CONVERGENT AND DIVERGENT THINKING
RELATED TO COGNITIVE STYLE

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This dissertation is affectionately
dedicated to my Mother, Mary Kelly Morgan.
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CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

Man's capacity to develop novel solutions and answers to problems is one of his most critical abilities. Each adaptation to the demands of a new situation can be viewed as a creative act. Studying this ability so that it can be better understood and fostered is, therefore, of crucial importance.

Traditionally the burden of fostering creative talent has been accepted by the school system. However, because education is concerned with the transmission of culture and the maintenance of the status quo it does not take too kindly to the eccentricities of creative people. For example, Getzels and Jackson (1961) and Torrance (1962b) have reported that teachers prefer the "high I.Q." to the "high creative" child in both secondary and elementary classes. Apparently, "creative" children tend to be regarded as a nuisance by their teachers because of their independence and divergent thinking which causes them to be considered as less desirable as students than their less original, but more conforming peers. But as Butcher puts it:
Any society, to avoid stagnation, needs a constant supply of original ideas at all levels; but the profoundly original men, who are the most fertile source of these ideas, are often the very people who most disturb society by threatening its established ways of thought and familiar structure.

How to foster creative talent without sacrificing the quality of education is one of the major problems confronting educators today. But as Roger Sperry, professor of psychobiology, specializing in the study of the brain observes,

(The) . . . message that emerges from the findings on hemisphere specialization is that our educational system and modern society in general (with its very heavy emphasis on communication and on early training in the three Rs) discriminates against one whole half of the brain. I refer, of course, to the non-verbal, non-mathematical minor hemisphere, which, we find has its own perceptual, mechanical, and spatial mode of apprehension and reasoning. In our present school system, the attention given to the minor hemisphere of the brain is minimal compared with the training lavished on the left, or major, hemisphere.

These findings together with what we now know regarding the psychology of thinking has caused many researchers to wonder whether certain people may prefer using one side of the brain over another. This would
account for differences in learning rate, learning style, and individual abilities.

It is only recently that educators, psychologists, and others have focused on the problem of individual differences. Most theories of education in the past have operated on the premise that people learn more or less in the same manner, or that what individual differences existed between learners were so slight as to be not worth researching. This focus is now changing, and increasingly more research is attempting to identify individual abilities of students so that alternative educational programs can be developed.

Although personality differences have been investigated by numerous great men throughout history, it is only in relatively recent times that the scientific method has been applied with any rigor. The history of the study of individual psychology can be traced back to the ancient Greeks. Aristotle was one of the first to attempt to categorize mankind into basic types. Later, in the nineteenth century, Francis Galton (1874) conducted a series of experiments in which he attempted to find out what types of 'mental imagery' people carry around in their heads. He found that there were essentially two types; one he called "visualizers" who thought in terms
of 'pictures' in the mind's eye, the other type was what he termed abstract thinkers of the type found among scientists. Galton concluded that deep thinkers consider mental images a nuisance and get rid of all such imagery by disuse.

More recent physiological and psychological studies involving the J.N.D. (Just Noticeable Difference) have indicated that people have different pain thresholds and many other auditory and discriminatory abilities which vary from individual to individual. Indeed, there is some evidence to suggest that artists and other highly creative people seem to be abnormally sensitive to stimuli compared to the average populace. For example, Proust lined his study with cork to avoid distractions; Van Gogh wept easily when reading Uncle Tom's Cabin. Many musicians and artists report a similar hypersensitivity to certain sounds and colors.

The picture that emerges from the psychological literature is that, owing to individual differences, no two people perceive an event in exactly the same way. This has important implications for education today. It, therefore, seems logical to assume that people will 'read' significance into events that will be entirely meaningless or at least have different meanings for others. This assumption implies that since different people find
different meanings in the same stimuli, they may learn in different ways also.

**Measuring Individual Abilities**

Much of the controversy concerning individual learning differences has focused on the measurement capabilities of the instruments, the most famous of which is the intelligence test. The standard intelligence test has enjoyed considerable popularity both as a measure of learning capability and as a predictor of later academic success. However, certain criticisms have been leveled at the I.Q. test in recent years. Many educators feel that it does not measure all intellectual abilities but merely those abilities associated with the school system as it is today. The emphasis of standard I.Q. tests is aimed at encouraging convergent thinking or thinking in which there is only one right answer. Moreover, it has been criticized as being "culture specific" and especially dependent on verbal fluency.

Similarly, as Getzels and Jackson (1962) indicate in their well known study, although the correlation between I.Q. and learning is positive, it nevertheless rarely accounts for more than one quarter of the variance in such crucial factors on school achievement and academic performance. Moreover, it has been observed that many
children who have high I.Q.'s are not necessarily high in such other areas as creativity and vice versa.

As Thurstone (1953) puts it:

To be extremely intelligent is not the same as to be gifted in creative work. This may be taken as a hypothesis. It is a common observation in the universities that those students who have high intelligence judged by available criteria are not necessarily the ones who produce original ideas. All of us probably know a few men who are both creative and highly intelligent, but this combination is not the rule.

And in a comprehensive study of the literature on creativity, Stein (1962) reports:

As with most other variables in the area of creativity, intelligence has been studied both as an independent and dependent variable. Basically, the evidence from both approaches is that while intelligence may be related to creativity in the general population in the sense that below a certain level people are not creative, high intelligence alone is not a guarantee of creativity for it needs to be combined with certain personality characteristics.

Implicit in these statements is the assumption that creativity and intelligence are separate, mutually exclusive categories which can be measured independently. This view has been the impetus for much of the recent interest in the problem of creativity versus intelligence.
Convergent and Divergent Thinking

Much of this present upsurge of research into creativity was initiated by Guilford's (1959) address at the Psychology Society at Stanford University, a key issue of which was the distinction he made between convergent and divergent thinking processes. Convergent thinking processes Guilford likened to the ability to produce the 'right' and 'best' answers and solutions to problems. Moreover, Guilford believed that the present day educational system dealt mainly with this type of thinking. Equally, if not more important, Guilford believed was 'divergent thinking' which he defined as the ability to generate new and original ideas for a given set of stimuli. Guilford defined creativity as:

the capacity of the individual to avoid the usual routine, conventional ways of thinking and doing things and to produce a quantity of ideas, and/or products which are original, novel, or uncommon and which are workable.

Unlike the popular definition of the term, it does not assume that this type of ability is only found in certain artists or scientific persons. Rather, it is assumed that creative abilities are found to some extent in all persons.

Guilford identified two constructs associated with creativity, Originality and Ideational Fluency.
Originality is defined as the production of uncommon, clever or remote responses; and Ideational Fluency is defined as the speed of calling up ideas independent of their quality. The tests of creativity developed by him involve the ability to deal inventively with verbal and measured symbols with object space relations. What most tests have in common was that the score depended not on a single predetermined correct response, as is the case with intelligence tests, but on the number, novelty, and variety of adaptive responses to a given stimulus.

Most of the researchers investigating creativity have adopted Guilford's definition as a basis for further research and definition.

Defining Creativity

The problem of defining creativity is still a controversial issue. The number of definitions of creativity are legion and it is not proposed to discuss them all here. Instead, some attempt will be made to summarize some of the more important definitions in order to formulate some conceptual framework relevant to the present study.

Essentially, there are three basic kinds of definitions identified in the literature. The first might be termed the trait approach in which creativity is considered to be some kind of personality variable inherent in the
individual; second, a production orientation can be adopted in which creativity is considered in terms of output (e.g., discovery, invention or artistic and original work. This is the approach normally associated with the layman's definition of creativity in which he stereotypes the bohemian artist or eccentric scientist.) Lastly, there is the process approach to creativity in which cognizance of these various elements are considered in interrelationship with each other. However, it is interesting to note that no matter what the approach taken, the common denominator is the idea of something being produced that is original and useful to society. Such a common denominator runs through all three approaches.

The Process Approach

Typical of the process approach to defining creativity is Wallas (1926) who was one of the first to recognize the sequential nature of the creative process. He identified four main stages:

1. Preparation. This is the stage in which the facts are gathered and the problem is identified and investigated from different directions.

2. Incubation. During this stage the person is not consciously thinking about the problem. Instead, there is a kind of internal process
of associating new ideas with past information. Some type of reorganization of the information seems to be taking place subconsciously.

3. **Illumination.** This is the stage during which the "happy idea" occurs, sometimes referred to as the "Eureka effect." In this stage the creator has a sudden insight and perceives the solution to the problem.

4. **Verification.** This is the stage in which the idea, which has been conceived through the first three stages, is tested to see whether or not it has any validity.

Of course these stages are not discrete and tend to overlap one another, but there is some validity to the findings as the same sequence has been reported by many researchers.

Gallagher (1964) has made the observation that different types of thinking and personality factors seem to be required for the various stages suggested by Wallas. For example, in the first and last stages of **preparation** and **verification,** memory, attention to logical sequence and evaluation, seem to be required. For **incubation** and **illumination,** he states, that divergent thinking and such
characteristics as risk-taking, tolerance of ambiguity and willingness to try out unusual ideas is more important.

Much of the controversy surrounding the definition of creativity has focused on just this issue, i.e., whether creativity can be considered as a separate cognitive process having certain distinct and definable characteristics from intelligence.

Wallach and Kogan, for example, criticize the use of the term "creativity" on the basis that no single set of behaviors are identifiable as a separate entity. The authors further believe that the label "creativity" is too diffuse in meaning to be useful as a construct in dealing with a separate cognitive function from intelligence.

However, Wallach and Kogan's main objections to "creativity" being treated as a separate factor from intelligence partly centers around the doubtful validity and reliability of the so-called measures of creativity. Many studies in the field have been equivocal in that they have yielded diverse and even contradictory results. This is to be expected from measures of divergence which are necessarily unstable. Obviously it is easier to obtain validity and reliability measures for 'convergent' measures in which only one right answer is expected and hence scored. Creativity scores cannot be as objective since
some degree of judgment must enter into scoring of the responses.

To overcome this difficulty some researchers prefer the term 'originality' to creativity (Cropley, 1966; Anderson, 1964) believing that it is a more 'objective' term. 'Originality' can then be operationally defined as the tendency to produce responses statistically uncommon by comparison with the responses of a criterion group. However, this definition tends to be too broad as a useful construct since the whole creative process is extremely complex.

The Trait Approach

Torrance adopted a trait approach in defining creativity and identifies various characteristics of creative thinking as fluency, flexibility, originality and the ability to elaborate, embroider or make detailed plans. Torrance operationally defined these traits as follows:

Fluency is the production of ideas. These are the children who seem to be "just running over with ideas," though not always the most talkative.

Flexibility in thinking; these children employ a variety of strategies or approaches in solving problems when one fails.

Originality is defined as the ability to get away from the obvious and commonplace and break away from the beaten path. These children see relationships and think of
ideas and solutions which are different from others in the class and from the textbook.

The ability to elaborate is found in those children who can take an idea or task and spell it out in detail. They can "embroider" or make a simple idea fancy or attractive. Their drawings are very detailed and they are able to develop very detailed and thorough plans or projects.

Torrance also advocates a process or problem solving approach to the study of creativity. He defined creativity as

a process of becoming sensitive to problems, definitions, gaps in knowledge, missing elements, disharmonies, and so on identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results.

This definition is consistent with George Kelly's theory of personal constructs in that it places emphasis on information processing, hypothesis formulation and confirmation. Again, the emphasis is on the active involvement of the individual in his interaction with the world; with his trying to make sense out of the numerous stimuli presented to him and the meanings he attaches to stimuli.
The Production Approach

Much of the research concerning the production approach has centered around various studies of artists and scientists and what they have recorded about this creative process.

However, the introspections of various creative people seem as mysterious as their productions and provide little insight into the process. For example, Poincare writes:

One evening contrary to my custom, I drank black coffee and could not sleep. Ideas arose in crowds; I felt them collide until pairs interlocked, making a stable combination. By the next morning I had established the existence of a class of Fuchsian functions, . . . I had only to write out the results, which took about a few hours.

Poincare's ideas coming "in crowds" is similar to Einstein's pronouncements on creativity and the need for "combinatory play" and "associative play." What is similar in both instances is the creative images seem to arise not in the usual way of analytic intellectual thought but in some other form, usually through some insight or inspiration. This has lead many psychologists to conclude that so-called creative people may process information in an entirely different form from less creative people. This point will be explored further in Chapter II.
Thus, although creativity is still little understood, it seems safe to say that, in considerable part, it is the ability to combine ideas from diverse areas of experience and thus connect things that are ordinarily treated separately. It also means that the relationship between constructs must needs be sufficiently loose to allow for one to see the new patterns and combinations that emerge. Using this as a working definition the following study has been proposed.

Statement of the Problem

The problem to be investigated may be stated as follows: Are intelligence and creativity related or are they distinct modes of thinking? If this is so, in what ways do convergers and divergers perceive or construe their world? Do they process information differently? Are divergent and convergent thinking related respectively to what Kelly terms 'loose' and 'tight' construing? This will be treated more fully in Chapter II.

Specifically, the present study attempts to answer the following questions stated as hypotheses:

$H_1$ Convergent and divergent thinking represent two independent constructs or concepts which can be measured separately.
$H_2$ Conventional I.Q. tests do not measure creative ability.

$H_3$ Convergers and divergers process information differently.

$H_4$ 'Loose Construing' is positively related to divergent or creative thinking processes.

$H_5$ 'Tight Construing' is positively related to convergent thinking process.

The study involves both a theory-building effort and also the collection and quantitative treatment of empirical data. The specific procedures used will be discussed in Chapter III.

**Organization of Research Report**

The report of this investigation is organized into five chapters. Chapter II which follows reviews selected literature and details the significant features of Kelly's Theory Personal Construct/as a measure of divergent and convergent thought. Chapter III details the methods, instruments, and procedures used. Chapter IV analyzes the findings and interprets the data, and finally, Chapter V summarizes the findings, their implications for learning theory and indicates further research needed in the field.
CHAPTER II
REVIEW OF THE LITERATURE

This Chapter summarizes some of the significant findings related to convergent and divergent thought processes. As indicated in the previous chapter, these are the dominant concepts that emerge from the many efforts to define more fully the nature of creativity. Research from the fields of personality, psychoanalytic, and physiological psychology will be assessed in an attempt to establish what is known about cognitive functioning. Some of the most recent findings in the area of physiological psychology will be discussed as they seem to be especially fruitful in shedding light into the intelligence-creativity process of thinking and appear to agree with much of the research into convergent and divergent thinking. Finally, George Kelly's Personal Construct Theory is discussed and the various findings are summarized using this theory as a unifying basis.

Personality and Creativity

Historically speaking, earlier investigators concentrated on personality differences between creative
and noncreative people. For example, many researchers have argued, with conviction, that creative behavior depends as much on personality as cognitive ability. The famous study by McKinnon, et al., at the Institute for Personality Assessment and Research at Berkeley has shown that the most creative people in architecture, literature, mathematics, and engineering science are distinguished from the less creative ones by, among other traits, their greater flexibility of thinking, breadth of perspective, openness to experience, freedom of impulse, breadth of interest, authonomy and integrity.

McKinnon (1964) also found that the most salient characteristics of the high creative group was the strong desire to be different from their peers, their ambition to produce a unique product.

As with most other variables in the area of creativity, intelligence has been studied both as an independent and dependent variable. In these studies, a psychometric definition of creativity has been used and two groups of subjects were selected. One group consisted of those individuals who scored higher on psychological tests of creativity than on tests of intelligence while the other consisted of those individuals who scored higher on tests of intelligence than on tests of creativity.
Several interesting differences between the two groups were found. A review of some of the major studies follows.

For example, Barron (1957) for his measure of intelligence used the Terman Concept Mastery Test. For his measures of originality he used Guilford's Unusual Uses, Consequences B, Plot Titles B, the Rorschach O+ Responses, originality ratings of T.A.T. stories, scores for infrequency of human movement responses to Rorschach-like inkblots, scores for infrequency of correct anagram solutions, and originality score based on a story composed by the subject. A high originality-low intelligence group (i.e., one standard deviation above the mean on the originality composite and, at the same time, one standard below the mean on the Concept Mastery Test) were compared with a high intelligence-low originality group (one standard deviation above the mean in Concept Mastery and one standard deviation below the mean in Originality). When tested on the Gough Advective Check List, the high originality-low intelligence group checked adjectives such as "affected, aggressive, demanding, dependent, dominant, forceful, impatient, initiative, outspoken, sarcastic, strong, suggestible." The words most frequently appearing among the low originality-high intelligence group were "mild, optimistic, pleasant, quiet, unselfish."
Perhaps one of the best known studies of creativity and intelligence was reported by Getzels and Jackson in 1962 who followed a similar design as was used by Barron. Two groups of adolescents were drawn from a private school whose students were almost all from the kind of upper-middle class homes that produce intellectually and academically superior students. All of one group was in the top fifth of the school in I.Q. but not in creativity; the reverse was true of the creative group, who nonetheless had high I.Q.s by normal standards. Students high on both creativity and intelligence were eliminated from the study.

The researchers found that the High I.Q. group was well above the school average in school achievement as might be expected, but not superior to the High Creative group. These results have been replicated in other schools and it would seem that tests of "creativity" have something to do with school learning.

Group HC might be regarded as "overachievers," that is, individuals whose achievement scores exceed expectations based on intelligence test scores. Explanations for overachievement tend to favor a strong motivational component, but when tested no difference in strength of motivation was found in either of the two measures in the HC group. Moreover, teachers preferred the HIQ group as
opposed to the HC group which would argue against favored treatment as an explanation of academic achievement.

Personality differences in terms of attitude and values were, however, found to be quite dissimilar. HIQs preferred those qualities they perceived as leading to adult success when presented with a list of traits. The HC group valued these qualities much less. For example, HC ranked "a sense of humor" near the top; HIQs ranked this item near the bottom. In terms of occupational preferences, the HC group named more unusual occupations while the HIQs named mostly traditional professions such as medicine, law, etc.

When presented with TATs, the HC group were found to be less "stimulus bound" and contained more humor, more overt aggression and violence than the HIQs. The same results were obtained when the groups were asked to draw a picture entitled "Playing Tag in the Playground."

These attitudinal, motivational, and emotional differences add up to two different ways of thinking, which may be referred to as different "cognitive styles." These two styles might also be labeled as different measures of convergent and divergent thinking and are associated in the same way with quantitative measures of school achievement. So far as learning is concerned, the two
styles appear to be equally effective, although why this is so is not clear. Maybe the HC students' greater imagination and flexibility produces transfer of learning just effectively as in the HIQ subjects.

E. Paul Torrance (1960) undertook to replicate two aspects of Getzel's and Jackson's work with eight different samples, including a selective school similar to the one they used, four elementary schools, including a parochial school and a rural school, a public high school, and two samples of graduate students. The mean correlations between creativity measures and various I.Q. measures were: .16 and .17 with the Stanford-Binet; .32 with the Otis Quick Scoring; .26 with the Kuhlman-Anderson; .24 with the California Test of Mental Maturity; -.02 with the Miller Analogies for one graduate group; and .11 for the other graduate group. Using the same methods used by Getzels and Jackson for selecting high I.Q. and high creativity students, he also compared the scholastic achievement of the two groups in each of his samples. In six schools Torrance found the same results as Getzels and Jackson: despite sizeable differences in I.Q., the two groups were equally superior in achievement to the population from which they were drawn. Only in a parochial school and a rural school were there any contradictions.
In a follow-up of the Getzels-Jackson study, Wallach and Kogan (1965) also tested 5th grade children for creativity and intelligence. The creativity tests required the child to generate as many unusual hypotheses as he could. For example, the child would be asked to name all the things he knew that are sharp and round. In a similar test to Guilford's, students were also asked to generate uses for objects, e.g., what are all the different ways you could use a newspaper or a cork. In a third test consisting of ambiguous line drawings the student was asked to suggest as many things as he could of what the drawings might represent.

A student was classified creative if he gave many answers to each of the tests, some of which were very unusual or unique in comparison to the answers given by the other students. Children were then grouped into four categories: highly intelligent and highly creative; highly intelligent and low in creativity; low in intelligence and highly creative; low in intelligence and low in creativity.

In testing for personality differences the researchers found that the girls who were both highly intelligent and highly creative were very self-confident in school and were popular with their friends. The opposite was found
for highly creative, low intelligence girls. They were found to be cautious, hesitant and had little self-confidence. The low-intelligence, low creative girls were slightly less cautious and hesitant than were the high creative, low-intelligence girls, and the former were more popular and outward going with their friends. Finally, the highly intelligent but low-creative girls were sought out by others but they often failed to return the friendship. However, differences among boys did not relate significantly to their social behavior with their peers.

Generally, the highly intelligent, high creativity student was more willing to risk trying out new or unusual ideas, had a less critical and severe attitude towards error. Highly-intelligent, high-creative girls seemed to be successful both in school and in her relationship with peers. They were also less anxious over generating unusual ideas.

In a five year longitudinal follow-up of this study, Kogan and Pankove (1972) retested the same children now in the tenth grade. Individual and group testing were used. Ideational productivity and uniqueness scores showed substantial stability over the interval for males retested by group administration and females tested individually. I.Q. unrelated to creativity at grade five,
remained the same for females at grade ten, but because positively correlated for males.

Also Cropley (1972) had given six creativity tests to a sample of seventh graders and followed them up five years later. Combining the tests into a single composit creativity predictor, he found correlations of .52 for boys and .46 for girls between the predictor and a component achievement score based on extra-curricular accomplishments in art, drama, literature, and music.

This would tend to argue in favor of convergent and divergent thinking being a relatively stable personality factor which does not alter with time.

Divergent Thinking and the Artistic Personality

Liam Hudson (1966, 1968, 1970) claims to have found a strong relationship between arts specialization and divergent thinking and science and convergent thinking. This hypothesis has received some confirmation, although the degree of the relationship is still rather debatable. He states:

The converger excelled in the conventional intelligence test; specialized in the physical sciences or classics; held conventional attitudes; pursued technical, mechanical interests in his spare time; and was emotionally inhibited. The diverger, by contrast, excelled at open-ended tests
(tests which do not have a single right answer); specialized in the arts or biology; held unconventional attitudes; had interests which were connected in one way or another with people; and emotionally speaking was uninhibited.

Hudson believes such differences have implications both for the study of career choice and of originality.

Hudson showed that boys, quite early on, develop a stereotype of a 'science' and an 'arts' boy and that those who commit themselves to science do so much earlier than those who commit themselves to the arts. This dichotomy is linked also with ways of thinking—both convergent and divergent.

In one of his experiments, Hudson instructed boys in such a way that they were encouraged to think divergently. The result was a great increase in the number of suggested uses for three objects in a modified version of the Uses of Objects test.

The converger, in other words, is not so much the boy who cannot think divergently, as the one who thinks fluently only when told unambiguously to do so... This is not to say that the divergent capacities of all boys are identical. High scorers on the first condition tend to be high scorers on the second. Rather, it seems that the fluency of most boys can be made to vary over quite a wide range and may have researces of mental fluency that under normal circumstances they keep to themselves.
Results can be influenced in ways other than instruction. In a further experiment, Hudson showed how the 'artist' can act the 'scientist' and vice versa. Boys were given similar versions of a creativity test to do in three roles—once as themselves, once as a character described as a bohemian artist, and once as if they fitted the role of a scientist. When playing the role of the scientist the boys gave typical 'scientist' responses, emphasizing practicality and ingenuity; when playing the role of 'artist' they gave much more flamboyant responses. The boys produced more responses both in quantity and diversity when playing the role of someone other than themselves.

This may indicate that divergent and convergent thinking can be learned, or at any rate, developed. However, it might be determined that one way of thinking predominates over another in certain individuals. Perhaps later in life people become "locked-in" to one or the other way of thinking.

**Psychanalytic Theory and Creativity**

Psychoanalysts have also investigated the role played by personality in the creative thinking process. These studies often stem from the belief that some form
of emotional imbalance is necessary to the production of works of art, viz. - the lives of Byron, Poe, and Van Gogh.

For example, Rogers' (1959) psychotherapeutic model identified three inner conditions necessary to the creative process, namely, (a) an openness to experience which includes a lack of rigidity and a tolerance of ambiguity, (b) an internal locus of evaluation which is in terms of one's own needs, not dependent on outside evaluations, and (c) the ability to experiment with concepts, to shape wild hypotheses and so forth.

Ernst Kris (1952) believes that creativity represents what he terms primary-process or primitive thinking. Examples of primary process thought are the fantasy world of dreams, free associations and transcendental trance states. Secondary process thinking, by contrast, is logical, analytic, and "reality oriented." Kris believes that the initial creative response comes from what he called "regression in the service of the ego," i.e., the creative person's ability to regress to primary-process thought for his inspiration. Once this is done the artist must proceed to translate his ideas into a written form, a painting, a composition or whatever. This requires secondary-process thought.
Baron (1957) also recognized the importance of primary and secondary process thinking in a study of two groups that varied in originality and intelligence scores. Baron states that

Primary process thinking to the exclusion of the secondary process marks the original but unintelligent person, secondary process thinking which carries the ego-control to the point where the ego is not so much strong as muscle-bound marks the intelligent but unoriginal person, an easy accessibility of both primary process and secondary process marks the person who is both original and intelligent.

This theory poses the interesting question as to whether creative people tend to use one primary process of information processing as opposed to secondary process thought. Be that as it may, the process approach to the study of divergent or creative thought appears to be one of the more fruitful avenues for research.

Some psychologists such as Ornstein (1972) believe that primary and secondary-process thought belong to different hemispheres of the brain. Ornstein believes the right hemisphere operates in a primary process manner while the left hemisphere is responsible for intellectual or secondary process thinking. This assertion has been born out by experiments with brain damaged subjects by
Sperry (1972). Ornstein's research findings indicate that although each hemisphere shares the potential for many functions, and both sides participate in most activities, in the normal person the two sides tend to specialize. Thus, the left hemisphere deals especially with verbal and mathematical functions, the mode of operation is primarily linear, and it seems to process information sequentially. Because this mode of operation must underlie logical thought, this hemisphere might typically be the one most employed for predominately convergent thinking.

Conversely, the left hemisphere Ornstein continues, seems specialized for "holistic mentation," i.e., the formulating of "gestalts." The left side of the brain's activity seems more suited to synthesizing activities. Its language ability is quite limited, and it is primarily responsible for spacial orientation, artistic endeavor, crafts, body image, recognition of faces. Its informational input is processed more diffusely and it has the capability of integrating many inputs simultaneously. This would appear to be the hemisphere most used in divergent thinking as its activities closely approximate creative thought processes.

Ornstein (1972) believes that Western man is, what he terms, 'left-hemisphere dominated' and is oriented
towards verbal and mathematical rationality. This observation is based on research into the bifunctional nature of the brain. In the left hemisphere of the brain has been found to be the location for language, rational cognition, sense of time—all of which Ornstein describes as linear. The right hemisphere, in most cases, has been found to be responsible for "nonlinear" (or nonverbal) thinking—in-tuition, special relationships, and the governing of most of the psychomotor activities (including painting and sculpting).

Citing numerous examples from Eastern thought, including Yoga, Zen, and Sufism, Ornstein further claims that the Eastern mind is dominated by right hemispherical thought. Ornstein concludes that the more intuitive, experiential side of Western man has been sadly neglected and that in order to maximize our potential it is necessary to utilize both modes of consciousness.

Physiological Measures of Convergent and Divergent Thinking

Certain measurable effects of primary process (diver-gent) and secondary process (convergent) thinking have been obtained by means of electroencephalograms which measure the degree of cortical arousal by means of brain wave
frequency. For example, alpha rhythms are produced when the mood is one of relaxation and meditation. The more aroused a person is the fewer alpha waves he produces. When reacting to stimuli alpha rhythms become blocked and are replaced by fast low amplitude brain patterns. It has been found that secondary thought processes or work calling for logical calculation requires medium arousal, from dream states at one end to emotional highs at the other.

Recent experiments conducted by Martindale, et al. (1975) into the nature of creative thought indicates that the supposed over-sensitivity of creative people may be due to the fact that they are blocking alpha rhythms more than uncreative people. Three experiments were conducted to test this hypothesis on previously identified creative students ranging from the playing of high pitched sounds to electric shocks to the "kinaesthetic aftereffect" test. In all the tests, the creative students consistently over-reacted and overestimated the intensity of the stimuli compared to the control group. The final test consisted of blindfolding subjects and having them rub their fingers over a block of wood and then asking them to judge the width of another triangular shaped block. So-called "augmenters" overestimate the size of the block and the creative subjects consistently "augmented" in this test. Martindale
concludes that:

These three experiments indicate that highly creative people amplify sights, sounds and textures, the stimuli around them. They feel shock and noise more intensely; they exaggerate sizes and sensations. This oversensitivity is the subjective counterpart of the physiological overreactivity that shows up in greater alpha blocking on EEG records.

Developing this line of thought a step further, the researchers hypothesized that the reason some creative people are oversensitive or unable to tolerate noise is that their basic resting level of brain activity is unusually high or low. In that case they would overreact to stimuli which does not bother normals with an increase in cortical arousal. To test this hypothesis the researchers linked subjects up to an electroencephalogram and administered two measures of creativity, Mednick's Remote Associate's Test (R.A.T.) and the Guilford Alternate Uses Test. They found that the most creative people were operating at a high frequency of alpha-low cortical arousal on the creativity tests. They had the lowest arousal and the most alpha brain waves on the purely creative measure (Alternate Uses) and the highest on the intelligence measure (R.A.T.). The noncreative subjects, because they concentrated too well and used secondary-process thought,
produced increased cortical arousal and fewer alpha waves on both tests.

The researchers further found that creative people do have high resting levels of brain activity as measured by the electroencephalogram, i.e., less alpha than non-creative people. Martindale, et al., sum up their findings as follows:

Creative and intellectual ability require two different thought processes: the former calls for low cortical arousal and diffusing one's powers of concentration; the latter calls for higher cortical arousal and focused attention.

This research seems to prove conclusively that there is a physiological basis for convergent and divergent, or primary and secondary thought process. The researchers conclude that creative people view the world and react to it unlike most of their peers do, not because they are eccentric or strange, but because they process information differently.

This conclusion has prompted many researchers to infer that convergers and divergers might have preferred modes of dealing with information. This preferred way of dealing with information has been labelled Cognitive Style.
Cognitive Style and Divergent Thinking

The cognitive style approach to the study of creativity attempts to link personality factors to productive thinking. Cognitive style is concerned with the characteristic way an individual approaches his environment. Gallagher (1964) reports that a number of investigators have identified "two distinct patterns or strategies which begin in early childhood and extend to all aspects of life." The first of these is characterized by freedom and striving for expression, and the other by extensive caution and concern for the opinion of others.

Gallagher summarizes some of the research into cognitive style done by Getzels and Jackson, Witken and Schachtel to which the author would add the work of Rötter. (Table 5) In all of this research a similar duality of styles can be identified, namely those who are what Witkin terms 'field dependent' and those that are 'field independent'.

Witken, et al.'s (1962) discoveries stem from the experiments in perception in which they constructed a "rod-and-frame" test. In this experiment a rod is attached to a frame in such a way that both parts move independent of one another. The frame can be tilted at various angles and the subject is asked to place the rod
TABLE 5
DIFFERENT LABELS FOR SIMILAR COGNITIVE STYLES*

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Productive</th>
<th>Nonproductive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getzels &amp; Jackson (1962)</td>
<td>&quot;High Creative&quot;</td>
<td>&quot;High I.Q.&quot;</td>
</tr>
<tr>
<td>*Witkin &amp; Associates (1962)</td>
<td>Field Independent</td>
<td>Field Dependent</td>
</tr>
<tr>
<td>Schachtel (1959)</td>
<td>Allocentric</td>
<td>Autocentric</td>
</tr>
<tr>
<td>Maslow (1956)</td>
<td>Growth</td>
<td>Defense</td>
</tr>
<tr>
<td>Rötter</td>
<td>Internal Locus of Control</td>
<td>External Locus of Control</td>
</tr>
</tbody>
</table>

*after Gallagher
in a vertical position. The researchers found that
certain individuals were strongly influenced by the frame
position in their attempt to place the rod vertically.
They further found that the same subjects also had other
consistent cognitive and personality traits and concluded
that this "field dependent" behavior was part of an en-
tire pattern and style of life.

With reference to cognitive style or preferred modes
of dealing with information, Kagan (1965) states:

It has been established that the
tendency to be impulsive or reflective
in selecting ideas for action is an ex-
tremely stable trait that generalizes
across a wide variety of tasks. When
faced with a problem suggesting multi-
ple possibilities for solution, some
children select the first answer that
occurs to them, and, in many cases, this
solution is incorrect. Others tend to
brood a longer period of time, consider-
ing the differential validity of the
various solution hypotheses that occur
to them. These children are called re-
flexive and they are usually more
accurate in their first reply. It should
not be surprising that reflective children
do better on problems of inductive reason-
ing, make fewer errors when learning to
read, and are regarded by the teacher as
inhibited.

It would appear, therefore, that the discovery
method of learning might be more successful with diver-
gent thinkers rather than convergent thinkers, because
it is more involving and encourages them to use his
ability to generate alternative solutions to problems.

It might be expected from the foregoing studies of personality and cognitive style that students scoring high on tests of creative thinking might prefer more open-ended learning strategies and assignments that are less structured and that allow greater freedom and flexibility for the individual student to use his initiative. Several studies have dealt with these issues and are summarized here.

One such study was reported by Tallmadge and Shearer (1969) who also identified convergent and divergent thinking types, although they did not call them this. They reported that learners possessing one learning style had technological interests, had low anxiety and were introverted (convergers). The other type were identified as having social, aesthetic interests, had high anxiety and were extroverted (divergers).

This study aimed at determining whether learning might be enhanced by employing instructional methods which differ in design and use as a function of learner characteristics. Two separate subject matter areas representing two distinctly different learning situations were investigated. Two separate courses were developed for each subject matter area, one reflecting an inductive instructional
approach and the other deductive method.

Type I learners (convergers) were given logico-mathematical subject matter (Transportation Technique) learned best by an inductive program and in a visual discrimination course (aircraft recognition) they learned best by programs the opposite of the ones found to be most effective for the first group. Thus, the hypothesis that students having a certain cognitive style or personality learn better in different ways.

Clark (1964) and Hamburg (1964) investigated two studies of the relationship of creative thinking and preferences for open-structured learning experiences in grades three through six. A questionnaire was administered to find out each student's preference for open-structure learning experiences. A closed-structure learning experience was described as one in which the goals and rules of behavior are established by the teacher with materials and methods specified. Other characteristics of closed-structure learning are conformity, importance of product, teacher orientation, autocratic, rigidity, other dependent, convergent thinking, and less chance for creativity, curiosity, fluency, inventiveness, and originality. Open-structure learning is characterised by process orientation, emphasis on the individual learner, democratic in leadership and
structure, flexible, independent, divergent thinking, and more chance for creativity, curiosity, inventiveness, and originality. The items of the questionnaire required respondents to express a preference for one activity over another.

Clark (1964) investigated the relationship between measures of creativity and measures of preference for open-structure learning in a sample of 177 students and found an overall coefficient of correlation of .32. Instead of correlating separate scores for fluency, flexibility, originality and elaboration, Clark used composite scores for separate tasks and combined all of the figural tasks and all the verbal ones. The coefficient of correlation between the preference questionnaire and figural creativity was .27 and for verbal creativity .24 (both significant at better than the .01 level).

In another similar study, Hamburg (1964) investigated 241 students in grades three through six and obtained a correlation of .24 between the composite creativity measures and preference for open-structure learning. Both Hamburg and Clark's studies indicated a tendency for higher correlations between creativity and preference for open-structure than between intelligence test scores and preference for open-structure. Significant variations in
the size of the relationship from classroom to classroom, ranging from zero to .48 in Hamburg's study and from zero to .51 in Clark's.

MacDonald and Raths (1964) using three levels of creativity identified by Torrance, placed children in a variety of curricular tasks varying in degree of openness of structure, frustration, passivity, and the like. They found that the highly creative children were more productive on frustrating tasks than were their less creative peers. The least creative children were less productive in open-tasks and the most creative ones reacted less favorably to closed tasks. (Thus, there would appear to be a positive correlation between creative thinking and a preference for open-structured learning experiences.)

Dreyer and Wells (1966) performed an in-depth study of 24 four and five year olds and their parents. The children were given a battery of creativity tests and were divided into high, middle, and low creative groups on the basis of the measures obtained. The researchers found that mothers of the more creative groups engaged in more independence-granting and achievement-inducing behavior. The parents of the more creative children had less domestic value consensus and more role tension than parents of the low creative group. Thus, creative students seem to
have a much higher tolerance for ambiguity, frustration, etc., all of which might be summarized as a preference for cognitive complexity.

Cognitive Complexity

Arguments in favor of a more complex cognitive structure in creative people has come from various sources. For example, Eisner (1963) reported that highly creative people seem able to tolerate a "great deal of ambiguity," and that immediate closure or answers to questions seem of little concern to them. Indeed, he found that in many instances they seem to prefer such complexity. MacKinnon (1961, 1962) made a similar discovery in the area of perceptual complexity and found significant correlations between complexity of preference and creativity in the range of 4.48.

Another personality study which attempted to relate choice of career with preference for cognitive-complexity-simplicity was that by Callister (1970). Using randomly generated polygons varying in complexity and also verbal scores based on Miller and Selfridge's approximations to natural language, she demonstrated a significant correlation between the five types of measure and was able to categorize subjects according to their preference for high and low complexity in general.
Moreover, the tests used for degree of complexity-preference seems to be indicative of a creativity trait in that the high-complexity-preferring subjects were found to possess many of the characteristics normally associated in other studies with creativity, although they were not the highest in intelligence—e.g., autonomy, introversion, fluency, and flexibility. Also, the validity of the complexity-preference approach was confirmed by the comparison of groups of students specializing in arts subjects, psychology, and engineering. With slightly varied results according to whether verbal or nonverbal material was used, the descending order for complexity preference was arts, psychology, and engineering students.

In an earlier study Barron (1955) found, for twelve of fifteen personality predictors, that persons high in originality prefer complexity and some degree of apparent imbalance in phenomena, are more complex psychodynamically, and have greater personal scope.

Abercrombie (1960) proposed an interesting theory related to cognitive complexity. He stated that what he termed "schemata" are the active organization of past reactions or past experiences into some meaningful organic response. Although these "schemata" help the person to adopt and organize the incoming stimuli,
Abercrombie believes that sometimes these schema develop a "rigid structure." In this instance, incoming information will then be perceived selectively and in terms of rigid schemata. This is what might be termed "stereotyping" or "high dogmatism" by Rokeach (1960). Thus, the individual experiences great difficulty in forming new relations or new associations, and any attempt to reorganize, as in the case with a creative person, becomes styled. Thus it might appear that according to this theory a distinction could be made between creative people and the degree of rigidity or flexibility of their schemata.

Flexibility, according to Abercrombie involves the cognitive restructuring of reality. Having a flexible cognitive schemata and having an awareness of the incongruity of the stimulus, the creative person is able to engage in manipulating and reorganizing these elements into modes of expression that are both novel and original.

Subsequently, Bieri (1955) introduced the concept of cognitive complexity-simplicity based on George Kelly's construct system. According to Bieri the focus of the structure of cognitive complexity is upon the ability of the individual to differentiate the behavior of others.

Bieri's structure is intended to have a more limited range
of generality than some of the studies previously cited in that it deals exclusively with processing of information in the social domain. Basic to this theory is the premise that the more cognitively complex the individual the greater number of dimensions he will use to construe the behavior of others. The roots of this theory spring directly from the systematic framework of George Kelly's Psychology of Personal Constructs (1955). The cognitive complex individual is assumed to have available a greater number of dimensions with which to construe the behavior of others than the less cognitively complex person.

As Bieri states,

In place of such mediational concepts as habit in behavioral learning theory, the cognitive theorist has a predilection for terms such as structure, schema, style, system, control, plan, or program. And here we tend to have more than just a semantic distinction, for the cognitive theorist accepts as a basic assumption that a process of stimulus or information transformation mediates any antecedent-consequent relation in behavior.

**Personal Construct Theory**

The concept of structure assumes a major role in Kelly's Theory of Personal Constructs. The basis of Kelly's (1955) Personal Construct Theory is that each individual develops his own personal repertoire of constructs, by means of which he structures his world and
tries to anticipate events. Kelly's fundamental postulate was that a person's psychological processes are channelized by the ways in which he successively construes events. By 'construing' Kelly meant the process of attributing significance to or investing with meaning, all events, contact (e.g., objects, persons, situations, relationships, etc.) which the individual experiences. This is achieved by way of simultaneous differentiation and generalization. This means that the individual sorts among his experiences in such a way as to arrive at groupings in terms of perceived similarities and differences. Kelly defined a "construct" as the "way in which two things are alike and by the same token different from a third" in some important or significant way to the individual.

In its simplest context a construct is a way in which two things are alike yet different from a third . . . A construction system is an arrangement of constructs in which the common features of certain constructs are, in turn, recognized as separating them from other constructs within the system . . . Construing is not to be confounded with verbal formulation. A person's behavior may be based upon many interlocking equivalence-difference patterns which are never communicated.

The construct system thus formed according to Kelly, is arranged in a hierarchical order. This means that the
various constructs form substructures within the larger cognitive system. Kelly further categorizes various constructs as **impermeable**, pre-emptive, propositional, and constellatory. Impermeable constructs are those which admit no new elements. Pre-emptive constructs are exclusive in nature. This is the 'nothing but' type of construction--'if this is a ball it is nothing but a ball'--Aristotle's law of identify. Constellatory constructs are those which define members by a fixed set of attributes. This represents stereotyped or typological thinking. A propositional construct is a construct which carries no implications regarding the other realm membership of its elements. This is uncontaminated construction.

It would seem obvious in this respect that 'construing' as Kelly conceived it is almost identical to what has traditionally been known in learning theory as 'concept formation'. For this reason Kelly's theory is especially suited to the present study. However, because of certain differences in this theory from the traditional approaches to concept formation, the terms 'construing' and 'construct' will be used. According to this theory the person is perceived as dealing with experience in essentially the same way as a scientist deals with it. That is, having arrived empirically at certain conceptualizations, he uses
the constructs he forms in anticipating and formulating predictions (hypotheses) concerning future events. Subsequent events are then perceived as either refuting or validating these predictions. This is essentially an illustration of the way in which a person learns.

Kelly's Personal Construct Theory has provided psychologists with an invaluable tool which enables them to enter into the private world of other people and to perceive it from the perspective of the other person (what in Jungian terms is called the "umwelt" or "world view.") Instead of the usual personality and attitudinal tests such as the semantic differential, Likert scale, etc., in which categories are given to the subject for his response, Kelly's system allows the subject to supply his own categories. This means that the constructs subjects supply are uniquely their own. They reveal their unique ways of putting together and making sense out of their world.

According to Bannister, Kelly's Construct Theory includes the idea of a creativity cycle; this "is one which starts with loosened construction and terminates with tightened and validated construction." Bannister states that

a person who always indulges in tight construing may have a massive concrete output to his credit, but will never
be able to produce new ideas since creative thinking can only result from loosening the connections between constructs and realigning them in an unusual way. Conversely, a person who thinks loosely all the time cannot be creative either, since he is unable to tighten up his ideas to the point where he can see what he has got and evaluate it. In the end there has to be a hypothesis to test.

For example, Bannister (1969) found that greater learning would occur when constructs were sufficiently loosely related to deal with new experiences. Thus, too much validation of constructs by experience might tend to lead to high dogmatism, prejudice, and lack of flexibility in learning.

Wallach and Kogan have devoted an interesting chapter which addresses the problem of concept formation under the heading of 'Categorizing and Conceptualizing'. The authors asked themselves the question: "Does categorization breadth bear any relationship to intelligence and creativity?"

By "categorization breadth" the authors meant the range of discriminable events assigned to a common class of objects by an individual. In other words, presented with an array of objects the number of classifications or categories assigned to a given class or construct depends on an individual's category system. Two further
distinctions within the general framework can be made. The first concerns the case in which the category is clearly specified (it may be learned by or directly provided to the subject during an experimental session), i.e., the "band width" of the category. For example, Wallach and Caron (1959) studied subjects who initially learned geometric figures possessing a particular angle termed "poggles." Subjects were then asked to judge whether a subsequent series of geometric figures, identical but for a variation in a single criterial attribute of acuteness of angle, belonged or did not belong in the "poggle" class. Then, for example, the larger the number of cases admitted to the class the broader the subject's "band width" or "poggle" category.

Similar research was conducted by Bruner and Tajfel (1961) and by Tajfel, Richardson, and Everstine (1964) using patterns containing a specified number of dots and lines of varying lengths serving as "target" stimuli. Subjects were asked to judge a series of dot and line patterns in terms of their belonging or not belonging to the "target" class. Narrow category breadth indicated high rejection rates, while wide category breadth implied high rates of acceptance. The study further demonstrated that neither form of categorization preference demonstrated
any marked advantage in making accurate judgments (i.e., delegating criterial patterns to the "target" class and assigning noncriterial patterns to the "nontarget" class.

Bruner and Tajfel also report that tendencies toward narrow categorizing are significantly correlated to intelligence. There has been little empirical research, however, the authors note attempting to relate conceptual band width to creativity.

In an attempt to remedy this situation, Wallach and Kogan (1965) addressed themselves to this problem. They used the Pettigrew category width test and modified form of the Gardner object-sorting test. Wallach and Kogan differentiate between categorizing and conceptualizing, treating the former as a problem in preferences for narrow vs. broad categories and the latter as a matter of the structural and content characteristics of concepts employed when grouping or integrating diverse arrays of stimuli. Conceptualizing was measured by applying the Kogan group-descriptive, inferential, and relational to the reasons given by subjects for the groupings formed in the object-sorting task. Also, a measure of thematic integration--another aspect of conceptual style--was used in which subjects were required to build a story around sets of words.
The researchers hypothesized that subjects exhibiting broad-band-width on the Pettigrew Test would rank significantly higher on the creativity index, on the grounds that performance in both areas involved a concern with category limits or boundaries. This was confirmed for both males and females, but more especially for the females. It was suggested that the band-width index might be measuring a tolerance for deviant instances, hence, this might account for its association with creativity.

Next, Wallace and Kogan asked themselves how creativity might show itself in a test of conceptual style. Using the scoring schema devised by Kagan, et al., the researchers assumed

that the analytic-descriptive response is much more relevant to the domain of intelligence than to the area of creativity. The foregoing conceptual mode requires that the subject detect common aspects inherent in the stimuli, an operation suggestive of convergent rather than divergent thinking. Since clarity, inferential-categorial response imply a search process in which the subject attempts to find a superordinate concept to handle a set of exemplars. This is abstraction in the classical sense, a process most psychologists would again link to intelligence rather than creativity.

However, Wallach and Kogan differed with Kagan as to the interpretation of the meaning of the relational mode. To Kagan this latter mode of responding was
identified as a "passive acceptance of the stimulus."

However, Wallach and Kogan believed that while relational responses might have such meaning in the case where themes are obvious, it seemed to them that relational responding in an object-sorting task might have more in common with creativity, "since such responding would represent a freewheeling, nonconventional approach in the face of instructions encouraging abstraction." However, these hypotheses were only partially confirmed and then only for the males.

In a related experiment conducted by Tulving (1966) it was demonstrated that in a free recall learning task (FRL) prior Past-List learning retards subsequent Whole-List learning. In this case Tulving hypothesized that

if subjective organization and formulation of higher order stimulus units is necessary for a subject to be able to recall more items in a FRL Task than can be handled by immediate memory, and if the number of stimulus units can be retrieved on any given trial is limited, then it follows that the existence of inappropriate stimulus units may hinder rather than facilitate memorization of the set of items.

This assertion formed the basis for an experiment by Bennett (1970) in which he hypothesized that the creative person would have greater facility in reorganizing the stimulus units than noncreative people and would thus record a higher level of performance on the final list.
The assumption was that the creative person is one whose cognitive structure facilitates in reorganization which enables him to reorganize the units more readily and, therefore, reach criteria with fewer trials. This hypothesis was partially supported by the data. Thus, a person's level of reorganization as measured by the Part-Whole-Free Recall, significantly correlated with verbal creativity as measured by the R.A.T.

This is similar to Ausubel's (1960) findings. He found that the learning and retention of unfamiliar but meaningful verbal materials could be facilitated by the advance introduction of relevant subsuming concepts or 'organizers'. This was attributed to two factors: (a) the selective utilization of relevant existing concepts in the learners' cognitive structure for integrative use as part of the organizing focus for the new task, thereby increasing the task's familiarity and meaningfulness and (b) the provision of maximum stabilization for the learning material in a relevant form appropriate for organizing concepts at an approximate level of inclusiveness. These findings are in agreement with Kelly's theory of 'constructing' events.

Phillips and Torrance (1971) explored the roles which concept attainment strategy types and remote associative
abilities play in divergent thinking among college students. The authors cite the work of Bruner, Gudenow, and Austin as having described the nature of certain concept attainment tasks in terms of systematic sequences of hypotheses and decision rather than as specific, single responses. Bruner, et al, delineated four major strategies: simultaneous scanning, in which subjects approach the task of concept attainment by generating and evaluating all possible hypotheses at the same time as each new piece of information is presented; successive scanning, in which subjects follow a single hypothesis at a time and examine each new piece of information only in terms of that hypothesis; conservative focusing, in which subjects deal not with specific hypotheses but rather with constraints on the feature that a correct hypothesis would have to take into account; and focus gambling, which is similar to conservative focusing except that subjects take high risks by varying more than one attribute at a time. Bruner believes that simultaneous scanning is most exacting and places emphasis on memory; successive scanning relieves cognitive strain but is likely to involve redundancy of cues; conservative focusing is relatively economical in that each one selected is informative; while focus gambling maximizes cues when correct, but involves higher risks.
Since the processes described by Bruner, et al., outline for simultaneous scanning and focus gambling are similar to those associated with divergent thinking, Phillips and Torrance hypothesized that those strategies would be associated with a higher level of divergent thinking than the more conservative strategies of successful scanning and conservative focusing. The researchers further hypothesized that divergent thinking would not be related to ability to produce remote associations where there is a single correct response, as in Mednick and Mednick's R.A.T. (Remote Associates Test).

The subjects for the study were 109 randomly assigned college undergraduates. Divergent thinking was measured by the Torrance Tests of Creative Thinking (Figural Form A); concept attainment type by Bruner's strategy tasks; and ability to produce remote associations by Mednick and Mednick's R.A.T.

The findings supported the hypothesis that focus gambling and simultaneous scanning, as defined by Bruner, et al., are the preferred strategies of the creative thinker and are useful in cognitive problem solving and decision-making. Although intended to measure creativity, the R.A.T. correlated significantly with intelligence scores and hence suggest that its predictive qualities
be those associated with convergent thinking. Phillips and Torrance found no significant relationship between divergent thinking ability as measured by the T.T.C.T. and R.A.T. measures. Nor was there much relationship between strategy type and level of performance on the R.A.T.

This study is extremely important since it is one of the few which demonstrates a direct relationship between creativity and preferred concept strategy and has many implications for learning theory based on individual differences. Again, however, it demonstrates the unreliability of the R.A.T. as a measure of divergent or creative thinking.

Summary

The studies cited above seem to indicate that intelligence and creativity are quite distinct cognitive functions. It might be argued, therefore, that the highly creative person is one who, in general, displays a greater preference for complexity, more tolerance of ambiguity as reflected in a looser teaching strategy, uses primary-process thinking and hence employs less analytic thought process in problem solving activities; has a more flexible construct system as reflected in the way he learns concepts.
Therefore, in terms of Kelly's Personal Construct Theory it may mean that a typical converger (secondary process thinker) may tend to form more logical or tighter constructs in his attempts to construe or make sense out of his world. The more diffuse or divergent thinker might be expected to form some kind of general "gestalt" out of the elements in his world and would put them together differently. Relationships would be less rigidly bound by the logic of analytic thought processes and hence 'construing' would be looser.

However, most of the studies have tended to be fragmentary in that they have investigated different aspects of the creativity dimension without providing any unifying concept around which these aspects can cluster.

For example, relatively few have investigated the relationship between creativity and cognitive style. Certainly no one, to the author's knowledge, has utilized Kelly's Personal Construct Theory in an effort to understand how cognitive styles differ in creative and intelligent students. What is essentially lacking from most of the studies cited is some unifying concept around which to develop a theory of creativity related to personality and learning style. The present study, by using Kelly's
Personal Construct System, will provide the groundwork for such a theory.

Kelly's theory is useful as a unifying concept in several respects. First, it is a theory of personality in that it may show us certain differences in the way divergers and convergers think in terms of 'loose' or 'tight' construing. Secondly, it has obvious points of contact with concept formation in learning theory in that it may enable us to perceive what differences exist, if any, between the way convergers and divergers 'construe' their world and hence learn. Third, it appears to unify a fairly diverse yet related body of research in creativity and concept formation on the one hand (Mednick, Bruner, Wallach and Kogan, etc.) and preference for cognitive complexity on the other (Bieri, Eisner, etc.).

Wallach and Kogan summarize this position as follows:

...it is quite evident that categorizing and conceptualizing activities have much to do with creativity and intelligence. Investigators working in the area of creativity in particular have often tended to seal off this area, treating it as a separate discipline, rather than exploring possible points of articulation with other relevant traditions. As we have shown, creativity, both alone and in interaction with intelligence level, bears upon matters of categorizing and conceptualizing styles. Conceivably, there are other aspects of cognition that
also should be examined for their possible relevance to creativity and intelligence. Clearly, the time is ripe for the creativity-intelligence issue to assume its proper perspective within the domain of the cognitive processes.

The present study is a modest step in this direction in that it attempts to relate learning theory to the personal cognitive style of the learner by means of Kelly's Personal Construct Theory.
CHAPTER III
METHODS AND PROCEDURES

This chapter describes the procedures used in this study. The Setting, Population and Sample, Instrumentation Design, Data Collection and Analysis are treated in detail.

Setting

The setting for this study was Annehurst School in Westerville, Ohio, located approximately thirteen miles from Columbus, the state capital. Once a small town, Westerville is now one of the most rapidly growing suburban areas in Franklin County with a population at the last census in 1972 of 29,000. The area is predominately young, white, professional, middle class, upwardly mobile, and in a state of flux; there is a high turnover of students due to relocation.

Sample

The population from which subjects for this study were selected were fifth and sixth grade pupils at Annehurst Elementary School. A total of 180 subjects ranging in age from nine to twelve years were tested. In the
initial testing phase, of the original 180, eighteen in the sixth grade and 45 in the fifth grade had to be eliminated owing to the lack of Iowa Cognitive Ability scores against which to compare the data. (Due to the high turnover rate of the school population, in one year about as much as 50% of the fifth grade had to be rejected. This was so because there were no Iowa Cognitive Abilities Test scores available for these students. Students are normally tested in the fourth and sixth grade; thus, there was little change in the composition of the sixth grade, but the fifth grade had changed markedly throughout the two years owing to the arrival of new students and the departure of previous students.) The final sample in the first phase of the experiment consisted of forty-four in the fifth grade and seventy-two in the sixth grade, a total N of 116.

In the second testing phase of the study, a further fourteen subjects had to be eliminated owing to the fact that they had failed to complete the Repertory Grid Test or had repeated the same numbers so often as to render interpretation meaningless.

Administration

This total sample of students was given a battery of "Creativity Tests." This consisted of the Cattel's "Hidden Shapes," "Word Association," "Uses for Things,"
and the making up of endings to "Fables." These were the same four tests as were used by Getzels-Jackson.

The test battery was administered in a period lasting just over one hour, viz.

- 3½ minutes for Cattel's Hidden Shapes
- 15 minutes for Word Association
- 15 minutes for Uses for Things
- 30 minutes for Fables

to the fifth and sixth grades consecutively. This was done in order to minimize any contamination which might occur as a result of discussing the tests with other students.

Precautions were also taken to avoid any copying or cheating which might occur between students. The room was large enough so that students could be spaced out far enough so that they would not see what their neighbors were writing.

Students were informed that they were participating in an experiment to see how they as individuals thought. It was emphasized that their test scores would not affect their I.Q. scores or school record, nor would their teachers see the results. They were also told that it was a test of creativity or imagination and that there were essentially no right or wrong answers. Without exception, the students appeared to do their conscientious best on the tests.
When the data were finally collected, a series of three independent judges then scored each test according to certain previously established criteria. (This was done on all tests except the Cattel test which was objectively scored.)

PHASE I: PARTIAL REPLICATION OF THE GETZELS-JACKSON EXPERIMENT ON CREATIVITY AND INTELLIGENCE

INSTRUMENTATION

Intelligence Tests

Intelligence test data were supplied by the school records office in which the study was conducted. These data were the Iowa Cognitive Ability Test (II CAT) which consists of three basic scores: verbal, nonverbal, and quantitative. According to a manual, provided by the school, "the Cognitive Abilities Test provides a set of measures of the individual's ability to use and manipulate abstract and symbolic relationships."

Creativity Tests

The creativity tests used in this study were the same as those used by Getzels and Jackson in order to replicate their study with a more diverse range of subjects. Essentially the instruments used measure flexibility, ideational fluency and originality. For example, one test calls for varied associations to stimulus words. Another calls for the ability to think up remote, clever, and/or
original responses to complex verbal situations.

Guilford has noted that scoring tests of creativity presents unusual problems. As always, no matter how objective one tries to be, there is always some element of subjectivity since individual judgment is unavoidable. In order to minimize this factor, three independent judges were used to score the test battery. The following is a more detailed description of each test.

Word Association

Description and rationale: This test provides the subject with twenty-five words, each of which has multiple meanings (e.g., ARM, CAP, DUCK, FAIR, PITCH). The subject is asked to write as many meanings as he can for each word. On this instrument successful performance according to Getzels and Jackson seems to require the ability to shift frames of reference within an organized structure.

Time allowance: Approximately fifteen minutes is necessary to complete the test.

Scoring: The score on this test was the total number of different meanings which the subject supplied. If the word is ARM, for example, and a subject responded: "arm of a chair, arm of a sofa, part of a man's body, to supply with weapons," this would earn a score of three for the word. This is because "arm of a chair" and "arm of a
"sofa" would receive only one credit between them as they refer to the same meaning of the word ARM. When questions arose as whether or not to give credit for particular meanings, the dictionary was used as the deciding authority. Recognized slang expressions, however, were given credit if different from the other supplied meanings. Meanings referring to homonyms of the stimulus words such as "unadorned" used in response to PLANE were not given credit.

Reliability (internal consistency): Using the responses of a single class chosen at random (N = 32), Getzels and Jackson obtained a coefficient of .87.

Uses Test

Description and rationale: In this test the subject is presented with the names of five common objects: bricks, pencils, paper clips, toothpicks, sheet of paper and is asked to write down as many different uses as he can for each item. At the top of the test the name of each object is followed by two examples—one which represents a common use, the other an unusual use. For example, "brick" is followed by "build houses" and "doorstop."

This test is derived from a description of two similar tests used by J. P. Guilford in his factor-analytic studies of cognitive ability. In the test labeled
"Unusual Uses" the subject is required to name several different unconventional uses for common objects. In the other, "Brick Uses," the subject is required to name uses for a common brick. Depending on whether the scoring uses the number of responses or number of classes into which responses may be placed, the test will assess "ideational fluency" or "semantic spontaneous flexibility."

The Uses Test was included in the creativity battery because it serves to measure a subject's ability to use the environment in an original manner and to shift frames of reference. Where the Word Association Test limits the number of responses by meanings commonly applied to the word, the Uses Test provides almost limitless responding opportunities.

Time allowance: Approximately fifteen minutes is necessary to complete the test.

Scoring: In the Uses Test, the two important considerations in scoring responses were the number of different uses suggested for each object and their uniqueness. In scoring, the first step was to identify all of the given uses for a particular item. The responses were then divided into common and uncommon uses and scored on the basis of the number of different uses for each item and the number of uncommon uses for that item. For example, in
response to the word "brick" a subject replies: "Use them to build houses; to build fireplaces; to build garden walls; to heat them and use them as bed warmers" would be scored 2-1. This is because there are two different uses and one uncommon use, bringing the item total to 3. These scores are then tallied over the five stimulus objects to provide the total score.

Clark and Mirels (1970) indicated that the "length of list" could be a confounding factor in scoring the Uses Test. That is, supposing one subject produces fifty responses of moderate ingenuity and a second subject produces only ten responses which are nevertheless highly original. In the usual scoring procedure the subject with fifty responses would be accorded the higher score. This problem is further compounded by the fact that the more original responses tend to occur towards the end of the list.

In an attempt to compensate for this problem, Clark and Mirels' scoring procedure was used. This method consists of summing the total number of original items in a subject's list; (originality is defined as those items listed by one fifth or less of the respondents). The total number of responses are then summed and divided into the originality score to correct for fluency and thus provide a percentage originality score for each subject.
Hidden Shapes G-37 (Perceptual Analysis: Gottschaldt Figures)\textsuperscript{5}

Description and rationale: Part of Cattell's Objective-Analytic Test Battery, this test consists of eighteen simple geometric figures. Each figure is followed by four complex figures, and the subject is asked to identify the complex figures in which the original simple figure appears.

Cattell reports that the test appears "with a high positive loading on a factor of 'critical exactness'" and he states that

A high score here is associated with conscientious exactness and reliability in a wide range of performances. The individual at the positive pole is penetrating, critical of himself and others--especially others--and not given to relaxing easily. . . . It may not be favorably prognostic in human relations, but should be predictive of individual and creative work thoroughly done.

Later Cattell renamed this factor "critical practicality" and states

The expression 'critical practicality' perhaps best expresses for the present the compulsiveness, criticalness, regard for accuracy and standards, and the general practical concern shown. (It might well be called 'editor's' or 'instrument maker's' factor!)
Getzels and Jackson state that

At a somewhat more intuitive level, the test appears to call for the ability to disregard superfluous detail in perceptual situations. The fact that the test appeared to tap the ability "to perceive essentials quickly" argued for its inclusion in the creative battery. Also, a correlational analysis of the creativity instruments showed that this test was empirically related to the others.

Time allowance: Subjects are permitted 3 1/2 minutes to complete this test.

Scoring: The test is scored according to the directions in Cattel's manual. That is, the total number of correct responses minus the total number of wrong responses equals the total score. There are two possible right responses to each of the eighteen items. Thus, a total score of 36 is possible.

Fables Test

Description and rationale: This test provides four fables whose last lines are missing. The subject is required in each fable to supply a moralistic, a humorous, and a sad ending. The test is open-ended which allows for the use of original ideas. "Fables" requires the subject to be able to bring an incomplete situation to a logical close and to shift frames of reference rather
quickly to provide the three types of ending required.

Time allowance: Subjects required approximately thirty minutes to complete the test.

Scoring: Getzels and Jackson's two major criteria of appropriateness and relatedness were used in the scoring of each fable ending. Decisions regarding the appropriateness of a response were based on the subject's ability to convey the appropriate emotional tone and write endings that were moralistic, humorous, or sad. If the ending was judged to fit the tone called for, it received a score of 1. Thus, in the four fables the highest possible appropriateness score was 12.

For appropriateness, a moralistic ending was defined as having connotations of good and bad. That is, in response to the fable "The Mischievous Dog" the answer "you'll soon get tired of wearing that bell" did not connotate a moralistic tone while "you are only ringing out your guilt" did convey the connotation of 'good' and 'bad' and would be given credit.

Humorous endings most frequently would contain incongruity or play on words. Usually, unsuccessful attempts at humorous endings involved excessive hostility (with little or no relation to plot), triteness, heavy-handed plays on words (e.g., in reference to the above fable,
"If I am a dog, then you're a hog"), or incongruity so far-fetched that it is unrelated to the story.

A sad ending is usually involved with death or disaster and may occasionally involve loneliness.

The criterion of relatedness is concerned with how closely the response is followed from the material presented.

Reliability: Getzels and Jackson obtained a coefficient of .87 using the responses of a single class (N= 46) chosen at random.

PHASE II: CREATIVITY AND INTELLIGENCE RELATED TO PERSONAL CONSTRUCT THEORY

Using Factor Analysis and establishing the median for intelligence and creativity, four groups were identified:

High Creative --- High Intelligence
High Creative --- Low Intelligence
High Intelligence --- Low Creative
Low Intelligence --- Low Creative

The second phase of the study was exploratory in nature and consisted of administering Repertory Grids to all students in the previously identified groups to determine whether there is any relationship between 'tight construing' and 'loose construing' in H.C. and H.I.Q. students.
A 'tight construct' as defined by Kelly is one which leads to unvarying predictions. According to the literature, tight construing would tend to be more prevalent in convergent thinkers and people who believe in one right answer, i.e., what Rokeach calls "high dogmatics."

'Loose construing' is a construct which leads to varying predictions but which retains its identity. It is expected that 'loose construing' will be more closely associated with 'divergent thinking'. 'Loose construing' is operationally defined as being those constructs in a repertory grid protocol which do not have a high correlation (i.e., about .30 or less). 'Tight construing', on the other hand, is operationally defined as those constructs in a repertory grid protocol which are highly correlated (i.e., .30 or greater).

This test was modeled after Kelly's test in which the subject is presented with a list of some twenty roles; for example, one might be a person with whom you have worked and who is easy to get along with. The subject then names the people who fulfill the roles for him. The examiner then selects the people named in groups of three and asks, "In what important way are two of them alike but different from a third?" The subject might then reply that two of them are 'unkind' and that the third is 'kind'.

By this means the subject has stated a polar scale, along which he perceives people to differ. This procedure is continued with many scales elicited from the subject himself and applied to people in his life who have significance for him.

Bannister (1960) has developed a modification of Kelly's approach which simplifies the process and at the same time enables comparisons to be made among subjects. Bannister asked subjects to write down on 36 cards the names of 36 adults (age 17+), people known personally to him. They could be people of any kind liked or disliked, present or past acquaintances, but they must be personally known to the subject. The first eighteen cards are then selected with the names of the people known on them and the subject is given a card with the word "likeable" on it. Subjects are asked to write down the numbers of the nine most likeable people out of the eighteen people being considered.

The experimenter uses a grid with the numbers 1 through 18 along the top and the numbers 1 through 10 down the side. Along the first row of the grid, the experimenter enters a check in the cells of the nine people out of the eighteen that have been nominated by the subject as most likeable. The experimenter may then present the subject
with a card marked "serious," and in the second row of
the grid indicate with ticks the nine people out of the
eighteen nominated as most serious. Bannister used ten
constructs: "likeable," "serious," "prejudiced," "good,"
"aggressive," "lazy," "sincere," "uneducated," "religious,"
"unreliable." When a subject has completed the ten con-
structs for the first eighteen people under consideration,
he then completes the constructs for the remaining eight-
een people.

Bannister used a complicated scoring technique which
cannot be easily summarized here but which enabled him to
obtain for each subject the type of relationship that ex-
ists between the various constructs.

Admittedly, Bannister was studying the effects of
schizophrenic thought disorder in Q-sorting, but his tech-
nique might be further modified to study the concept
forming processes associated with learning.

It was proposed to use a modified version of
Bannister's grid including his constructs in the present
study by virtue of the fact that it is simpler and easier
to administer and more understandable to fifth and sixth
graders than Bannister's Repertory Grid.

Initially, a pilot test using nine subjects drawn
from the fifth and sixth grade was used to see how
successful pupils were at generating their own constructs. This consisted of a twelve-by-twelve grid. Subjects were then supplied with twelve numbered slips of paper and required to generate the names of twelve adults (i.e., 17+ years) personally known to them. Next, they were asked to generate constructs by asking themselves in what way were two of the persons names similar yet different to a third in some significant or important way to them. When the subject had generated a list of twelve constructs, he was then required to rank order them from 1 to 12 in order of most like the construct to least like the construct and enter the corresponding numbers on the slips of paper in sequence, i.e., if the construct was "likeable" and the subject thought number '9' was most likeable, he/she would enter a nine in the first column of the appropriate construct and so on. The last two categories required the subject to rank order the people in terms of how he considered them most like to least like himself, and finally how ideally he would like to be.

However, the categories generated did not appear to be very usable, mainly because of their trivial nature. Also, because of the difficulty of categorization and comparison it was decided to supply the constructs in the final testing phase of the study. Instead, therefore, Bannister's categories were used for this section.
Validity and Reliability

Several tests of creativity were considered for use in this study, as there are many to choose from.

The criteria established were that the tests should measure "ideational fluency" (Guilford) and the "production of original and unusual responses" and that they could be administered during a normal class period as part of the routine school day.

Torrance's tests were considered, but it was determined that the reliability and validity scores were not as high as those of Guilford's. For this reason, it was decided to use Guilford's tests because they met the above criteria, had high reliability and validity, and because the researcher wanted some basis for comparison with the Getzels and Jackson study, which used these tests.

All of the above instruments have been used in several studies and so have been validated and proven reliable in a number of instances.

Essentially, the tests given were the same as those administered by Getzels and Jackson with the exception of make-up problem. This test required subjects to make up problems to quantitative data and were judged by a panel in terms of appropriateness and inventiveness, but it was omitted because it appeared to replicate the
Fable test. Another problem with the Getzels-Jackson experiment was that a very narrow range at the top of the I.Q. group was tested. The present study remedied this by investigating a much broader range of subjects and levels of intelligence.

Analysis of Data

The primary statistical procedure used to analyze the data in Phase I of the study was Factor Analysis. This procedure was used because it was hypothesized that intelligence and creativity were two separate and distinct cognitive constructs. It was able to confirm this hypothesis because Factor Analysis's principal use is to exaggerate whatever differences exist between variables.

In the second phase of the experiment, the Repertory Grid Analysis Computer Program was used to process the second set of data to establish multiple correlations between the constructs and hence degree of construing.

One-way ANOVA and F or T tests of significance were then performed on each of the four groups.

SUMMARY OUTLINE OF SEQUENCE OF STEPS FOR DATA COLLECTION AND ANALYSIS

PHASE I: Partial Replication of Getzels-Jackson Study of Creativity and Intelligence

1. Total fifth and sixth grade given battery of creativity tests.
2. Three independent judges score all four tests separately.

3. Each student's creativity scores compared against his/her Iowa Test of Cognitive Abilities.

4. BMD-073-VARIMAX Factor Analysis with Orthogonal and Oblique Rotation performed on data to find if the two tests are in fact measuring different kinds of cognitive abilities.

5. Factor Analysis scores for each student obtained together with median scores for intelligence and creativity using SPSS.

6. Using medians as cut-off point, four groups were established:

   High I.Q.   --   High Creative
   High I.Q.   --   Low Creative
   High Creative   --   Low I.Q.
   Low Creative   --   Low I.Q.

(E.g., High Creative -- Low I.Q. = subject above the median in creativity but below the median in intelligence and vice versa for High I.Q. -- Low Creative.)
PHASE II: CREATIVITY AND INTELLIGENCE RELATED TO KELLY'S PERSONAL CONSTRUCT THEORY

1. Modified Repertory Grid administered to total fifth and sixth grade students. (Students asked to rank order significant adults in terms of supplied constructs.)

2. Multiple Correlation Matrix performed by computer on each student's Repertory Grid.

3. One-way analysis of variance performed on each group in the four quadrants; mean and standard deviation are obtained.

4. F or T test of significance performed on data obtained in four groups.

5. Hypothesis that High Creatives (Diversers) and Highly Intelligent (Convergers) construe "loosely" and "tightly" respectively, confirmed or unconfirmed.
CHAPTER IV

PRESENTATION OF RESULTS AND INTERPRETATION

A correlation matrix of all seven variables (Cattel, Word Uses, Word Association, Fables, Iowa Verbal, Nonverbal and Quantitative Test of Cognitive Abilities) was calculated. (See Table 1). Sex was eliminated from the final correlation matrix as it appeared not to load on any particular variable. Factor Analysis using Principal Axis Solution was performed on the data and rotation to simple structure was achieved by means of varimax rotated factor matrix.

Factor analysis of the total subjects intercorrelation matrix for the seven measures showed that there were only 2 eigenvalues greater than 1.00 and that the two factors had relatively high loadings, and of the seven measures all rotated to simple structure. Therefore, the principal axis solution was chosen.

The two factor solution for the total subjects, rotated by the Kaiser Varimax procedure, is given in Table #1. Measures with loadings of ±.20 were considered important in naming a factor with confidence.
<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>FACTOR MATRIX BEFORE ROTATION</th>
<th>VARIANCE ROTATED FACTOR MATRIX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FACTOR I</td>
<td>FACTOR II</td>
</tr>
<tr>
<td>1. Cattel's Hidden Shapes</td>
<td>0.39754</td>
<td>-0.13651</td>
</tr>
<tr>
<td>2. Word Association</td>
<td>0.60589</td>
<td>0.26337</td>
</tr>
<tr>
<td>3. Uses for Things</td>
<td>0.38651</td>
<td>0.21652</td>
</tr>
<tr>
<td>4. Fables</td>
<td>0.65989</td>
<td>0.51572</td>
</tr>
<tr>
<td>5. Iowa Cognitive ABS</td>
<td>0.80460</td>
<td>-0.08191</td>
</tr>
<tr>
<td>- Verbal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Iowa Cognitive ABS</td>
<td>0.72814</td>
<td>-0.31141</td>
</tr>
<tr>
<td>- Nonverbal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Iowa Cognitive ABS</td>
<td>0.75854</td>
<td>-0.31142</td>
</tr>
<tr>
<td>- Quantitative</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Cattel measure loaded heavily on the intelligence factor (0.39442) as was expected, while Word Uses and Fables loaded high on the creativity factor (0.58760, 0.41092, 0.81549 respectively).

Interpretation of the Factor Analysis

The interpretation of a rotated factor matrix has a tendency to be quite subjective. The figure one is willing to accept as significant is often the arbitrary one. Luckily, there were no negative loadings and the achievement of simple structure make the interpretation somewhat easier in this study.

Thus, the first factor is easily identifiable as a convergent factor. All three Iowa Tests (Verbal, Non-verbal and Quantitative) together with the Cattel 'Hidden Shapes' load heavily on this factor. Spacial visualization as used in the Cattel Test appears to correlate heavily with the Iowa Cognitive Abilities Test which also measure some of the same variables. This factor might appropriately be described as Guilford's "g" factor, or general intelligence. The loadings of the creativity scales are relatively low, particularly 'Uses' and 'Fables' indicating a probable separation of the two concepts (intelligence and creativity).
### TABLE 2
INTER-CORRELATION MATRIX OF ALL SEVEN VARIABLES

<table>
<thead>
<tr>
<th>TESTS</th>
<th>Cattel's 'Hidden Shapes'</th>
<th>Word Association</th>
<th>Uses for Things</th>
<th>Fables</th>
<th>VOA COGNITIVE ABILITIES</th>
<th>Quantitative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Verbal</td>
<td>Nonverbal</td>
</tr>
<tr>
<td>1. Cattel's 'Hidden Shapes'</td>
<td>0.13</td>
<td>0.16</td>
<td>0.50</td>
<td>0.23</td>
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<td>0.07</td>
<td>0.41</td>
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<tr>
<td>3. Uses for Things</td>
<td></td>
<td>0.63</td>
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<td>0.47</td>
<td>0.36</td>
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<td>4. Fables</td>
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<td></td>
<td>0.22</td>
<td>0.42</td>
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<td>5. Verbal Intelligence</td>
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<td>6. Nonverbal Intelligence</td>
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<td>7. Quantitative Intelligence</td>
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## TABLE 3
INTERJUDGE RELIABILITY OF
FOUR "CREATIVITY" MEASURES

<table>
<thead>
<tr>
<th>MEASURES</th>
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<tr>
<td>1. Cattel's 'Hidden Shapes'</td>
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<tr>
<td>2. Word Association</td>
<td>.96</td>
</tr>
<tr>
<td>3. Uses for Things*</td>
<td>.83</td>
</tr>
<tr>
<td>4. Fables</td>
<td>.65</td>
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</table>

**NOTE:** All measures were hand scored  
*Corrected for Fluency (Clarke Mirels, 1970)
These results are all the more interesting and surprising when one considers them in the light of the fact that corrections were made for fluency after Clark and Mirels. Under these circumstances one might have expected there to be less difference between the factor loadings on each of the two factors.

Factor II is related to divergent thinking since all the non-creativity measures had low loadings on this factor. Two measures control Factor II, flexibility and originality as represented by Word Association, Uses for Things and Fables Tests with factor loadings of .59, .42, and .82.

Even although these definite loadings were found for the total sample, it is still unclear as to what one might name it. Since 'Words' and 'Fables' tended to have the highest loadings on this factor followed by fluency, the factor might be identified as 'flexibility-originality' factor. Thus, an interrelationship seems to exist between flexibility and the generation of original ideas.

Based on the two factor varimax solution, factor scores for each of the 116 subjects were then obtained.

Medians were established for both the intelligence and the creativity factor (intelligence = .20795, creativity =
-.053555) in order to establish the four equal groups (HH, LC-HIQ, LIQ-HC and LL) of 24 subjects to a group.

Multiple Correlation Matrices were obtained using a Repgrid computer program for each subject. The next stage of the operation presented some peculiar problems. Since the Repgrid was initially designed to be used on one subject at a time, it did not easily lend itself to the type of mass use to which it was subjected. The problem was to select one number from each subject's matrix that would be representative of the whole. It was decided to treat the matrices as simple correlation matrices and to use the median value as representative of each subject's score. This was perhaps the grossest measure that could be used, but more refined methods might have had different but more complicated results in terms of interpretation. The median score so selected was used as a measure of each subject's degree of 'tightness' or 'looseness' of construing.

In order to normalize the distribution, z-transformation scores were obtained using the formula developed by Fisher:

\[ z_r = \frac{1}{2} \log_e (1 + r) - \frac{1}{2} \log_e (1 - r). \]

This had the effect of making it possible to treat the correlation scores as normal data.
A one-way analysis of variance was performed on the resulting data in each of the four groups, but no significant difference could be found at the .05 level. There were several examples of 'loose' and 'tight' constructors but the results were scattered throughout the quadrants.

Findings

Therefore, the first hypothesis, viz.

\[ H_1 \] Creativity and intelligence represent two independent constructs or concepts which can be measured separately was supported. Although the study showed that the correlation of intelligence to creativity was high, factor analysis revealed that two separate dimensions or cognitions had been tested. Therefore, in response to the first question the answer is "yes," there is a separate cognitive concept from intelligence which can be labelled divergent or creative thinking according to the definition specified. This would also tend to indicate in the second hypothesis that

\[ H_2 \] Conventional I.Q. tests (in this case the Iowa Test of Cognitive Abilities) do not measure creative ability.
<table>
<thead>
<tr>
<th>GROUP</th>
<th>MEAN</th>
<th>S.D.</th>
<th>OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High Creative - High Intelligence</td>
<td>154.739</td>
<td>77.369</td>
<td>N=23</td>
</tr>
<tr>
<td>2. High Creative - Low Intelligence</td>
<td>129.833</td>
<td>71.288</td>
<td>N=18</td>
</tr>
<tr>
<td>3. High Intelligence - Low Creative</td>
<td>145.200</td>
<td>133.562</td>
<td>N=25</td>
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<tr>
<td>4. Low Intelligence - Low Creative</td>
<td>151.042</td>
<td>103.118</td>
<td>N=24</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td></td>
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<td><strong>N=90</strong></td>
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The conventional intelligence tests seem to measure mainly convergent thinking abilities.

In response to the three related final hypotheses:

$H_3$ Convergers and divergers process information differently

$H_4$ 'Loose Construing' is positively related to divergent or creative thinking processes

and $H_5$ 'Tight Construing' is positively related to convergent thinking processes,

the findings would tend to indicate that the answer was "no." However, this might simply mean that the instrument used was not sensitive to the types of concerns listed above. A different instrument might have confirmed the above hypotheses. However, at the moment this is purely speculative and one must accept the findings as they stand.
CHAPTER V
SUMMARY, CONCLUSION, AND IMPLICATIONS

The main purpose of this study was to determine the relationship, if any, between creativity and information processing or cognitive style. It was hypothesized that people who habitually used one type of thinking (convergent or divergent) over another will tend to form constructs differently and hence learn differently.

The first phase of the study specifically was:

a) To repeat the Getzels-Jackson experiment using the same measures of creativity but with a much wider range of intelligence and not merely with the highly intelligent.

b) To determine whether intelligence and creativity are two distinct and measurable concepts or cognitive abilities.

The second phase of the study was exploratory in nature and essentially tried to determine if there was any difference between highly creative, low intelligence subjects and highly intelligent but low creative subjects and the way they formed constructs. It was hypothesized
that creativity or divergent thinking was likely to reflect 'looser construing' patterns as measured by George Kelly's Repertory Grid Test. This was expected to show up in terms of lower correlations between constructs in a multiple correlation grid matrix.

The basis for this assumption came from a number of studies which tended to indicate that divergent thinkers tended to think less in absolutist or 'black and white', one-right-answer terms, than typical divergent thinkers. A number of studies were cited which supported the view that creative people tend to prefer complexity, have more tolerance for ambiguity, prefer less structured classroom teaching, and learn in different ways to typical convergent thinkers.

Kelly's Personal Construct Theory was used because it provided a useful tool with which to measure the degree of construing used by an individual in the way in which he related such constructs as 'likeable' and 'good', 'prejudice' and 'religious', etc. within his construct system. The assumption was that the convergent thinkers would tend to form tighter constructs around these dimensions than divergent thinkers who would, it was assumed, perceive greater degrees of complexity and ambiguity between the constructs; hence, they would not necessarily perceive all
similar constructs such as "likeable" and "good" as being closely correlated.

The evidence from the literature seemed to support this conclusion and also physiological evidence was presented.

In Phase I of the study a partial replication of the Getzels-Jackson study was made to determine four groups of subjects:

- High I.Q. -- High Creative
- High I.Q. -- Low Creative
- High Creative -- Low I.Q.
- Low Creative -- Low I.Q.

This was done by administering a series of 'creativity' measures to 116 fifth and sixth grade students. The measures used were (a) The Cattel Hidden Shapes Test as a measure of figural cognition, (b) The Guilford 'Uses' Test as a measure of ideational fluency, (c) The Word Association Test as a measure of flexibility, and (d) making up endings to Fables Test as a measure of originality. All tests were administered at the same time to prevent contamination of the scores.

Each of the four tests was scored independently by three separate judges to minimize the effect of subjective judgments. Each student's creativity score was compared
against his Iowa Cognitive Abilities Test and Factor Analysis was performed on the data using SPSS. It was found that two factors could be distinguished separately, i.e., creativity and intelligence or divergent and convergent thinking.

Four groups (HH, LL, HL, LH) were then identified by determining the medians for intelligence and creativity. Thus, any student who scored above the two medians would be classified as a HH, anyone who scored below the two medians was a LL, and anyone who was above the median for creativity but below the intelligence median was a HC-Low I.Q. and vice versa for the HIQ-Low Creativity Group.

No significant differences were found for sex. Sex was found to be a confounding variable and was eliminated from the final analysis.

Phase II of the study consisted of administering a modified Repertory Grid Test to all fifth and sixth grade students. However, instead of using Kelly's method of eliciting constructs from subjects, constructs were provided from Bannister's modified Repertory Grid. This was done so as to provide some basis for comparison between students and because elicited constructs tended to be trivial (as proven in a pilot test with ten fifth and sixth graders) and because there was research evidence
that supported the validity of provided constructs vs. elicited constructs.

Students were asked to list significant adults whom they knew personally and to rank order them in terms of most to least like the construct and to complete the grid by fitting in the numbers corresponding to the names on the slips of paper. These grids were then submitted to a Repertory Grid Analysis computer program which produced multiple correlations of constructs. The median and z-score was then calculated for each student. Analysis of Variance and tests of significance were then performed on the resulting data.

**Findings**

The first hypothesis, that creativity and intelligence represent two independent constructs or concepts which can be measured separately, was supported. The seven scores obtained from the tests were intercorrelated and the resultant matrix was factored using the principle axis method with squared multiple correlations as the main diagonals. Two of the factors had eigenvalues in excess of 1.00, and these rotated to simple structure using Kaiser's varimax procedure. Two distinct factors were obtained. This was interpreted as supporting the hypothesis that creativity (or divergent) measures were distinct from intelligence.
(on convergent) measures.

Therefore, from the results of the study the answer to the first question is "yes," there is a separate cognitive concept from intelligence which can be labeled creativity according to the definition specified.

However, because there is a high correlation between intelligence and creativity, the relationship between creativity and intelligence still remains highly ambiguous. As stated above, conclusions drawn depend, to a large extent, upon the types of instruments and the definition of creativity used. (The R.A.T.* is a case in point.)

In the second phase of the study the hypothesis that creativity or intelligence was related to loose or tight construing was not supported by the results obtained. Even although the results failed to support this hypothesis this may have been more a fault of the technique used than for any other reason. It may be that Kelly's Repertory Grid, since it uses social roles as elements and personality characteristics as constructs may not lend itself so readily to the learning-type process that was under investigation in this study. For example, it may be that some other instrument or a variant of the Grid Method may be more suitable to measure the differential "construing" system used by convergers and divergers.

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*Remote Associates Test
Another problem might have been that the subjects were too young and the method used too complex for them to deal with. Although they appeared to understand what was required some of their rank ordering may have been entirely randomized.

It might also be that at the fifth and sixth grade level the construct system is sufficiently 'loose' anyway. (This would account for the large percentage of low correlations or loose constructs in their Grid Matrices.) Perhaps it is only later that constructs became fairly 'tight'. To avoid this problem it might be interesting to experiment with an older, more mature group.

The type of population sampled in the study is much more varied than the Getzels-Jackson study and hence more representative of the fifth and sixth grade population of the nation as a whole. However, the sample was fairly select in that it was totally white, professional class children from a suburban setting. It would be erroneous, therefore, to generalize the findings beyond this type of group. There still needs to be further replications made of the study with larger and more diversified populations in order to substantiate the above findings.

It may be that since Kelly's Repertory Grid was intended to analyze individuals it may not readily lend itself to the type of mass statistical analysis attempted
here. A more refined technique of interpretation might have yielded more significant results. For example, it might be interesting to find out which constructs are most or least tightly construed for High Creative or High I.Q.s.

The findings also tend to support Bieri's hypothesis that this type of Repertory Grid measures only social interaction. Since this study investigated Cognitive Style perhaps a protocol using constructs associated with learning experiences might have yielded better results.

Further Research

It might be possible in future to utilize some form of the experiments of Heidbreder (1946), Baum, and Underwood to study the way in which divergent thinkers and convergent thinkers form concepts.

For example, Heidbreder presented a set of four stimulus objects to subjects followed by a four or five associative nonsense word such as "Relk," "Joft," or "Glift." Heidbreder hypothesized that concrete objects such as trees, hats, or faces would be learned more easily than abstract concepts such as "threeness" or "justice," which do not have a single objective referent. Her hypothesis was confirmed. Subsequently it might be found
that divergers formed "abstract" concepts more readily than convergent thinkers.

In another related experiment Underwood and Richardson restricted themselves to studying concept formations related to sense impression, i.e., such things as colors, shapes, sizes, textures, weights, smells, sounds, etc. Thus, when presented with the stimulus words:

atom, crumb, flea, gnat

"small" was the sensory associate to gnat in 76% of the cases, to crumb 79%, to flea 86%, and to atom 87% of the cases. In response to the word "eye," 32% responded with "round," 26% with blue, 10% with small, 8% with brown, and 6% with shiny.

Much research has been generated on the basis of these experiments, and it has been possible to compute average percentage probabilities for whole populations based on the studies. For example, the four stimulus words:

baseball, head, button, knob

the word "round" has an average probability of 66.25% while the word "hard" has an average associative probability of only 8.25%.

It would have been interesting in all of these experiments to find out if the responses having the lowest
associative probability came from the most highly creative subjects. It might be possible to adapt and scale Mednick's Remote Associates test to allow for varying degrees of probable responses with the most remote response coming from the most creative.

This might be the direction further research would take in investigating the individual differences approach to concept formation.

Implications

Bannister has demonstrated the way in which construct theory has implications for education. He states:

Children being taught arithmetic are shown methods for dealing with numbers in certain ways so as to get certain types of answers. They then move on to another subject, say algebra, to learn other ways of dealing with numbers. But what of the child who has found that arithmetical procedures are quite adequate for solving all the problems with which he has been presented? If at the end of his arithmetic construing system he could not deal, the experience of invalidation might have encouraged him to view algebra as a salvation rather than a pointless exercise. The experience of being 'wrong' is educationally as important as the experience of being 'right'.

It may be that subjects prefer one type of thinking as opposed to another and that this pattern has been reinforced throughout a child's life enabling one to label
him as being either a converger or a diverger.

With the current widespread interest in creativity and in helping children to express themselves, it is interesting to speculate what the long-term results might be. The emphasis today seems to be a general loosening up in educational circles. Alternative methods of teaching from the open classroom to various ways of motivating the child, particularly the discovery method, are being experimentally adopted. All of this is good. However, this very lack of structure can cause numerous problems for future generations. Too many divergent thinkers in the world might cause us to lose sight of the rigor that necessarily accompanies any scientific endeavor. As De Bono puts it,

Lateral thinking is not a substitute for vertical thinking. Both are required. They are complimentary. Lateral thinking is generative. Vertical thinking is selective.

In other words, it is necessary to use our imagination and intuition in the search for answers to problems, but in the search for solutions and the formulating of hypotheses we must not forget the role of convergent thinking also.
BIBLIOGRAPHY


Butcher, H. J. "Divergent Thinking and Creativity." In Advances in Educational Psychology 1, W. D. Wall and V. P. Varma (Eds.), University of London Press, Ltd., 1972.


1. Write your name and grade down.

2. Write down the name of 12 adults and/or friends on each of the numbered slips of paper.

3. Using the characteristics listed below, rank order the slips of paper before you and insert the number on the slip (not the name) in the squares below. For example, the first characteristic is "likeable". You would then decide who is the most "likeable" to the least likeable and insert the numbers in the squares below. Repeat this process for all 10 characteristics.

4. In number 11 you are required to rank order the people in terms of how like your personality they are. In number 12 you are to rank order the people in terms of whom you would like most to be like to least like to be like and fill in the appropriate numbers.

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