THE RELATIONSHIPS AMONG SELECTED VARIABLES OF CREATIVE THINKING AND VISUAL, AUDITORY, AND TACTUAL SENSORY PERCEPTION

APPROVED:

Graduate Committee:

Major Professor

Minor Professor

Committee Member

Dean of the School of Education

Dean of the Graduate School
THE RELATIONSHIPS AMONG SELECTED VARIABLES OF CREATIVE THINKING AND VISUAL, AUDITORY, AND TACTUAL SENSORY PERCEPTION

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By

George Pritchy Smith, B. A., M. Ed.
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CHAPTER I

INTRODUCTION

Creativity has emerged during the past two decades as a rich field for psychological and educational exploration. In 1950 Guilford pointed out that "... less than two-tenths of one per cent of the books and articles indexed in the Abstracts for the previous twenty-three years had dealt directly with the subject of creativity" (15, p. 445). During the time lapse between 1950 and 1960, many theories and research reports, frequently related only by coincidence, were published. Beginning with Torrance (43) in 1962 and Golann (12) in 1963, comprehensive reviews of literature attempted to synthesize and bring order to the growing knowledge about creativity. Two current reviews, one published by Nackler and Shontz (27) in 1965 and the other by Gowan, Demos, and Torrance (13) in 1967, represent similar efforts at synthesis.

These reviews indicate that most theory and research can be categorized into three flexibly defined areas of creativity: the process, the product, and the person. Pine and Holt, as early as 1960, said, "The study of creativity can begin from at least three different standpoints: the process, the product, and the person" (35, p. 371). Later, Golann's review
centered upon the same three areas as well as a fourth, measurement of creativity. Of course, other topical patterns have been used to organize the literature on creativity. Mackler and Shontz (27), for instance, have written an impressive review centered upon theoretical approaches--psychoanalytic, associational, Gestalt, existential, interpersonal, and trait. Nevertheless, process, product, and person are recurring themes.

This study rightly belongs with those investigations dealing with process. Emphasis is placed upon the relationship of perceptual input to behavioral output, the beginning and end of the creative thinking process. No attempt, however, has been made to study facets of the process occurring between input and output. Behavioral scientists have assumed that human beings explore their environment and systematize it in relationship to themselves and to their past experiences. Theoretically, they have assumed also that datum supplied by the eye, ear, touch, nose, and mouth was in some way responsible for the quality of response. Perhaps it is. This study is an investigation of the relationships among three creative thinking variables--fluency, flexibility, and originality--and the perceptual acuity of the visual, auditory, and tactual sensory modes.

Statement of the Problem

The problem of this study was the relationship between each of three variables of creative thinking--Verbal Fluency,
Verbal Flexibility, and Verbal Originality as measured by the Torrance Tests of Creative Thinking: Verbal Form A—and the perceptual discrimination of the visual, auditory, and tactual sensory modes.

Purpose of the Study

The primary purpose of this study was to investigate the relationship between each of three variables of creativity—Verbal Fluency, Verbal Flexibility, Verbal Originality—and each of nine measures of sensory perception. The nine sensory measures included three visual, three auditory, and three tactual tasks.

In the course of investigating this problem, two sub-purposes were included:

1. To determine which combination of sensory predictor variables best related to each creative thinking variable
2. To test the verity of the three theoretical propositions upon which this investigation was based.

Hypotheses

The relationships among creative thinking variables and sensory perception were investigated by testing the following hypotheses:

1. There will be a significant negative correlation between Verbal Fluency scores and each of the following sensory perception scores:
1. **Visual Length (of line) Discrimination**
   - **Visual Load Discrimination**
   - **Visual Shade Discrimination**
   - **Auditory Length (of tone) Discrimination**
   - **Auditory Pitch Discrimination**
   - **Auditory Decibel Discrimination**
   - **Tactual Length (of peg) Discrimination**
   - **Tactual Load Discrimination**
   - **Tactual Texture Discrimination**

2. There will be a significant negative correlation between Verbal Flexibility scores and the following sensory perception scores:
   - **Visual Length (of line) Discrimination**
   - **Visual Load Discrimination**
   - **Visual Shade Discrimination**
   - **Auditory Length (of tone) Discrimination**
   - **Auditory Pitch Discrimination**
   - **Auditory Decibel Discrimination**
   - **Tactual Length (of peg) Discrimination**
   - **Tactual Load Discrimination**
   - **Tactual Texture Discrimination**

3. There will be a significant negative correlation between Verbal Originality scores and the following sensory perception scores:
   - **Visual Length (of line) Discrimination**
   - **Visual Load Discrimination**
c. Visual Shade Discrimination
d. Auditory Length (of tone) Discrimination
e. Auditory Pitch Discrimination
f. Auditory Decibel Discrimination
g. Tactual Length (of peg) Discrimination
h. Tactual Load Discrimination
i. Tactual Texture Discrimination.

4. There will be a significant multiple correlation between the criterion of Verbal Fluency and the nine sensory predictor variables.

5. There will be a significant multiple correlation between the criterion of Verbal Flexibility and the nine sensory predictor variables.

6. There will be a significant multiple correlation between the criterion of Verbal Originality and the nine sensory predictor variables.

Background of the Study

The following model permits a speculative interpretation of the processes that occur as one moves from pure sensing toward creative output:
The individual encounters his environment through the sensory avenues, interprets this sensory input, then reacts—sometimes thinking creatively, sometimes not. The three main processes on the continuum—sensing, perceiving, and creative thinking—are ordered as most psychologists consider them. Ruch (38), for instance, places perception midway between sensing and thinking. In its purest form sensing does not involve past learning. Perceiving, however, utilizes both sensory data from present stimulation and past learning. Creative thinking, defined as the fusion of perceptions in a new way (24), is independent, though not necessarily so, of stimuli from physically present objects since it can be accomplished through the medium of symbols. It is misleading, however, to view the three processes as distinctly separate phenomena. First, it is difficult to distinguish clearly the point at which pure sensing ends and perceiving begins, particularly on an operational level for research. Furthermore, the process of creative thinking involves any one of the senses or a synthesis of any two or more. What is suggested is that sensory perception may not only be antecedent but also concomitant in its relationship to creative thinking.

The foregoing model is tentative but functional. It is tentative until, first, a relationship between sensory perception and creative thinking can be shown to exist and, secondly, until the true sequential nature of the relationship
can be proven. It is functional as a broad theoretical framework within which to view the three specific propositions about creative people that are relevant to this investigation.

**Proposition I:** Creative people are more sensitive to their environment than are less creative people.

Many theorists, Adler (2), Fromm (11), Moreno (32), Lasswell (22), Schachtel (39), and Tumin (46), stress that creative people are more sensitive to their environment, that they are more aware of the world in which they live. Carl Rogers believes that one of the three qualities characteristic of a potentially creative person is an "openness to experience: extensionality" (37, p. 75). MacKinnon describes the creative person as "open to experience both of the inner self and the outer world" (26, p. 3). Rollo May says, "Creativity is the encounter of the intensively conscious human being with his world" (31, p. 68).

**Proposition II:** Being more open through their sensory modes, creative people have more acute perceptual discrimination than do less creative individuals.

It is suggested that when theorists use concepts such as a greater "openness to experience" and a more intense "encounter with the world" to describe creative persons, they imply that on the operational level creative persons are more open through their sensory modes and therefore have keener perceptual discrimination than do less creative individuals. Some psychologists (30, 6, 37) emphasize that
there is a strong relationship between perception and creativity, but they speak almost exclusively of higher level kinds of psychological perception rather than of a specific ability to perceive accurately on a sensory level. Gowan's summary of Hollister's theory, for instance, illustrates the kinds of perception most often mentioned as being related to creativity:

Fostering discrimination in the growing child between self, between reality and fantasy, and body-feelings, ideal self and real self, means and ends, concrete and symbolic all help a child to become more mentally healthy and therefore more creative (13, p. 82).

However, a few authorities do relate sensory perception to creativity. These authorities constitute two groups: those who have conducted research which suggests that there is a relationship between sensory perception and creativity and those theorists who have speculated about the nature and sequence of that relationship.

The former have contributed two studies which lend indirect support to the premise that creative people have keen perceptual discrimination. First, administering creativity tests under varied conditions of visual and kinesthetic stimulation, Mackler and Shontz (23) found art majors and dance majors, who supposedly possessed a superiority in the visual and kinesthetic sensory modalities, to be more creative than visually handicapped and physically but not visually disabled people. Kaplan and Singer (20) found that open-minded subjects had keener olfactory, gustatory, tactual,
auditory, and visual sensitivity than did closed-minded subjects. While this study did not deal directly with creativity, it does permit one to infer that creative people, like open-minded individuals, have keen sensory perception since the two possess many of the same personality and intellectual traits. In fact, open-mindedness seems to be a necessary condition for what Guilford terms divergent thinking (17). Furthermore, the close relationship between creativity and open-mindedness is clarified by Gowan, who says, "Investigations with the California Psychological Inventory, for example, show that flexibility (creativity) and tolerance (lack of authoritarianism) are well correlated" (13, p. 11).

In addition to research, theorists who have described the sequence of the relationship between sensory perception and creativity provide a second line of support for Proposition II. Parnes suggests that keen sensory perception is antecedent and contributive to creative output in a description of a creative problem-solving course at the University of Buffalo. He says, "Perceptual, emotional, and cultural blocks are demonstrated in the course. Under perceptual blocks are covered such matters as . . . failure to use all the senses in observing" (33, p. 34). Parnes' premise is congruous with the model on page 5 and is congruous with the thinking of most theorists; for if by definition creativity is the fusion of perceptions in a new way (24) or the molding of experiences into new organizations (42), the implication is clear that
acute sensory perception precedes and contributes to creative thinking. Few theorists, if any, have entertained the possibility that a creative state of mind precedes sensory acuity or that a reciprocal relationship exists. The question of sequence, however, is not the purpose of this investigation and is relevant here only because the fact that theorists have discussed it lends theoretical support to the premise that any relationship exists at all.

Proposition III: While people tend to develop distinct sensory styles, thus preferentially creating a dominance and superiority of perceptual acuity in a single sensory modality, creative people exhibit an over-all superiority of perceptual discrimination in all sensory modes that less creative individuals do not possess.

The findings of the Kaplan-Singer study suggest this third proposition concerning the interactive and supportive nature of sensory perception in the creative person. Finding open-minded people superior in all perceptual modes led Kaplan and Singer to conclude:

... closed-mindedness and open-mindedness are not phenomena which appear in some areas of an individual's living and not in others, but much more they are pervasive phenomena, the closed-minded is not only closed-minded vis-a-vis personal and highly autocentric experience, he is also closed vis-a-vis objectifiable data. Conversely, the open-minded person exhibits this orientation vis-a-vis both autocentric experience and objectifiable data (20, p. 130).
At first, an over-all superiority would seem to be contrary to the theories of Adler (2), Revesz (36), Lowenfeld (23), and Mackler and Shontz (28), which maintain that individuals tend to develop a distinct sensory style; i.e., primarily a visual style, a kinesthetic style, et cetera. The two viewpoints are not contradictory, however. It is maintained here that creative persons not only exhibit superiority in a single sensory style but also have an over-all organismic kind of superiority in perceptual acuity. The nature of sensory function in creative people is one in which openness in one sensory mode is interactive and supportive of the other sensory modes. Thus, the creative person actually sees, hears, smells, touches, and tastes more discriminately than does the less creative counterpart.

In summary, three propositions form the theoretical basis for an investigation of the relationships among selected variables of creativity and the perceptual acuity of the visual, auditory, and tactual sensory modes:

I. Creative people are more sensitive to their environment than are less creative people.

II. Being more open through their sensory modes, creative people have more acute perceptual discrimination than do less creative individuals.

III. While people tend to develop distinct sensory styles, thus preferentially creating a dominance and superiority of perceptual acuity in a single sensory modality, creative
people exhibit an over-all superiority of perceptual discrimination in all sensory modes that less creative individuals do not possess.

Significance of the Study

This study was significant for three reasons. First, the bulk of existing knowledge has dealt with the relationship between creativity and intelligence (9, 45, 8, 10, 52), social environment (5, 3, 54, 41, 49, 7), and personality traits (25, 26, 48, 4). Little, if any, research has been conducted to investigate directly the perceptual acuity of creative people. Secondly, this study will put three theoretical propositions about creative people to an experimental test. Findings related to these propositions will add to knowledge about creativity and fill in gaps in present theory. Third, long-range significance lies in this study's laying the groundwork for studying the sequence of the relationship between creativity and perceptual acuity. In the future, should perceptual acuity prove to contribute significantly to the creative process, experimental evidence will support planned perceptual training in the public schools.

Definition of Terms

For the purposes of this study, the following definitions were established:

1. Creativity is "a process of becoming sensitive to problems, deficiencies, 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 restating these hypotheses and possibly modifying and retesting them; and finally communicating the results" (44, p. 6).

2. Creative thinking refers specifically to Guilford's divergent thinking factors—fluency, flexibility, and originality—as reflected by verbal communication. These four creative thinking abilities constitute the essence of the thought processes which are necessary to fulfill Torrance's definition of creativity as quoted above.

3. Difference Limen (DL) is a numerical representation of one's perceptual discrimination or the smallest amount of stimuli change that the subject can perceive 50 per cent of the time.

Limitations of the Study

1. This study was limited in that it was impossible to construct tasks in different sensory modalities which could be deemed equal in difficulty. Thus, there was no way to tell whether the visual tasks were comparable to the auditory or the tactual tasks, et cetera.

2. This study was limited in that the errors of habituation and anticipation were only partially controlled by the randomization techniques used in developing the perception tests.
Description of the Instruments

The Torrance Tests of Creative Thinking: Verbal Form A is composed of five sub-tests. According to Torrance, "Ask and Guess" captures the essence of creative thinking. The Asking Activity measures one's sensitivity "to what is unknown, to gaps in knowledge" (44, p. 10) since he is required to ask questions which cannot be answered by simply looking at a picture. The Guess Causes and Guess Consequences Activities reveal the subject's ability to hypothesize cause and effect. Together the "Ask and Guess" activities yield fluency, flexibility, originality, and elaboration scores. The fluency score is the number of relevant responses; the flexibility score represents the number of different categories of questions, causes, or consequences; the originality score is the statistical infrequency of these responses; and the elaboration score is the detail incorporated into the questions and hypotheses.

Regarded as one of Torrance's most reliable measures with a high degree of face validity, the "Product Improvement Test" requires subjects to think of unique ways to improve a stuffed toy. The task permits the subjects "to 'regress in the service of the ego' and . . . play with ideas that they would dare not express in a more serious task" (44, pp. 11-12). The task yields fluency, flexibility, originality, and elaboration scores.

In "Unusual Uses" the subject is confronted with a situation in which he must list interesting and unusual uses
for cardboard boxes. To respond productively requires the ability to free one's mind of a well-established set (44). Like the previously described test, "Unusual Uses" yields four scores.

The "Unusual Questions Activity" is designed to assess "divergent power" by asking the subject to list unusual questions about cardboard boxes. The task yields only fluency and originality scores.

In the "Just Suppose Test" the subject is asked to predict the possible outcomes from the introduction of a new variable into an impossible situation. The subject must "play with" the possibility and imagine all of the consequences. The task yields fluency, flexibility, and originality scores.

At least three different kinds of scores—individual sub-test scores on fluency, flexibility, and originality; single factor scores for fluency, flexibility, and originality; and composite creativity scores—can be derived from Verbal Form A. Each sub-test yields a score for fluency, flexibility, and originality, but two of the sub-tests do not yield an elaboration score. In fact, since the Personnel Scoring Service has not yet established a satisfactory scoring procedure for elaboration, it presently provides no scoring service for elaboration on any of the verbal tests. Single factor scores, recommended by Torrance (44, p. 72) as the most useful, are derived by summing all sub-test scores for a single variable; thus, a single fluency score may be derived adding the
five fluency scores from the five sub-tests. A composite or total creativity score, however, may be derived by first obtaining single factor scores for fluency, flexibility, and originality, then obtaining a total of these three scores. While some research studies have used the composite or total creativity score (50, 34) as an index of one's total amount of creative energy, Torrance says, "... such a practice is not recommended" (44, p. 72). Having used both single factor and composite scores, Yamamoto (51) found that a composite score does not add significantly to the predictive validity of the verbal tests.

Reliability and Validity

While the Torrance Tests of Creative Thinking are relatively new, the 1966 Norms-Technical Manual (44) reviews available studies on reliability and validity. The only reliability coefficients reported, however, are test-retest correlations between Form A and Form B rather than between different testings of Form A. In addition, only two studies are reported using samples of college students. Dalbec (1966) reported test-retest reliability coefficients of .59 for Verbal Fluency, .35 for Verbal Flexibility, .73 for Verbal Originality. Using battery totals, Sommers (1961) found reliabilities of .97 and .80 for two college samples. Reviewing fifteen reliability studies, Holland (19) reports that the majority of the reliability coefficients exceed .70. Yamamoto
(53) found reliability coefficients of .83 and .73 over a ten-week time interval for college samples on fluency and "good quality responses."

Because people behave creatively in diverse ways and since myriad definitions of creativity exist, Torrance submits that "the concept of an overall validity coefficient for tests of creative thinking ability is grossly inappropriate" (44, p. 23). Some support, however, has been collected on content, construct, concurrent, and predictive validity. To insure content validity, Torrance made a deliberate effort to base test stimuli, test tasks, instructions, and scoring procedures on the best theory and research available. He does not, however, report intercorrelations among measures derived from the sub-test scores of college students. Among elementary children attitudinal rigidity correlated -.37, -.40, and -.32 with originality, fluency, and flexibility (Fleming and WcIntraub, 1962). Yamamoto (1963) found correlations of .49 and .51 between a composite creativity score and originality in the imaginative stories of elementary children. A correlation of .79 between ESP scores and scores on the "Unusual Questions Test" and a correlation of .52 between the Creative Motivation Inventory and the Unusual Questions Test have been reported for junior high students.

Despite criticism, Torrance regards peer nominations, sales productivity, and achievement as criteria of concurrent validity. He has found that elementary children who were
chosen by their peers as being creative also scored significantly higher on creative thinking tasks than those who received no nominations. Wallace (1961) found that saleswomen of "creative service departments" scored significantly higher on fluency, flexibility, inventiveness, and originality than did saleswomen of "non-creative departments." Bish (1964) found significant correlations ranging from .36 to .42 between verbal creativity measures and CAT scores. Circelli (1965) found that combined fluency, flexibility, and originality scores correlated .32, .26, and .26 respectively with the Gates Reading Test, California Arithmetic Test, and the California Language Test. Duenk (1966) found that combined verbal and figural measures of fluency, flexibility, originality, and elaboration correlated from .47 to .77 with Industrial Arts Performance. Similar wide ranges of correlations have been reported between measures of creativity and the Miller's Analogy Test (Bentley, 1966) and measures of intelligence (Hutchinson, 1963) (Bowers, 1966).

Long-range studies of predictive validity are few. Erickson (1966) found that college graduates' originality, elaboration, and total creativity scores correlated significantly with the majority of the individual creative activities of a check list. Examples of "creative activities" were "wrote a poem," "subscribed to a professional magazine," "received grant for original research," et cetera.
Perceptual Discrimination Tasks

Three visual, three auditory, and three tactual tasks were designed for this study. Each was designed in accordance with the Method of Constant Stimuli, regarded by Guilford (16, p. 118) as the most accurate of the psychophysical methods. While the Method of Constant Stimuli has long been used to measure sensory acuity (1, 16, 29, 40, 47), only recently have attempts been made to use the method to detect sensory styles of individuals in relationship to personality and intellectual traits. Kling (21), however, recently used the Method of Constant Stimuli in developing diagnostic tests for determining the auditory and visual sensitivity of individuals and groups for placement and teaching. This method permitted the computation of a DL (difference limen), a numerical representation of each subject's perceptual discrimination.

The same basic procedure was used to develop the nine sensory tasks. For each task a given number of stimuli varying in equal measurement apart was selected from a range proven to be well within human sensory ability, barring, of course, extreme physical impairment. Next, a standard or constant stimulus, the mid-point of the range, was chosen to be presented in temporal sequence with each of the comparative stimuli. It was then decided that six presentations of each comparative stimulus with the standard would be sufficient to obtain a valid measurement of perceptual discrimination. The
order of presentation was determined randomly. First, a table of random numbers was used to determine whether the standard stimulus would be presented before or after the comparative stimulus in each trial. Secondly, the comparative stimulus for each trial was determined by drawing numbers from a box until each comparative stimulus had been selected six times.

Following the procedure outlined above, each perceptual task was designed with forty-eight trials—with the exception of the sandpaper tactual task which had only twenty-four trials. Each comparative stimulus was paired six times with the standard stimulus, with the subject having to indicate whether the second stimulus of each trial had greater or less sensory value than the first. Testing time for each perceptual task was approximately twenty minutes.

A brief description of each perceptual task, the materials, and the technical procedures used in developing each task follows:

**Visual Length Task**

The Visual Length Task required the subject to discriminate between black lines which were graded in steps of 1/16 inch, four lines being longer and four shorter than the standard. The standard line was 2 inches while the comparative lines were 1 3/4, 1 13/16, 1 7/8, 1 15/16, 2 1/16, 2 1/8, 2 3/16, and 2 1/4. The subject responded to the second stimulus of each trial by recording an "L" for longer or "S" for shorter on the answer sheet. This task was constructed by
centering strips of black tape, cut the specified stimulus lengths, upon 5 x 5 inch white cards.

**Visual Load Task**

The Visual Load Task required the subject to perceive differences between groups of dots which varied in density, four groups having more and four groups having fewer dots than the standard. The standard stimulus had 25 dots, whereas the comparative stimuli had 21, 22, 23, 24, 26, 27, 28, and 29 dots. The subject responded by recording "M" for more and "F" for fewer. This task was constructed by pasting black dots, punched from black construction paper, on white construction paper. The dots in each group were arranged without identifiable patterning within a circle having a 6-inch diameter. Once the order of presentation was determined, the trials were filmed by an 8 millimeter Kodak movie camera on Super 8 millimeter color film.

**Visual Shading Task**

The Visual Shading Task required the subjects to perceive differences between varying shades of gray. The standard was a gray obtained by a 14 second camera lens exposure while the comparative stimuli were 10, 11, 12, 13, 15, 16, 17, and 18 second exposures. The subject responded "L" for lighter and "D" for darker. The different shades of gray were obtained by using a constant lens setting and exposure time with 1 second intervals. All shades were developed for 1 1/2 minutes with
1 1/4 minutes agitation and 1/4 minute still development in Kodak Dektol Developer at 68°F. All exposures were developed on the same piece of F4 photographic paper to eliminate time and temperature variables.

**Auditory Length Task**

The Auditory Length Task, recorded on tape, required the subject to discriminate between varying lengths of A440 cycle tone. The stimuli were graded in 1/4 seconds, four being longer and four shorter than the standard. The standard tone was 3 seconds long while the comparative stimuli were 2, 2 1/4, 2 1/2, 2 3/4, 3 1/4, 3 1/2, 3 3/4, and 4 seconds. The subject responded with "L" or "S". Accuracy in obtaining length differences of 1/4 second was made possible by first recording 10 minutes of A440 tone, then calculating the inches of tape that were equal to 1/4 second of playing time on a Wollensak tape recorder played at a speed control of 7 1/2. The tape of A440 tone was cut according to the number of inches needed for each stimuli, then spliced with intermittent lengths of leader tape to give 2 seconds between each stimuli and 7 seconds between each trial.

**Auditory Pitch Task**

The auditory Pitch Task, also taped, required the subject to discriminate between pitches graded in intervals of 1/126 of an octave. The standard pitch was A^b (415.31 cycles per second). The comparative stimuli were A^b 415.31 - 1/126,
- 3/126, - 2/126, - 1/126, +1/126, +2/126, +3/126, +4/126 of an octave. The subject responded with "H" or "L". This task was made in the NTSU Electronic Music Composition Laboratory on a Moog Electronic Synthesizer I. A basic sine wave sound was recorded on an Ampex Model 354 tape recorder at 7 1/2 inches per second on 1/4 inch Scotch 201 magnetic tape. All factors, pitch, timbre, amplitude (70 decibels), were held constant. A 2-second interval of silence was used between each tone, and a 7-second interval was used between trials.

Auditory Decibel Task

The Auditory Decibel Task, also on tape, required the subject to perceive differences in loudness of a 500-cycle tone as generated by a Beltone 10C Audiometer. The standard dial setting was 100 decibels, while the comparative stimuli settings were 96, 97, 98, 99, 101, 102, 103, and 104 decibels. The subjects indicated whether the second tone was "louder" or "softer." A Beltone 10C Audiometer was wired directly into the tape recorder described above in order that a 500-cycle tone of varied decibel settings could be recorded without interference of extraneous noise. The kind of tape and the silence intervals used were the same as those for Auditory Pitch Task.

Tactual Length Task

The Tactual Length Task required the blindfolded subject to perceive differences between pegs graded in steps of 1/16
inch. The standard and the comparative stimuli matched the lengths used in the Visual Length Task. The subject verbalized "longer" or "shorter" to the test administrator who recorded the response on the answer sheet. Pegs were cut the specified stimulus lengths from 3/8-inch dowel rod, then placed in small blocks which served as holders. All work was done in the NTSU Industrial Arts Department.

**Tactual Load Task**

The Tactual Load Task required the blindfolded subject to perceive differences between groupings of raised characters which were similar to Braille dots. The standard had 15 characters. The comparative groupings had 11, 12, 13, 14, 16, 17, 18, and 19 characters. The subjects responded "more" or "fewer." The period on an IBM elite typewriter was used to put the raised character groupings on 2 x 2 inch cards of thick paper. The pressure dial on the typewriter was held constant on 8 for all stimulus cards. A wooden holder was designed with a slot in order that the subject's finger could be guided easily.

**Tactual Texture Task**

The Tactual Texture Task required the blindfolded subject to perceive differences between sandpaper samples which were graded by the manufacturer as 2/0, 3/0, 5/0, and 6/0. The standard was 4/0. The subject responded "rougher" or "smoother." Sandpaper sheets of 2/0, 3/0, 4/0, 5/0, 6/0 were cut into
3 x 3 inch squares and mounted on 5 x 5 inch wooden blocks.

Pilot Study on Sensory Acuity

During the fall semester of 1968, a pilot study was conducted on fifteen volunteer freshmen from Psychology 163 classes to determine (1) the best procedures for administering the tasks, (2) whether undergraduates could be trained to give the tasks, and (3) the discriminatory value of each perceptual task. The best procedures determined from the pilot study are outlined in the sections entitled Perceptual Discrimination Tasks. It was also found that undergraduates with a thirty-minute training session and two or three practice trials could administer the tasks.

It was decided that the perceptual tasks did discriminate, although some were more discriminating than others. The decision was an intuitive one based upon examination of the range and the dispersion of scores along the range of each task. The number of possible right responses for each of the tasks was forty-eight with the exception of the Tactual Texture Task which had only twenty-four possible right answers. For Visual Length, $R$ was 11; for Visual Load, $R$ was 11; for Visual Shade, $R$ was 6; for Auditory Length, $R$ was 11; for Auditory Pitch, $R$ was 23; for Auditory Decibel, $R$ was 17; for Tactual Length, $R$ was 9; for Tactual Load, $R$ was 17; for Tactual Texture, $R$ was 10.
Procedures for Collecting the Data

Selection of the Subject
Population

One hundred twenty-five subjects were randomly drawn from an original population of two hundred volunteers enrolled in Psychology 163 during the spring semester of 1969 at North Texas State University. All one hundred twenty-five subjects were administered the Torrance Tests of Creative Thinking, Verbal Form A. However, due to withdrawal from school and absenteeism because of illness, activities conflicting with the testing schedules, and similar circumstances, not all the randomly drawn subjects were used in the study. Those with incomplete data on any of the ten instruments were dropped from the study. Consequently, a total of ninety students served as subjects.

Procedures for Administering Tests

Subjects were administered the Torrance Tests of Creative Thinking, Verbal Form A and nine perceptual discrimination tasks. All creativity tests were administered during each student's regular classtime, to different sized groups, but never to groups exceeding twenty subjects. The tests were scored by Personnel Press Scoring Service, which utilizes scorers trained by Dr. Torrance. (Coefficients of reliability for scoring are generally in excess of .90.) The perceptual acuity tasks were administered in the evenings at times when rooms were available for testing.
Procedures for administering the perceptual acuity tasks varied according to the specific task. The Visual Load Discrimination task and the three auditory tasks were administered to small groups of ten subjects. The remaining tasks—Visual Length Discrimination, Visual Shade Discrimination, Tactual Load Discrimination, and Tactual Texture Discrimination—were administered individually.

Several precautions were taken to control relevant variables. First, while eighteen different people administered the perceptual acuity tasks, the same two persons administered each perceptual task to all subjects. Secondly, subjects were seated approximately ten feet from the movie screen and the tape recorders for the Visual Load Discrimination and the three auditory tasks. Third, volume control on the tape recorders was held constant. Fourth, to control the space error in tactual measurement, subjects alternated from the index finger of the right hand to the index finger of the left hand on half the trials. Since the Tactual Load and Tactual Texture stimuli tended to wear down with use, identical but new test materials were substituted throughout the testing. The standard was changed twenty-five times; the comparative stimuli, five times for the Tactual Load Task. For the Tactual Texture Task the standard was substituted twelve times; the comparative stimuli, two times. (See Appendix B for instructions used in administering the perceptual tasks.)
Treatment of the Data

Preliminary treatment of the data was conducted in the following manner:

1. Composite Fluency, Flexibility, and Originality scores were obtained for each subject by summing the sub-test scores.

2. Each subject's DL for each perception task was computed. A frequency distribution of each subject's responses was made for each perceptual task. The probable error, which was the subject's DL, of each of these distributions was computed.

The tenability of the hypotheses of this study was tested in the following manner:

1. Hypotheses 1 through 3 were tested by computing a Pearson product moment correlation between the scores of each creative thinking variable and the scores of each perception task.

2. Hypotheses 4 through 6 were tested by using multiple correlation regression analysis. An F test was used to test for statistically significant differences between multiple correlations.

3. The .05 level of significance was required throughout the study.


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CHAPTER II

REVIEW OF RELATED LITERATURE

The literature for this investigation of the relationship between creative thinking and sensory perception is organized into three sections dealing with theory and research supportive of the three theoretical propositions presented in Chapter I. Cognitive perception in relation to creativity is emphasized in the literature concerning Proposition I. The literature relevant to Proposition II deals primarily with sensory perception, its relationship to cognitive perception, and its relationship to creativity. Cross-modal sensory functioning is emphasized in the literature relevant to Proposition III.

The distinction between sensory perception and cognitive perception is important in the literature reviewed for the three theoretical propositions. Sensory perception refers to what is often called psychological perception, thus "sensation plus meaning" (11), rather than pure sensation since it is impossible to measure one's sensory acuity as it exists apart from past experience. Cognitive perception, on the other hand, describes states of perceptual fluidity and solidity on an ideational level at some point along the perceptual continuum beyond immediate sensory impressions. Cognitive perception
refers to such concepts as "perceptual openness," "open- and closed-mindedness," and "field-independent" and "field-dependent" cognitive structures.

**Proposition I:** Creative people are more sensitive to their environment than are less creative individuals.

Proposition I suggests that cognitive perception, specifically perceptual openness, is related to creative thinking. Theorists, many of whom were mentioned in Chapter I, believe that creative people are intensely aware of the world in which they live. These theorists place emphasis upon cognitive rather than sensory perception. Jackson and Messick, for instance, describe the creative person as possessing a "fluidity of conceptual systems" (22, p. 325) and an "intellectual fluidity" which permits them "... to perceive objects in their own right--independent of their symbolic representation, their stereotyped function, or their relatedness to the immediate needs of the viewer" (22, p. 326).

Three theorists--Carl Rogers, Rokeach, and Witkin--have well defined theoretical formulations concerning the relationship between perceptual openness and creativity which, because of their representative nature, merit review. Carl Rogers believes that one of the three qualities characteristic of a potentially creative person is an "openness to experience: extensionality" (34, p. 75). Openness, he adds, seems the opposite of psychological defensiveness.
In a person who is open to experience each stimulus is freely relayed through the nervous system, without being distorted by any process of defensiveness. Whether the stimulus originates in the environment, in the impact of form, color, or sound, on the sensory nerves, or whether it originates in the viscera, or as a memory trace in the central nervous system, it is available to awareness. This means that instead of perceiving in predetermined categories... the individual is aware of this existential moment as it is, thus being alive to many experiences which fall outside the usual categories... It [openness] means a lack of rigidity and permeability of boundaries in concepts, beliefs, perceptions, and hypotheses (34, p. 75).

Related to Roger's concept of "openness to experience" is Rokeach's open-mindedness. Although his early work did not investigate the relationship between open-mindedness and creativity, Rokeach (35) has recently suggested that open-mindedness may be a precondition for creativity. "Openness to experience" and "open-mindedness" are not synonymous, but both bear some similarities. For instance, the open-minded individual, contrasted to the closed-minded individual, is open to contradictory beliefs. Rokeach views his theory of open- and closed-mindedness as having three major dimensions: a belief-disbelief dimension, a central-peripheral dimension, and a time perspective dimension. A person's system is open to the extent that he can "... receive, evaluate, and act on relevant information received from the outside on its own merits, unencumbered by irrelevant factors in the situation arising from within the person or from the outside... Conversely, the more closed... the more difficult should
it be to distinguish between information received about the world and received about the source" (36, p. 57).

Other cognitive styles which are similar to perceptual openness and which have been related to creativity in theory are Witkin's field-dependence and field-independence (53). One major difference between field-dependent and field-independent persons is their respective relationship to their environment. The field-dependent person is unable to function independently of environmental support; he is characterized as somewhat passive, lacking initiative and activity; and he readily submits to authority. Conversely, the field-independent people, often called "analytical perceptual performers" are characterized by "... activity and independence in relation to the environment ..." (53, p. 469). Spotts and Mackler (44) make more specific distinctions between the two. While both are responsive to environmental influence, the field-dependent person "... lacks the capacity to organize and integrate effectively both inner experience and environmental events" (44, p. 243). The field-independent person exhibits "... a greater more articulated awareness of his own inner experiences and environmental events ..." and an "... unusual capacity to remodel and reconstitute them in new patterns ..." (44, p. 243). While Witkin has not centered his research upon the relationship between creativity and field-dependent and field-independent perceptual orientations, he does point out, as others (44) have noted, that Wertheimer
postulated that "... problems that call for a high degree of creativity ... also require that the 'parts' be separated from the contexts in which they are embedded and brought into new relationships" (53, p. 477).

There is, however, some controversy over whether or not Witkin's "field-independence" and Rokeach's "open-mindedness" are actually the same psychological phenomena. Spotts and Mackler (44) imply that the two concepts are very similar; Rokeach (36) and Bloomberg (6) suggest that they are not precisely the same. Open- and closed-minded people, for instance, differ on perceptual synthesis but not on perceptual analysis; whereas, field-independent and field-dependent people differ on perceptual analysis (36). Both concepts, however, appear to be a kind of perceptual openness, and both with their kinship to perceptual analysis and perceptual synthesis seem necessarily related to the creative process.

In addition to theoretical support, some experimental evidence exists which supports the premise that perceptual openness is related to creativity. Administering Rokeach's Dogmatism Scale and Mednick's Remote Associates Test to graduate students, Jacoby (23) found a correlation coefficient of -.248 which failed to reach statistical significance. However, the results were in the predicted direction since Jacoby hypothesized an inverse relationship between scores on the Dogmatism Scale and the creativity test. Jacoby concluded that "... the results are suggestive" (23, p. 822). Schulman
found more impressive evidence. Using eighty-nine subjects from academically advanced fourth grade classes in an almost exclusively Negro neighborhood, he used the Drawing Completion Test (DCT) as a measure of creativity and the Changing Figures Test (CFT) and the Finding Enclosed Areas Tests (FEAT) as measurements of perceptual openness. The correlation between the DCT scores and the CFT scores was -.23, indicating a small but significant relationship in the predicted direction. The correlation between creativity scores and the FEAT was .48, significant at the .01 level. Noting that all the seventeen subjects who scored highest on the creativity measure (DCT) except one also scored above the mean on the FEAT and that 40 per cent of those who scored above the mean FEAT score scored below the mean DCT score led Schulman to conclude that "creativity presupposes openness in perception but that people who are perceptually open are not necessarily creative" (40, p. 93). Similarly, after investigating the relationship between dogmatism and value patterns, life history, and counseling, Kemp concluded that "it becomes increasingly clear that the highly dogmatic individual is less likely to live the more creative individualized life of the one less hampered by the effects of dogmatism" (25, p. 75).

A few studies have studied the relationship between creativity and field-independence. Beirri, Bradburn, and Galinsky (3) found only a slight relationship between the two variables. Getzel and Jackson's study (15) yielded
inconclusive evidence. Only Spotts and Mackler (44) have clearly found field-independent persons to be more creative than field-dependent persons. One hundred thirty-eight undergraduate male college students were administered four creative thinking tests—Ask and Guess, Circles, Decorations, and Tin Cans—and two measures of perceptual field-independence—Witkin's Embedded Figures Test and Jackson's Hidden Figures Test. Spotts and Mackler found that "individuals with field-independent cognitive styles were consistently more creative in the tasks used in this study than individuals with field-dependent orientations" (44, p. 239).

Research investigating the creative person's preference for complex and simple stimuli provides an indirect line of evidence for Proposition I. If creative people are more cognitively open to their environment than less creative people, then they can confront and make better use of disorder and complexity than can less creative people. Lee (28) measured the ability of high creative and low creative college students to attend to and utilize personal and impersonal cues. He found that both male and female "creatives" performed better on the test which required attention to a variety of personal cues. The better performance on variety of person-cues, in turn, significantly related to better performance on variety of impersonal cues. The magnitude of the correlations (.22 and .27), however, was low, and findings were only suggestive. Taylor and Eisenman (48) obtained more impressive
findings between high creative and low creative art students. Subjects were selected by an art teacher as high or low in creativity, then asked to select their three most-preferred, three least-preferred, three most-meaningful, and three least-meaningful polygons from a set of twelve. Subjects were also administered the Creative Design Test which required each to create his own designs. High creative subjects not only selected significantly (.01 level of confidence) more complex designs but also created significantly (.001 level of confidence) more complex designs. Similarly, Barron (2) found that creative persons, both artists and scientists, chose much more frequently disorderly and irregular designs, whereas average people chose orderly, symmetrical designs.

In summary, the proposition that creative people are more sensitive, thus more open, to their environment than less creative people finds support both in theory and research. Many theories, particularly those of Rogers, Rokeach, and Witkin, are in agreement that creativity and perceptual openness are related. Research findings are less decisive, particularly in view of contradictory findings. Overall, however, it must be said that the weight of the evidence, whether perceptual openness is operationally defined as open-mindedness, field-independence, or sensitivity to complexity, does show a tendency toward experimentally establishing that a relationship between creativity and perceptual openness does exist.
Proposition II: Being more open through their sensory modes, creative people have more acute perceptual discrimination than do less creative individuals.

While Proposition I suggests that creative people are more open on a cognitive level, Proposition II proposes that creative people are also more open through their visual, auditory, tactual, olfactory, and gustatory sensory modes. Furthermore, it suggests that when theorists use concepts such as a greater "openness to experience," "open-mindedness," and "field-independence" to describe creative persons, they imply that creative persons also have keener perceptual discrimination on a sensory level than do less creative individuals. Sensory openness, then, can be operationally defined for purposes of measurement as the ability to discriminate between sensory stimuli.

Proposition II rests upon two lines of evidence. First, while the contradictions have not clearly been resolved, theoretical and experimental evidence fairly well support that perceptual openness on a cognitive level is related to creative thinking. If it can be shown by theory and research that perceptual openness on a cognitive level is related to sensory openness, measured as sensory acuity, then a relationship between creativity and sensory acuity can possibly be shown to exist. The second line of evidence rests upon related research concerning sensory deprivation and sensory styles.
Schactel (39) posits a theoretical explanation of the relationship between cognitive perception and sensory perception. He suggests that cognitive openness is inextricably intertwined with sensory openness. To Schactel two basic perceptual modes are evident: the autocentric mode and the allocentric. The autocentric mode is subjective, relatively incapable of objectifying what one senses. Theallocentric mode is more objective. Whereas the autocentric mode is more related to inner feelings and self-awareness, the allocentric mode enables one to attend to the physical, objective properties of the outer world. As Kaplan and Singer (24) have noted, Schactel's theory proposes that the various sensory modalities are primarily allocentric or autocentric. The visual, auditory and tactual modalities, being more capable of objectifying the world, are primarily allocentric although they may at times stimulate subjective experience within the organism. The olfactory and gustatory modalities are primarily autocentric, stimulating subjective experiences and feeling tones rather than denoting specific physical properties and shapes of stimuli in the environment. What Schactel suggests, as have others (24), is that cognitive openness is an extension of sensory openness. Theoretically, sensory openness with its close kinship to perceptual openness may be a necessary condition for creativity. As Schactel says it, creativity is the "art of seeing the familiar fully in its exhaustible
being, without using it autocentrically for purposes of remaining embedded in it and reassured by it" (39, p. 184).

Two studies support Schactel's theory. Basing their research upon theoretical formulations borrowed from Schactel and Rokeach, Kaplan and Singer (24) investigated the sensory openness of open- and closed-minded people. Those subjects whose dogmatism scores were in the upper third of a random distribution constituted the closed-minded group; those who scored in the lower third constituted the open-minded group. Hypothesizing that the closed-minded group would exhibit significantly lowered sensory acuity than would the open-minded group, the experimenters administered to each subject olfactory, gustatory, tactual, auditory, and visual discrimination tasks. When comparisons were made, significant differences in favor of the open-minded group were found on all sensory tasks except the visual. Although the difference was not statistically significant on the visual task, a difference was observed in the predicted direction. Another study, conducted by Moore (31), reinforces the Kaplan-Singer findings. Moore, who used verbal reinforcements which required the subject to attend to auditory and visual cues, found

\[\ldots\] that low dogmatic persons are more attuned to and accepting of all incoming information, including the reinforcements of the experimenter

\[\ldots\] high dogmatic persons seem to be literally more 'closed' to the objective meaning of incoming stimuli (31, p. 41).
Both the Kaplan-Singer study and the Kemp study support the premise that open-minded people possess keen perceptual discrimination.

While neither the Kaplan-Singer nor the Kemp studies deal directly with creativity, they do permit one to infer that creative people, like open-minded individuals, have keen sensory perception since the two, as personality types, possess many of the same personality and intellectual traits. In fact, the research reviewed under Proposition I indicates that open-mindedness seems to be a necessary, although not sufficient, condition for creative thinking.

Another indirect line of support for Proposition II lies in the research on sensory deprivation of animal and human subjects. Presently, enough research has been conducted to illustrate that the development of cognitive functioning in animals and human beings is severely retarded under conditions of extreme deprivation. Unless there is sensory input, the organism remains vacuous, incapable of creative, adaptive behavior. Deutch states, "All organisms learn about the world around them through their sensory and perceptual processes, and the development of these processes plays a crucial role in the more general psychological and cognitive development of children" (10, p. 18). Animal studies clearly show the effects of sensory deprivation. Reisen (33) found that kittens and chimpanzees reared in total darkness suffer a permanent inability to learn certain perceptual habits. Thompson
and Heron (49) found that dogs deprived of early sensory experiences were inferior in problem-solving ability to dogs which were reared under conditions of normal sensory stimulation. In addition, deprived dogs showed an inferior ability to discriminate relevant aspects of experimental situations, an inability to adapt to the environment, and an inability to pay attention.

Studies investigating the effects of impoverished sensory stimulation on human beings reveal similar findings. Institutionalized infants who lacked stimulation—intellectual, sensory, physical, and emotional—have been found to have impaired thinking ability, particularly the abilities to make generalizations, develop abstract concepts, and solve problems, when compared to home-reared children. They were also less imaginative and creative in their play than were home-reared children (32). Goldfarb (16) and Skeels and Dye (40) found similar deleterious effects, particularly in intellectual development. Eisen (12) reports a case study in which lowered learning ability resulted from auditory deprivation during infancy because of excessive middle ear infections. Hebb (18) reports that Von Senden found that persons who had congenital cataracts removed experienced great difficulty in identifying geometric forms, even though they had previously learned the properties of the forms tactually.

Since it is established by well known studies that cognitive development is built upon sensory experience, it is
reasonable to hypothesize that creative thinking, which Getzels and Jackson define as a "fairly specific type of cognitive ability" (14, p. 16), is retarded by sensory deprivation just as are other cognitive functions. This conclusion seems fairly clear in the case of extreme or total sensory deprivation, but little or no research reveals the effects of varying amounts of sensory deprivation, particularly upon creativity. Nor is it clear from research whether it is the kind and content of the experience or the acuity of the specific sensory modes which holds the most potential for stimulating creativity.

One study conducted by Mackler and Shontz (30), however, provides fairly direct support for Proposition II. The experimenters administered to subjects from five groups—art majors, visually disabled, dance majors, physically but not visually disabled, and a control group—a battery of Torrance and Guilford creativity tests first under neutral conditions, then two weeks later under conditions of visual and kinesthetic stimulation and destimulation. The art majors and the visually disabled were selected to represent the extremes, high and low, of a visual creativity dimension; the dance majors and the physically disabled represented the extremes of a kinesthetic dimension of creativity. Visual stimulation consisted of viewing a fifteen-minute film; visual destimulation consisted of sitting undisturbed in a totally dark room for fifteen minutes. Kinesthetic stimulation consisted
of fifteen minutes of calisthenics. Kinesthetic destimulation, on the other hand, required subjects to sit still in a fully lighted room for fifteen minutes. Both stimulation and destimulation increased performance on the creativity tests significantly for all five groups, but the art majors and the dance majors remained the most creative under all conditions. The physically disabled group was consistently the least creative, and the visually handicapped remained next to the least creative. Thus, the two groups which possessed superiority in a sensory modality were also the most creative; but since the purpose of the investigation did not require the five groups to perform specific perceptual discrimination tasks, findings only imply a relationship between creativity and perceptual discrimination of the sensory modes.

**Proposition III:** While people tend to develop distinct sensory styles, thus preferentially creating a dominance of superiority of perceptual acuity in a single sensory modality, creative people exhibit an over-all superiority of perceptual discrimination in all sensory modes that less creative individuals do not possess.

Going beyond Proposition II, Proposition III maintains that creative persons not only exhibit superiority in a single sensory style, but also exhibit a global sensory acuity which is superior to that of less creative people.
The nature of the sensory function in creative people is one in which openness in one sensory modality is interactive with and supportive of the other sensory modalities. Thus, the creative person actually sees, hears, smells, touches, and tastes more discriminately than does the less creative person.

No real experimental evidence exists which supports the proposition that creative people possess an over-all organis-mis superiority in sensory discrimination. Not only have creativity and intersensory facilitation never been investigated jointly, research findings concerning intersensory facilitation in relationship to abilities other than creativity, primarily learning and reading, are not in agreement. General reviews written by Conway (9), Ryan (38), Travers (51), and Gilbert (15) reflect the contradictory findings.

Some research supports the existence of intersensory facilitation. Horn (21) found that auditory, visual, and kinesthetic imagery contributes to learning. Lobb (29), comparing tactual and visual discriminations of angularly shaped objects among groups of eighth graders, found (a) that vision was more effective than touch in learning to discriminate forms unimodally, (b) that visual-tactual sequencing was superior to tactual-visual sequencing in discriminations requiring joint participation of the two modalities, and (c) that cross-modal conditions interact with training. Similarly, Severin (42) concluded that when relevant cues are
summated across modalities multiple-modality communications are superior to single-modality communication; but when cues are redundant, multiple-modality and single-modality communications are equal. Studies conducted by Stevens (46), Hartman (17), and Child and Wendt (7) suggest intersensory facilitation between vision and hearing. That discrimination training in one modality facilitates the relearning of forms in other modalities is supported by studies conducted by Gaydos (13) and Krauthamer (27). Birch and Lefford (4) and Blank and Bridger (5) have conducted studies which show that the ability to integrate information from one modality with information gained from another modality occurs in developmental stages. Conners, Schuette and Goldman (8) found that lower class children, especially five-year-olds, have impaired abilities to integrate and transfer visual and haptic (impressions derived from touch, pressure, and kines-thesis) experiences.

Research investigating the relationship between intersensory perception and reading ability lends support to the contention that intersensory facilitation does exist. Sterritt and Rudnick (45) found that the reading comprehension of fourth graders was related to the ability to transpose between auditory-temporal and visual-spatial patterns. Rudnick, Sterritt, and Flax’s findings suggested that "... as individual perceptual abilities become less important to reading progress, variations in auditory perceptual abilities
and/or the ability to transpose between audition and vision may become more important" (37, p. 586).

Other studies have failed to confirm that intersensory facilitation enhances learning; still others have failed to find intersensory facilitation to be a fact. Reviewing the literature concerning intersensory facilitation, Travers (51) points out that most of the research has been inadequately conducted and that multi-sensory learning presently cannot be shown to be superior to single-modality learning. After conducting carefully controlled research using visual, auditory, and combined presentations to settle the single versus multiple-modality dispute, Van Mondfrans and Travers (52) concluded that using two sensory modalities has no advantage over using one when learning redundant material. Using the Method of Constant Stimuli to measure audition and vision, Kling (26) did not find significant correlations between auditory and visual discrimination. He pointed out that his findings supported Holmes' (20) contention that individual differences in sensory modes are not highly correlated.

Research findings relevant to the proposition that creative people possess an organismic superiority in sensory perception in which the individual sensory modalities are supportive of one another are inconclusive. The majority of the findings do indicate that intersensory facilitation as a psychophysical phenomenon does exist, but Kling's study (26)
casts doubts upon the contention that discriminatory abilities among the sensory modes are correlated. Whether or not multi-sensory acuity characterizes the creative person is not yet known.
CHAPTER BIBLIOGRAPHY


CHAPTER III

PRESENTATION AND ANALYSIS OF DATA

Theoretical formulations, particularly those of Rogers (3), Rokeach (4, 5), Witkin (3), and Schactel (6), and research suggest that creative thinking is related to sensory perception. This study investigated the relationship between each of three variables of creative thinking—Verbal Fluency, Verbal Flexibility, and Verbal Originality—and the perceptual discrimination of the visual, auditory, and tactual sensory modes. From 200 college freshman volunteers, 125 subjects were selected randomly for participation in the study. Of the 125 randomly selected subjects, ninety completed the Torrance Tests of Creative Thinking: Verbal Form A and nine sensory perception tasks constructed in accordance to the psychophysical Method of Constant Stimuli.

Hypotheses 1, 2, and 3 stated that there would be a significant negative correlation between Verbal Fluency scores (Hypothesis 1), Verbal Flexibility scores (Hypothesis 2), and Verbal Originality (Hypothesis 3) and the scores of each of the following sensory perception tasks:

1. Visual Length (of line) Discrimination
2. Visual Load Discrimination
3. Visual Shade Discrimination
4. Auditory Length (of tone) Discrimination  
5. Auditory Pitch Discrimination  
6. Auditory Decibel Discrimination  
7. Tactual Length (of peg) Discrimination  
8. Tactual Load Discrimination  

To test these hypotheses a Pearson's product moment correlation was computed between each set of creativity scores (Fluency, Flexibility, and Originality) and each set of sensory perception scores. The resulting correlations are presented in Table I.

**TABLE I**

PRODUCT-MOMENT COEFFICIENTS OF CORRELATION BETWEEN MEASURES DERIVED FROM VERBAL A FORM OF TORRANCE TESTS OF CREATIVE THINKING AND SCORES DERIVED FROM NINE SENSORY PERCEPTION TASKS

(N = 90)

<table>
<thead>
<tr>
<th>Creativity Measure</th>
<th>Sensory Perception Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Fluency</td>
<td>-.010</td>
</tr>
<tr>
<td>Verbal Flexibility</td>
<td>-.034</td>
</tr>
<tr>
<td>Verbal Originality</td>
<td>-.043</td>
</tr>
</tbody>
</table>
Only four variables—Visual Length, Visual Load, Visual Shade, and Auditory Decibel—correlated in every case with Verbal Fluency, Verbal Flexibility, and Verbal Originality in the predicted direction. None of the correlations, whether negative or positive, was found to be significant at the .05 level. Additional analysis of the data was conducted by plotting a scattergram of the correlations of greatest magnitude to see if a curvilinear relationship existed. No such relationship was found. Consequently, Hypothesis 1, which stated that there would be a significant negative correlation between Verbal Fluency scores and the scores of each of the sensory perception tasks, was rejected. Hypothesis 2, which stated that there would be a significant negative correlation between Verbal Flexibility scores and the scores of each sensory perception task, was rejected. Hypothesis 3, which stated that there would be a significant negative correlation between Verbal Originality scores and the scores of each sensory perception task, was also rejected.

Hypotheses 4, 5, and 6 stated that there would be a significant multiple correlation between each of the three creativity criteria and selected sensory predictor variables. Multiple linear regression analysis with stepwise results was used to test these hypotheses. The multiple correlations between Verbal Fluency, Verbal Flexibility, and Verbal Originality and the nine sensory predictor variables are reported in Table II.
TABLE II
COEFFICIENTS OF MULTIPLE CORRELATIONS BETWEEN EACH CREATIVITY CRITERION AND THE NINE SENSORY PERCEPTION TASKS

<table>
<thead>
<tr>
<th>Creativity Measure</th>
<th>$R^2$</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Fluency</td>
<td>.115</td>
<td>N.S. *</td>
</tr>
<tr>
<td>Verbal Flexibility</td>
<td>.108</td>
<td>N.S.</td>
</tr>
<tr>
<td>Verbal Originality</td>
<td>.072</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

*N.S. = not significant.

None of the coefficients of multiple correlation was significant. Consequently, the following hypotheses were rejected:

Hypothesis 4: There will be a significant multiple correlation between the criterion of Verbal Fluency and the nine sensory predictor variables.

Hypothesis 5: There will be a significant multiple correlation between the criterion of Verbal Flexibility and the nine sensory predictor variables.

Hypothesis 6: There will be a significant multiple correlation between the criterion of Verbal Originality and the nine sensory predictor variables.

Since none of the three multiple correlations was significant, it was unnecessary to obtain stepwise linear regression analysis to show the sensory predictor variables in order of their contribution to each of the criterion scores.
Since no significant relationships between creativity and sensory perception were found, Fisher's $t$ tests were computed to see if the means of the creativity variables for the sample used in this study differed significantly from the means of other college samples. The first nine entries in Table III are the means and standard deviations for college samples reported in the *Norms Technical Manual* (6); the last entry presents the means and standard deviations for the North Texas State University (NTSU) freshman sample.

Several differences are apparent in Table III. The NTSU sample mean of 81.9 for Verbal Fluency was significantly larger than only one of the other college means, but of the seven $t$'s indicating that the NTSU mean was smaller, three were significant beyond the .05 level. The NTSU sample mean of 40.5 for Verbal Flexibility was also significantly smaller than four of the other college sample means. On Verbal Originality the NTSU sample mean of 35.8 was significantly smaller than all of the nine other college sample means. Over all, the NTSU sample was less creative than most other college samples, particularly on Verbal Originality.
TABLE III

COMPARISON GROUP NORMS AND NORTH TEXAS STATE UNIVERSITY FRESHMAN SAMPLE MEANS AND STANDARD DEVIATIONS FOR THE TORRANCE TESTS OF CREATIVE THINKING, VERBAL FORM A

<table>
<thead>
<tr>
<th>Group</th>
<th>No.</th>
<th>Fluency Mean</th>
<th>St. Dev.</th>
<th>Flexibility Mean</th>
<th>St. Dev.</th>
<th>Originality Mean</th>
<th>St. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Arts College Soph., Large State Univ.</td>
<td>120</td>
<td>71.0</td>
<td>22.4</td>
<td>38.1</td>
<td>8.0</td>
<td>45.0**</td>
<td>17.5</td>
</tr>
<tr>
<td>Nursing Fresh., Large State Univ.</td>
<td>97</td>
<td>88.5</td>
<td>26.4</td>
<td>44.3*</td>
<td>9.7</td>
<td>54.8**</td>
<td>19.3</td>
</tr>
<tr>
<td>Nursing Seniors, Large State Univ.</td>
<td>74</td>
<td>100.4**</td>
<td>28.4</td>
<td>49.3**</td>
<td>10.0</td>
<td>64.1**</td>
<td>23.9</td>
</tr>
<tr>
<td>Nursing Fresh., Diploma Program</td>
<td>64</td>
<td>78.9</td>
<td>23.4</td>
<td>39.1</td>
<td>7.1</td>
<td>46.0**</td>
<td>18.9</td>
</tr>
<tr>
<td>Nursing Seniors, Diploma Program</td>
<td>54</td>
<td>87.5</td>
<td>25.3</td>
<td>41.7</td>
<td>9.4</td>
<td>44.6*</td>
<td>18.5</td>
</tr>
<tr>
<td>Nursing Freshmen, Junior College</td>
<td>117</td>
<td>101.9**</td>
<td>26.2</td>
<td>45.3**</td>
<td>10.3</td>
<td>46.4**</td>
<td>16.3</td>
</tr>
<tr>
<td>Graduate Students, NDEA Counseling Institute, Small State Univ.</td>
<td>30</td>
<td>105.8*</td>
<td>30.1</td>
<td>48.1**</td>
<td>9.9</td>
<td>71.1**</td>
<td>25.5</td>
</tr>
<tr>
<td>Female Arts Coll. Fresh., Catholic College</td>
<td>119</td>
<td>86.0</td>
<td>26.0</td>
<td>42.1</td>
<td>9.0</td>
<td>68.4**</td>
<td>28.1</td>
</tr>
<tr>
<td>Female Arts Coll. Soph., Catholic College</td>
<td>97</td>
<td>84.7</td>
<td>19.8</td>
<td>41.6</td>
<td>7.2</td>
<td>62.3**</td>
<td>20.3</td>
</tr>
<tr>
<td>North Texas State Univ. Freshmen</td>
<td>90</td>
<td>81.1</td>
<td>25.6</td>
<td>50.5</td>
<td>9.7</td>
<td>35.8</td>
<td>15.0</td>
</tr>
</tbody>
</table>

* .01 level of significance.

**.001 level of significance.
Intercorrelations among Verbal Fluency, Verbal Flexibility, and Verbal Originality were computed, then compared to intercorrelations reported in the Norms Technical Manual (7). The intercorrelations among the creativity variables for the sample used in this study are presented in Table IV.

TABLE IV

INTERCORRELATIONS OF MEASURES DERIVED FROM TORRANCE TESTS OF CREATIVITY, VERBAL FORM A
(N = 90)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Verbal Fluency</th>
<th>Verbal Flexibility</th>
<th>Verbal Originality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Fluency</td>
<td>---</td>
<td>.890*</td>
<td>.737*</td>
</tr>
<tr>
<td>Verbal Flexibility</td>
<td>---</td>
<td>---</td>
<td>.729*</td>
</tr>
<tr>
<td>Verbal Originality</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

*.001 level of significance.

Torrance (7) does not present intercorrelations on the Verbal Form A for college samples, but he does report intercorrelations for grades two through seven. The correlation of .890 between Verbal Fluency and Verbal Flexibility for the NTSU college freshmen is noticeably higher than those ranging from .45 to .83 for elementary school children. The correlation of .737 between Verbal Fluency and Verbal Originality is slightly higher than the correlations ranging from .40 to .70.
for elementary school children. The difference is not so great, however, when it is pointed out that correlations generally range from .60 to .70. The correlation of .729 between Verbal Flexibility and Verbal Originality for the NTSU college freshmen, on the other hand, is slightly lower than the correlations ranging from 175 to .87 reported by Torrance. The rather slight differences between intercorrelations for this college sample and intercorrelations reported by Torrance may be due to age dissimilarities.

Intercorrelations among sensory perception tasks were computed for two purposes: to see if intercorrelations within each sensory modality were high and to see if cross-modal correlations between sensory modalities were high. The results are summarized in Table V.

Among the three visual tasks only one significant correlation was found. The low correlation of .266 ($p < .05$) between Visual Length and Visual Load indicates that the ability to make discriminations between visual stimuli varying in dot density is slightly related to the visual ability to judge varying lengths of line. No significant correlation was found between Visual Length Discrimination and Visual Shade Discrimination, nor between Visual Load Discrimination and Visual Shade Discrimination.
TABLE V
INTERCORRELATIONS AMONG MEASURES DERIVED
FROM SENSORY PERCEPTION TASKS

(N = 90)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Length</td>
<td>---</td>
<td>.266*</td>
<td>.095</td>
<td>.092</td>
<td>.223*</td>
<td>-.056</td>
<td>.091</td>
<td>.057</td>
<td>.085</td>
</tr>
<tr>
<td>Visual Load</td>
<td>---</td>
<td>.158</td>
<td>.034</td>
<td>.230*</td>
<td>-.013</td>
<td>.083</td>
<td>.052</td>
<td>.123</td>
<td></td>
</tr>
<tr>
<td>Visual Shade</td>
<td>---</td>
<td>.035</td>
<td>.057</td>
<td>.163</td>
<td>.000</td>
<td>.204</td>
<td>-.013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory Length</td>
<td>---</td>
<td>.229*</td>
<td></td>
<td>.102</td>
<td>.250*</td>
<td>-.073</td>
<td>.138</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory Pitch</td>
<td>---</td>
<td></td>
<td></td>
<td>.063</td>
<td>.110</td>
<td>-.046</td>
<td>.052</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory Decibel</td>
<td>---</td>
<td></td>
<td></td>
<td>-.081</td>
<td>.070</td>
<td>-.045</td>
<td>.045</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tactual Length</td>
<td>---</td>
<td></td>
<td></td>
<td>-.041</td>
<td>.143</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tactual Load</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.233*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tactual Texture</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Similar correlational patterns were found within each set of three auditory and tactual tasks. Among the auditory tasks a low correlation of .229 (p < .05) was found between Auditory Length Discrimination and Auditory Pitch Discrimination. Correlations between Auditory Length Discrimination and Auditory Pitch Discrimination and between Auditory Pitch Discrimination and Auditory Decibel Discrimination were not significant. Similarly, among the three tactual tasks a low correlation of
.233 (p < .05) was found between Tactual Load Discrimination and Tactual Texture Discrimination; whereas, correlation coefficients between Tactual Length and Tactual Load and between Tactual Length and Tactual Texture discriminations were not significant.

Three low but significant cross-modal correlations were found. Auditory Pitch Discrimination correlated .233 and .230, respectively, with Visual Length and Visual Load Discrimination at the .05 level of significance. In addition, a correlational coefficient of .250 (p < .05) was found between Auditory Length Discrimination and Tactual Length Discrimination.

Summary of Findings

1. None of the creative thinking variables (Verbal Fluency, Verbal Flexibility, and Verbal Originality) was related to any of the sensory perception discriminations.

2. None of the creative thinking variables was related highly to any combination of sensory perception discriminations.

3. The North Texas State University college sample was significantly less creative than most college samples, particularly on Verbal Originality.

4. Intercorrelations among the verbal creative thinking variables were relatively high. The correlation between Fluency and Flexibility was .89 (p < .05); between Fluency and Originality, .737 (p < .05); and between Flexibility and Originality, .729 (p < .05).
5. For the most part, the ability to make one kind of discrimination within a single sensory modality was not related to the abilities to make other discriminations within the same modality; nor was the ability to make discriminations in one sensory modality highly related to the abilities to make discriminations in another sensory modality.


CHAPTER IV

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This study investigated the relationship between three variables of creative thinking--Verbal Fluency, Verbal Flexibility, and Verbal Originality--and the perceptual discrimination of the visual, auditory, and tactual sensory modes. One hundred twenty-five subjects were randomly selected from two hundred college freshman volunteers. Ninety of the randomly selected subjects completed the Torrance Tests of Creative Thinking: Verbal Form A and nine sensory discrimination tasks. The sensory tasks were constructed according to the Method of Constant Stimuli.

Derived from theory and research, three propositions provided the theoretical rationale for this investigation:

I. Creative people are more sensitive to their environment than are less creative people.

II. Being more open through their sensory modes, creative people have more acute perceptual discrimination than do less creative individuals.

III. While people tend to develop distinct sensory styles, thus preferentially creating a dominance and superiority of perceptual acuity in a single sensory modality, creative people exhibit an over-all superiority of
perceptual discrimination in all sensory modes that less creative individuals do not possess.

The following hypotheses were stated:

1. There would be a significant negative correlation between Verbal Fluency scores and the scores of each of the nine sensory discrimination tasks (Visual Length, Visual Load, Visual Shade; Auditory Length, Auditory Pitch, Auditory Decibel, Tactual Length, Tactual Load, and Tactual Texture).

2. There would be a significant negative correlation between Verbal Flexibility scores and the scores of each of the nine sensory tasks.

3. There would be a significant negative correlation between Verbal Originality scores and the scores of each of the nine sensory discrimination tasks.

4. There would be a significant multiple correlation between Verbal Fluency and selected sensory predictor variables.

5. There would be a significant multiple correlation between Verbal Flexibility and selected sensory predictor variables.

6. There would be a significant multiple correlation between Verbal Originality and selected sensory predictor variables. Pearson product moment correlations were computed to test hypotheses 1, 2, and 3. Multiple linear regression analysis was computed to test hypotheses 4, 5, and 6.
Additional analysis of data required Fisher's test. None of the hypotheses was confirmed.

The following statements summarize the findings:

1. Verbal Fluency, Flexibility, and Originality were not related to any of the sensory discrimination tasks.

2. Verbal Fluency, Flexibility, and Originality were not related to selected sensory predictor variables.

3. The North Texas State University college sample was significantly less creative than most college samples, particularly on Verbal Originality.

4. Intercorrelations among Verbal Fluency, Flexibility, and Originality were relatively high.

5. Abilities to make different discriminations within a single modality were not highly related; abilities to make discriminations in a single modality were not highly related to abilities to make discriminations in other modalities.

Discussion

Three possible explanations for finding no relationship between creativity and single or combined perceptual discriminations of the sensory modes seem worthy of discussion. First, Maddi (4, 5) contends that the motivation for creative production stems from a need for variety which is met by internal rather than external stimulation. Research conducted by Maddi and others (5) indicates that when creative persons, operationally defined as producers of novelty, were observed
unknowingly during a sham waiting period and measured on the amount of time spent exploring the objects in the room, they tended to "... avoid attending to the external environment in favor of attending to the internal environment" (4, p. 345). Novelty of productions showed a -.42 correlation with the amount of time spent exploring and .27 and .26 with measurements of introspection. In light of these findings, one might expect to find little or no correlation between sensory acuity and creativity since the sensory modes are the channels through which the human organism receives external rather than internal stimulation.

Secondly, contrary to Maddi's explanation that creative persons avoid attending to external stimulation, Huguelet (2) contended that the creative person is acutely sensitive to objects in his environment but because of his very sensitivity he might have difficulty performing certain perceptual tasks. The processes which permit the creative individual to organize stimuli uniquely are the same processes which interfere with "efficient structuring." She found that low-creative groups, high in I.Q., were significantly superior to high-creative groups (high-creative, low I.Q. and high-creative, high I.Q.) in eye-motor coordination, perception of space relations, Gestalt closure, and visual perseveration.

A third explanation may lie in the tasks used in this study. If, contrary to the findings of this study, creative people possess a superiority of sensory discrimination, the
perceptual tasks developed according to the Method of Constant Stimuli for this study may not adequately measure sensory discrimination, at least not for creative persons. It is conceivable that monotony may very well be perceived adversely by creative persons and that forty-eight trials of two stimuli presentations for nine different tasks may reduce the creative person's desire to attend carefully to each trial. This contention is somewhat supported by Maddi and others (5) who found that inducing monotony in a context which also encouraged passivity while subjects were engaged in a creative task led to an increase in desire for novelty but a decrease in the actual production of novelty. Of course, it may be argued that one's ability to attend to monotonous stimuli is a part of the ability to utilize the senses to discriminate accurately. If so, then creativity seems not to be related to perceptual acuity. However, if perseverance to attend to monotony is not a part of sensory discrimination, ways to measure sensory discrimination apart from monotony will have to be devised in order to get a more accurate measurement of the creative person's powers of sensory discrimination.

Conclusions

The findings of this study do not deal directly with Proposition I. The research reviewed, however, does lend
support to Proposition I. Cognitive openness does seem to be
a necessary but not a sufficient condition for creativity.

The findings of this study do, however, warrant two
major conclusions relevant to Proposition II and Proposition
III. First, Proposition II is not supported. That Verbal
Fluency, Flexibility, and Originality scores were not related
to any of the sensory discrimination scores indicates that
creative people are not characterized by sensory openness.
Thus, creativity does not seem dependent upon perceptual dis-
crimination of the sensory modes, at least when creativity
and sensory perception are measured by the instruments used
in this study. Although cognitive openness is related to
both creativity and sensory acuity, it does not follow that
creativity and sensory acuity are related. When theorists
stress that creative people are more sensitive to and aware
of their environment than are less creative people, they do
not mean that creative people are more "sensitive" and "aware"
through their sensory modes. At present, it must be main-
tained that the creative person's superior awareness refers
only to a "cognitive" awareness, not a "sensory" awareness.
Apparently, the complex cognitive processes which account
for individual differences in creative thinking lie beyond
the level of sensory input. It may be that accurately per-
ceiving sensory input is much less important than how the
input is utilized. It may be, also, that the specific
content and meaning of global sensory experiences are more
related to creative thinking than are judgments about minute
differences in density, length, and texture.

Secondly, that neither Verbal Fluency, Flexibility, nor
Originality were related to any combination of visual,
auditory, and tactual discriminatory abilities negates Prop-
osition III. Creative people do not exhibit a superiority of
inter-sensory functioning, nor does the evidence support the
contention that the nature of sensory functioning is one in
which superiority in one sensory mode is interactive and
supportive of the other sensory modes. This conclusion is in
agreement with Kling's (3) conclusion that superiority in one
sense modality neither facilitates, inhibits, nor is compen-
sated for in other modes. Both Kling's study and this one
support Holmes' (1) contention that there are not high corre-
lations between individual differences in the sensory modes.
The implication seems clear, as Kling noted, that if "... there exists an 'intersensory facilitation,' such facilita-
tion is probably not at the level of elementary perception,
but on somewhat higher levels of cerebral association"
(3, p. 181).

Recommendations

Based on the findings of this investigation, the
following are recommended:

1. Further investigations of the relationships between
creativity and sensory functioning need to be conducted, but
with emphasis upon variety of sensory stimulation rather than upon sensory discrimination. For example, further research needs to be aimed at determining the influence of varied sensory stimulation upon creative production.

2. Should the relationship between creativity and sensory discrimination be pursued further, tasks other than one constructed in accordance to the Method of Constant Stimuli should be used in order to avoid the effect of monotony.
CHAPTER BIBLIOGRAPHY


APPENDIX
# APPENDIX A

## Thinking Creatively With Words

by E. Peel Terrance

### Worksheet A

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Sex</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>School</th>
<th>Grade</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Try</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
</table>
 Activities 1-3: ASK-AND-GUESS

The first three activities will be based on the drawing below. These activities will give you a chance to see how good you are at asking questions to find out things that you don’t know and in making guesses about possible causes and consequences of happenings. Look at the picture. What is happening? What can you tell for sure? What do you need to know to understand what is happening, what caused it to happen and what will be the result?
Activity 1. **ASKING.** On this page, write out all of the questions you can think of about the picture on the page opposite this one. Ask all of the questions you would need to ask to know for sure what is happening. Do not ask questions which can be answered just by looking at the drawing. You can continue to look back at the drawing as much as you want to.

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................

4. ........................................................................................................

5. ........................................................................................................

6. ........................................................................................................

7. ........................................................................................................

8. ........................................................................................................

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10. .........................................................................................................

11. .........................................................................................................

12. .........................................................................................................

13. .........................................................................................................

14. .........................................................................................................

15. .........................................................................................................

16. .........................................................................................................

17. .........................................................................................................

18. .........................................................................................................

19. .........................................................................................................

20. .........................................................................................................

21. .........................................................................................................

22. .........................................................................................................

23. .........................................................................................................

GO ON TO NEXT PAGE
Activity 2. GUESSING CAUSES: In the spaces below, list as many possible causes as you can of the action shown in the picture on page 2. You may use things that might have happened just before the things that are happening in the picture, or something that happened a long time ago that made these things happen. Make as many guesses as you can. Don’t be afraid to guess.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

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14.

15.

16.

17.

18.

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20.

21.

22.

23.

GO ON TO NEXT PAGE
Activity 3. GUESSING CONSEQUENCES: In the spaces below, list as many possibilities as you can of what might happen as a result of what is taking place in the picture on page 2. You may use things that might happen right afterwards or things that might happen as a result long afterwards in the future. Make as many guesses as you can. Don't be afraid to guess.

1. ______________________________________________________________
2. ______________________________________________________________
3. ______________________________________________________________
4. ______________________________________________________________
5. ______________________________________________________________
6. ______________________________________________________________
7. ______________________________________________________________
8. ______________________________________________________________
9. ______________________________________________________________
10. ______________________________________________________________
11. ______________________________________________________________
12. ______________________________________________________________
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14. ______________________________________________________________
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17. ______________________________________________________________
18. ______________________________________________________________
19. ______________________________________________________________
20. ______________________________________________________________
21. ______________________________________________________________
22. ______________________________________________________________
23. ______________________________________________________________
24. ______________________________________________________________
25. ______________________________________________________________
Activity 4: PRODUCT IMPROVEMENT

In the middle of this page is a sketch of a stuffed toy elephant of the kind you can buy in most dime stores for about one to two dollars. It is about six inches tall and weighs about a half pound. In the spaces on this page and the next one, list the cleverest, most interesting and unusual ways you can think of for changing this toy elephant so that children will have more fun playing with it. Do not worry about how much the change would cost. Think only about what would make it more fun to play with as a toy.

1. 

2. 

3. 

4. 

5. 

Activity 5: UNUSUAL USES (Cardboard Boxes)

Most people throw their empty cardboard boxes away, but they have thousands of interesting and unusual uses. In the spaces below and on the next page, list as many of these interesting and unusual uses as you can think of. Do not limit yourself to any one size of box. You may use as many boxes as you like. Do not limit yourself to the uses you have seen or heard about; think about as many possible new uses as you can.

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 
13. 
14. 
15. 
16. 
17. 
18. 
19. 
20. 
21. 
22. 
23.
Activity 6: UNUSUAL QUESTIONS

In this activity, you are to think of as many questions as you can about cardboard boxes. These questions should lead to a variety of different answers and might arouse interest and curiosity in others concerning boxes. Try to think of questions about aspects of cardboard boxes which people do not usually think about.

1. __________________________________________
2. __________________________________________
3. __________________________________________
4. __________________________________________
5. __________________________________________
6. __________________________________________
7. __________________________________________
8. __________________________________________
9. __________________________________________
10. __________________________________________
11. __________________________________________
12. __________________________________________
13. __________________________________________
14. __________________________________________
15. __________________________________________
16. __________________________________________
17. __________________________________________
18. __________________________________________
19. __________________________________________
20. __________________________________________
21. __________________________________________
22. __________________________________________
23. __________________________________________
Activity 7: JUST SUPPOSE

You will now be given an improbable situation—one that will probably never happen. You will have to just suppose that it has happened. This will give you a chance to use your imagination to think out all of the other exciting things that would happen IF this improbable situation were to come true.

In your imagination, just suppose that the situation described were to happen. THEN think of all of the other things that would happen because of it. In other words, what would be the consequences? Make as many guesses as you can.

The improbable situation—JUST SUPPOSE clouds had strings attached to them which hang down to earth. What would happen? List your ideas and guesses on the next page.
APPENDIX B

Instructions for Sensory Perception Tasks

Visual Length Task:

In this experiment, we want to see how accurately you can perform a task that requires the visual discrimination of different lengths of line. The lines will be presented in pairs, first one, then the other. You will look at the first line; then the experimenter will place it behind a shield before he presents the second line to you. Upon looking at the second line, you must immediately state whether it is longer or shorter than the first. Remember always to answer in terms of the second line presented to you. If you are in doubt, make the most intelligent judgment you can.

Try this example:

(Experimenter presents a 1 3/4 - 2 1/4 combination.)

Yes, the answer is longer.

Visual Load Task:

In the following experiment, we want to see how accurately you can perform a task that requires the visual discrimination of different groups of dots. The groups of dots will be presented in pairs, first one, then the other. You will see the first group of dots; then in 2 seconds you will see the second group. You must immediately decide whether the second group of dots has more or fewer dots than the first. Then record on
the answer sheet "M" for more and "F" for fewer. Remember always to answer in terms of the second group of dots. There will be a 7-second interval of silence between each trial in order that you have ample time to respond. If you are in doubt, make the most intelligent judgment you can.

Are there any questions?

Try this example:

(Experimenter begins film. Enough time has been allowed on the film for the subject to respond and for the experimenter to say the following instructions.)

Yes, the answer is more.

Get ready for trial one.

Visual Shade Task:

In this experiment, we want to see how accurately you can perform a task that requires the visual discrimination of different shades of gray and black. The shades will be presented in pairs, first one, then the other. You will look at the first shade; then the experimenter will place it behind a shield before he presents the second shade. You must immediately state whether the second one is darker or lighter than the first. Remember always to answer in terms of the second shade. In other words, is the second shade darker or lighter than the first? If you are in doubt, make the most intelligent judgment you can.
Try this example:

(Experimenter presents a 10 - 18 combination.)

Yes, the answer is darker.

**Auditory Length Task:**

In this experiment, we want to see how accurately you can perform a task which requires the auditory discrimination of different lengths of the same tone. The tones will be presented in pairs, first one then the other. You will hear the first tone; then in three seconds the second tone will be presented. You must immediately decide whether the second tone is longer or shorter than the first; then record on the answer sheet "S" for shorter or "L" for longer. Remember always to answer in terms of the second tone. If you are in doubt, make the most intelligent judgment you can.

Try this sample trial:

Yes, the second tone is shorter. You should have recorded an "S" on your answer sheet.

Get ready for trial one.

**Auditory Pitch Task:**

In this experiment, we want to see how accurately you can perform a task which requires the auditory discrimination of different pitches. The tones will be presented in pairs, first one, then the other. You will hear the first tone; then
in 2 seconds you will hear the second tone. You must imme-
diately decide whether the second tone is higher or lower
than the first; then record on the answer sheet "H" for
higher or "L" for lower. Remember always to answer in terms
of the second tone. There will be a 7-second interval of
silence between each trial in order that you have ample time
to respond. If you are in doubt, make the most intelligent
judgment you can.
Are there any questions?
Try this sample trial:

Yes, the second tone is lower. You should have recorded "L"
on your answer sheet.
Get ready for trial one.

**Auditory Decibel Task:**

In this experiment, we want to see how accurately you
can perform a task which requires the auditory discrimination
of the same tone presented at different volumes. The tones
will be presented in 48 pairs, first one, then the other. You
will hear the first one; then in two seconds you will the
second tone. You must immediately decide whether the second
tone is louder or softer than the first; then record on your
answer sheet "L" for louder and "S" for softer. Remember
always to answer in terms of the second tone. If you're in
doubt, make the most intelligent judgment you can.
Try this sample trial:

(Stop tape recorder.)

Yes, the second tone is softer. You should have recorded an "S" on your answer sheet.

Get ready for trial one.

Tactual Length Task:

In this experiment, we want to see how accurately you can discriminate different peg lengths. The pegs will be presented to you in pairs. Wearing a blindfold, you will use the thumb and forefinger of the right hand to sample the length of the first peg and then the second on the first 24 trials. You will use the thumb and forefinger of the left hand for the last 24 trials. You must immediately state whether the second one is longer or shorter than the first. In other words, always respond in terms of the second peg. If in doubt, make the most intelligent judgment you can. You must hold your hand still during the trials so the pegs can be presented easily to you. After sampling each peg, you must open wide your thumb and forefinger.

Try this example:

(Experimenter presents a 1-9 combination.)

Yes, the answer is longer.
Tactual Load Task:

In this experiment, we want to see how accurately you can perform a task that requires the tactile discrimination of the number of braille dots. The cards on which the dots have been typed will be presented in pairs. Wearing a blindfold, you will stroke the samples lightly, using the index finger of the right hand for the first 24 trials and the index finger of the left hand for the second 24 trials. After the two samples have been presented to you, you must immediately state whether the second one has more or fewer dots than the first. Remember always to answer in terms of the second group of dots presented to you. If you are in doubt, make the most intelligent judgment you can. You must hold your hand on the testing block so that your finger will fit into the slot easily for each trial.

Try this example:

(Experimenter presents a 1 - 9 combination.)

Yes, the answer is more.

Are there any questions?

Tactual Texture Task:

In this experiment, we want to see how accurately you can perform a task that requires the tactile discrimination of different grades of sandpaper. The sandpaper blocks will be presented to you in pairs. Wearing a blindfold, you will stroke the samples lightly, using the index finger of the
right hand for the first 12 trials and the index finger of the left hand for the second 12 trials. After the two samples have been presented to you, you must immediately state whether the second one is rougher or smoother than the first. Remember always to answer in terms of the second sample presented to you. If you are in doubt, make the most intelligent judgment you can. You must hold your hand in a fixed position so the samples of sandpaper can easily be presented to you.

Try this example:

(Experimenter presents a 4 - 8 combination.)

Yes, the answer is smoother.
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