Tests of Creative Thinking

The most popular and widely used measures of creativity in children are the Torrance Tests of Creative Thinking (Torrance, 1966). A test based primarily on assessing the divergent production abilities discussed by Guilford in the Structure of Intellect model, the TTCT yields scores for fluency, flexibility, originality, and elaboration.

There are two forms of this test—figural and verbal. Items on the test consist of open-ended questions or task completion items. Instructions to the individual urge that he or she be as original as possible. Samples of the types of items that might be found on these tests follow.

Verbal Form

In the space below list all the uses you can think of for a brick. List as many interesting and unusual uses as you can think of. Do not limit yourself to any one size brick. You may use as many bricks as you like. Do not limit yourself to uses you have seen or heard about; think of as many possible new uses as you can.

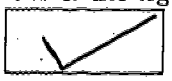
1. _____

2. _____

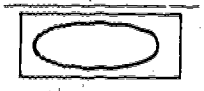
3. _____

Figural Form

By adding lines to the incomplete figures on this page, you can sketch some interesting objects or pictures. Try to think of some picture or object no one else will think of. Try to make it tell as complete and interesting a story as you can by adding and building on your first idea. Make up an interesting title for your drawing and write it at the bottom of the block next to the number of the figure.



1. _____



2. _____

3. _____

4. _____

Studies of the reliability and validity of this instrument indicate that the consistency of scoring and agreement between scorers on this test is quite high (Torrance, 1966). Questions have been raised, however, about the validity of the instrument because of its high correlations with measures of intelligence in comparison with lower correlations with other measures of creativity. Within gifted populations, however, there have been repeated studies showing low correlations between IQ scores and the Torrance Tests of Creative Thinking (Dellas & Gaier, 1976). Slight variations in working time, test atmosphere, and directors on the TTCT seem to yield different kinds of results and different patterns of correlations with other variables (Wallach & Kogan, 1965).

A final question raised about the Torrance Tests concerns aptitude versus achievement. The degree to which the Torrance Tests represent one or the other of these types of tests suggests the appropriate use of the test. However, like the intelligence/achievement dilemma, this issue is not likely to have an easy solution. At this point, it

seems safe to say that the Torrance Tests do in fact measure something different from the variables measured by intelligence tests.

Other Measures of Divergent Production

There are many other creativity tests that assess student divergent thinking products. These include the completion of tasks such as Alternate Uses, Consequences, Plot Titles, and the Utility Test derived by Christensen, Guilford, and Wilson (1958).

Many studies of these tests have been conducted to determine the degree to which they predict given creative production criteria such as ratings of creativity by judges of products, pure ratings, etc. These studies yielded highly inconsistent and nonconclusive findings. It is, therefore, impossible to say at this time whether these tests measure creativity, some aspect of creative thinking, or some quality not closely related to creativity at all.

Personality as a Basis for Assessing Creativity

Using the personality model for viewing creativity suggested that measures of learning style variables such as preference for cognitive complexity, cognitive flexibility, and perceptual openness may provide some information about individual creativity. A measure of cognitive complexity (Revised Art Scale of the Welsh Figure Preference Test) was used in a number of studies to successfully distinguish creative from noncreative artists using some other measure of creativity as a criterion (Dellas & Gaier, 1976). The personality orientation has also been employed in justifying the use of such scales as the California Psychological Inventory and the IPAR to identify creative individuals.

Other Measures of Creative Thinking

The tests discussed in the preceding sections represent commercially available instruments for measuring creativity. There are many, many more of these available and to review or summarize them is beyond the scope of this publication. In addition, they represent only a small portion of instruments used to assess creativity. Hundreds of rating scales, semantic differentials, and self report forms have also been developed. A number of these are listed in the Appendix and sources of many more are listed in the following Basic Reference.

BASIC REFERENCES on Measuring Creativity

The books listed below provide listings and descriptions of tests, rating scales, and questionnaires that might be used in the assessment of either creative potential, creative achievement, or self ratings of creative attitudes.

Borich, G. D., & Madden, S. K. *Evaluating classroom instruction: A sourcebook of instruments.* Reading MA: Addison-Wesley, 1977.

Buros, O. K. *Mental measurements yearbooks.* Highland Park NJ: Gryphon Press, 1938, 1940, 1949, 1953, 1959, 1965, 1972.

Johnson, O. G. *Tests and measurements in child development: Handbook II.* San Francisco: Jossey-Bass, 1976.

Johnson, O. G., & Bommarito, J. W. *Tests and measurements in child development: Handbook I.* San Francisco: Jossey-Bass, 1971.

Kaltsounis, B. Instruments useful in studying creative behavior and creative talent. *Journal of Creative Behavior,* 1971, 5, 117-126, 162-165, 268-274.

3 Approaches to the Stimulation and Development of the Creative Thinking Process

The stimulation of the creative thinking process in children and adults has been attempted through a wide variety of approaches. The many techniques that have been discussed range from indirect approaches that include more provision for an open and free atmosphere to highly structured programed materials. Within each of the approaches, there has been conflicting evidence about the effectiveness of the technique. In general, however, the research seems to suggest that many approaches have been successful in contributing to the development of the specific thinking skills that appear to contribute to the overall creative thinking process. A discussion of these approaches, the ways they might be incorporated into the regular classroom, and outcomes you might expect are presented in the following sections.

SETTING THE STAGE FOR CREATIVE THINKING

A first consideration of the teacher who wishes to stimulate creative thinking must be the classroom environment itself. That the teacher and the classroom climate provided by that teacher are crucial variables to be considered in planning for the development of creative thinking skills is suggested not only by the general literature on the effectiveness of teaching strategies, but also by the studies of creativity programs that show significant differences among pupils using the same program but in different classrooms with different teachers (Callahan & Renzulli, 1974). Although no specific research has been done that controls threatening and nonthreatening environments alone, it is a well accepted notion that nonthreatening environments are most conducive to creative production.

Torrance, in reviewing a number of his studies of creative behavior in the classroom, concluded that the primary values that a teacher should exhibit for maximizing creative potential are: "re-

spect for the questions and ideas of the child, respect for his right to initiate his own learning effort, and respect for his right to reject, after serious consideration, the adult's ideas in favor of his own" (Torrance, 1965, p. 252). Furthermore, most of the specific strategies and programs that focus on developing creative thinking skills are predicated on the assumption that certain open and nonjudgmental conditions are established in the classroom prior to the initiation or implementation of these programs. For example, the New Directions in Creativity (Renzulli, 1973) program cautions teachers to avoid using certain expressions or evaluative judgments that are counter to those values which Torrance found to be so important. Examples of phrases to be avoided include:

Don't be silly.
Let's be serious.
That's ridiculous.
Quiet down.
The principal won't like it.
Let's be practical.
You should know better.
What's the matter with you?
That's not our problem.
We've tried that before.
That's not part of your assignment.
That's childish.
A good idea, but . . .
It won't work.
Don't be so sloppy.

Torrance's research studies also support the notion of maintaining a nonjudgmental attitude in the classroom. It has been shown that children who work under conditions of unevaluated practice and are encouraged to experiment freely will tend to generate more creative responses in subsequent sessions than children who practice under highly evaluative conditions (Torrance, 1965). This is not to suggest that evaluation is not an important component of the creative process, but rather that adult judgments must be suspended for the creation of open and free environments. The development of self evaluation is an important component of efforts to develop creative thinking abilities and appropriate self concepts regarding creative productivity. With gifted children, the ability to evaluate the worth of one's own products becomes a crucial skill; often the product will have no existing standard by which it can be judged or will represent such novel thinking that few will be able to adequately evaluate its worth.

BASIC REFERENCE on Classroom Environment

The book *Rewarding Creative Behavior* presents a philosophy, research, and suggestions for creating environments in which creativity should flourish.

Torrance, E. P. *Rewarding creative behavior: Experiments in classroom creativity*. Englewood Cliffs NJ: Prentice-Hall, 1965.

Modeling Creative Thinking

The important role of the teacher and teacher behaviors has been emphasized by studies of modeling and its effects on divergent production. Basing their studies on the effectiveness of modeling in changing other kinds of behavior, several researchers looked at the effects of videotaped models on children's fluency and originality. In one study (Belcher, 1975), groups of students viewed either a model who gave many unusual uses for a tin can or the same model giving the same number of uses, but very unoriginal uses. A second group read a booklet on brainstorming and a final group acted as a control and received no special treatment. The film in which the model displayed original uses produced the most positive effect on fluency and originality. A similar study that used models exhibiting high or low fluency and flexibility in responding demonstrated that high model fluency resulted in higher fluency and flexibility in both a parallel, similar task and on a task requiring considerable generalization (Zimmerman & Dialessi, 1973).

Other methods have also been used to present models of creative thinking. In one study, the use of reading materials that described a creative person in the process of problem solving (Olton & Crutchfield, 1969) resulted in increased scores on tests of divergent thinking.

Although research in this area is very sparse, the results so far would suggest that teachers can increase the number, the diversity, and the originality of responses from children in their classrooms by exposing them to models who are fluent, flexible, and original. Since the teachers are obviously models in the classroom, it would seem that if they wish to facilitate creative thinking in the classroom, they should first model the behaviors they wish to develop. It would also seem that the use of models, on film or in printed literature, who exhibit creativity would prove useful in generating a readiness to respond creatively.

Instructions To Be Creative

One very simple teacher behavior that can be highly effective in influencing the creative responding of children is to give instructions that request that the students exhibit more creative responses (Maltzman, Bogartz, & Breger, 1958; Ridley & Birney, 1967). Verbal in-

structions to role play a creative person (i.e., uninhibited person) while engaging in creative thinking will produce more original responses (Levy, 1968). Instructions to imitate models who were giving flexible and divergent responses have also been shown to increase creative behavior in children (Harris, 1975). Although this very simple instruction seems obvious and easily implemented, it is often neglected. There should be a conscious effort on the part of the teacher to implement this direction in a variety of ways to avoid the pitfall of making the directions monotonous. That is, the teacher must be creative in instructing students to be creative. This might provide an excellent opportunity for modeling creative behavior!

Open Versus Traditional Classrooms

The impact of classroom arrangement on creative expression was recently the subject of a number of research studies. A summary of the research evidence indicated that open classrooms generally result in superiority of performance on various measures of creativity (Ramey & Piper, 1974; Solomon & Kendall, 1976). It is important to note that in these research studies it was not simply the arrangement of the physical space that constituted the identification of a classroom as open or traditional, but also goal statements and ratings of emphasis on regime, competence, obedience, grades, and independence of students. The results of these studies suggest that if an open classroom adopts those values and creates an atmosphere that is conducive to creative thinking, there will be an increase in certain creative thinking skills. Furthermore, it should *not* be concluded that traditional classroom settings that incorporate those same values and create the type of accepting atmosphere that fosters creative thinking would not also produce such results. For example, in a study that simply recorded teacher-student interactions, it was found that when teachers were "open" (clarifying, stimulating, accepting, or facilitating), students tended to be "productive" (discovering, exploring, experimenting, synthesizing, deriving implications). However, when teacher behaviors were "closed" (judging, directing, reproving, ignoring, probing, or priming), then student behaviors tended to be "reproductive" (parroting, guessing, acquiesing, reproducing facts, reasoning from given or remembered data) (Macdonald & Zaret, 1969).

In conclusion, the literature suggests that physical arrangements in the open classroom generally coincide with the adoption of instructional procedures and teacher attitudes which foster the development of these thinking skills, and that it is the instructional procedures and teacher attitudes that are more influential in affecting student production. The results of these studies also suggest that immediate transition from traditional to open classrooms may result in a temporary decreased level of verbal creativity until students adjust (Ramey & Piper, 1974).

In listing those components of the classroom environment that seem to influence the development of creative thinking, reinforcement of creative behaviors must be given consideration. Nearly every book, paper, or lecture on the topic of creativity emphasizes the need to reward students for giving unusual and unique responses or for creating novel products. Research in the area of applied behavioral analysis has given considerable support to the idea that rewarding novel responses will increase the likelihood of the production of more unique responses. Maloney and Hopkins (1973), for example, were able to increase the number of different adjectives, action verbs, and sentence beginnings used by students in creative writing activities by using a competitive game and giving a "reward" of 5 extra minutes of recess. Increases in these mechanical aspects of the skills of composition were accompanied by higher ratings of creativity for compositions produced after 17 days of this activity. There was also evidence to indicate that the increased writing skill was accompanied by a change from negative attitudes toward writing to more positive attitudes. It would thus appear that one can modify sentence structure and the use of particular parts of speech both quantitatively and qualitatively by the use of systematic reinforcement.

Other studies have shown an increase in the diversity of forms produced in block building activities through social-verbal reinforcements, and increased novelty in easel paintings done by young children through the use of descriptive reinforcement. (Descriptive reinforcement entailed giving comments that were directed toward a specific aspect of the painting such as, "That is a very straight line you are drawing.") The evidence presented in these studies seems to support the idea that the complex behaviors we call creative thinking or painting, etc., may be synthesized and positively affected by applying specific reinforcement techniques to aspects of those behaviors that make up the terminal skill desired. The use of operant conditioning principles in the development of creative thinking skills is more thoroughly reviewed by Holman, et al., in the following Basic Reference.

BASIC REFERENCE on Using Operant Conditioning to Develop Creative Thinking Skills

This chapter presents a review of the various operant conditioning techniques and specific behaviors that have been currently receiving attention in the literature.

Holman, J., Goetz, E. M., & Baer, D. M. The training of creativity as an operant and an examination of its generalization characteristics. In B. C. Etzel, J. M. Le Blanc, & D. M. Baer (Eds.), *New*

developments in behavioral research: Theory, method, and application. In honor of Sidney W. Bijou. Hillsdale NJ: Lawrence Erlbaum Associates, 1976.

There is some initial evidence that the type of reward may have a differential effect depending on the socioeconomic class of the child. It would appear, for example, that material reinforcements (prizes) are less effective with middle SES groups than with lower SES groups (Johnson, 1974).

An example of the introduction of operant conditioning techniques to creative writing activities is given in Teacher Guide 1.

TEACHER GUIDE 1
A Good Writing Game*

This game is designed to increase the number of different action verbs, adjectives, and sentence beginnings used in student compositions. An indirect result should be an increase in creative writing abilities.

1. Write a noun on the chalkboard and instruct the students to write a 10 sentence story using the noun as the story topic. Upon completion of the story (allow about 40 minutes) have the children turn in their papers and score each one in the following way:

   One point for each adjective.
   One point for each adverb.
   One point for each action verb.
   One point for each prepositional phrase.
   One point for each compound sentence.
   One point for each different adjective.
   One point for each different adverb.
   One point for each different action verb.
   One point for each different sentence beginning.

2. Divide the class into two teams based on the scores earned in the first item. Rank the class from highest scores to lowest scores. Assign the highest child to Team I, the second highest to Team II, etc. This should provide balanced teams with equal chances of winning in the competitions that follow.
3. On the first day the game is played, ask the students to list three different adjectives. Write these adjectives on the chalkboard. Then, tell the students that you want them to write a 10 sentence story about the noun you are going to write on the board and that you want them to use as many different adjectives as they can. Inform them that each person will receive 5 points for each different adjective used and that the team score will be the sum of the individual scores. The team with the highest score will go to recess 5 minutes early. You might also say that both teams can win if the difference between their total scores is less than 100 points or if both teams score greater than a criterion score you set.
4. Continue this activity for several days and then change the instructions to include as many different action verbs as possible, giving 10 points for each different action verb. After several days, add 10 points for each different sentence beginning.
5. This game can be modified to include different adverbs, use of compound sentences, prepositional phrases, clauses, etc.

*Adapted from Maloney and Hopkins (1973).

It has been suggested that one of the inhibitors of creative development is a monotonous environment. To assess the effects of monotony and novelty, Maddi, Charlens, Maddi, and Smith (1962) divided their subjects into four groups. The first group was exposed to novel (visual and oral) stimulation, the second group was exposed to monotonous stimulation, and the last two were exposed to more normal and usual stimuli. Creativity ratings obtained from stories about pictures of people indicated that monotonous stimulation resulted in the least novel stories. There was no apparent difference between the groups in the novel and normal stimulus conditions.

Fuerst and Zubek (1968) found that sensory and perceptual deprivation caused experimental groups exposed to those conditions to score significantly lower on Guilford's tests of ideational fluency than control groups experiencing normal stimulation. More support for the effectiveness of stimulation in increasing creativity was offered in a study by Mackler and Shontz (1965). Five groups of subjects (art majors, dance majors, visually disabled, physically disabled but not visually disabled, and a control group) were systematically administered tests of creative behavior under conditions of varying degrees of visual and kinesthetic stimulation. Another group of 40 students was administered the same tests under neutral conditions. The first four groups had been chosen to represent extremes in visual and kinesthetic creativity to determine whether the increases in creativity would be a function of the subjects' initial level of creativity, the intensity of the stimulation, and the "sensory congruence" of the stimulation with the subjects' life style. Creativity scores were increased by all forms and all levels of stimulation.

Taylor's (1970) gifted subjects were exposed to auditory, visual, olfactory, gustatory, and somesthetic (body) stimulation and generally exhibited more confident and spontaneous production. Extending his previous work to include an analysis of the size of the drawings, degree of openness, and esthetic creativity ratings, Taylor found that following stimulation, the high school age subjects produced larger drawings (an indication of psychological openness according to the author), drawings rated significantly more psychologically open by psychologists, and drawings rated more esthetically creative. Taylor concluded that "simultaneous sensory stimulation is a feasible means for inducing openness which is an important condition of creativity" (1970, p. 54).

Warm-up activities can also be used to establish a psychologically safe environment in the classroom. The literature suggests that involvement in gamelike situations that relate to the creative problem solving task to be presented is likely to increase the originality of solutions in problem solving situations (Nash, 1975; Torrance, 1963).

DIRECT APPROACHES TO STIMULATING CREATIVITY

A major goal of creativity training programs is facilitating the production of original ideas. The operational definition of creativity adopted by Renzulli (1973), for example, is based on the production of ideas or products that are new, original, and satisfying to the individual or someone else at some point in time. This type of originality, like originality admired in creative works or ideas in the larger, cultural sense, is more frequently the result of the generation, evaluation, and synthesis of many ideas than the result of a single spontaneous revelation. That is to say, the initial solution to a problem is not usually the most unique or elegant solution an individual can produce. Therefore, fluency of ideas becomes an important characteristic of the creative thinker and the fluency principle is adopted as a necessary, but not sufficient, condition in programs that number production of original ideas among their goals. A number of approaches have been used to achieve the goal of stimulating children to produce a large number of responses to a question. Among these are brainstorming and word association.

Originality, as one of the attributes measured by the various tests of creativity and as an essential part of any definition of creative thinking, also seems to require the formation of unique relationships between and among ideas. According to Mednick (1962), creative thinking requires new combinations of formerly unassociated ideas. The more diverse the sources of the unassociated ideas, the more creative (original) the association. In fact, Mednick and Mednick (1967) developed a test of creative thinking based on that principle (Remote Associates Test). The RAT requires the subject to supply a single associate relating to three unrelated stimulus words. In line with the emphasis on new associations for creativity, the facilitation of original thinking has also been attempted through word association training and brainstorming.

Word Association Training

Early evidence of the fluency principle in word association training was presented by Maltzman, Bogartz, and Breger (1958) in an experiment that called for repeated associations to the same word list. On the average, over 75% of the responses on the fifth presentation of the list were responses unique to the subject being tested. Only 25% of the responses on the initial presentation of the list were in that category. Responses to a new test list by a group that had experienced repeated associations to the original list were statistically more original (as judged by the frequency with which they occurred) than those of a control group. Followup studies have generally given further support to this approach to training original thinking (Maltzman, et al., 1958; Maltzman, Simon, Raskin, & Licht, 1960; Rosenbaum, Arenson, & Panman, 1964).

Later studies (Clark & Mirels, 1969; Mednick, 1962; Paulus, 1970;

Stalton, 1970) supported the hypotheses that early responses to a given stimulus tend to be the more common ones, even when stimuli are more complex than simple words, and the greater the number of responses generated, the higher the probability that an original response will be produced (originality usually being defined in terms of the statistical infrequency of the response).

The usefulness of the fluency principle in training creative thinking would be highly questionable without evidence of transfer effects. Such evidence has been provided by Flavell, Cooper, and Loiselle (1958); Judson, Cofer, and Gelfand (1956); Maltzman, et al. (1960); and Freedman (1965). Training that involves repeated presentation of a stimulus with instructions to give a different response at each presentation constantly resulted in more uncommon responses to new stimulus materials and increased originality in problem solving. In addition, Maltzman, et al. (1960) and Ridley and Birney (1967) found that word association training increased scores on Guilford's Unusual Uses Test and Plot Titles Test. It may be concluded, therefore, that activities that require the student to generate multiple responses will usually result in the generation of more unusual responses on that task and perhaps generalize to other problem solving tasks. There are, of course, saturation or extinction effects that should be taken into account when encouraging children to generate multiple responses.

Instructions To Be Original

As discussed earlier, another fundamental tenet underlying creativity training is the assumption that instructions to be original will facilitate the production of original responses. Ridley and Birney (1967) found that instructions to be original increased scores on Guilford's Unusual Uses Test, and results of an experiment by Maltzman, Bogartz, and Breger (1958) showed that both training and originality instructions produced a significant increase in originality on a free association test list. It should be noted, however, that experimental groups receiving training and instructions were significantly more original than a control group receiving only training.

Brainstorming

Acting on the assumption that creativity can be stimulated and fluency can affect creative production, increasing attention has been placed on the problem of developing specific techniques to unlock creative potential. Brainstorming, the method most widely used and researched, focuses on the generation of new ideas by groups of individuals. According to Foshay, "brainstorming can best be understood as an attempt to give social sanction to openness" (1961). As originally described by Osborn (1953) and further explained by Clark (1958), brainstorming procedures follow one general rule: ideas must be produced freely without consideration of quality.

Thus, brainstorming is considered to be one activity that will develop ideational fluency.

The effectiveness of this method in generating new ideas is attributed to varying phenomena. Clark (1958) claimed that the free atmosphere of a brainstorming session allows ideas to get to the subconscious where a group of free associations is triggered. Osborn (1953) proposed that the stimulating effect of verbalized ideas on the producer and others in the group and the effect of rivalry are the reasons for increased productivity during brainstorming sessions. The stimulating effect of individuals in a group upon one another is evidenced by Osborn's (1953) finding that one third of the ideas produced in group brainstorming are characterized as being based on another person's expressed idea.

Basic Guidelines for Brainstorming

The basic guidelines of the brainstorming procedure are: (a) criticism is ruled out, (b) "free wheeling" is welcomed, (c) quantity is desirable, and (d) combination and improvements are sought. The leader's role in brainstorming is to explain these rules, to see that they are adhered to, and to prevent the group from breaking down into smaller groups. The problem discussed should be as specific as possible, and, according to Osborn, the ideal number of persons in a group is between 5 and 10.

The extent to which the basic rules are followed, the role of the leader of the group, the size of the group (brainstorming has been used by individuals as well as by groups), the addition of evaluation procedures following a session of unevaluated practice and generation of ideas, types of problems, types of individuals, and training are all modifications of Osborn's original procedure.

Research on Brainstorming

The popularity of the brainstorming technique has generated much research into its effectiveness, the effect of modifications, and the interactions between these modifications. The type of problem posed to the group and the technique used to present the problem are modifications that have been considered by researchers. Parloff and Handlon (1963) found that by making a distinction between "real" and "unreal" problems and observing groups as they attempted to solve these problems the groups left more generated ideas unreported for the unreal problems than for the real problems. However, the overall number of solutions was the same for both types of problem. Thus, teachers can choose either real or fanciful problems to practice brainstorming techniques.

Presentation of the same problem in four different ways—verbal description, photographic representation, scale models illustrating the problem but not allowing manipulation of the parts, and scale models allowing manipulation of the parts—did not significantly af-

fect measures of "goodness of solution" (Lorge, Tuckman, Aikman, Spiegel, & Moss, 1955). However, modification of instructions in order to turn situations into problem solving tasks resulted in an increase in the number of proposed alternative solutions to a problem and an increase in the number of highly creative solutions (Maier & Solem, 1952). The sequence of tasks presented also affects performance on brainstorming tasks. If easier tasks (those having many easily arrived at possible answers) are presented first, a "set" of high fluency is apparently produced that carries over to more difficult tasks.

One of the assumptions underlying the use of brainstorming techniques was that the removal of evaluation increases the generation of creative ideas; yet, the major criticism aimed at brainstorming as a creative problem solving technique has revolved around the evidence presented in the literature that unevaluated idea generation often results in a smaller percentage of high quality ideas. Hyman (1960) questioned the fluency assumption when subjects who were given instructions to produce a large quantity of responses produced 68% more responses, but failed to produce enough "good" (uncommon and of high quality) responses to yield as high a percentage of "good" responses as the control group. He concluded that a large quantity of responses may lead to quality responses for some, but not all, types of problems.

Arici (1965) attempted to test the principle that "quantity breeds quality" by correlating the number and quality of solutions produced under brainstorming conditions. Although all correlations were positive, they did not differ significantly from zero.

A series of followup experiments supported the brainstorming principle. In one experiment, subjects untrained in problem solving were given 5 minutes to produce ideas to solve a given problem. The total number and the number of good ideas were tallied for each half of the total list and compared. Significantly more good ideas appeared in the last half of the list. In the second experiment, subjects who had been trained in deferred judgment principles were asked to produce ideas toward solution of a given problem for 15 minutes. On this occasion the number of good ideas was totaled for each one third of the total number of ideas. Significantly more good ideas were produced in the final one third of the list with no significant difference between the first two portions of the test. Although there was no significant difference between the first one third of the list and the second one third of the list, there was a trend toward increasing proportions of good ideas as quantity was increased. According to the author, the results suggested that "extended effort in producing ideas on a creative thinking problem tends to reward problem-solvers with a greater proportion of good ideas with increased quantity" (Parnes, 1961, p. 122).

Brainstorming has been shown to be an effective means of training individuals and groups to be more fluent; however, there is a sec-

ondary effect of the generation of many low quality ideas. Consequently, brainstorming has been criticized as an inefficient problem solving strategy. At the same time, research showed that training in the evaluation or judgment of creative problem solutions results in the production of a higher percentage of quality ideas, but for fewer ideas (Stratton, Parrott, & Johnson, 1970). The next logical step would be to investigate the possibility of incorporating some of the brainstorming techniques with strategies for self evaluation of the quality of ideas. At least one study has demonstrated the effectiveness of this approach (Stratton & Brown, 1972). This study compared brainstorming strategies, training that instructed the individual in judging responses according to some criterion, training that combined the two strategies, and no training. The combined strategies produced the greatest percentage of high quality responses (both of the other strategies proved more effective than no training at all). It follows that the teacher would not necessarily hamper the production of quality ideas by instructing or informing students of criteria for judging the quality of ideas. It should be noted, however, that the individual is still allowed to judge his or her own products rather than having judgment passed by the group or the group leader (teacher).

Brilhart and Jochem (1964) found deferred judgment (that is, separation of ideation and evaluation) superior to the textbook pattern of problem solving (problem-criterion-solution-evaluation). In a further investigation of the effects of suspended judgment, Christensen, Guilford, and Wilson (1957) administered the Plot Titles Test with and without instructions to write clever titles. It was assumed that directions to write clever titles would call for evaluation on the part of the student. The effects of calling for clever titles were a reduced number of low quality responses and a higher average rating of degree of cleverness. Guilford (1962) attributed the conflicting evidence in the research on the effects of suspending judgment to the kind of evaluative attitude of the thinker. That is, if evaluation is used as a tool in the narrowing down of possible areas of search for the solution, then it is an effective aid in creative problem solving. However, if evaluation creates a fear of unconventionality, social unacceptability, or of being wrong, then suspended judgment is preferred.

The experience with evaluation and the tone set in the brainstorming activity suggests that the leader and his or her training and attitude are important variables in brainstorming. Groups with participatory leaders were superior in quantity of output, while groups with nonparticipatory (guided but could not contribute ideas) leaders were superior in quality of output (Anderson & Fiedler, 1964). Fiedler, Bass, and Fiedler (1961) found that groups under stressful conditions functioned better with firm leadership, while groups working in pleasant, nonpressured situations performed more creatively with permissive, nondirective leadership. Since brainstorm-

ing is generally a nonstressful situation, it would appear that nondirective leadership should be best for creative production in that situation.

The previously discussed results of Brilhart and Jochem (1964) further suggested that leaders should be trained in techniques that keep the ideation and evaluation aspects of brainstorming separate. In addition, the attitude of the leader is an important variable. If the leader perceives the task as a problem to be solved rather than as a decision to be made, better results are achieved by the group (Hoffman, Harburg, & Maier, 1962; Maier & Solem, 1952).

Osborn suggested that 12 was the optimum number of individuals for a brainstorming group. However, most studies on the effectiveness of brainstorming techniques have been done with groups of two, three, or four persons, and little research has been done on the effect that variation in group size has on the results of research on creative problem solving. The little research that has been done has been criticized for methodological inadequacies that result in meaningless conclusions (Thomas & Fink, 1963). It has been found that an initial problem that creates antagonism because of a difference in attitudes within the group will inhibit creative behavior on later problems. However, an initial problem that helps develop interpersonal attraction among members of a group with varied attitudes will enable the group to perform more creatively on later problems—even if those problems would ordinarily bring out antagonisms (Triandis, Hall, & Ewen, 1964).

All of the variables discussed relate to the problem of the creativity of the *group* in brainstorming activities. However, the schools are concerned with making the individual more creative. The following questions, then, become considerations for the educator: Does brainstorming inhibit or enhance the creative thinking of the individual as he or she interacts in a group to solve a problem? Does brainstorming training inhibit or enhance the creative thinking of an individual when he or she attempts to solve a problem alone? Do groups or individuals find more creative solutions to problems? Does training affect the creative behavior of the individual or group?

One of the fundamental questions asked by investigators in the field of creativity centers around the effect that group participation has on individual creative production. Does brainstorming facilitate or inhibit creative thinking? If groups with or without training in brainstorming produce consistently more creative solutions than individuals, and if training in brainstorming enhances the group performance, then training in group brainstorming is warranted. Or, if individual creative performance is enhanced by group brainstorming, then training in group brainstorming is warranted. However, if individuals are more creative than groups and groups inhibit the creativity of the individual, then a technique that provides for individual training is more warranted. That is, if individuals perform less creatively or equally well after brainstorming training, then the

technique is clearly not an effective means of developing creativity in individuals. "Group creativity cannot be very productive unless individual creativity has taken place . . . individual and group brainstorming can help unlock the subconscious sources of creativity" (Rapp, 1967, p. 65). This statement by Rapp points out the importance of examining the effects of brainstorming on individual creativity.

The most extensive research on the effects of brainstorming on individual creativity was a result of the development of a course in creative problem solving at the State University of New York at Buffalo in which the brainstorming principle was emphasized. To justify the use of the deferred judgment principle of brainstorming in individual production of ideas, individual students were asked to generate possible solutions to problems for 5 minutes per problem. In one situation, the students were told to solve the problem in ordinary fashion; in the other problem situation, the individuals operated according to the principle of deferred judgment. With uniqueness and usefulness as the criteria for quality, the deferred judgment method resulted in the production of more ideas rated as good (Meadow, Parnes, & Reese, 1959).

Numerous studies of the effectiveness of this course for developing creative thinking produced positive results. In an experiment in which both trained and untrained subjects listed all possible uses of a broom or hanger, it was found that all subjects produced more good ideas (judged according to uniqueness and value) under brainstorming conditions than under nonbrainstorming conditions (listing only good ideas), and subjects trained in the problem solving course produced more good ideas than those who had not taken the course. The authors concluded that "brainstorming instruction is an effective method for increasing the production of good ideas in a particular type of creative thinking problem, and that it is more effective if preceeded by extensive training in its use" (Parnes & Meadow, 1959).

In another study designed by Meadow and Parnes (1959) to evaluate the effects of the problem solving course on creative abilities and selected personality variables, 10 measures were made of matched experimental and control groups at the beginning and the end of the course. The results were:

1. The experimental group had a significantly greater increase in number of ideas on both measures of quantity of ideas.
2. The experimental group had a significantly greater increment in quality of ideas in three out of the five measures of quality.
3. The experimental group showed a significantly greater increment on the California Psychological Inventory-Dominance Scale (the personality trait that the course was designed to develop).

In the third study of the creative problem solving courses, Parnes and Meadow (1960) evaluated the persistence of the effects produced by that course. An experimental group (persons having com-

pleted the course 8 months to 4 years prior to the experiment) and a control group (enrolled at the university, but having had no instruction in the creative problem solving course) were matched for vocabulary ability and then given six creative ability tests: Guilford's Apparatus (quality), Unusual Uses (quality), and Plot Titles (quality and quantity) Tests, and the AC Test of Creative Ability-Uses of Wire Coathanger Test (quality and quantity). The experimental subjects scored higher on all six measures than the two combined control groups. The authors concluded that the effects of the course persist for at least 8 months after its termination. A very recent study of the creative problem solving course reconfirmed findings that enrollment in that course results in increased divergent production abilities. Incidentally, cognition and convergent production scores were also increased in this study (Reese, et al., 1976). If we assume that college students represent an above average population of students, there is some grounds for expecting these effects to generalize to younger bright students. Evidence that this might be true is given in the study described next.

The creative problem solving course developed at the University of Buffalo has also been used effectively with gifted high school students (Parnes, 1967). The Minnesota Tests of Creativity (a forerunner of the TTCT) were administered before and after a 5 week course to an experimental group; the same test was also administered twice with a 5 week time lapse to a control group. Experimental high ability students (measured by the Otis Test of Mental Ability) showed a significantly greater increase in scores on the creativity tests than students of the same ability who did not receive training. Experimental students of low ability showed greater increases than control students of comparable ability. The difference did not reach significance, although it closely approached it at the .05 level. A comparison of increases of high and low ability students in the course showed no significant difference. Student ability was not a limiting factor in the development of creative thinking.

Meadow and Parnes suggested that the effects of the problem solving course be interpreted with caution. Although the course has left students with beneficial results, the authors questioned how much of the improvement was due to group brainstorming and how much was due to open questioning and a free atmosphere, suggesting that the latter may be a necessary and sufficient condition for the development of creativity with brainstorming as one technique to establish those conditions. Gallagher (1975) warned further that something meaningful must be done with the results of brainstorming in the classroom or it becomes merely a game.

Further support of the beneficial effects of brainstorming on individual creativity was offered by Anderson (1963), Lindgren (1967), Lindgren and Lindgren (1965), and Dunnette, Campebell, and Jaastad (1963). Lindgren (1967) demonstrated that a brief brainstorming session may be effective with some college students in stimulating

creativity in drawing, sketching, and design. Anderson (1963) demonstrated the additive effect that brainstorming has in a course in creative thinking by comparing scores on the Minnesota Tests of Creative Thinking. Students who received only brochures that included selected writings and ideation exercises had consistently lower mean scores on the test than students who received the brochures plus a series of oral exercises based on Osborn's brainstorming principles. Dunnette et al. (1963) found that individual brainstorming produced more ideas when it followed group participation with deferred judgment than when it was not preceded by such participation. Lindgren and Lindgren (1965) studied the effects of group brainstorming on individual creativity by examining the number and quality of cartoon captions produced. In two different cultures (American and Middle Eastern), they found a significantly higher level of responses when the exercise followed group brainstorming.

Heuristics

Heuristic strategies are best considered as tools or guidelines for developing creative ideas. Many specific strategies have been developed to assist the individual in approaching a problem creatively. These include attribute listing, synectics, morphological analysis, questioning strategies, and bionics.

Attribute Listing

One means of influencing the generation of new ideas is called attribute listing (Parnes, 1961). Designed to generate ideas to improve or change something, the technique requires the individual to list all the important characteristics of an item and then suggest how changes in the attributes would result in an improvement or a new use. For example, one might ask the question: What are all the attributes or characteristics of a clock? Students would probably begin by noting size, color, style, shape, etc. The teacher should press for more abstract, unusual characteristics such as sound, type of time, and type of clock movement (spring, pendulum, etc.). Then the next step is to consider each attribute and determine how the clock could be improved by altering that attribute. What are all the different colors we could use to make the clock more attractive? What about clocks painted with the school colors, for example?

Morphological Analysis

A closely related technique, the morphological synthesis technique, requires the individual to identify two or more dimensions of a problem, list the specific values along each dimension, and then examine all possible combinations of those values (Parnes, 1961). When a student has engaged in the attribute listing activity, he or she may then choose two, three, or four attributes to alter simultaneously. For ex-

ample, looking at all combinations of sizes, styles, and movements may yield new ideas. Morphological analysis may also be used to look at other potential combinations of unrelated variables to come up with creative ideas. A manufacturer may be looking for a new way to package a product and combinations of shapes and materials for containers. Why not package cereal in round containers?

An extensive list of questions used to stimulate the students' thinking during brainstorming sessions was developed by Arnold (1962) and incorporated into the creative problem solving course described previously. These questions are also useful in attempting to implement the attribute listing or morphological synthesis techniques. The questions include:

Other Uses

Can it be put to other uses as is?
Can it be put to other uses if it is modified?

Adaptation

What else is like it?
What other ideas does it suggest?
What could you copy?
Whom could you imitate?

Modification

What new twist could be made?
Can you change the color, size, shape, motion, sound, form, or odor?

Magnification

What could be added?
Can you add more time, strength, height, length, thickness, or value?
Can you duplicate or exaggerate it?

Minification

Can you make it smaller, shorter, lighter, or lower?
Can you divide it up or omit certain parts?

Substitution

Who else can do it?
What can be used instead?
Can other ingredients or materials be used?
Can you use another source of power, another place, or another process?
Can you use another tone of voice?

Rearrangement

Can you interchange parts?
Can you use a different plan, pattern, or sequence?
Can you change the schedule or rearrange cause and effect?

Reversibility

Can you turn it backward or upside down?
Can you reverse roles or do the opposite?

Combination

Can you combine parts or ideas?
Can you blend things together?
Can you combine purposes?

Transformation

Can you change its form in any way?
Can you burn it, punch a hole in it, paint it?

Bionics

Bionics, the search for metaphors and similes in nature for problems faced by man and consequent solutions suggested by those similes and metaphors, is another suggested means of developing creativity.

For the most part, these individual strategies have not been researched, but programs or courses that incorporate a number of these strategies have been shown to be effective (see the discussion of programs that follows). More specifically, Ridley and Birney (1967) devised a booklet combining five strategies of heuristic value that contains principles for solution of problems requiring divergent principles (such as transformation). The booklet contains illustrations of the use of the strategy as well as blank spaces for application of the principles to each of three common objects. Training with these heuristic principles had a significant positive effect on scores on the Guilford Unusual Uses Test and the Plot Titles Test. Other training strategies were found to be more successful after heuristic training than after word association training or no training. That the teaching of such strategies as transformation techniques, brainstorming, "piggy-backing," bionics, and morphologic synthesis is an effective means of training original thinking was also demonstrated by Davis and Manske (1966), Warren and Davis (1969), Hutchinson (1967), and Stratton and Brown (1972).

Examples of implementing these strategies are given in Teacher Guide 2, Teacher Guide 3, Teacher Guide 4, and Teacher Guide 5.

TEACHER GUIDE 2
Running Shoes: A Lesson Using Attribute Listing and Morphological Synthesis

In planning a lesson using attribute listing and morphological analysis, try to keep in mind that fluency, flexibility, originality, and elaboration are important in producing unique and useful solutions to a problem. In working with gifted children, these concepts can be explained and then reviewed and emphasized prior to beginning the activity.

With the immense popularity of tennis shoes and other types of running shoes, students will be familiar with the attributes and desirable characteristics of these shoes. One might begin this lesson by defining an attribute if this is the first time this strategy has been used. Be sure the students understand the concept of attributes. Then, ask the students to list attributes of running shoes while someone records each response on the chalkboard. List these attributes horizontally across the board. (At this point keep the principles of brainstorming in mind.) Encourage the students to think in terms of many categories—physical composition of the shoes, durability characteristics, fashion attributes, other physical characteristics, etc. Students may come up with such attributes as size; color (of soles, uppers, shoelaces); types of soles—crepe, rubber, etc.; cost; type of uppers—leather, canvas, etc.; or shape of soles (higher at the heel, the toe, etc.).

Gifted students should be encouraged to think in abstract as well as concrete terms. Suggestions upon which students can "piggy-back" other abstract suggestions may be necessary at first. For example, style (e.g., adding racing stripes) might be mentioned as an attribute to be considered.

The next step is go back to the first attribute and ask the students to begin to suggest ways in which each attribute could be modified. At this point, students may wish to combine, alter, or add attributes as new ideas come to mind. For example, a student may wish to suggest that shoes be made so that soles can be interchanged. This might create a new category called "construction."

Style	Color	Types of Soles	Types of Uppers	Shapes of Soles
Racing stripe	Solid	Crepe	Canvas	Even
Mono-grammed	Stripes	Rubber	Leather	Higher at toes
Multicolor laces	Two tone	Leather	Canvas and leather	Higher at heels

Style	Color	Types of Soles	Types of Uppers	Shapes of Soles
Make to look like other shoes		Odor eater soles Built in odometer Lined with odor eaters Built in foot powder	New fabric with air circulation	Thicker to last longer

Encourage students to list all possible alterations, not just those that they have observed. If students have difficulty in suggesting modifications of the attributes listed, you might refer them to the list of questions found on pages 00–00. It is also important for students to develop and apply criteria for judging their ideas. The attractiveness, usefulness, practicality, and sales appeal might be considered for the product in this example.

TEACHER GUIDE 3
Adaptation

To introduce the concept of adaptation, the teacher might ask the students to explain the old adage, "There is nothing new under the sun." Then, suggest to the students several ideas or creative products that have emerged as a result of borrowing and building on the ideas of others. For example:

1. Where did the idea for the musical *My Fair Lady* originate? It was based on George Bernard Shaw's play, *Pygmalion.* And didn't Shaw originally get the idea from a myth?
2. Where did the American game of football originate? It is an adaptation of the English game of rugby.
3. Which original song has the same melody as "My Country 'Tis of Thee"? "God Save the Queen" has the same melody.

At this point, the distinction should be made between plagiarism or stealing ideas and using an idea to develop other more exciting or useful ideas.

To introduce the students to using the principle of adaptation, ask them how many ways a timer has been used to modify a given appliance. As an example, oven timers that turn the oven on and off at a given time may be suggested. Or, you might point to timers that will start a coffee pot perking at a given time or turn lights on and off. Ask students to list all the existing adaptations they know about and then to suggest new ways in which timers could be used. Encourage them to think of their use in many different settings—homes, banks, factories, offices, schools, etc.

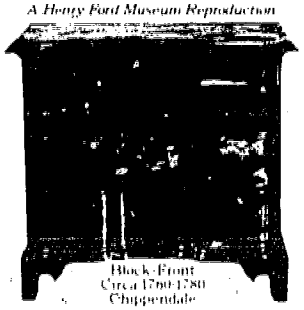
The next step in developing the students' awareness and skill in using adaptation might be to ask them to give examples of other adaptations that have led to new products, new books, or new inventions. (Television shows based on movies or books, four slice toasters, and wall telephones can be cited as examples.) For each adaptation, ask the students to give the original idea and then the adaptation.

Finally, ask the students to begin listing some adaptations to existing ideas that they feel might result in even better ideas. To encourage students, begin by listing such things as a self sharpening pencil, a toothbrush that gives fluoride treatments, or a pencil that knows all of the right answers.

TEACHER GUIDE 4
Forced Relationships

Using one or more of the ads shown here, ask the students to describe the process through which they think the creators of these products derived the ideas that ultimately resulted in the product.

A Henry Ford Museum Reproduction



Block-Front
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Chippendale

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Astonishing value. Solid state pocket calculator, with memory, handles all normal calculations; is also *pre-programmed* to convert Metric measurements at the touch of a button. Converts to or from metric: length, weight, temperature, wet and dry measure and other common measures. Just enter or calculate in either, then press "convert" keys to read in the other system. Operates on AA batteries (included). Satisfied or money back. (MC, BA, AE, call 513/294-4000).

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Carry TEN TIMES a Wheelbarrow Load with INCREDIBLE EASE!

These BIG, strong carts are **perfectly** balanced on two huge wheels — roll easily over lawns and gardens — carry up to 400 lbs. of load — huge volume capacity means you make fewer trips — you'll save time **and** steps.

If you are **still** struggling with a wheelbarrow or inadequate cart (with tiny wheels) send for FREE Cart Catalog. Build-it-yourself kits, too.

GARDEN WAY RESEARCH, Dept. 70474
Charlotte,
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Christmas by Mail

Do all your gift shopping at home the easy way. You'll find the best of everything on the pages of our holiday catalogues, from imaginative stocking stuffers to once in a lifetime luxuries. For your FREE holiday catalogues, call TOLL-FREE 800-527-4535 (in Texas, call TOLL-FREE 800-492-5270; in Dallas, 233-1007) or mail this coupon to: The Horchow Collection, P.O. Box 34257, Dept. 41205, Dallas, Texas 75234.

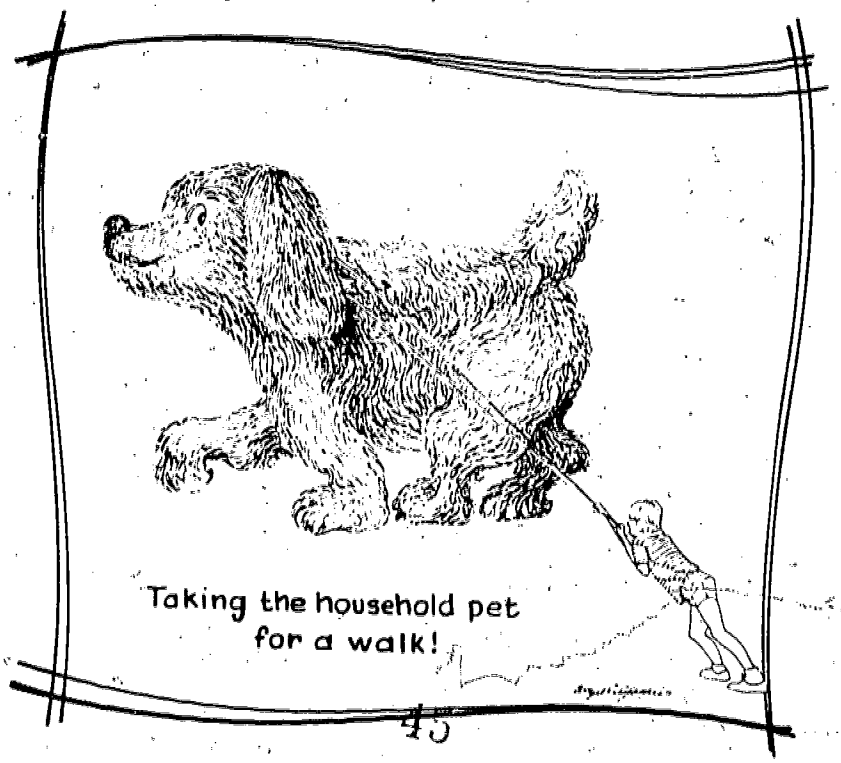
Now ask the students to list any other objects they can think of that represent the combination of two or more distinct ideas (consider a jacknife with bottle opener, locked filing cabinets, etc.).

Finally, ask the students to generate three new products that represent a combination of two other ideas. It will usually help the students to generate new ideas if the teacher participates and generates several ideas also. You may begin by suggesting a classroom desk with built in calculators or pencil sharpeners.

TEACHER GUIDE 5
Introducing Heuristic Strategies in Brainstorming

A list of questions that might be used to stimulate the child to modify an idea in order to produce a more creative idea is given on pages 30–31. These include magnification, minification, transformation, combination, other uses, adaptation, modification, substitution, rearrangement, reversibility, and combination. The "unusual uses" type of activity found on a number of creativity tests and as part of many creativity training programs such as *The New Directions in Creativity Programs* (Renzulli, 1973) are excellent starting points for practicing these strategies. A simple exercise, such as asking the students to generate new and unusual uses for automobile tires, will provide practice in the technique of brainstorming. The teacher may introduce the activity by calling for each student to name an alternative use for automobile tires. It may be helpful to systematically go through each question on the list presented on pages 30–31, thus beginning with other uses for the tire in its standard form. For example, tires are used for agility exercises in football. Can they be put to other uses if modified? A tire can be melted down to make rubber balls. What else is like it?

Encourage students to generate fanciful ideas as well as practical ideas. The following cartoon shows how a cartoonist com-



bined minification and modification to create a humorous idea. Or, you might suggest using automobile tires as washers in faucets for giants.

It is necessary, as Gallagher (1967) pointed out, to avoid using only artificial, isolated brainstorming activities. Brainstorming must also be used in sound problem solving situations. For example, an art lesson may make considerable use of the questions used as guidelines in the brainstorming process. A student may be presented with the task of representing a given human model. The obvious first question to ask is what medium will be used—oils? pastels? sculpture? pen and ink drawing? graphics? If I choose graphics, will it be a lithograph, silkscreen, wood block print, an etching? Will the final product be larger, smaller, or life size? Can I divide up, interchange, or omit parts to strengthen the theme? What ideas other than the model are suggested? All of these questions may be asked in seeking ideas about representing the model.

It should be very apparent that evaluation skills are again important in these activities. Which of the ideas that I have generated are the "best ideas"? Which will best serve my purpose?

The use of metaphorical modes of thinking to produce creative solutions of problems has been developed by William Gordon in a strategy called *synectics*. The basic principle underlying this technique has been labeled making the familiar strange. Application of this strategy requires the individual to look at the familiar objects around him or her in a new perspective. The corollary to this principle is making the strange familiar. To use this principle, the creator attempts to locate elements in the problem that are similar to situations or objects with which he or she is familiar or understands. The use of metaphors to accomplish these goals involves unique comparisons based on three particular techniques: (a) direct analogy, (b) personal analogy, and (c) compressed conflict.

Direct analogy is the comparison of two situations or objects to look for similarities. How is popcorn like a flower? How is a sandwich like a crowd? *Personal analogy* requires that the individual put himself or herself in the place of an element of a problem. How would you feel if you were toothpaste in a tube? How could you be sure you would get out before the tube is thrown away? Questions such as these might be asked to solve the problem: How can we get the most toothpaste out of the tube? The final strategy, *compressed conflict*, involves looking at supposed opposites in combination to find new relationships. For example, what is an example of a loud whisper or a sad smile? Teacher Guide 6 outlines a beginning lesson using personal analogy.

These techniques have been shown to be very useful in industry as aids to creative problem solving. Attempts to present the techniques in a series of workbooks and to present a basic course in synectics at the college level have been successful in producing more creative problem solvers (Gordon, 1960). One attempt at introducing synectics techniques through a program for elementary school children was called *Making It Strange*. This program will be discussed in the final section of the book.

Research on the effectivess of this strategy has been done primarily with adults and college age students. Corporations have, for a number of years, used this technique to solve problems and this technique was also successfully incorporated into the creative problem solving course at the State University of New York at Buffalo (Gordon, 1972).

BASIC REFERENCE on Synectics

Gordon, W. J. J., & Poze, T. *The basic course in synectics*. Cambridge MA: Porpoise Books, 1971.

TEACHER GUIDE 6
Synectics: Personal Analogy

One of the techniques described in the synectics approach for creativity is the use of personal analogy or putting oneself in the role of some other person or object. The following is an outline of questions that might be used in this approach:

1. Imagine that you are a bicycle. What does it feel like to be a brand new bicycle? What color are you?* Why? What kind of person is going to buy you? What will you have as extra equipment?
2. Where would you like to go on your first trip? How do you feel as you climb a long hill? What would make your trip easier? How does it feel to coast down the hill? Imagine your brakes are slammed on. How do you feel?
3. You are now 5 years old. What is the most exciting thing that happened to you as a bicycle? How have you changed? What does it feel like to be an old bicycle? What do you think will happen to you now? What can you do to make yourself more useful, to get back into shape?

This activity could be extended to involve direct analogies by asking questions such as: How is a bicycle like a television set? Or how are the gears like a book?

*You might introduce the notion of forced comparisons by asking: Which is faster, a blue bike or a green bike? Why?

BASIC REFERENCE on Heuristic Strategies

This book attempts to provide ideas for those who wish to improve creative and problem solving skills. It provides brief descriptions of models, strategies, practice items, and numerous references.

Koberg, D., & Bagnall, J. *The universal traveler: A soft-systems guide to creativity, problem-solving and the process of reaching goals.* Los Altos CA: Welham Kaufman, Inc., 1976.

Frank Williams has incorporated fluency, flexibility, originality, and elaboration into a model for teaching productive-divergent thinking within the regular curriculum of the elementary school. However, he extends the number of thinking processes to include curiosity, risk taking, and complexity. This model is designed to serve as an inservice training model that provides instructional teaching strategies for developing these thinking skills in all the areas of subject matter common to the elementary school curriculum. According to Williams and Eberle (1961), these teaching strategies are derived from empirical descriptors of behaviors and strategies that encourage productive thinking. A list of these strategies with some examples of how they might be employed to enhance divergent production is presented in Table 1. Research on the actual effects of employing this strategy in the classroom is not presently available.

Table 1
Teaching Strategies for Developing Productive-Divergent Thinking

Name	Meaning
1. Paradoxes	Situation opposed to common notion. Discrepancy in belief but true in fact.
2. Analogies	Situations of likeness. Similarities between things.
3. Sensing Deficiencies	Gaps in knowledge or information. Discrepant events.
4. Thinking of Possibles	Thinking of probabilities. Constructing alternatives.

5. Provocative Questions	Inquiry to bring forth meaning. Summons to discovering new knowledge.
6. Attribute Listing	Inherent properties. Ascribing qualities.
7. Exploring Mystery of Things	Detective work on unfamiliar knowledge. Examine unnatural phenomena.
8. Reinforcing Originality	Rewarding original thinking. Strengthen unlikely but relevant responses.
9. Examples of Change	Provide opportunities for making alterations, modifications, or substitutions.
10. Organized Random Search	Use a familiar structure to lead at random to a new structure.
11. Examples of Habit	Build a sensitivity against rigid and habit-bound thinking.
12. Skills of Search	Developing skills for historical, descriptive, or controlled experimental search.
13. Tolerance for Ambiguity	Open-ended situations which do not force closure.
14. Intuitive Expression	Feeling about things through all the senses. Sensitive to inward hunches about knowledge.
15. Process of Invention	Study incubation and insight.
16. Adjustment to Development	Process of development rather than adjustment to something already developed.
17. Study Creative People	Analyze traits of eminently creative people and the process which led to their creations.
18. Interact with Past Knowledge	Allow opportunities to toy with information.

	Nurture ideas from previously stored knowledge.
19. Evaluate Situations	Deciding upon ideas in terms of their consequences and implications.
20. Receptive to Surprise	Alert to the significance of unexpected ideas or spontaneous thoughts.
21. Creative Reading Skills	Develop a utilitarian mind-set and learn the skill of idea generation by reading.
22. Creative Listening Skill	Learn the skill of idea generation by listening to information which allows one thing to lead to another.
23. Visualization Skill	Practice describing concepts from unaccustomed vantage points. Express ideas in a different form or view.

Note. From Frank E. Williams and Robert F. Eberle, *Content, process, practice: Creative production in the classroom.* Edwardsville IL: American Edwardsville, Inc., 1968.

Enhancing Creativity by Modifying What Subjects Say to Themselves

Based on success in using explicit self directions in helping clinical patients gain self control, Meichenbaum (1975) designed packages of statements about self that would (a) make the students aware of their negative self statements in relation to their creative abilities and (b) train them to emit incompatible, positive attitudinal self statements; task relevant problem analysis and task execution self statements; and reverielike, free associating, imagery inducing self statements. These packages incorporated principles drawn from the process orientations, product orientations, and personality orientations described previously. Examples of these statements are given in Table 2.

Table 2
Examples of Self Statements Used in Meichenbaum's Study of Self Instructions

Self statements arising from an attitudinal conceptualization of creativity.
Set—inducing self statements:
What to do: Be creative, be unique.
Break away from the obvious, the commonplace.
Think of something no one else will think of.
Just be freewheeling.
If you push yourself you can be creative.
Quantity helps breed quality.
What not to do: Get rid of internal blocks.
Defer judgments.
Do not worry about what others think.
Not a matter of right and wrong.
Do not give the first answer you think of.
No negative self statements.
Self statements arising from a mental abilities conceptualization.
Problem analysis—what you say to yourself before you start a problem:
Size up the problem; what is it you have to do?
You have to put the elements together differently.
Use different analogies.
Do the task as if you were Osborn brainstorming or Gordon doing synectics training.
Elaborate on ideas.
Make the strange familiar and the familiar strange.
You are in a rut—okay, try something new.
How can you use this frustration to be more creative?
Take a rest now; who knows when the ideas will visit again.
Go slow—no hurry—no need to press.
Good, you are getting it.
This is fun.
That was a pretty neat answer; wait till you tell the others!
Self statements arising from psychoanalytic conceptualization.
Release controls; let your mind wander.
Free-associate, let ideas flow.

Relax—just let it happen.
Let your ideas play.
Refer to your experience; just view it differently.
Let your ego regress.
Feel like a bystander through whom ideas are just flowing.
Let one answer lead to another.
Almost dreamlike, the ideas have a life of their own.

Using these instructional packages as a basis for training, six 1 hour training sessions were given that (a) pointed out to the students their negative statements about their abilities, (b) presented a rationale for the use of the packages, (c) studied the self statements in the package, and (d) practiced problems using these statements. (Modeling of the statements as used in a problem solving process was also provided.) The trained group exhibited significantly greater gains on measures of creative ability (Consequences Test, Unusual Uses Test, Revised Art Scale, Holtzman Inkblot Test, and the adjective checklist) than the untrained control group. The trained group also showed greater gains on all measures except self perception of creativity than a group with training that focused on creativity as a process to be studied, but with no training or modeling of self instructional packages.

Psychodrama, Sensitivity Training, and Related Techniques

Ortman (1969) suggested psychodrama as a possible means of developing creativity. He maintained that the psychodramatic techniques of role reversal, the double antagonist situation, soliloquy, and mirroring (others mirror behavior of the subject) enhance openness to experience. In addition, he claimed that the restructuring of situations, enacting sociodramas, and objective observation develop sensitivity to problems; nonverbal drama and concretization of symbolic processes increase the fluency of ideas; spontaneity training encourages flexibility; and the future technique promotes an intuitive alertness to the possible. Furthermore, he claimed, the total involvement of the group and sharing experience are conducive to perceiving rather than judging. Unfortunately, there is no research that supports or refutes these tenets.

In a similar vein, sensitivity training has been suggested as a means of releasing potential creativity by increasing the self awareness of subjects; but, like psychodrama, it has not been investigated empirically (Ortman, 1966; Culbert & Culbert, 1967). Another technique that is intended to minimize "predetermined conceptualizations that tend to block original thinking" combines reflected light images with music in a darkened room (Gates, 1968). It is claimed that the novelty of the MRLI (Mobile Reflected Light Images) induces people to play with new ideas and concepts. Because no ex-

ternal standards for evaluation exist, there is no fear of failure involved in the experimentation. The dark room allegedly minimizes fear and, it is suggested, the music so involves the individual that fear of criticism from fellows is further reduced. Again, no research supports the use of this technique for enhancing creative thinking.

A very recent approach to training of divergent thinking provides instructions in emotive responding to increasingly abstract visual stimuli (Dellas, 1971). Basing her research on the idea that defensiveness is an inhibitor to creative thinking and postulating that such training would reduce defensiveness, Dellas found that such training did significantly facilitate performance on measures of divergent thinking.

INCORPORATING STRATEGIES INTO REGULAR CLASSROOM INSTRUCTION

Creativity training strategies have generally been studied as isolated phenomena or as part of "creativity training programs" rather than as part of the regular classroom instruction. That is, the various strategies discussed previously have generally been used as activities set aside from reading, social studies, language arts, etc. There have been several notable areas, however, in which these strategies have been incorporated as part of reading programs, creative writing programs, and various fine arts programs.

Studies made of programs that have included strategies to improve fluency, flexibility, and originality have produced promising results. For example, a study of the Reading 360 Program (Nash & Torrance, 1970) and a study using the Junior Great Books series (Casper, 1964) both produced changes in fluency of response. The 360 program also influenced originality, flexibility, and questioning strategies. Similarly, numerous studies conducted by Torrance using those strategies in creative writing programs have demonstrated increased scores on the Torrance Tests of Creative Thinking and on ratings of creative writing (Torrance, 1976). Two of the creativity programs that will be discussed in the section on specific programs were based on the regular curriculum and were shown to have positive effects on creative thinking. The New Directions in Creativity program was shown to be effective as part of a language arts curriculum and the Purdue Creativity Program, which is based on historical figures and incidents, was also shown to be effective.

It would thus seem to be reasonable that alterations in the regular curriculum could serve the purpose of generating more creative thinking responses in children. The existing body of knowledge about transfer of training effects also supports the conscious modification of regular curricular activities in order to suggest to students that the skills developed are applicable to a wide variety of disciplines and serve to help problem solving in many situations (Bichler, 1974).

The incorporation of these strategies into regular classroom activ-

ities requires some time and planning, but can be used to achieve the same goals as alternative teaching plans. Teacher Guide 7 provides an example lesson using questioning strategies that allow for the development of fluency, flexibility, and originality while at the same time teaching some basic principles of grammar. The Basic Reference on Incorporating Creative Thinking Strategies into Regular Classroom Activities provides more suggestions.

BASIC REFERENCE on Incorporating Creative Thinking Strategies into Regular Classroom Activities

James A. Smith developed a series of textbooks that translate the basic principles of creativity into specific methodology and teaching strategies that can be incorporated in the elementary school curriculum. The first volume in the series provides a basic outline; the remaining volumes concentrate on specific ideas in specific content areas. Although designed for elementary level classes, they contain many ideas that can be used as springboards for lessons at any age level. The first volume in the series is:

Smith, J. A. *Setting conditions for creative teaching in the elementary school.* Boston: Allyn and Bacon, 1966.

Other volumes include the following:

Setting conditions for creative teaching in the language arts.

Setting conditions for creative teaching of reading and literature.

Setting conditions for creative teaching of the creative arts.

Setting conditions for the creative teaching of the social studies.

Setting conditions for creative teaching of mathematics.

Setting conditions for creative teaching of science.

TEACHER GUIDE 7
A Noun Is a Verb Is an Adjective*

Let us assume that you wish to teach the principle that the same word may serve as a noun, an adjective, or a verb depending on its use in the sentence. Rather than using the traditional approach of presenting the students with a series of sentences and pointing out that the same word is used in many ways, try the sequence of activities listed here.

1. First, ask the students to imagine that they have been walking in the woods and have stopped by a fresh water spring to take a drink. Ask them to begin to describe how they feel and how the water looks, tastes, feels, or sounds. From the descriptions they give, begin to pick out words that could be used as two or more parts of speech. For example, they may use *running* or *singing* as an adjective to describe the spring water. *Running* or *singing*, or course, can be adjectives, verbs, or nouns. Similarly, *cool* may be used as an adjective or verb. Pick out several of the words and ask the students to use them in a different way. For example, if they describe the water as cool, ask them to create a sentence in which *cool* does not describe something. Or ask them to use *spring* in a way that does not describe a kind of water.
2. After a number of these sentences have been written on the chalkboard, ask the student what the word does in each sentence—i.e., does it describe, does it show action, or is it the name of something? At this point, the distinctions between noun, verb, and adjective can be made and, at the same time, the student can be shown that one word can serve as any one of the three parts of speech.
3. Now ask the students to think of as many words as they can that can be used in more than one way. From the list generated, select a number of these, ask the students to write sentences using each word as a noun, a verb, and an adjective. Be careful not to request that students use words as parts of speech that are impossible. For example, do not request that *glass* be used as a verb.

*Adapted from Smith (1966)

Renzulli and Callahan (1975) outlined suggestions for the teacher who wishes to construct activities for the classroom. The four basic principles they consider important are: fluency, openendedness, environmental relevancy, and enjoyment. The fluency principle suggests that activities designed to foster creativity should provide the opportunity and, in fact, encourage students to produce more than one response to a given question or task. The principle of openendedness is closely related to the fluency principle and is simply interpreted as providing activities that have no predetermined answers. The teacher should not be looking for any given response to the task presented. The third suggestion, providing for environmental relevancy, is designed to prevent penalizing students for lack of knowledge about a particular subject. Students from any cultural background and socioeconomic status should have the information to respond to the item with minimal input. Finally, students should enjoy the activities presented. Enjoyment can be increased by allowing students to create and present activities, by allowing for laughter and silliness, and by having the teacher also involved in the activities.

In constructing creativity activities for the New Directions in Creativity program, the authors incorporated the four principles in addition to using the Guilford Structure of the Intellect (SOI) model as a way of systematically developing activities to develop fluency, flexibility, and originality. A teacher who wished to follow a similar pattern in mathematics might use activities similar to those found in Teacher Guides 8 and 9. Note that each Teacher Guide provides a listing of the type of activity as well as specific creativity and content objectives.

TEACHER GUIDE 8
Special Ciphers

Type of Activity: Divergent Production of Symbolic Relations

Objectives:

1. *To develop ideational fluency and flexibility.*
2. *To manipulate numbers using basic mathematical operations to illustrate relationships between those numbers.*

Teaching Suggestions:

This activity provides an excellent opportunity to introduce the meanings of the words *redundant* and *deficient* by illustrating that redundant numbers have divisors that total *more* than the number and deficient numbers have divisors that total *less* than the number. (If the meaning of the word *cipher* is not known, it should also be defined for the student.)

A brief review of the definition of the word *divisor* will be a helpful introduction to this lesson. A few simple examples where children simply list all the divisors of a given number will serve to review the concept of *divisor* and establish the atmosphere for generating more than one response to a problem. Care should be taken at this point *not* to use prime numbers because of the restrictions on these numbers. After several examples and a review of the word *divisor*, the activity sheets can be distributed. The children may work through the introductory section alone or as a class, but it is very important that the children understand the definitions of *redundant* and *deficient* sufficiently well to complete the activity. Children who have difficulty may be helped by being asked to complete the exercise in two steps. First, ask them to choose a number and list all of its divisors. Then ask them to add the divisors and decide whether it is redundant or not.

It may be necessary to point out that the given number is not considered a divisor for the definitions of *perfect, redundant,* and *deficient* numbers even though a number is evenly divisible by itself.

Followup Activities:

Challenging the students to look for redundant or deficient numbers of three or four digits will provide excellent opportunities for teamwork and competitive games. Preparing charts of all the perfect, deficient, and redundant numbers from 1 to 100 should lead the children to the conclusion that a number must fall into one of those three categories. After the second activity sheet is completed, students should be encouraged to discover that all prime numbers must be deficient and give a reason why.

Children who show special talents in math may be led to conclude that a square number is equal to the product of the number of dots on one side of the square times itself (see second activity sheet). The derivation of the term *squared* as the process of multiplying a number by itself can then be introduced as a derivation of this property of a number.

Children who are especially interested in the history of mathematics or properties of numbers can be referred to *Take A Number* by Jeanne Bendick and Marcia Levin (1961).

Caution: The next three perfect numbers are 496, 8128, and 33,550,336.

Activity Sheet #1

In your math classes you have learned to add, subtract, multiply, and divide numbers in order to solve problems. Have you ever studied the numbers themselves? The ancient Greeks spent a great deal of time studying the properties of numbers and found some numbers to be very special. For example, what are all the numbers you can think of that are divisors of 6? That is, which numbers can you divide into 6 evenly?

Now, add these numbers. What is the sum?____ A number that equals the sum of all its divisors is called a *perfect* number. Can you name another perfect number?____

If the divisors of a number add up to *more* than the number itself, the number is called *redundant*. How many redundant numbers can you list?

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

If the divisors of a number add up to less than the number itself, the number is called *defective*. How many defective numbers can you list?

_____ _____ _____

Activity Sheet #2

The ancient Greeks also studied prime numbers. A prime number can only be evenly divided by 1 and itself. How many prime numbers can you list?

The Greeks also enjoyed arranging numbers according to shapes. One kind of number they discovered this way was a *square* number. Four is a square number since four dots may be arranged in a square (the same number of dots on each side) like this ⁘ . Nine is also a square number ⁙ . How many square numbers can you find?

The Greeks also found triangle numbers like 3 ∴ and 6 ∴. How many triangle numbers can you list?

TEACHER GUIDE 9
Noting Numbers

Type of Activity: Divergent Production of Symbolic Units

Objectives:

1. To develop ideational fluency.
2. To develop the ability to group things according to a common attribute.
3. To be able to distinguish between conjunctive and disjunctive classes.

Teaching Suggestions:

To introduce this activity, ask the children how many students are in the class. Then, ask them how many grains of sand there are on all the beaches in the world. This should provide the students with a basic understanding of the concept of the word *infinity*. After the students have attempted to list all the infinite things they can think of, encourage them to try the more abstract concepts like "an infinite amount of love." Be sure to praise unusual and clever responses.

The second exercise, negative numbers, may be difficult for some of the children, but encourage them to use their imaginations. Suggestions such as "two under par" from golf or "second down and twelve"—suggesting a loss of yardage from football—may be helpful.

Followup Activities:

The last exercise on Activity Sheet #2 asks students to list numbers that are even *and* divisible by 3. Since this exercise requires responses that possess a combination of attributes, it illustrates the concept of conjunctive class. After they have completed this exercise, you might ask if they can tell how this exercise differs from the others. Lead them to see the difference between single and multiple attribute classes.

Conjunctive classes may be based on two or more attributes (for example students may be asked to list numbers that are even, greater than 50, and divisible by 3) and the level of challenge can easily be raised by increasing the number of common attributes. There are an "infinite" number of activities that can be developed using the Noting Numbers format. This exercise provides an excellent opportunity to introduce Venn diagrams to the class and point out the way in which conjunctive and disjunctive classes are illustrated in diagrammatic fashion.

A display of pictures from magazines, drawings, or student photographs that illustrate the examples of infinity listed by the children will make an interesting and informative display.

Activity Sheet #1

You have heard people speak of an infinite amount of something. Infinite means "without end." Infinite things go on forever and ever. How many infinite things can you think of?

_____	_____	_____
_____	_____	_____
_____	_____	_____

You have probably heard of negative numbers. A negative number is one that is less than 0. One of the times we hear of negative numbers is during a rocket launch when the countdown is "zero minus 3," then "zero minus 2," then "zero minus 1," and finally "Liftoff!" How many other uses can you think of for negative numbers?

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Activity Sheet #2

1. List all the numbers you can think of that are divisible by 4.
2. List all the numbers you can think of that are divisible by 3.
3. List all the numbers you can think of that are even numbers and are divisible by 3.

SPECIFIC PROGRAMS AND CURRICULA DESIGNED TO DEVELOP CREATIVITY

Productive Thinking Program

One approach to the development of creative problem solving techniques is programed instruction. At first glance, programed instruction seems to be the least probable method of dealing with the development of creative thinking abilities. The following arguments have been used to support such a notion. First, the prestructuring of material and step by step guidance may lead to undesirable similarity in the thought processes of all children in the program. Second, the controlled nature of programed instruction might fail to take account of the fact that there are some equally appropriate means of achieving an adequate understanding of subject matter. Third, programed learning may be too effortless, with the program supplying too much of the initiative for learning. Fourth, there is too little opportunity for questioning, dissent, or rejection of content. Finally, there is little opportunity to provide for practice in tolerance of ambiguity, complexity, and lack of closure (Covington & Crutchfield, 1965).

The developers of the Productive Thinking Program argued that the effects of programed instruction which present a bleak forecast to those who might consider such an approach are, in fact, mitigated by relaxing the rigid set-up of most programed materials and by using new programing techniques that are more in accord with the requirements for creative thinking. Self pacing, self direction, and self administration are examples of features of programed instruction that readily lend themselves to creativity and should be emphasized in efforts to develop creative thinking. In addition, according to the authors, greater use of branching techniques will provide greater opportunity for freedom of choice and alternative ways of thinking. Olton (1969) summarized the argument by claiming that:

> There is reason to believe that this antithesis between programmed instruction and creative thinking is only superficial, that programs can be written in such a way that the student is called upon to use and develop a rich diversity of productive thinking skills.... And indeed certain features of programming give it some decided advantages as a vehicle for developing creative thinking in the student. For one thing, programmed material can provide the individual with great procedural flexibility—he can think, puzzle, and proceed at his own pace, exploring many or few cognitive avenues as he goes. For another thing, programmed instruction requires that the student actively participate, requiring him to do the thinking himself, rather than allowing him passively to fill a notebook with someone else's thoughts. (p. 17)

As evidence of the success that has been achieved with programed instruction, one can look to results from the State University of New York at Buffalo studies concerning a unit on creative thinking presented in that form to high school students (see Brainstorming section of this chapter).

An attempt at developing a programed unit at the elementary school level consists of a set of 16 cartoon-text booklets for fifth and sixth grades that present detective type mysteries for the student to solve. Instructions in productive thinking skills that accompany the stories are designed to teach ways to generate many ideas, including unusual and clever ones; to evaluate ideas with respect to relevant facts; to examine problems in different ways; and to integrate various thinking skills. This program has been extensively researched.

The earliest evidence in support of the program was presented by Covington and Crutchfield (1965). Fifth and sixth grade classes were presented the materials (an abridged 13 lesson unit) for 1 hour per day for a 3 week period. Teachers were explicitly instructed to supplement the lessons, and pupils were compared with a control group on an 8 hour test battery that included measures of the number of clarifying questions asked, number and quality of ideas generated, and number of solutions achieved. Instructed pupils did significantly better than control pupils on these tasks. Instructed pupils also showed significant positive changes in the degree to which they valued problem solving and activities associated with it. These effects were constant across intelligence, sex, and initial pretest levels of performance and persisted 5 months later. A later study by the same researchers (Crutchfield, 1966) using all 16 lessons yielded similar results.

Studies by Olton (1966) and Olton and Crutchfield (1969) under similar conditions (distributed presentation of lessons, teacher participation, and measurement criteria similar to programed exercises) showed consistently significant gains in

> Ability to perform such creative functions as generation of ideas of high quality, asking relevant questions, making effective use of information, being sensitive to discrepancies or other puzzling aspects of a situation, and achieving solutions to problems. These gains were found to occur across a wide spectrum of ability levels. (p. 21–22)

Olton (1969) investigated the program further and asked groups of students to write essays on poverty. The groups that had been through the programed instruction unit wrote longer essays that were judged to be of higher quality. He also examined the rate of teacher presentation and teacher participation as an important variable. When materials were presented at the rate of one lesson per day with little or no teacher participation the effect was not as impressive as when the program was spread out over 8 weeks and in-

cluded class discussions. A followup assessment after 6 months showed that instructional and attitudinal gain were still evident.

On the other hand, Ripple and Davey (1967) failed to find significant differences on divergent thinking measures between an eighth grade control group and an eighth grade group using an abbreviated form of the Productive Thinking Program. Similarly, a study by Treffinger and Ripple (1971) failed to offer support for the effectiveness of the program and the authors' claim that problem solving skills learned in the program would transfer to other areas of study. Wardrop, Olton, Goodwin, Covington, Klausmeir, Crutchfield, and Rond (1969) found fewer significant differences favoring students involved in the Productive Thinking Program on the same criterion measures that had previously yielded results favoring such students. Furthermore, those significant differences that were found in the study were on measures of convergent thinking while divergent thinking tasks failed to yield such differences. These studies all were constructed so that teacher involvement in the program was minimal.

In a summary of these findings, Treffinger and Ripple (1971) attributed the conflicting results to three variables within the designs: (a) the spacing of lessons and the provision for supplementary practice, (b) the degree of teacher participation in the presentation of program materials, and (c) the criteria used to measure the effectiveness of the materials. Generous spacing of lessons, provision for supplementary practice, a greater degree of teacher participation, and criteria of evaluation that closely resemble Productive Thinking Program exercises provided for the most positive experimental gains in the reported research.

A serious question raised about both the design and evaluation of this program concerns the convergent nature of the activities in the program and the problem solving activities used as criteria in the majority of the studies. Only minimal attention has been paid to the development of divergent abilities in this program. Another problem exists in the experimental design of research on the Productive Thinking Program. In studies where the Torrance Tests of Creative Thinking were used in whole or part as a criterion measure in pretest/posttest designs, the dynamic nature of the tests and possible interactions with program and/or posttest results made interpretation of the results difficult. Designs that used problem solving tasks as criteria have been criticized as employing an extension of the training materials and measuring only the narrow problem solving abilities type of the program and not general problem solving abilities or creative thinking (Treffinger & Ripple, 1971).

Creative-Arts-In-Miniature

Crutchfield also developed and evaluated a program similar to the Productive Thinking Program based on a "Creative-Arts-In-Minia-

ture" approach that guides pupils step by step through a problem to a solution. The problems progress from the very simple to the highly complex. When tested, students who had had the training experience surpassed the control group in question asking, generation of many "good" ideas, utilization of clues, and production of ideas that give solutions (Crutchfield, 1965). The effects of these criterion measures were still evident 5 months later. No other research evidence about this material is available, and, once again, the convergent nature of the program makes its usefulness in nurturing general creative thinking abilities questionable.

Purdue Creative Thinking Program (PCTP)

The results indicated previously for programs based on problem solving suggest that there is an additional need for programs that are more general and less structured in their approach to creativity. One more general and less structured approach to creative thinking may be found in the Purdue Creative Thinking Program. This program (Feldhusen, Bahlke, & Treffinger, 1970) is aimed at fostering the divergent thinking abilities of verbal and figural fluency, flexibility, and elaboration in addition to the problem solving abilities that are the aim of the Productive Thinking Program. The program's three parts—audiotape presentations of principles of creative thinking, short stories about famous American pioneers, and a series of short exercises—have been researched in order to determine the effects of the total package as well as differential effects of the several components of the program.

The earliest studies of the effects of the program were conducted with pupils in grades 3, 4, and 5 using the total program (Feldhusen, et al., 1969). The results of posttests on the Torrance Tests of Creative Thinking indicated significantly higher scores for the experimental groups on measures of verbal and nonverbal originality, but not fluency, flexibility, or elaboration. Groups receiving instruction through the PCTP in a later study by Robinson (1969) gained more than control groups on verbal and nonverbal fluency, flexibility, and originality, but the fact that there were only two classes involved in the study sheds some doubt on the generalizability of the results.

The second phase of research on this program sought to determine the relative effectiveness of the components of the program. Exposing fourth, fifth and sixth grade students to single components of the PCTP resulted in the conclusion that no one component or combination of components was effective at all three grade levels or for all criterion measures (Torrance Tests of Creative Thinking). A longitudinal study by Speedie, Treffinger, and Feldhusen (1971) showed this effect to persist 7 months later. Their results further indicated that students need practice in and reinforcement for using the principles of creative thinking in addition to simple instruction for the

maximum development of skills in that realm of the cognitive processes that includes those abilities.

Idea Book, Imagi-Craft, and Creative Research

Meyers and Torrance (1961) developed workbooks for elementary school students with portions suitable for junior high school students. The materials consist of open ended questions, lines to complete to produce figures suggested in the child's imagination, and "silly" story writing exercises. The motivation lies in the assumption that this type of exercise is fun for children. According to Torrance (1976), use of these workbooks in the classroom resulted in creative growth as measured by creativity tests. Other indications of significant improvement in creative thinking abilities after use of the Idea Book were noted by Britton (1967) and Torrance (1967a).

A study by Freiheit (1969) of one of the workbooks (*Stretch*) failed to show significant mean gains in total verbal and nonverbal creativity scores between experimental and control groups, but did show a significant mean gain in verbal originality for experimental subjects. This measure was most related to the content material of the treatment. Failure to find other significant differences was speculatively attributed to minimal teacher direction, possible overshadowing of content over creativity material, short period of time for learning, or the "fourth grade slump" in creativity. (There appears to be a clear period of decline in creative functioning at about age 9 in the American culture.)

Torrance and Meyers also developed materials aimed at teaching students at the upper elementary level to do creative research. This material has not been field tested (1967b). Torrance also helped to develop the Imagi-Craft materials. A set of 10 record albums with accompanying teacher guides, the materials deal with great moments of geographic and scientific discovery, invention, and fantasy. The goal is to teach fourth grade children about "the nature of the creative process, the value of creative people, and to engage children in creative thinking experiences similar to those described in the dramatizations" (1967b, p. 140).

Thinking Creatively: A Guide to Training Imagination

Davis and Hautman (1968) attempted to develop a creativity program for use with grades 6 through 8. It is in the form of dialogue among four characters and concentrates on the development of favorable attitudes. The scientist-inventor character teaches the other three characters a number of creative thinking techniques such as attribute listing, morphological analysis, checklisting, synectics, and free association techniques. A pilot study of this program with seventh grade students resulted in experimental subjects exhibiting 65% more ideas on three divergent thinking tasks than control subjects. Their ideas were also rated as significantly more creative. In

addition, the trained groups displayed significantly more confidence in their creative ability, more appreciation of unusual ideas, and more awareness of the importance of creative innovation.

New Directions in Creativity

The definition of creativity adopted by the author of this program is operational, relative rather than absolute, and expressed as follows:

> Creativity is the production of an idea or product that is new, original or satisfying to the creator or to someone else at a particular point in time, even if the idea or product has been previously discovered by someone else or if the idea will not be considered new, original, and satisfying at a later time or under different circumstances. (Renzulli, 1973, p. 3)

The approach taken to training this type of creative thinking is based on one aspect of Guilford's Structure of the Intellect model of human abilities—the divergent production operation. Particular attention was given to the facility for producing many ideas, readiness to change modes and categories of thought, and ease in modification and adaptation of given information. Two research studies on these materials indicate the potential for influencing creative thinking abilities (Callahan & Renzulli, 1973; Ford, 1975). The importance and influence of the teacher was again noted in the Callahan and Renzulli study with the classroom being the only variable that showed a significant influence on the students in the program as measured by the Torrance Tests of Creative Thinking. Self perceptions and teacher perceptions of student creative thinking abilities were increased as a result of participation in the activities when used in pilot programs (Callahan & Renzulli, 1973).

Inservice Training

The least structured and most subject oriented approach to creativity was developed by Hutchinson (1967). This approach consisted of a 4 day inservice workshop for both teachers and students during which the principles of group methods, brainstorming, ideational fluency, originality, and planning elaboration were presented. The experimental group then studied a social studies unit with instructions to keep those principles in mind and apply them wherever possible. The control group simply studied the unit using traditional methods. The training resulted in significant gains by the experimental group of students in 4 out of 10 creativity measures (apparatus fluency, plot titles fluency, clip uses fluency, and clip uses-flexibility). Most of these gains, unfortunately, were in the area of fluency with no gains in such areas as originality, elaboration, or transformations. The lack of gains in these areas suggests a need for more time to explore the other principles, but it may also suggest that the fluency principle was the simplest, easiest to apply, and,

therefore, the most practiced principle with little attention given by the teachers to activities that allowed practice in other areas. Since there was no control of the type of activity in the classroom, there can be no way of judging the factors that accounted for the results. This evidence does suggest that there is a need for providing activities that will systematically allow children to develop a number of the abilities necessary for creative thinking.

Summary

From a review of the research on materials that developed into complex training materials, several conclusions may be drawn. First, the tasks on which success of the program are measured are very similar to exercises in the program, causing one to question the breadth of influence the program has. Second, the packages are highly dependent on teacher effectiveness and involvement for their success. Third, the programs that have been researched (the Productive Thinking Program, the Purdue Creative Thinking Program, the Buffalo Creative Problem-Solving Course, the Meyers-Torrance materials, and New Directions in Creativity) offer promise of affecting creative thinking abilities and problem solving, although some are more oriented toward convergent thinking. Torrance (1976) and Mansfield and Busse (1974) have come to similar conclusions in their review of these materials. It should be emphasized that teacher involvement is a crucial variable in the effectiveness of the programs, suggesting that those factors that influence the setting of the classroom environment are important whether the teacher intends to design a unique curriculum or to implement packaged materials.

BASIC REFERENCE on Published Instructional Material for Teaching Creativity and Problem Solving

The first third of this book provides a basic introduction to techniques used to develop creative thinking and problem solving. The last two thirds of the book contain a listing of books and instructional materials on teaching creative thinking. Included for each entry is information on the publisher, instructions on how to order the material (including price), a description of the material and target audience, and the underlying rationale.

Feldhusen, J. F., & Treffinger, D. J. *Teaching creative thinking and problem-solving*. Dubuque IA: Kendall/Hunt Publishing Co., 1977.

4 The Teacher as a Researcher or Will It Work in My Classroom?

Although many of the teaching strategies and curriculum ideas for enhancing creative thinking abilities presented in this book have been researched and field tested, every teacher is aware that each classroom is unique. Knowledge of the unique characteristics of a given class should guide each individual teacher in making decisions about what will work in a particular classroom. Every teacher is a little different from all other teachers; every student is a little different from all other students. Therefore, what works with one teacher and his or her students may not be successful for another teacher with another group of students. In fact, what works for one teacher with one group of students may not even be suited for a different teacher working with the same group of students. Consequently, teachers who attempt to implement the ideas presented here should try to verify that the program, teaching strategy, or curriculum model they adopt is really working to achieve the goals they have established for their students. Because many of the research findings related to the enhancement of creative thinking abilities are based on samples of children with average intelligence, or adults rather than gifted children, it is particularly important that teachers verify the findings in their own classes.

In evaluating the effectiveness of a given idea for use in a classroom, the teacher might consider several factors. Among these are the teacher's own ease and comfort with the idea, student satisfaction with the process, and, finally, the degree to which the objectives of instruction are being achieved. Each of these factors is important to the ultimate usefulness of any idea, and each one interacts with the others to produce final outcomes.

There are several possible approaches to assessing the changes in students that might occur as a result of using the New Directions in Creativity materials, or a synectics approach, or a teacher's own ap-

proach to teaching creative thinking. The most common approach to making judgments about these changes is to use creativity tests. Among the commonly used tests are the Torrance Tests of Creative Thinking (Torrance, 1966), the Remote Associates Test (Mednick, 1967), and the Wallach and Kogan tasks (Wallach & Kogan, 1965). If you wish to use these tests to measure changes in your students, you might administer the test before beginning to use the materials and then after a sufficient amount of time has elapsed in order to feel reasonably sure that changes should have occurred. To be sure that any changes that occurred can be attributed to the teaching strategy you chose, it would be appropriate to also test a group of students who were not exposed to the materials. If this group does not change as much as the students who use the materials, then you can be more certain that it is the materials and not simply time that brought about the changes.

There are other ways to assess the impact of these strategies on student performance. For example, you might select a set of student papers or other products from the beginning of the year and one from the end of the year, and then ask a judge to pick the more creative of each student's pair of projects. (The judge, of course, should not be told which product was completed first.)

Similarly, judges might be asked to rate a student product on a rating scale of creative performance. Comparisons of ratings prior to implementation of the program can be compared to ratings of products completed after the attempts to develop this talent. Some sources of rating scales that might be used are found in the Appendix. Other rating scales may be found in the *Guidebook for Evaluating Programs for the Gifted and Talented* (see Basic Reference in this section).

BASIC REFERENCE on Evaluating Programs for the Gifted and Talented

This guidebook discusses many approaches for evaluating entire programs for the gifted and talented. However, many of the ideas are appropriate for evaluating outcomes of instruction. Furthermore, there are many examples of rating scales and survey instruments that would prove useful in rating the effectiveness of creativity programs.

Renzulli, J. S. *A guidebook for evaluating programs for the gifted and talented*. Ventura CA: Office of the Ventura County Superintendent of Schools, 1975.

Other measures of creative production are also found in the Appendix and might prove useful to the teacher wishing to assess creative development.

In evaluating the effectiveness of the strategies or programs chosen to develop creative thinking skills, it is obvious that one would like to assess the degree to which students have actually learned new problem solving strategies, become more original, etc. However, it would also seem important to assess the affective impact that the activities have had on the students. Research has demonstrated that students retain those skills that they value and learn most quickly those things which are enjoyable. It follows logically that the introduction of new approaches to thinking should be evaluated for its affective impact as well as its cognitive impact. For example, it would be important to appraise the degree to which students have come to value these strategies in thinking, the degree to which they are aware of the type of problems that warrant application of these strategies, and the degree to which they feel comfortable in engaging in activities that are open ended in nature, require flexibility in response, or require tolerance for ambiguity. A number of instruments have been developed that might prove useful to the teacher who is attempting to assess these outcomes. One such measure is called the Creativity Attitude Survey (Schaefer, 1971). For each of the 32 statements on this scale, the student must indicate his or her agreement or disagreement with the statement. The items are designed to measure the following dimensions: confidence in the student's own ideas, appreciation of fantasy, theoretical and aesthetic orientation, openness to impulse expression, and desire for novelty. The following are examples of items from the scale:

I like to play "make believe" games.
I often act on the spur of the moment without stopping to think.
I think daydreaming is always a waste of time.
I feel that thinking up ideas that are "way out" or "fantastic" is a waste of time.
I would rather think up a picture of my own than trace or copy one.
I would rather learn strange new games than play games that I know well.
Other children have better ideas than I do, and it is best to follow what they do.
Artists are sissies.
I would rather buy a paint-by-number than paint a picture by myself.

Another instrument that could be used to assess affective changes is the Pennsylvania Assessment of Creative Tendency (Rookey, 1974). This instrument is a self assessment of self direction, evaluative ability, flexible thinking, original thinking, elaborative thinking, willingness to take risks, ease with complexity, curiosity, and fluent thinking ability. Some examples of items on this scale are given below.

If the last page of a book is missing, the book is not worth reading.
I would like to make up a new song.
TV news shows are boring.
Learning how to do things is more important than getting excellent marks.
I like to make things without following directions.
I think I could make up stories as good as those in books.

Many other scales for assessing attitudes toward creative thinking activities and for assessing student perceptions of their own creativity may be found in the Appendix and in the Basic References on the Measurement of Creativity. Most of these scales take only 10 to 20 minutes to administer but will provide some valuable information to the teacher about the success he or she has achieved in meeting particular affective objectives. If they are administered prior to the implementation of the activities designed to have an impact on these attitudes and again some time after the program has been operating and change is expected, some assessment of the effects of the teaching strategies can be made. As with changes in the achievement arena, it would be desirable to compare changes in students in the group in which creativity has been a primary objective with changes in a group where creativity was not a primary objective. Comparisons could also be made between groups in which different strategies had been used to try to achieve the same objectives.

A teacher who is interested in evaluating the affective consequences of a program for developing creative thinking abilities might also choose to solicit the opinions of the students in the classroom about the particular activities used. A simple questionnaire designed for this purpose follows. Through an instrument such as this, the teacher can gather information about the degree to which the students enjoyed the activities presented as well as information about the students' perceptions of the effects the program had on their thinking.

Regardless of the judgments you make about whether or not to continue using a particular teaching strategy or set of creativity training materials, it is important to keep in mind that each class and each teacher are unique and that some assessment must be made of the success of these materials and strategies in attaining the goals you have in mind. No matter how good the material might look in the package or how impressive the literature, the ultimate test is how well they work in your classroom.

A Student Questionnaire

Name _____ Teacher's Name _____

Directions: The following questions ask for your opinions about the creativity exercises you have been working on in this class. This is

a chance for you to let others know how you feel about these activities. Please answer each question as honestly as possible. Check the one answer that most clearly expresses your opinion.

1. If you were going to teach sixth grade next year, would you

   ____ include more creativity activities than you have had this year.

   ____ include fewer creativity activities than you have had this year.

   ____ include the same number of creativity activities as you have had this year.

   ____ include no creativity activities.

2. If you were given a choice next year, which of the following would you do?

   ____ Vote to continue working on creativity exercises like the ones we used this year.

   ____ Vote not to continue working on these activities.

   ____ Have no opinion.

3. Which activity does your class enjoy the most?

   ____ Spelling

   ____ Reading

   ____ Arithmetic

   ____ Creativity exercises

4. The discussions we have about our responses to the creativity activities

   ____ often help me think of new ideas.

   ____ sometimes help me think of new ideas.

   ____ are fun, but seldom help me think of new ideas.

   ____ are a waste of time.

5. Discussions we have about our responses to the creativity activities

   ____ are valuable and should follow *every* activity.

   ____ are sometimes valuable, but only helpful for some activities.

   ____ are valuable for some students, but not for me.

___ take up too much time. I would rather work on other activity sheets.

6. The teacher
   - ___ allows us to think of wild ideas and accepts them whether they are practical or not.
   - ___ accepts only practical and useful responses.
   - ___ allows us to express wild ideas, and then helps us to judge whether our ideas are practical and useful and accepts our opinion.

7. The creativity program has
   - ___ helped me think of many ways to solve a problem.
   - ___ helped me find the right solution to problems.
   - ___ has not helped me solve problems.

8. When we work on these activities
   - ___ a few boys and girls do most of the talking.
   - ___ the teacher does most of the talking.
   - ___ the teacher and a few boys and girls do most of the talking.
   - ___ we all try to contribute to the discussions.

9. I would like to work on this type of activity
   - ___ every day.
   - ___ two or three times a week.
   - ___ once a week.
   - ___ none of the above.

10. When working on these activity sheets, I like to work best
    - ___ alone.
    - ___ with one other person.
    - ___ in a small group.
    - ___ with the whole class.

11. While working on the creativity activities, I most often
    - ___ wish we had more time to work.
    - ___ feel we have just about the right amount of time to work.
    - ___ think we spend too much time on each activity.

12. These creativity activities are

___ as important as the other subjects I study in school.

___ more important than other subjects I study in school.

___ fun, but not as important as other subjects I study in school.

___ a waste of time.

13. Do you feel that the creativity exercises have made your regular school work more interesting? I feel they have

___ made it less interesting.

___ made it neither more nor less interesting.

___ made it slightly more interesting.

___ made it quite a bit more interesting.

___ made it a great deal more interesting.

14. Do you feel that your thinking has improved since you began working on the creativity activity sheets? My thinking

___ became poorer.

___ did not change.

___ improved slightly.

___ improved quite a lot.

___ improved greatly.

15. Do you feel that the creativity exercises helped you in your regular schoolwork? These exercises

___ have made me poorer in my regular schoolwork.

___ have not helped me in my regular schoolwork.

___ have helped me slightly in my regular schoolwork.

___ have helped me quite a bit in my regular schoolwork

___ have helped me a great deal in my regular schoolwork.

16. Do you now enjoy using your mind more than you did before you began using the creativity activity sheets? I now enjoy using my mind

___ less than before.

___ about the same as before.

___ a little bit more than before.

___ quite a bit more than before.

___ very much more than before.

17. Now that I have worked on these creativity activities, I believe I am

___ more creative than I used to be.

___ less creative than I used to be.

___ about the same as I used to be.

___ not creative at all.

18. When working on creativity exercises I

___ had to think harder than I do in other classes.

___ thought about as hard as I did in other classes.

___ did not have to think as hard as I do in other classes.

19. Working on these activities was

___ more fun than working on other subjects.

___ about the same as working on other activities.

___ boring and not as much fun as some other subjects.

Which subjects are more fun?

_____ _____

_____ _____

20. These activities were

___ too hard.

___ difficult, but I could do them if I really tried.

___ neither too hard or too easy, just about right.

___ too easy.

21. When I am working on the creativity activities

___ I think in different ways than I do when I am working on my other work. My brain must do different things.

___ I think in the same way as I do when I am working on my other work. My brain does the same things.

5 A Summary of Practical Implications for The Teacher

The research presented in the previous chapters leads to some general considerations about what a teacher might do to encourage creative production by students in the classroom.

1. Provide a nonthreatening atmosphere. The classroom environment should be structured in such a way that students' ideas and opinions are respected, ridicule of new ideas is eliminated, questioning is encouraged, and questions are asked that allow students to be open and uninhibited in response.
2. Refrain from becoming the judge of the worth of all products in the classroom. An open, nonjudgmental attitude on the part of the teacher will allow more freedom for divergent production as well as the evaluative skills necessary for the complete creative process. Encourage students to develop criteria to judge both the work of peers and themselves.
3. Model creative thinking and/or introduce other individuals who are able to illustrate the creative thinking process to the students. The teacher should take care to model creative problem solving procedures on as many occasions as possible, not simply during "creativity time."
4. Attempt to integrate activities and questions that encourage divergent production and evaluation into as many content areas as possible. The necessity of illustrating transfer of these skills to all areas of thinking cannot be overestimated.
5. Make a conscious effort to remind students to be creative, to be original, to try to think of new ways to solve a problem, etc.
6. Systematically reward novel production. The use of operant conditioning to reinforce specific types of novel behavior can lead to an overall increase in creative production. For example, the reinforcement of the use of a variety of sentence structures

in an essay has been shown to influence overall creative writing skill. Care should be taken to choose appropriate reinforcement. Gifted children can be expected to value rewards that are somewhat unique.

7. Provide stimuli for as many of the senses as possible. A variety of stimuli encourage the student to view the problem from a variety of perspectives and also seem to enhance the sense of openness and psychological freedom.
8. Make use of warm-up activities when moving from highly structured convergent or memory type activities into activities requiring students to engage in creative production. Such brief activities should be used to reaffirm the nonthreatening environment and are most effective if they relate to the task to be accomplished.
9. Incorporate activities into the classroom instruction that require students to generate a large number of correct responses. That is, provide open ended questions that have no single, right answer.
10. Instruct students in the principles of brainstorming, but incorporate strategies for self evaluation of the quality of ideas. Furthermore, brainstorming activities will be most productive if tied to "real problems" or "meaningful production" rather than simple games.
11. Be a participant in the actions. Do not merely pose problems, but be an active problem solver.
12. Encourage students to express positive self statements about their creativity and avoid negative self evaluations. Provide them with guiding statements of attitudes, approaches to problems, and orientations to the process.
13. Attempts to incorporate published material into the curriculum are dependent on the understanding and commitment of the teachers who are using the curriculum. No packaged materials are independent of the teacher's use of those materials, and the effectiveness of creativity training materials seem to be particularly influenced by the teacher's attitude and the environment of the classroom.
14. Whichever strategies are adopted for classroom use must be evaluated within the particular classroom with your particular students and teaching style. What works in one situation will not always work in others. Continual assessment of the objectives of instruction is crucial.

References

Anderson, D. N. An experimental evaluation of two methods for developing creative problem solving abilities in an industrial arts course. *Dissertation Abstracts*, 1963, *24* (5), 1934–5.

Anderson, L. R., & Fieldler, F. E. The effect of participatory and supervisory leadership on group creativity. *Journal of Applied Psychology*, 1964, *48*, 227–236.

Arnold, J. E. Useful creative techniques. In S. J. Parnes & H. F. Harding (Eds.), *A sourcebook for creative thinking*. New York: Scribner's, 1962.

Arici, H. Brainstorming as a way of facilitating creative thinking. *Dissertation Abstracts*, 1965, *25* (11), 6381–2.

Baer, D. M., Rowbury, T. G., & Goetz, E. M. Behavioral traps in the preschool: A proposal for research. In A. D. Pick (Ed.), *Minnesota symposia on child psychology*, 1976, *10*, 3–27.

Belcher, T. L. Modeling original divergent responses. *Journal of Educational Psychology*, 1975, *67*, 351–358.

Bendick, J., & Levin, M. *Take a number*. New York: McGraw-Hill, 1961.

Bichler, R. F. *Psychology applied to teaching* (2nd ed.). Boston: Houghton Mifflin, 1974.

Brilhart, J. K., & Jochem, L. M. Effects of different patterns on outcomes of problem-solving discussion. *Journal of Applied Psychology*, 1964, *48*, 175–179.

Britton, R. J. A study of creativity in selected sixth grade groups. (Doctoral dissertation, University of Virginia, 1967). *University Microfilms*, 1967, No. 68–3133.

Callahan, C. M., & Renzulli, J. S. Development and evaluation of a creativity training program. *Exceptional Children*, 1974, *41*, 44–45.

Casper, T. P. Effects of the junior great books program on four exper-

imental operations and certain of the componental factors defined by J. P. Guilford. (Doctoral dissertation, St. Louis University, 1964). *Dissertation Abstracts*, 1964, *25*, 4570–4571. (University Microfilms No. 64–13, 453)

Christensen, P. R., Guilford, J. P., & Wilson, R. C. Relation of creative responses to working time and instructions. *Journal of Experimental Psychology*, 1957, *53*, 82–88.

Christensen, P. R., Merrifield, P. R., & Guilford, J. P. *Consequences: Manual of administration, scoring, and interpretation* (2nd ed.). Beverly Hills CA: Sheridan Supply, 1958.

Clark, C. A. *Brainstorming*. New York: Doubleday, 1958.

Clark, P.M., & Muels, H.L. *Fluency as a contaminating factor in the measurement of creativity*. Paper presented at the annual meeting of the National Council on Measurement in Education, Ohio State University, February, 1969.

Covington, M. V., & Crutchfield, R. S. Facilitation of creative problem solving. *Programmed Instruction*, 1965, *4*, 3–5, 10.

Crutchfield, R. S. Creative thinking in children: Its teaching and testing. In O. G. Brim, R. S. Crutchfield, & W. H. Holtzman (Eds.), *Intelligence perspectives in 1965*. New York: Harcourt, Brace & World, 1966.

Culbert, S. A., & Culbert, J. Sensitivity training within the educational framework. *Journal of Creative Behavior*, 1967, *2*, 14–30.

Davis, G. A., & Hautman, S. E. *Thinking creatively: A guide to training imagination*. Madison: Wisconsin Research and Development Center, University of Wisconsin, 1968.

Davis, G. A., & Manske, M. E. An instructional method for increasing originality. *Psychonomic Science*, 1966, *6*, 73–74.

Dellas, M. *Effects of creativity training, defensiveness and intelligence on divergent thinking*. Paper presented at the annual meeting of the American Educational Research Association, New York NY, February, 1971.

Dellas, M., & Gaier, E. L. Identification of creativity. *Psychological Bulletin*, 1976, *73*, 55–73.

Dunnette, M. D., Campebell, J., & Jaastad, K. The effect of group participation on brainstorming effectiveness for two individual samples. *Journal of Applied Psychology*, 1963, *47*, 30–37.

Feldhusen, J. F., Bahlke, S. J., & Treffinger, D. J. Teaching creative thinking. *Elementary School Journal*, 1969, *70*, 48–53.

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

Fiedler, F. E., Bass, A. R., & Fiedler, J. M. *The leader's perception of co-workers, group climate and group creativity: A cross-validation* (Technical Report No. 1). Urbana IL: Group Effectiveness Laboratory, University of Illinois, May 1961.

Flavell, J. H., Cooper, A., & Loiselle, R. H. Effect of the number of preutilization functions on functional fixedness in problem solv-

ing. *Psychological Reports*, 1958, 4, 343–350.
Ford, B. G. *An evaluation of creativity training activities with mentally retarded youngsters*. Unpublished doctoral dissertation, University of Connecticut, 1975.
Foshay, A. W. The creative process described. In A. Miel (Ed.), *Creativity in teaching*. Belmont CA: Wadsworth, 1961.
Freedman, J. L. Increasing creativity by free-association training. *Journal of Experimental Psychology*, 1965, 69, 89–91.
Frerheit, S. G. *The effects of a training program upon the creative performance of fourth grade children* (Technical Report No. 79). Madison: Wisconsin Research and Development Center, University of Wisconsin, 1969.
Fuerst, K., & Zubek, J. P. Effects of sensory and perceptual deprivation on a battery of open-ended cognitive tasks. *Canadian Journal of Psychology* (2nd ed.), 1968, 22, 122–130.
Gallagher, J. J. *Teaching the gifted child* (2nd ed.). Boston: Allyn and Bacon, 1975.
Gates, J. Mobile reflected light images: A description of a process for stimulating aesthetic and creative behavior in students. *Journal of Creative Behavior*, 1968, 2, 58–62.
Getzels, J. W., & Jackson, P. W. *Creativity and intelligence*. New York: Wiley, 1962.
Gordon, W. J. J. *Synectics*. London: Collier Books, 1960.
Guilford, J.P. Factors that aid and hinder creativity. *Teacher's College Record*, 1962, 62, 380–92.
Guilford, J. P. Traits of creativity. In H. H. Anderson (Ed.), *Creativity and its cultivation*. Chicago: Harper & Row, 1959.
Harris, M. B. Modeling influences on creative behavior. *School Psychology Digest*, Winter, 1975, 29–33.
Hoffman, L. R., Harburg, E., & Maier, N. R. F. Differences and disagreement as factors in creative problem solving. *Journal of Abnormal and Social Psychology*, 1962, 64, 206–214.
Hutchinson, W. L. Creative and productive thinking in the classroom. *Journal of Creative Behavior*, 1967, 1, 419–427.
Hyman, H. *Some experiments in creativity*. New York: General Electric Relations Services, 1960.
Johnson, R. A. Differential effects of reward vs. no reward instructions on the creative thinking of two economic levels of elementary school children. *Journal of Educational Psychology*, 1974, 66, 530–533.
Jones, T. P. *Creative learning in perspective*. New York: Wiley, 1972.
Judson, A. J., Cofer, C. N., & Gelfand, S. Reasoning as an associative process: II. "Directions" in problem solving as a function of prior reinforcement of relevant responses. *Psychological Reports*, 1956, 2, 501–507.
Levy, L. H. Originality as role-defined behavior. *Journal of Personality and Social Psychology*, 1968, 9, 72–78.
Lieberman, J. N. A developmental analysis of playfulness as a clue

to cognitive style. *Journal of Creative Behavior*, 1967, 1, 391–397.
Lindgren, H. C. Brainstorming and the facilitation of creativity expressed in drawing. *Perceptual and Motor Skills*, 1967, 24, 250.
Lindgren, H. C., & Lindgren, F. Brainstorming and orneriness as facilitators of creativity. *Psychological Reports*, 1965, 16, 577–583.
Lorge, I., Tuckman, J., Aikman, L., Spiegel, J., & Moss, G. Solutions by teams and by individuals to a field problem at difficult levels of reality. *Journal of Educational Psychology*, 1955, 46, 17–24.
Macdonald, J. B., & Zaret, E. A study of openness in classroom interactions. Unpublished manuscript, Marquette University. Cited in C. Rogers, *Freedom to learn*. Columbus OH: Merrill, 1969.
MacKinnon, D. W. The personality correlates of creativity: A study of American architects. In P. E. Vernon (Ed.), *Creativity*. Middlesex, England: Penguin, 1970.
Mackler, B., & Shontz, F. C. Life style and creativity: An empirical investigation. *Perceptual and Motor Skills*, 1965, 20, 873–896.
Maddi, S. R., Charlens, A. M., Maddi, D. A., & Smith, A. J. Effects of monotony on imaginative productions. *Journal of Personality*, 1962, 30, 513–527.
Maier, N. R. F., & Solem, A. R. The contribution of a discussion leader to the quality of group thinking: The effective use of minority opinions. *Human Relations*, 1952, 5, 277–288.
Maloney, K.B., & Hopkins, B.L. The modification of sentence structure and its relationship to subjective judgments of creativity in writing. *Journal of Applied Behavior Analysis*, 1973, 6, 425–433.
Maltzman, I., Bogartz, W., & Breger, L. A procedure for increasing word association and its transfer effects. *Journal of Experimental Psychology*, 1958, 56, 393–398.
Maltzman, I., Simon, S., Raskin, D., & Licht, L. Experimental studies in the training of originality. *Psychological Monographs*, 1960, 74, (6, Whole No. 493).
Manfield, R.S., & Busse, T.V. The effectiveness of creativity training programs. *Childhood Education*, 1974, 00, 53–56.
Maslow, A. H. *Toward a psychology of being*. New York: Van Nostrand, 1968.
Meadow, A., & Parnes, S. J. Evaluation of training in creative problem solving. *Journal of Applied Psychology*, 1959, 43, 189–194.
Meadow, A., Parnes, S. J., & Reese, H. Influence of brainstorming instructions and problem sequence on a creative problem solving test. *Journal of Applied Psychology*, 1959, 43, 413–416.
Mednick, M. T., & Mednick, S. A. *Remote Associates Test*. Boston: Houghton-Mifflin, 1967.
Mednick, S. A. The associative basis of the creative process. *Psychological Review*, 1962, 69, 220–232.
Meichenbaum, D. Enhancing creativity by modifying what subjects say to themselves. *American Educational Research Journal*, 1975, 2, 129–145.

Myers, R. E., & Torrance, E. P. *Invitations to thinking and doing*. Minneapolis MN: Perceptive Publishing Company, 1961.

Nash, W. R. The effects of warm-up activities on small group divergent problem-solving with young children. *The Journal of Psychology*, 1975, *89*, 237–241.

Nash, W. R., & Torrance, E. P. *A preliminary study of the effects of reading 360 on creative development and functioning*. Athens GA: Georgia Studies of Creative Behavior, 1970.

Olton, R. M. A self-instructional program for developing productive thinking skills in fifth- and sixth-grade children. *The Journal of Creative Behavior*, 1969, *3*, 16–25.

Olton, R. M., & Crutchfield, R. S. Developing the skills of productive thinking. In P. Mussen, J. Langer, & M. Covington (Eds.), *New directions in experimental psychology*. New York: Holt, Rinehart, and Winston, 1969.

Ortman, H. L. How psychodrama fosters creativity. *Group Psychotherapy*, 1966, *19*, 201–212.

Osborne, A. F. *Applied imagination*. New York: Scribner's, 1963.

Parloff, M. B., & Handlon, J. H. The influence of criticalness on problem solving in dyads. *Psychiatry*, 1963, *27*, 17–27.

Parnes, S. J. Effects of extended effort in problem-solving. *Journal of Educational Psychology*, 1961, *52*, 117–122.

Parnes, S. J. Education in creativity. In J. C. Gowan, G. D. Demos, & E. P. Torrance (Eds.), *Creativity: Its educational implications*. New York: Wiley, 1967.

Parnes, S. J., & Meadow, A. Effects of "brainstorming" instructions on creative problem solving by trained and untrained subjects. *Journal of Educational Psychology*, 1959, *50*, 171–176.

Parnes, S. J., & Meadow, A. Evaluation of persistence of effects produced by a creative problem-solving course. *Psychological Reports*, 1960, *7*, 357–361.

Paulus, D. H. *Are sub-tests of the Torrance Test independent?* Paper presented at the annual meeting of the American Educational Research Association, Minneapolis, Minn., March, 1970.

Ramey, C. T., & Piper, V. Creativity in open and traditional classrooms. *Child Development*, 1974, *45*, 557–560.

Rapp, M. A. The brainstorming attitude. In J. C. Gowan, G & E. P. Torrance (Eds.), *Creativity: Its educational implications*. New York: Wiley, 1967.

Reese, H. W., et al. Effects of a creative studies program on Structure of Intellect factors. *Journal of Educational Psychology*, 1976, *68*, 401–410.

Renzulli, J. S. *New directions in creativity: Mark I*. New York: Harper & Row, 1973.

Renzulli, J. S. *The enrichment triad model: A guide to developing defensible programs for the gifted and talented*. Wethersfield CT: Creative Learning Press, 1977.

Renzulli, J. S., & Callahan, C. M. Developing creativity training activ-

ities. *Gifted Child Quarterly*, 1975, *19*, 38–45.
Ridley, D. R., & Birney, R. C. Effects of training procedures on creativity test scores. *Journal of Educational Psychology*, 1967, *58*, 158–164.
Ripple, R. E., & Davey, J. S. The facilitation of problem solving and verbal creativity by exposure to programmed instruction. *Psychology in the Schools*, 1967, *4*, 240–245.
Robinson, W. L. *Taped-creativity series versus conventional teaching and learning*. Master's thesis, Atlanta University, 1969.
Roe, A. A psychologist examines sixty-four eminent scientists. *Scientific American*, 1952, *187*, 21–25.
Rogers, C. R. Toward a theory of creativity. In S. J. Parnes & H. F. Harding (Eds.), *A sourcebook for creative thinking*. New York: Scribner's, 1962.
Rookey, T. J. Validation of a creativity test. *Journal of Creative Behavior*, 1973, *7*, 211–213.
Rosenbaum, M. E., Arenson, S. J., & Panman, R. A. Training and instructions in the facilitation of originality. *Journal of Verbal Learning and Verbal Behavior*, 1964, *3*, 50–56.
Schaefer, C. E. *Manual for the Creativity Attitude Survey*. Jacksonville FL: Psychologists and Educators, 1971.
Smith, J. A. *Setting conditions for creative teaching in the elementary school*. Boston: Allyn and Bacon, 1966.
Solomon, D., & Kendall, A. J. Individual characteristics and children's performance in "open" and "traditional" classroom settings. *Journal of Educational Psychology*, 1976, *68*, 613–625.
Speedie, S. M., Treffinger, D. J., & Feldhusen, J. F. Evaluation of components of the Purdue Creative Thinking Program: A longitudinal study. *Psychological Reports*, 1971, *29*, 395–398.
Stalton, R. P. Associative structure and writing creative sentences. *Proceedings of the 78th Annual Convention of the American Psychological Association*, 1970, *5*, 613–614.
Stratton, R. P., & Brown, R. Improving creative thinking by training in the production and/or judgement of solutions. *Journal of Educational Psychology*, 1972, *63*, 390–397.
Stratton, R. P., Parrott, G. L., & Johnson, D. M. Transfer of judgement training to production and judgement of solutions on a verbal problem. *Journal of Educational Psychology*, 1970, *61*, 16–23.
Taylor, I. A. Creative production in gifted young (almost) adults through simultaneous sensory stimulation. *Gifted Child Quarterly*, 1970, *14*, 46–55.
Thomas, E. J., & Fink, C. F. Effects of group size. *Psychological Bulletin*, 1963, *60*, 371–384.
Torrance, E. P. *Education and the creative potential*. Minneapolis: University of Minnesota Press, 1963.
Torrance, E. P. *Rewarding creative behavior: Experiments in classroom creativity*. Englewood Cliffs NJ: Prentice-Hall, 1965.
Torrance, E. P. *Torrance Tests of Creative Thinking*. Princeton NJ:

Personnel Press, 1966.
Torrance, E. P. Creative teaching makes a difference. In J. C. Gowan, G. D. Demos, & E. P. Torrance (Eds.), *Creativity: Its educational implications*. New York: Wiley, 1967(a).
Torrance, E. P. The Minnesota studies of creative behavior: National and international extensions. *Journal of Creative Behavior*, 1967, *1*, 137–154 (b).
Torrance, E. P. Can we teach children to think creatively? In A. M. Beondi & S. S. Parnes (Eds.), *Assessing creative growth: Measured changes—Book Two*. Great Neck NY: Creative Synergetics, 1976.
Treffinger, D. J., & Ripple, R. E. Programmed instruction in creative problem solving. *Educational Leadership*, 1971, *28*, 667–675.
Triandis, H. C., Hall, E. R., & Ewen, R. B. *Member heterogeneity and dyadic creativity* (Office of Naval Research contract report NR 177–472, Nonr-1834 (36)). Urbana: University of Illinois, 1964.
Wallach, M. A., & Kogan, N. *Modes of thinking in young children: A study of the creativity intelligence distinction*. New York: Holt, 1965.
Wallas, G. Stages in the creative process. In A. Rothenberg and C. R. Hausman (Eds.), *The creativity question*. Durham NC: Duke University Press, 1976.
Wardrop, J. L., Olton, R. M., Goodwin, W. L., Covington, M. V., Klausmeir, H. J., Crutchfield, R. S., & Rond, T. The development of productive thinking skills in fifth-grade children. *Journal of Experimental Education*, 1969, *37*, 66–
Warren, T. F., & Davis, G. A. Techniques [illegible] thinking: An empirical comparison of three methods. *Psychological Reports*, 1969, *25*, 207–214.
Williams, F. E., & Eberle, R. F. *Content, process, and practice: Creative production in the classroom*. Edwardsville IL: American of Edwardsville, 1968.
Zimmerman, B. D., & Dialessi, F. Modeling influences on children's creative behavior. *Journal of Educational Psychology*, 1973, *65*, 127–134.

Appendix

Selected Measures of Creative Process, Potential Attitudes, and Products

Name of Test	Author	Type of Measure	Source from Which Measure May Be Obtained	Age
Bugart Symbol Test of Originality	Herbert J. Bugart	Visual-written test of originality	Bugart, H. J. *The development of a visual-verbal measure of general creativity*. ERIC Document No. 019801	Reading young through adult
Carlson Analytical Originality Scoring Scale	Ruth K. Carlson	Rating scale of originality of children's stories	*Sparking words: 200 Creative and practical writing ideas*	Elementary and intermediate grades
Children's Individual Test of Creativity	N. S. Metfessel, Marilyn Burns, & J. T. Foster	Individual test of creativity	Marilyn Burns 3858 Buena Park Drive Studio City CA 91604	Preschool through elementary grades
Classroom Creativity Observation Schedule	David A. Denny	Observation schedule of classroom behaviors fostering pupil creativity	David A. Denny State University College Oneonta NY 13820	Kindergarten to 9 years
Cognitive Orientation Questionnaire of Creativity	Schulamith Kreitler and Hans Kreitler	Questionnaire referring to beliefs about curiosity	Schulamith Kreitler Department of Psychology Tel Aviv University Tel Aviv, Israel	4 to 8 years
Creative Writing Rating Scale	Jack R. McClellan	Rating scale	McClellan, J. R. *Creative writing characteristics of children*. Doctoral Dissertation, University of Southern California, Los Angeles, 1956.	8 to 12 years

Creativity Attitude Survey	Charles E. Schaefer	Self report questionnaire	Psychologists and Educators, Inc., Suite 212, 211 West State Street, Jacksonville IL 62650	6 to 12 years
Creativity Self-Report Scale	John F. Feldhusen	Self report questionnaire on creative and divergent thinking	John F. Feldhusen Educational Psychology Section Purdue University SCC-G West Lafayette IN 47906	Junior high through adult
Drawing Completion Test	Helen H. Davidson Judith W. Greenberg	Divergent production in figural materials	Judith W. Greenberg The City College Convent Avenue New York NY 10031	8 years to adult
Drawing Completion Task (DCT)	David Schulman	Drawing rating scale	Schulman, D. Openness of perception as a condition for creativity. *Exceptional Children*, 1966, 33, 89–94.	Elementary and junior high
Gross Geometric Forms	Ruth B. Gross	Visual-pictorial rating scale of drawings	Ruth B. Gross Department of Psychology Xavier University Cincinnati OH 45229	3 to 10 years
Instances, Alternate Uses, Similarities, Pattern Meanings, Line Meaning	Michael A. Wallach Nathan Kogan	Paper and pencil measure of ideational fluency	Wallach, M.A., & Kogan, N., *Modes of thinking in young children*. New York: Holt, 1965.	8 years and older
Maws' About Myself Scale	Wallace H. Maw Ethel W. Maw	Curiosity rating scale	Maw, W. H., & Maw, E. W. Self-appraisal of curiosity. *Journal of Educational Research*, 1968, 61, 462–466.	Grades 4 through 6.

Pennsylvania Assessment of Creative Thinking	Thomas J. Rookey	Attitude inventory	Thomas J. Rookey Educational Development Center East Stroudsberg State College East Stroudsberg PA 19301	9 to 14 years
Scale for Rating Behavioral Characteristics of Superior Students (SRBCSS)	Joseph S. Renzulli, et al.	Rating scale of student characteristics including creativity	Creative Learning	Elementary to high school
Something About Myself (SAM)	Joe Khatena	Self report checklist	Joe Khatena Department of Educational Foundations Marshall University Huntington WV 25701	Adolescent to adult
Starkweather Originality Test for Young Children	Elizabeth K. Starkweather	Fluency	E. K. Starkweather Family Relations and Child Development Dept. Oklahoma State University Stillwater OK 74074	3½ to 6½ years