

THE EFFECT OF STIMULUS PRESENTATION ON ORIGINAL THINKING

BY PRESCHOOL CHILDREN

by

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CHAPTER 1

Introduction

Active manipulation of objects in the environment has been viewed by Piaget (1969) as a necessary component of cognitive development. The role of activity has been studied in relation to learning and memory tasks in which activity was found to facilitate performance (Wolff & Levin, 1972; Wolff, Levin, & Longobardi, 1974). Goodnow (1969) assessed the effect of active handling on kindergarten children's responses to a task commonly used to assess creativity. She found that the children gave more "nonstandard" uses for the stimuli when they were permitted to look at and handle than when allowed to "look only" at the materials. Dansky and Silverman (1973) and Roy (1978) also report enhanced responding from children allowed to freely manipulate the materials. The effect of play on production of creative responses is thus related to the studies of activity.

After conducting pilot studies on creativity with preschool children, Starkweather (1964) expressed her dissatisfaction with available test materials. She suggested that line drawings as stimulus materials were inappropriate for this age due to the children's desire to handle the test materials while responding. In response to the children's desire to handle the materials, she designed and tested a set of three-dimensional styrofoam forms to be used in assessing children's creativity (1964, 1971). These three-dimensional forms allowed the children to handle them while taking the test.

Moran, Milgram, Sawyers, and Fu (Note 1) conducted a study of two- vs. three-dimensional materials to assess stimulus effects of responses in preschool children. Using Starkweather's Originality Test materials (1971), Moran et al. found that fluency and original responses increased when the children were given the three-dimensional forms to handle.

From these studies, two relevant factors emerge related to the study of original thinking in young children: the type of stimulus representation and the method of exploration. Whether one factor is of greater value in facilitating the child's creative expressions was not clear. What remained to be answered was a question of the relative effect of stimulus dimensionality, the mode of exploration, and the possible interaction of these two factors on the generation of creative ideas by young children.

Purpose

The purpose of this study was to investigate the effect of stimulus dimension and mode of exploration on preschool children's responses to the pattern meanings and unusual uses tasks. Specifically, this study examined children's responses to:

- 1) two-vs. three-dimensional stimuli;
- 2) visual vs. visual plus haptic exploration, and;
- 3) the interaction of stimuli dimension and mode of exploration.

Justification

According to Mednick (1962), a response hierarchy exists in that first responses to a stimulus are generally popular, everyday responses

and are followed by more creative original responses later in the hierarchy. Mednick's hypothesis has not been examined among young children. This may be because past research generated only a limited number of responses to each stimulus by young children, e.g. Busse, Blum, and Gutride (1972) reported mean responses on the patterns meanings task of 1.19 and Ward (1968) of 1.98. With so few responses being given the entire hierarchy may not have been expressed. The present study was designed to investigate the effects of stimulus and testing procedures on the number and uniqueness of responses given by pre-school children. In this way, it was hoped that the research might contribute to the development of an assessment tool for the study of creativity in young children.

Definitions

Specific terms used in this study will be defined as follows:

- 1) original thinking--one facet of creativity measured by the pattern meanings task and the unusual uses task in this study.
- 2) three-dimensional (3-D) stimuli--objects used in this study.
- 3) two-dimensional (2-D) stimuli--line drawings of three-dimensional objects used in this study.
- 4) two-dimensional with perspective (2-DD) stimuli--line drawings with visual depth added of three-dimensional objects used in this study.
- 5) verbal stimuli--the name of objects used in this study.
- 6) visual exploration--condition in which subject may only look at stimuli.

7) visual plus haptic exploration--condition in which subject may look at and handle the stimuli.

8) total fluency--the total number of responses (both popular and unique) given on the pattern meanings and unusual uses tasks, excluding repeat and bizarre responses.

9) unique response--any response given by only one child in a group.

10) popular response--any response given by more than one child in a group.

Hypotheses

In order to evaluate the findings of the present study, criteria were developed which contribute to the selection of an optimal method of stimulus presentation for use in assessing original thinking in young children. These criteria are:

1) A high intertask correlation between pattern meanings and unusual uses tasks would suggest that these tasks are measuring the same construct--original thinking. According to Wallach and Kogan (1965) the pattern meanings and unusual uses tasks measure original thinking. A high correlation between these two tasks might give credence to this contention in this age group.

2) Significant intertask correlations between the pattern meanings and unusual uses tasks which are greater than correlations of either task to intelligence would suggest that fluency on these tasks is not directly directed to IQ. It is Wallach's (1970) contention

that original thinking is not related to intelligence. Therefore, a low correlation with IQ would suggest that the original thinking tasks used in the present study are not directly related to intelligence and are measuring a different construct.

3) Greater number of responses per stimulus item such that there will be an adequate sampling of the response hierarchy. Moran, Sawyers, Fu, and Milgram (Note 2) reported mean responses per item of 3.4 given by preschoolers for two-dimensional stimuli on the pattern meanings task. This mean was appreciably higher than those reported by Busse, et al. (1972) and Ward (1968) who cited mean responses of 1.19 and 1.98, respectively. Using 3-D stimuli, Moran, et al. (Note 2) obtained even higher mean responses (4.10) from their subjects.

4) A positive relationship between total fluency and high quality unique responses would suggest support for Mednick's theory with young children. According to Mednick's theory (1962) an associative response hierarchy exists in which popular answers emerge early while unique high quality responses appear later in the response sequence. It is assumed that with more responses given (fluency) a greater number of high quality unique responses will also be observed. Thus, a significant positive correlation between total fluency and high quality unique responses would support Mednick's hypothesis.

Based on these criteria, it is predicted that variation in stimulus dimension and the mode of exploration permitted will affect total fluency and unique responses to the pattern meanings and unusual uses

tasks. It is further predicted that stimulus dimension and mode of exploration will affect total fluency and unique responses in an ordered progression. It is also predicted that the degree of fit between the criteria and the findings from this study will also progress in the following order. This ordered progression is from 2-D visual exploration, to 2-D visual plus haptic exploration, to 3-D visual exploration, to 3-D visual plus haptic exploration. The effect of the two-dimensional drawings with visual depth (2-DD) on total fluency and unique responses cannot be predicted due to a lack of relevant empirical data and therefore will not be considered in the hypotheses.

CHAPTER 2

Review of Literature

This chapter presents theory and research which relate to the investigation of stimulus dimension and mode of exploration with young children. Piaget's cognitive-developmental theory and E. J. Gibson's theory of perceptual development are reviewed as they relate to the role of action in the development of cognition and perception. Research on sensory modality dominance, the role of activity in learning, and the effects of play on creative expression is also reviewed. Only those studies using young children as participants were considered pertinent to this review. Mednick's theory and model of a response hierarchy are discussed and finally, the techniques and materials used to assess creativity in children are reviewed.

Role of Action in Development

Action plays an important role in the development of cognition, perception, as well as learning and creative expression. These factors are related to the modes of exploration utilized in investigating objects in the environment. These may have an effect on children's responses to original thinking tasks. This section reviews the theories and research dealing with the role of action on the above mentioned factors.

Cognitive development. According to Piaget's cognitive-developmental theory, knowledge is conceived of as a process of acting on objects, images and symbols either physically or mentally. The individual's developmental stage determines to a large extent whether the actions are covert or overt.

In infancy the actions are overt, sensory-motor ones; e.g., grasping, reaching, or sucking an object. These actions are considered sensory-motor schemes and as such are entirely overt and "in the action" rather than "in the mind" of the infant (Brainerd, 1978). From these overt actions with the object itself the child begins to develop the concept of object relations. The child sees himself in relation to objects within his environment as well as the way in which objects relate to one another (Thomas, 1979).

The child in the sensory-motor period builds representative schemata of objects. How a child relates to an object is based on vision, touch, and manipulation of the object itself. This entirely practical intelligence of perception and movement result in "the construction of schemata of action that will serve as substructures for the operational and notional structures built up later on" (Piaget, 1969, p. 30).

Although further advanced than the child in the sensory-motor stage, the preoperational child still uses concrete and static images of reality. "Thus although the child does represent reality rather than simply act in it, the representations are much closer to overt actions..." (Flavell, 1963, p. 158). Young children execute "reality sequences" in thought just as they might do in overt action (Flavell, 1963). These step-by-step mental experiments are tied to concrete actions and events.

The concrete operational stage is identified by the formation of dynamic mental images and increasingly internalized, schematic cognitive actions (Flavell, 1963). The mental operations of this stage

are still however tied to perceptual experience and concrete, tangible information (Brainerd, 1978). Formal operations occur when the child can execute manipulations abstractly.

Piaget's concept of intelligence-as-action provided the across-stage continuity for his theory (Flavell, 1963). Flavell continues,

Piaget's theory permits him to see adult logical operations as sensory-motor transformations, rather than as a different species of behavior entirely. Both involve actions as the common denominator: overt (and therefore slow-moving, concrete, etc.) actions in the case of simple schemas; internalized (and thereby mobile, abstract, etc.) actions in the case of operations. (Flavell, 1963, p. 83)

The concepts of cognition-as-action and intelligence-as action are cited repeatedly in the works of Flavell (1963) and Brainerd (1978) concerning Piaget. Piaget, himself wrote

...knowledge is derived from action, not in the sense of simple associative responses, but in the much deeper sense of assimilation of reality into the necessary and general coordinations of actions. To know an object is to act upon it and to transform it, in order to grasp the mechanisms of that transformation as they function in connection with the transformative actions themselves. To know is therefore to assimilate reality into structures of transformation, and these are the structures that intelligence constructs as a direct extension of our actions. (Piaget, 1969, p. 29)

From Piaget's perspective, especially with young children, direct action on or exploration of an object is necessary for assimilation and eventually accommodation of the object into new schemes. This conceptualization is related in part to children's exploration behavior in response to original thinking task stimuli.

Perceptual Development. E. J. Gibson also relates perceptual development with experience in the environment. "The change process is said to consist of an increase in the ability of an organism to get information from its environment, as a result of practice with the array of stimulation provided by the environment" (Gibson as cited in Flavell, 1977, p. 153). With perceptual experience and practice, information available in the environment but not initially detected is gradually isolated and given attention (Flavell, 1977).

Closely associated with the Piagetian concept of object relations are Gibson's processes of abstraction, filtering, and peripheral mechanisms. In the course of perceptual experience with a variety of objects and events, the child abstracts or extracts invariant features and relations among features (Flavell, 1977). From these perceptions, an increasing perceptual sensitivity is acquired which allows the child to discriminate between similar objects not previously distinctive.

Perceptual sensitivity leads therefore to the development of individual differences in attentional biases and preferences. When these biases and preferences interact with the environment, some stimulus dimensions (e.g., color, size, and shape) are more noticeable or perceptually salient for certain individuals than for others (Flavell, 1977). Dimension salience may also change with age as well as with individual differences and from one task to another.

Through perceptual experiences, information is extracted from the environment. Thus, in reaction to original thinking tasks, perceptual exploration provides a better understanding of the stimuli presented and may influence responding.

Sensory Modality Dominance. It is a popular belief that touch is the dominant sensory mode, particularly during early childhood. This belief is founded in observations of children as they explore the environment. Despite support from Piagetian theory, studies dispute the theorem of primacy of touch even for young children.

Cross-sectional studies have examined sensory dominance using learning and recognition tasks. Schneiderman (1971) reports that vision was more important to object perception than tactile perception with her sample of 2-6 year olds. Millar (1971) reported that although the 3- and 4-year-olds wanted to touch the objects, performance on visual matching was superior to the haptic conditions. Visual cues facilitated recognition for 4-year-olds, but haptic cues did not improve visual performance (Millar, 1971).

Cross-modal and intramodal matching of shape and texture in visual and tactual modalities was studied by Rose, Blank, and Bridges (1972). Three-year-olds performed equally well across all matching tasks when there were no memory demands. However, a delay between presentation of stimulus and selection hampered all conditions involving a tactual component. The researchers report these findings in support of Goodnow's (1971) suggestion that poor cross-modal learning in children may be due to difficulty in storing tactual perceptions

rather than a tactual information processing deficit (Rose, Blank, & Bridges, 1972).

Davidson, Pine, and Wiles-Kettenmann (1980) compared the haptic and visual matching of retarded and nonretarded children of different developmental levels. They found that accuracy improved with development and visual matching was usually better than matching by hand. Stimulus complexity, modality, and mental age affected accuracy and haptic search styles. Developmental shifts toward greater numbers of active haptic search styles with increasing mental age were reported.

Although studies on sensory modality dominance render inconclusive findings, they also suggest that various factors may affect the choice of sensory mode used in exploring the environment. Further examination is needed regarding the relative effect of visual and tactile exploration on children's exploration of task stimuli.

Activity and learning. In attempting to identify a dominant sensory modality for learning, researchers have isolated the variables and attempted to eliminate interaction effects. The effect of the child's activity on learning examines the question more globally.

The effect of activity on children's learning and theories of the development of imagery have extended Piaget's theory. Wolff and Levin (1972) studied the development of imagery in kindergarten and third grade children. Using a paired-associates memory task, they found that the overt interaction of stimulus and response items (toys paired randomly) by either the child or the experimenter

facilitated learning at both age levels. This finding lends support to Piaget's claim that the imaging process is inextricably linked to overt or covert motor activity (Wolff & Levin, 1972). In the second phase of their experiment, the subject manipulated the stimulus-response pairs from behind a screen. The researchers reported that the performance of children who engaged in overt but invisible activity was superior to that of children of either age who did not manipulate the objects. Wolff and Levin again support Piaget's notion of the development of dynamic imagery involving transformations of objects themselves or systematic changes in spatial position (Wolff & Levin, 1972).

A yoked control procedure was used by Wolff, Levin, and Longobardi (1974) in which kindergarteners either produced or observed interactions between pairs of toys. Immediate testing produced no performer-observer differences, however after a 24-hour delay, the performers were significantly more able to pair the items as previously presented than the observers. Explicit instructions given to the subjects to remember the pairings did not change the results significantly. "The children could not summon any strategy to improve their performance beyond that resulting from overt manipulation" (Wolff, Levin, & Longobardi, 1974, p. 223).

Based on Wolff, et al. (1974) study, Borowski, Levers, and Gruenenfelder (1976), tested the training and transfer of prepositional mediators in a paired-associate task for nursery school and first-grade children. In order to assess the affects of active

participation during strategy acquisition and awareness of the strategy's usefulness, the children were given a pretest and post-test using recognition testing procedures. The sample was then assigned to one of four groups based on pretest scores. The groups were designated as (1) passive observation instructions, (2) active manipulation instructions, (3) active instructions together with a film in which another child demonstrated strategy-based acquisition, and (4) recall, or nonmediational instructions. Borowski, et al. found that 84% of the children who spontaneously manipulated the objects displayed almost perfect strategy transfer, performing about 50% better than the controls during post-test. "While object manipulation during strategy training is not a prerequisite for successful strategy transfer, is nevertheless is a highly reliable predictor" (Borowski, Levers, & Gruenenfelder, 1976, p. 785).

Koenigsberg (1973) reported in her study of letter reversals and orientation with preschool children that demonstrations were necessary and sufficient to produce improved letter discrimination in this age group. She viewed sensory-motor activity as "merely one means of channeling attention" (Koenigsberg, 1973, p. 768).

Using the uses-for objects task from Torrance (1962), Goodnow (1969) studied the effects of active handling on responding. She asked kindergarteners to give uses for a Kleenex, a paper clip, and a screwdriver under two conditions: one where they looked at the object held by the experimenter, and the other where they were allowed to look-at-and-handle the object. The subjects were given a

mixture of the two conditions across the three stimuli, for example, the child would look at the Kleenex, handle the paper clip, and look at the screwdriver. The child was then asked to name all the things they could do with the stimuli, make with it, or use it for. Responses were recorded and categorized as "standard" or "nonstandard" uses. The standard uses for each of the stimuli are described as follows: (1) Kleenex--anything that involves wiping or cleaning; (2) paper clip--any use involving clipping or holding things together or in place; and (3) screwdriver--any action involving the use of screws. Non-standard uses therefore involved any other use of the materials not described above. For example, wrapping would be a nonstandard use for the Kleenex, while shooting the clip from a rubber band or digging in the dirt with the screwdriver were examples of nonstandard responses for the remaining stimuli. Up to five repeat responses of similar uses (e.g., using a Kleenex to wipe your face, nose, eyes) were credited for scoring.

The main result reported by Goodnow was that more nonstandard uses were given by the children when an object was both seen and handled. Under look-only conditions, the group had a fairly even number of standard and nonstandard uses. However, the look-and-handle conditions brought out more nonstandard uses and only a few children gave only standard uses (Goodnow, 1969). Goodnow suggests that active handling of the object breaks a set of responses suggested by the look of the object. Hand movements in many cases remained "fluid and varied at a time when the children readily became 'stuck' and

repetitive if they have to proceed by ideas and words alone" (Goodnow, 1969, p. 211).

Research in the area of activity on children's learning seems to suggest that active manipulation of objects improves children's task performance in various settings. Manipulation of task stimuli and its effect on original thinking needs to be examined further.

Creativity and the Effects of "Play"

When creativity is discussed, questions concerning the effects of activity are reshaped and the term "play" is commonly associated with these studies (Dansky & Silverman, 1973, Roy, 1978). In most cases, the free play or unstructured activity consists of the children's manipulation and exploration of materials provided. Manipulation and exploration allows the child to examine and discover the physical properties of an object. Only when objects have become familiar does play activity begin (Hutt, 1970).

Piaget's theoretical perspective is used to define play as "any behavior which is characterized by a predominance of assimilation over accommodation" (Dansky & Silverman, 1973, p. 38). Play occurs as the child relaxes efforts to accommodate to reality, therefore play should have the potential to facilitate creative thought processes.

In their study of play's effect on associative fluency, Dansky & Silverman (1973) assigned ninety 4- to 6-year-olds to three groups: (1) the play group, (2) the imitation group, and (3) a group of children given a coloring book and crayons as a "neutral experience." During the experimental sessions, the play groups was allowed to play with the stimulus items (paper towels, a screwdriver, a wooden board

with 5 screws in it, a pile of paper clips, 15 blank 3 x 5 cards, 10 empty matchboxes and a tray containing 6 wet paper cups); and the imitation group watched the experimenter's manipulation of the items and then repeated the actions. The alternate-uses test was given immediately following the 10 minute experimental sessions. The screwdriver, paper clips, matchboxes, and paper towels were presented individually and the children were permitted to see but not handle the objects as they responded. Responses were scored as either standard or nonstandard in a manner following Goodnow's (1969) method.

Dansky and Silverman (1973) reported that subjects in the play condition produced significantly more nonstandard responses for every item than subjects in the imitation or control conditions. Although the imitation group children had handled the various stimuli, fluency of responses did not increase above the control group's base-line level. This supports Piaget's view that imitative behavior is dominated by a tendency to accommodate to environmental demands. This may limit opportunities to generate novel associations (Dansky & Silverman, 1973).

Roy (1978) studied the effects of play, imitation, and an intellectual task (similar to Twenty Questions) on associative fluency. Using the Dansky and Silverman design, she also noted the effects of handling on fluency. Her findings are consistent with Dansky and Silverman (1973) and support the facilitative qualities of play. Object handling was scored as a "yes-no" response and in the analysis it was found to shift the balance of responses from standard to non-standard uses using Goodnow's (1969) scoring strategy.

Studies of play behavior, with active exploration as an important component, also suggest that stimulus familiarity may facilitate both the quality of play and creative thought processes. Stimulus familiarity, through manipulation and exploration of task material, and its influence on original thinking need to be investigated.

Mednick's Model of Response Hierarchies

Mednick (1962) proposed a model which theoretically described the creative response sequence. He postulated an order effect in which common responses to a stimulus were given early in the response sequence and unusual responses emerged later.

While a number of studies on adults have supported Mednick's model, few have been conducted with children. Ward (1969) tested the model with 7- and 8-year-olds. He found that common responses decreased and unusual ones increased over time, thus supporting the model.

Milgram and Rabkin (1980) used 4th, 7th, and 12th graders as subjects in their developmental test of the theory. Using an abbreviated form of the Wallach and Kogan creativity assessment, they found a significant order effect particularly for high quality responses (unusual responses judged by the degree of fit to the stimulus and originality or elegance of the response). Further they reported that the order effect appears to be a developmental phenomenon appearing before age 12 in more original children only (Milgram & Rabkin, 1980).

Mednick's postulation needs to be further examined. If, there is an order effect in the generation of unusual responses, this finding has great impact on the development of stimulus items that can better tap the full range of responses that a child is capable of generating.

Creativity Testing: Techniques and Limitations

The techniques used by Wallach and Kogan in their 1964 study of creativity and intelligence were administered by female experimenters under game-like conditions without time limitations. Three of the techniques were verbal--the instances, the alternate uses, and the similarities tasks; and two were visual--the pattern meanings and the line meanings tasks. Each yielded two measures, one concerned the ability to generate associates, and the other, the uniqueness of the associates produced (Wallach & Kogan, 1965). These instruments were found to be quite reliable and consistent with older elementary school children.

Starkweather, however, found the line drawings used by Wallach and Kogan and others impractical for use with young children who wanted "to handle the materials about which they were talking" (Starkweather, 1964, p. 112). Therefore, she developed 10 simple three-dimensional styrofoam objects to be used in the Starkweather Originality Test (1971). In the pretest, the children were encouraged to think of a variety of responses by the researcher. In the test proper, the experimenter presented the child with half of the 40 total test pieces in an open-top box. The children were encouraged to take one piece

at a time from the box and tell what it might be. Once all twenty pieces had been seen, the children were given the other twenty pieces, two of each of ten shapes in assorted colors. The test provided four opportunities for the children to respond to each shape. All responses were accepted and recorded including repeated responses. Repeat responses were not credited during scoring nor were responses altered by a minor adjective such as ball and big ball (Starkweather, 1971). No mention was made of the examiner's sex or any time limitations.

Each child's responses were compared with all the other responses made by that child. The child giving the greatest variety of responses was judged to be the most original (Starkweather, 1971). Teacher judgments and comparisons with the child's freedom of expression score were used to validate the Originality Test. Significant agreements were found between these two scores and the Originality Test score (Starkweather, 1971).

Moran, Sawyers, Fu, and Milgram (Note 2, 1982) examined the methods and stimulus materials used in the study of creativity in preschool children. In reviewing the literature, they noted that Busse, Blum, and Gutride (1972) dropped the uses task from their creativity assessment of disadvantaged 4-year-olds due to the children's failure to provide meaningful responses. Moran, et al. (Note 2, 1982) reported that the uses tasks, with verbal stimuli, resulted in generating the fewest responses from the children tested. It was hypothesized that the children might have had difficulty understanding the concept of

function and were possibly bound by the concreteness of the stimuli. It is not clear whether the children were actually shown the stimulus items for the uses tasks or simply provided with the verbal stimuli.

Moran, Milgram, Sawyers, and Fu (Note 1, 1982) advocated the use of three-dimensional patterns task as a better measure of creativity than the two-dimensional patterns. The latter had a significant correlation with intelligence. This view was based on their study using the Starkweather Originality Test materials in two- and three-dimensional form with instructions from Wallach and Kogan (1965). Forty-seven children (mean age 4-6 years) were asked to respond to each piece answering the question, "What could this be?" In the second phase of the study, thirteen children from the original sample repeated the experiment, however the stimuli originally presented in two-dimensional form were shown as three-dimensional stimuli and the three-dimensional stimuli from the first phase were presented in two dimensions. Statistical analysis revealed that the 3-D stimuli elicited more responses regardless of stimulus item. The children were allowed to handle both the 2-D and 3-D stimuli and no time limitations were placed on responding.

Summary

Piaget and Gibson emphasize action and experience in the cognitive and perceptual development of the child. From the tangible object to a mental image of the object, all representations involve action. Overt actions of the child are seen as necessary forerunners of the internalized action (thought) of adults. From these theories

it would seem feasible to expect that the primary sensory mode for learning would be touch. Studies have found, however, that even for young children, vision is dominant. These studies used the tactile perception of children, while studies of activity's role in learning combined the tactile with visual and allowed free movement. In these studies children who were allowed to actively participate performed better than those who observed the action taking place.

Goodnow (1969) linked the studies of learning and creativity with her investigation of the effects of active handling on the uses task. She found that active participation facilitated responding and shifted the type of response from standard uses to nonstandard uses. Free play, which might also be called unstructured handling, was also found helpful in increasing responses and the uniqueness of responses in other studies (Dansky & Silverman, 1973; Roy, 1978).

The materials used in the study of creativity and original thinking and young children have also been investigated. Starkweather (1964, 1971) cited the child's need to hold the stimulus and created a set of materials the child could hold. Studies using her materials in two- and three-dimensional forms have supported her claims that allowing the children to handle the materials would increase interest and responses.

The relationship between stimulus dimension and the mode of exploration allowed remains tentative. The relative influence of each on the generation of response by young children has not been evaluated through research.

CHAPTER 3

Methodology

This study investigated the effects of stimulus dimension and mode of exploration on preschool children's responses on two original thinking tasks. More specifically, children's responses to two- vs. three-dimensional stimuli, visual vs. visual plus haptic exploration, and the interaction of stimuli dimension and mode of exploration were examined.

Subjects

The 80 children participating in this study included 39 males and 41 females. The children were recruited from four child care centers in Southwest Virginia. Twenty-nine children were from Center A; 11 children were from Center B; 23 children were recruited from Center C; and 17 children attended Center D. Centers A and C were college laboratory centers providing care for children of varying SES and using students in Child Development as assistant care givers. Centers B and D were privately owned and operated child care facilities.




The children ranged in age from 46 to 65 Months (\bar{X} = 55.4 months). Their mean IQ was 123.4 with scores ranging from 94 to 152. All of the children except three black and three oriental children, were caucasian.

A letter or recruitment briefly describing the study was distributed by the researcher and child care center personnel to each parent of a child meeting the age criterion. Written parental consent

for their children's participation was obtained prior to testing (Appendix A).

Research Materials

Intelligence Test. IQ scores were extrapolated from the Information and Picture Completion subtests of the Wechsler Preschool and Primary Scale of Intelligence (Wechsler, 1967) using a formula devised by Tellegren and Briggs (1967). A validity coefficient of $r = .82$ was reported by Silverstein (1970) for this short form.

Original Thinking Tasks. Two tasks--the pattern meanings task and the unusual uses task--were used to assess the effects of stimulus dimension and mode of exploration on original thinking. Fluency and uniqueness of responses were used as criteria to assess the effects being examined. The pattern meanings task stimuli (, , and ) , adapted from Starkweather (1971), were presented in two forms (two dimensions and three dimensions), and in two conditions of exploration (visual and visual plus haptic). The stimuli used in the pattern meanings task are presented in Appendix B, C, and D. The unusual uses task stimuli (pencil, screwdriver, and box) were taken from Wallach and Kogan (1965), Goodnow (1969) and Torrance (1963), respectively (Appendix B, C, and D). These stimuli were also presented in the same two forms and two conditions. Verbal stimuli alone, were also used with one of the condition groups for the unusual uses task.

Procedure

The examiners for this study visited each child care center at least once before the test sessions began. During these visits the examiners engaged in playful interaction with the children in order to establish rapport with the children prior to testing. It was thought that the requirement of correct answers on the IQ measure might make the children more restrictive in their responses to the original thinking tasks. Therefore, in order to eliminate possible carry-over effects from the IQ testing one examiner administered all the IQ tests and during a second session, the second examiner administered the original thinking tasks. All testing took place in a room removed from the child's classroom and every attempt was made to equalize the testing environments. The children were asked to play games with the examiner and no child was forced to cooperate.

The IQ scores were used along with the age, sex of the child, and center attended in matching the children and randomly assigning them to one of the following conditions:

- | | |
|---------------|--|
| Condition I | Children in this group were presented 2-D forms for visual exploration. |
| Condition II | Children in this group were presented 2-D forms for visual and haptic exploration. |
| Condition III | Children in this group were presented 3-D forms for visual exploration. |
| Condition IV | Children in this group were presented 3-D forms for visual and haptic exploration. |
| Condition V | Children in this group were presented 2-D with perspective forms for the pattern meanings task for visual and haptic exploration. Verbal stimuli was used for the unusual uses task. |

A description of each group of subjects by sex, age, center attended, and IQ is presented in Table 1.

Intelligence Test

The Information and Picture Completion subtests of the Wechsler Preschool and Primary Scale of Intelligence were administered to the children individually. The standardized procedures and instructions given in the test manual (Wechsler, 1967), were used for both administration and scoring of the subtests.

Original Thinking Tasks

Original thinking was measured utilizing the pattern meanings task and the unusual uses task. The pattern meanings task and the unusual uses task stimuli were presented in either two-dimensional form (Appendix B), three-dimensional form (Appendix C), or two-dimensional with perspective form (Appendix D). The method of presenting the stimuli by the examiner to a child and the mode of exploration allowed by a child varied according to the test condition assigned. The verbal instructions and questions given by the examiner under each condition remained the same. These instructions and questions will be presented in a later section, following a description of the mode of exploration and the methods of presenting the task stimuli.

Table 2 is a summary of the stimuli dimension, modes of exploration, and method of stimulus presentation used in test conditions I, II, III, IV, and V. Verbal instructions were similar for all five

Table 1
Description of Groups

| | Sex | | Center Attended | | | | Age (in months) | Mean IQ |
|---------------|-----|---|-----------------|---|---|---|--------------------|------------|
| | M | F | A* | B | C | D | | |
| Condition I | 9 | 7 | 7 | 2 | 5 | 2 | 55.38 | 123.81 |
| Condition II | 7 | 9 | 7 | 1 | 5 | 3 | 54.13 | 122.94 |
| Condition III | 7 | 9 | 7 | 2 | 4 | 3 | 57.25 | 120.75 |
| Condition IV | 9 | 7 | 4 | 3 | 5 | 4 | 56.19 | 123.44 |
| Condition V | 7 | 9 | 4 | 3 | 4 | 5 | 54.88 | 121.13 |

*Center A was the Virginia Tech Child Development Laboratory;

Center B was Tommorrow's World Child Care Center;

Center C was the Early Learning Center--New River Community College; and

Center D was Carousel Learning Center.

Table 2
Stimulus Dimensions, Method of Presentation
and Modes of Exploration for each Condition

| | Stimulus Dimension | | Mode of Exploration | Method of Stimulus Presentation |
|---------------|-----------------------|--------|---|---|
| | Patterns | Uses | | |
| Condition I | 2-D | 2-D | Visual | Examiner held stimulus. Child explored visually while giving responses. |
| Condition II | 2-D | 2-D | Visual & Haptic | Examiner gave stimulus to child for visual and haptic exploration, while giving responses. |
| Condition III | 3-D | 3-D | Visual | Examiner held stimulus. Child explored visually while giving responses. |
| Condition IV | 3-D | 3-D | Visual & Haptic | Examiner gave stimulus to child for visual and haptic exploration, while giving responses. |
| Condition V | 2-D in perspective | spoken | <u>Patterns</u> -- Visual & Haptic <u>Uses</u> -- listening without seeing object. | <u>Patterns</u> --Examiner gave stimulus to child for visual and haptic exploration while giving responses. <u>Uses</u> --Examiner said each stimulus name verbally. Child responded without seeing the objects. |




conditions. The method of stimuli presentation and mode of exploration used in each condition are as follows:

Visual Exploration. In these conditions (I and III) the children were only allowed to look at the stimuli while giving responses. The stimuli were presented by the examiner one at a time. The examiner held each stimulus at the children's upper chest level, which allowed the children to look down slightly on the item. If the children attempted to take the stimulus away from the examiner, they were told that the examiner would hold the item.

Visual and Haptic Exploration. In these conditions (II, IV and V) the children were allowed to look at and touch the stimuli while giving responses. The examiner handed the stimulus to the children at their upper chest level. This was done to insure that each child received the stimulus in the same orientation as those who were allowed visual exploration only. Any changes in perceptual orientation resulted from the child's direct manipulation of the stimulus.


Verbal (spoken) Presentation of Stimuli. This mode of presentation was used only in Condition V on the unusual uses task. The words representing the stimuli objects (pencil, screwdriver, and box), were spoken by the examiner. The children were not shown the objects in either 2-D or 3-D form. They were to respond to the task instructions after hearing the object name spoken by the examiner. (It should be noted that on the unusual uses task in Conditions I-IV verbal instructions accompanied the stimuli).

The stimulus materials were presented in a constant order regardless of test condition. The pattern meanings task stimuli were presented first followed by the unusual uses task stimuli. The order of presentation for the pattern meanings task stimuli were as follows:

(1)  (used as an example), (2)  and (3) . The order of presentation for the unusual uses task stimuli was as follows:

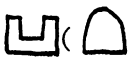
(1) pencil (used as an example), (2) a screwdriver, and (3) a box.

Pattern Meanings Task Instructions

Each child was asked to be seated upon entering the testing room. The examiner sat directly in front of the child during testing. The examiner began by saying, "Today, I have a game with shapes. After looking at each one, I want you to tell me all of the things you think each shape could be. Here is an example." The examiner then showed the  as an example in the appropriate mode of presentation according to the condition described above. The examiner then continued saying, "What could this be?"

The child was allowed to respond and all responses were accepted. The examiner then added other possible responses not mentioned by the child such as a box, a window or peep hole, and a square doughnut. The examiner then said, "You see, there are lots of different answers in this game. Do you understand how to play?" If the child did not appear to understand the game, the examples were repeated by the examiner.

When the child understood the game, the examiner proceeded with presenting the two test stimuli one at a time. The verbal instructions

were as follows: "I want you to tell me all the things you think this shape could be. What could this  be? Take as long as you want." If the child stopped responding the examiner asked, "What else can it be?" No other comments or verbal reinforcements were used during the test session. This probing continued until the child indicated that he or she had no more responses to give.

Unusual Uses Task Instructions

Upon completion of the pattern meanings task, the examiner said, "This next game is called, 'What can you use it for?' I'll explain how to play. The first thing we are going to play with is a pencil." The examiner then showed the pencil as an example in the appropriate mode of presentation according to the child's condition group described above. The examiner then continued by saying, "I want you to tell me all the things you can make with it, ways to play with it, or things you can use it for. What can you use a pencil for?"

The child was allowed to respond and all responses were accepted. The examiner then added other possible uses not mentioned by the child such as a flagpole, pretend it was an airplane, and to dig in the dirt with. The examiner then said, "You see, there are lots of different answers in this game, too. Do you understand how to play?" If the child did not appear to understand the game, the examiner repeated the examples.

If the child understood the game, the examiner proceeded with presenting the two test stimuli one at a time. The verbal instructions were as follows: "I'll show you something and I want you to

tell me as many uses for it as you can think of. How can you use a screwdriver (box), how can you play with it or what can you make with it? Take as long as you want. If the child stopped responding, the examiner asked, "What else can it be used for? How can you play with it, use it, or what can you make with it?" This probing continued until the child indicated that he or she had no more responses to give. No other comments or verbal reinforcements were used during the test session. When the unusual uses task was completed, the children were then thanked for their cooperation and help and escorted back to their classroom.

Scoring of Data

The children's responses to the four test stimuli were recorded verbatim by the examiner on a data collection form (Appendix E). For each stimulus in the pattern meanings and unusual uses tasks, a frequency distribution within each group was constructed. Each response given by a child was recorded. A response given by only one child in that condition group was considered a unique response (Wallach & Kogan, 1965). Responses given by two or more children in a single condition were considered popular. A response was identified as a repeat response if it had already been given for that particular stimulus by the same child or if the response was altered by the addition of a minor adjective (e.g., ball and big ball). Repeat responses, bizarre responses, and "no responses" were coded separately from unique and popular categories. Of the 1076 total responses, 147 were repeat responses and 40 were classified as bizarre or "no response."

The unique responses given on the patterns task were also judged for their quality. A high quality response was one which achieved a high degree of fit to the stimulus and was clever or elegant when judged by subjective criteria (Milgram, Milgram, Rosenbloom, & Rabkin, 1978). Two independent judges, unaware of the children's assigned test condition, judged the quality of the pattern meanings task unique responses. A reliability of 89% was achieved between the judges on the 110 unique responses. Disagreements were resolved by a third judge.

Analysis of Data

The effects of stimulus dimension and mode of exploration on children's responses to original thinking tasks were analyzed using analysis of covariance. Condition group served as the independent variable and the dependent variables were total fluency and unique responses. Intelligence was used as the covariate due to its tendency to statistically influence total fluency, $r = .21$, $p < .07$.

In order to evaluate possible variation in responding due to the subjects' sex, age, and center attended, analyses of variance were conducted. No significant effects were found for these variables on fluency or unique responses. Due to these findings and the assignment of subjects to condition groups based on these variables, they (age, sex, and center attended) were disregarded in further analyses of the dependent variables.

Correlational analyses were also used in evaluation of the data. Intelligence was partialled out as a variable in some of the analyses to control for the effect of IQ.

CHAPTER 4

Results and Discussion

This chapter presents the results of the statistical analyses of the data pertaining to the proposed four criteria related to stimulus dimension and mode of exploration considered in this study. The results are also discussed as related to other research, theory, and observations of the examiner.

Intelligence, age, sex, and center attended were seen as variables which might contribute to group differences. Thus, the first step in analyzing the data was to conduct correlational analyses on these variables and total fluency and unique responses. There was a tendency for IQ to influence total fluency ($r = .21$, $p < .07$) and center attended to influence high quality unique responses, $F(3, 75)$, 3.29 , $p < .03$. No other significant relationships were found. Since the children were assigned to condition groups based on these variables, they were disregarded, except for IQ and center attended, in further analyses. IQ was partialled out of all other correlations and used as covariate in analyses of variance.

Results Evaluated by Criteria

Using the criteria discussed below, it was predicted that variation in stimulus dimension and the mode of exploration would affect total fluency and unique responses on the pattern meanings and unusual uses tasks. It was also predicted that the variations in stimulus dimension and mode of exploration would result in a greater degree of fit with the criteria and that the degree of fit would

increase in the following progression: 2-D visual exploration, 2-D visual plus haptic exploration, 3-D visual exploration, and 3-D visual plus haptic exploration. (Discussion from Condition V, which was not included in the progression, are presented in Appendix F).

The following four criteria were identified as they may contribute to the selection of the optimal method of stimulus presentation for preschool children. The four criteria are:

1) A high intertask correlation between pattern meanings and unusual uses tasks would suggest that these tasks are measuring the same construct--original thinking.

Intertask correlations revealed trends in the relationships between the method of stimulus presentation and total fluency on the original thinking tasks only in Condition IV. When the children were allowed to look at and handle the 3-D stimuli, intertask correlation between pattern meanings and unusual uses total fluency was $\underline{r} = .49$, $\underline{p} < .05$. When IQ is partialled out of the analysis, however, the correlation loses statistical significance, $\underline{r} = .48$, $\underline{p} < .07$.

Correlations between the unusual uses task and the pattern meanings task by stimulus dimensions (2-D, 3-D, and 2-DD) and the two modes of exploration (visual and visual plus haptic) were calculated. These correlations revealed significant intertask correlations for the 3-D stimuli and the visual plus haptic mode of exploration and are presented in Table 3.

The results indicate that three-dimensional stimuli and visual plus haptic exploration provide the strongest correlations between the pattern meanings and unusual uses tasks on total fluency and unique

Table 3
Correlations Between Responses on Patterns and Uses Tasks
by Stimulus Dimension and Mode of Exploration

| | <u>N</u> | Total Fluency | Popular | Unique |
|--------------------|----------|---------------|---------|--------|
| <u>Dimension</u> | | | | |
| 2-D | 32 | .11 | .13 | .22 |
| 3-D | 32 | .51** | .36* | .14 |
| 2-DD | 16 | .08 | -.10 | .22 |
| <u>Exploration</u> | | | | |
| Visual | 32 | .11 | .16 | -.04 |
| Visual/ Haptic | 32 | .37** | .11 | .33* |

*p < .05

**p < .01

responses. Both of these factors are present in Condition IV. Based on these correlations, the suggestion can be made that Condition IV offers the best correlations between the two original thinking tasks of any other condition group assessed.

2) Significant intertask correlations between the pattern meanings and unusual uses tasks which are greater than correlations of either task to intelligence would suggest that fluency on these tasks is not directly related to IQ.

As shown in Table 4, only two groups meet this criterion: Conditions III and IV. Both these conditions make the presentation of materials in three-dimensional form. The only significant relationship, however, is found in Condition IV ($\underline{r} = .49$, $\underline{p} < .05$). This result highlights the ability of the 3-D stimuli and haptic as well as visual exploration to enhance intertask correlation.

When dimension of the stimuli was analyzed alone, three-dimensional stimuli correlated with total fluency on the unusual uses and pattern meanings tasks at $\underline{r} = .51$, $\underline{p} < .004$. Fluency on the uses task and patterns task correlated with IQ at $\underline{r} = .15$ and $\underline{r} = .08$, respectively, when the stimulus was presented in three-dimensional form. No significant relationship was found for 2-D stimuli.

Mode of exploration was also analyzed separately and revealed a correlation of $\underline{r} = .37$, $\underline{p} < .01$, between the pattern meanings and unusual uses tasks when visual plus haptic exploration was allowed. IQ correlated with pattern meanings at, $\underline{r} = .23$ and with unusual uses at, $\underline{r} = .17$.

Table 4
Intertask Correlations and Correlations of Original Thinking
Tasks to IQ by Condition

| | Uses Task-Patterns Task | Patterns-IQ | Uses-IQ |
|------------------|-------------------------|-------------|---------|
| <u>Condition</u> | | | |
| I | -.17 | -.02 | .39 |
| II | .43 | .39 | .10 |
| III | .38 | -.16 | .12 |
| IV | .49* | .17 | .13 |
| V | .08 | .15 | .23 |

*p < .05

3) Greater number of responses per stimulus item such that there will be an adequate sampling of the response hierarchy.

Analysis of covariance revealed the tendency for an interaction of dimension and exploration to effect total fluency scores, $F(1, 63) = 3.20, p < .08$. Individual analysis of group differences in total fluency, using the Dunn's test, showed a significant difference, $t(16) = 3.63, p < .05$, between Condition III ($\bar{X} = 9.62$) and Condition IV ($\bar{X} = 13.31$). That is the highest and lowest means existed in the 3-D conditions (see Table 5).

Examination of mean responses showed a decrease in unique responses when the stimuli were handled particularly for two-dimensional stimuli. Analysis of covariance, however, showed no significant effects of dimension, exploration or the interaction of these factors on total unique responses.

It appears, therefore, the condition that is most capable of eliciting the greater number of responses is Condition IV (3-D stimuli for visual plus haptic exploration). Several reasons can be suggested for this finding. First, the attention channeling capabilities of the three-dimensional stimuli when paired with visual and haptic exploration may maintain a child's attention long enough to generate a larger portion of the hierarchy of responses. Second, handling and manipulating the actual object may break the set of responses elicited by looking at the object alone. Possible avenues of thought not previously considered may be tapped. It was often observed during administration

Table 5
Mean Responses on the Pattern Meanings Task and
Unusual Uses Task by Condition

| | I ^a | II ^b | III ^c | IV ^d | V ^e |
|------------------------|----------------|-----------------|------------------|-----------------|----------------|
| <u>Pattern Meaning</u> | | | | | |
| Popular | 2.31 | 3.31 | 1.81 | 3.75 | 3.56 |
| Unique | 3.31 | 2.56 | 3.31 | 3.43 | 2.25 |
| Fluency | 5.62 | 5.87 | 5.12 | 7.18 | 5.81 |
| <u>Unusual Uses</u> | | | | | |
| Popular | 4.00 | 4.31 | 3.44 | 4.56 | 3.68 |
| Unique | 1.62 | .81 | 1.06 | 1.56 | .88 |
| Fluency | 5.62 | 5.12 | 4.50 | 6.12 | 4.56 |
| <u>Total PM/UU</u> | | | | | |
| Popular | 6.31 | 7.63 | 5.25 | 8.31 | 7.25 |
| Unique | 4.94 | 3.37 | 4.37 | 5.00 | 3.12 |
| Fluency | 11.25 | 11.00 | 9.62 | 13.31 | 10.37 |


^aCondition I--2-D Visual

^bCondition II--2-D Visual Plus Haptic

^cCondition III--3-D Visual



^dCondition IV--3-D Visual Plus Haptic

^eCondition V--PMT 2-DD Visual Plus Haptic
UUT Verbal
(See Appendix F for discussion)

of this task that the child would turn the object in various ways as though looking for something. Generally the child would then demonstrate how the object might be used before stating the use. For example, a child moved her hand over the curved edge of the stimulus () while saying, "Wheee" would then say, "It could be a slide." As Goodnow (1969) suggested it seemed that the hands remained fluid and suggested responses the mind had not yet thought of.

It is interesting to note that the greatest differences in total fluency exist between Conditions III ($\bar{X} = 9.62$) and IV ($\bar{X} = 13.31$). It was predicted that Condition III, which allowed visual exploration of the 3-D stimuli, would yield more responses than Conditions I ($\bar{X} = 11.25$) and II ($\bar{X} = 11.00$). This was not confirmed. Lower mean responses given by children in Condition III could be due to three possible reasons.

First, when shown the 3-D stimulus, almost without exception, the children in Condition III ("look only") reached for the stimulus. This behavior was not observed under the 2-D "look only" condition. When this happened the examiner said, "I'll hold the object." This verbal refusal of the child's desire to touch the stimuli, may have seemed reprimanding, and this may have inhibited the children from freely giving responses. Often, however, the children refrained from taking that particular stimulus again only to attempt to hold the next stimulus presented. Some children would verbally respond to the questions about the stimulus then try to show the examiner what they meant through demonstration. They would take the stimulus from the examiner,

demonstrate, then return it to the examiner. For example, with the first pattern stimulus () a child said, "Well, if you turn it over, it could be a bridge. Let me show you." The child took it out of the examiner's hand, demonstrated the bridge (), then gave it back to the examiner. It is possible that the child's repeated attempts to hold the object may have in some way blocked responding or at least inhibited fluent thought.

Secondly, according to Piaget, during the preoperational stage of development, the child may possess static mental imagery of objects. Flavell (1963) stated that for a child of this stage of development the mental "representations are much closer to overt actions" and that the child executes step-by-step "reality sequences" on objects (p. 158). It seems feasible to suggest that the children may have had difficulty in mentally changing the orientation and/or perspective of the stimulus as it was presented. The examiner did observe on more than one occasion children trying to "stand on their heads" to get a different view of the object. Again this behavior was not noted with the line drawings (2-D) stimuli under the visual exploration condition (Group I). This inability to mentally change the orientation of the object may have resulted in the children's "centering" of their attention. Thus, narrowing their perspective possibly resulted in the lower number of responses seen in Condition III.

Finally, as mentioned earlier, almost every child tried to take the stimuli. Once it was made clear that the examiner would hold it,

some of the children seemed to lose interest. They would then look around the testing room and ask questions not related to the study. Without being allowed to handle the 3-D stimuli they seemed less attentive. While this lack of attention might have been expected in the 2-D visual exploration condition, children in Condition I did not attempt to take the stimuli or show any interest in the drawing other than looking at it.

It is clear this combination of dimension and exploration in Condition III is least effective in the generation of responses on these tasks. It appears that some constraints might serve to limit the effectiveness of this particular interaction. The exact nature of the interaction is unknown and in need of further investigation.

Clearly, these explanations are speculative and post hoc. However, the suggestion of a dimension and exploration mode interaction is intriguing and qualifies the previous research of Moran, et al. Stimuli presented in three dimensions are not necessarily better than those presented in 2-D, since 3-D tasks had both the highest and lowest mean responses in the present study. Three-dimensional stimuli and visual plus haptic exploration appears to be a better task presentation method than 3-D with visual exploration only. The mean responses for two-dimensional tasks are intermediate.

4) A positive relationship between total fluency and high quality unique responses would suggest support for Mednick's theory with young children.

A series of correlations were performed to evaluate the relationship between total fluency and high quality unique responses from the pattern meanings task. Since analysis of covariance revealed a significant effect for center attended on high quality unique responses, $F(3, 75) 3.29, p < .03$, and a correlation of $r = -.24, p < .03$, this variable was partialled out of the analysis. For the total sample ($N = 80$) total fluency and high quality unique responses from the patterns task correlated at $r = .49, p < .001$. When correlated by condition group, significant relationships were found for Condition II, $r = .71, p < .004$, and for Condition IV, $r = .56, p < .04$.

Evaluation of the findings by condition group showed that, regardless of stimulus dimension, the conditions allowing visual plus haptic exploration showed significant relationships between total fluency and high quality unique responses.

Summary

Review of the results reported above point out that certain dimensions and modes of exploration are more effective in eliciting responses from young children. Consistently the results point to the combination of 3-D stimuli presented for visual plus haptic exploration as the most effective method of stimulus presentation.

Intertask correlations between the pattern meanings task and the unusual uses task were only significant for Condition IV and the correlations of either task and IQ were not related. The pattern meanings and unusual uses tasks under Condition IV are measuring the same

construct, i.e. original thinking, and are distinct from IQ. The combination of 3-D stimuli and visual plus haptic exploration used in Condition IV also elicited the greatest number of responses, and was significantly related to the correlation of total fluency and pattern meanings high quality unique responses.

Analyses of covariance used to test the prediction that condition group would influence total fluency and unique responses revealed no significant effects. A clear progression for an increase in responses given from 2-D visual exploration, to 2-D visual plus haptic exploration, to 3-D visual exploration, to 3-D visual plus haptic exploration, is not indicated. However, certain modes of exploration (visual plus haptic) and stimulus dimensions (3-D) seem to influence the generation of responses. Consistently these two factors emerge as relevant to the criteria under consideration for the selection of the optimal method of stimulus presentation.

CHAPTER 5

Summary, Conclusions, and Recommendations

Cognitive and perceptual theories stress the importance of experience and action in development. Piaget theorized that all thought began with overt action. Studies of sensory modality dominance discount the primacy of touch, even at the preschool age, while stressing the importance of vision in learning tasks. Research into the role of action on learning has supported Piaget's theory. Play has been found to facilitate creative responding in young children.

Research on creativity of young children has consisted mainly of "dribble down" methods used with older subjects. Starkweather (1964, 1971) examined the materials used in the assessments of creativity and found them unsatisfactory because the children were not permitted to handle the materials. Moran, et al. (Note 1) studied two- and three-dimensional representations of Starkweather's materials with preschool children. They found that the three-dimensional forms which the children could handle, elicited more responses than the 2-D materials. An increase in the number of responses generated becomes important when Mednick's theory of a response hierarchy is considered. Based on his position, more responses generated increases the possibility that unique responses will be elicited. Therefore, in order to assess creativity (or original thinking) in young children enough responses must be given in order to pass the everyday responses which occur early in the sequence to get to the unique ideas expressed in later responses.

The purpose of this study was to investigate the effects of stimulus dimension and mode of exploration on preschool children's responses to original thinking tasks. The stimuli for the original thinking tasks were presented in three forms: 2-D, 3-D, and 2-D with perspective. They were also presented under two conditions: visual exploration and visual plus haptic exploration. The pattern meanings task stimuli were adapted from Starkweather (1971) and the unusual uses task was adapted from Wallach and Kogan (1965).

The sample consisted of 39 males and 41 females ranging in age from 46-65 Months (\bar{X} = 55.4 months). All of the children attended child care centers in Southwest Virginia. Two subtests (the Information and Picture Completion) from the Wechsler Preschool and Primary Scale of Intelligence (1967) were given to the children prior to administering the original thinking tasks. This was done to obtain an extrapolated IQ score for each child. The children were randomly assigned to one of five condition groups based on IQ scores, sex, and center attended. The condition groups were as follows: (1) 2-D visual exploration, (2) 2-D visual plus haptic exploration, (3) 3-D visual exploration, and (4) 3-D visual plus haptic exploration. The fifth group used 2-D drawings with perspective for the pattern meanings task and verbal stimuli for the unusual uses task.

It was predicted that variation in stimulus dimension and the mode of exploration permitted would affect total fluency and unique responses to the original thinking tasks. Further, it was predicted

that these factors would effect total fluency and unique responses in an ordered progression and that the degree of fit between the four criteria, which might contribute to the selection of the optimal method of stimulus presentation, would increase in the same progression. The ordered progression was from 2-D visual exploration, to 2-D visual plus haptic exploration, to 3-D visual exploration, to 3-D visual plus haptic exploration.

The four criteria used and the findings are as follows:

1) High intertask correlations between the pattern meanings task and the unusual uses task were found only for Condition IV which presented the stimuli in three dimensions for visual plus haptic exploration. This finding suggests that when the stimulus materials are presented in 3-D and the subjects are allowed to handle them, the pattern meanings task and the unusual uses task are measuring the same construct--which is assumed to be original thinking.

2) Intertask correlations which were greater than correlations of either task to IQ were also found for the 3-D stimuli presented for haptic as well as visual exploration. Again, Condition IV, (3-D stimuli and visual plus haptic exploration) which combined these factors, was the only condition group for which this relationship was found.

3) Greater mean responses per stimulus item were found as a result of both stimulus dimension and the exploration allowed. Three-dimensional stimuli and visual plus haptic exploration showed increases in mean responses over 2-D and visual exploration only. Condition IV

appeared to the condition most capable of eliciting the greater number of responses (while Condition III appeared lowest), thereby more effectively tapping the response hierarchy and increasing the likelihood that unique responses will emerge.

4) A positive relationship between total fluency and pattern meanings high quality unique responses was found for those conditions allowing visual and haptic exploration. Conditions II and IV, therefore offer limited support for Mednick's theory since as the total number of responses increased so did the number of high quality unique responses.

Conclusions

The results of the present study indicate that the use of 3-D stimuli, visual plus haptic exploration, and the combination of both are the best modes to be used in development of an assessment tool for studying creativity in young children. It appears that stimuli presented in three dimensions and allowing haptic exploration may significantly contribute to the increased production of total responses as well as unique responses on original thinking tasks. Further research is warranted on other factors which may influence responding such as stimulus items used, instructions given, the type of classroom environment, the child's cognitive style, and other individual differences. Results from these studies may provide other factors relevant to the development of a creativity assessment.

Recommendations for Further Study

There are several recommendations which can be made for further investigations into this area. These are based on findings from the present study as well as observations by the examiner.

1) The extent of handling done by the child on each stimulus should be recorded. Even in conditions which allowed haptic exploration, some children did not handle the object. This might establish a more direct link between haptic exploration and fluency. A possible scoring method for haptic search styles is described by Davidson, Pine, and Wiles-Kettenmann (1980).

2) The instructions to the unusual uses task should be simplified by requesting one type of response at a time. The instructions used in this study were stated so the three types of responses were requested at once, i.e. use it for, make with it, or play with it. This may have inhibited the variety and number of responses given if the child did not pay attention to a particular part of the instructions. In addition, each time the children were probed for further answers they could freely respond to a different kind of idea expressed in the instructions. This may have interrupted their thought processes and in turn affected the response hierarchy.

3) The screwdriver used as one of the stimuli for the unusual uses task should be eliminated. Many of the children responded that the screwdriver was not to play with because it was dangerous. (This response was also given for the pencil used as an example for the

uses task). This also suggested that while the children knew what a screwdriver was they had very little experience using one.

4) The study could be designed to evaluate differences within subjects. As in Goodnow's (1969) study the stimuli could be presented in a variety of forms and conditions during the same test session. A test-retest design could also be used, presenting the same stimuli in a different form and condition on a separate occasion.

5) A larger more representative sample using the design of the present study might achieve better discrimination among conditions and increase the generalizability of the findings.

6) Replication of the present study using a different age group could illustrate the effect of age on the relative influence of dimension and exploration.

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APPENDIX A

Parental Consent Letter



COLLEGE OF HOME ECONOMICS

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061 - 8299

DEPARTMENT OF MANAGEMENT, HOUSING AND FAMILY DEVELOPMENT (703) 961-4794 or 4795

April 13, 1982

Dear Parents,

I am a graduate student in Child Development at Virginia Tech. My research deals with creativity in preschool children. I am asking for your permission to interview your preschool-age child.

The children will be interviewed individually at their child care centers. They will be asked to identify some shapes and to give uses for familiar items. There are no right or wrong answers and no names will be used in reporting the findings. A summary of the results will be available when the research is concluded in mid-June.

If you have any questions regarding your child's participation, please contact me or Dr. Victoria Fu at the numbers given below. If you are willing to participate, please sign the form below and return it to your child's center, before April 21, 1982.

Your cooperation is deeply appreciated. Thank you.

Sincerely,

Gail B. Kelso
552-7074 or 961-6148

Dr. Victoria R. Fu
961-4796

My child has my permission to participate in the study of creativity and preschool children.

parent's signature

Child's name _____

Child's birthdate _____

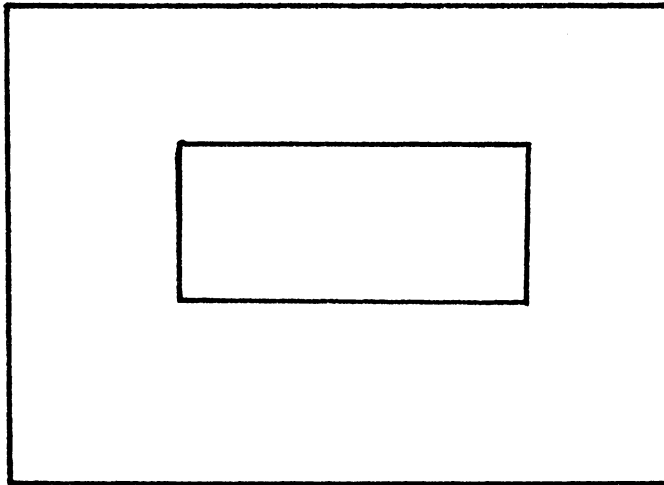
APPENDIX B

Two-dimensional stimuli

APPENDIX B

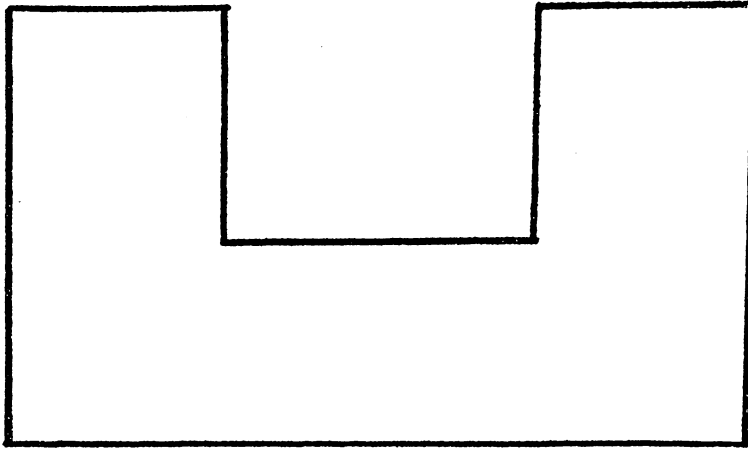
Two-dimensional stimuli

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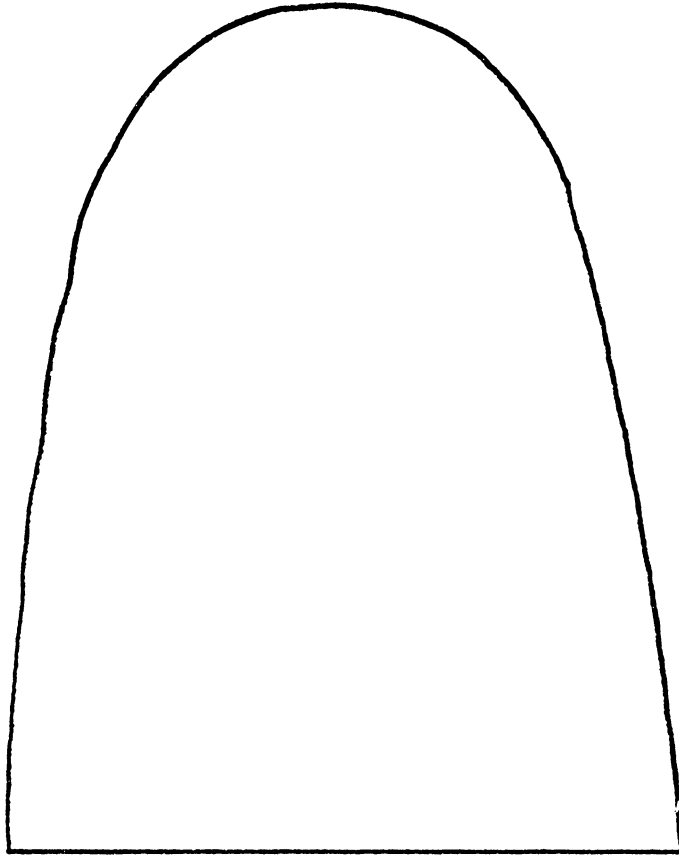


Example

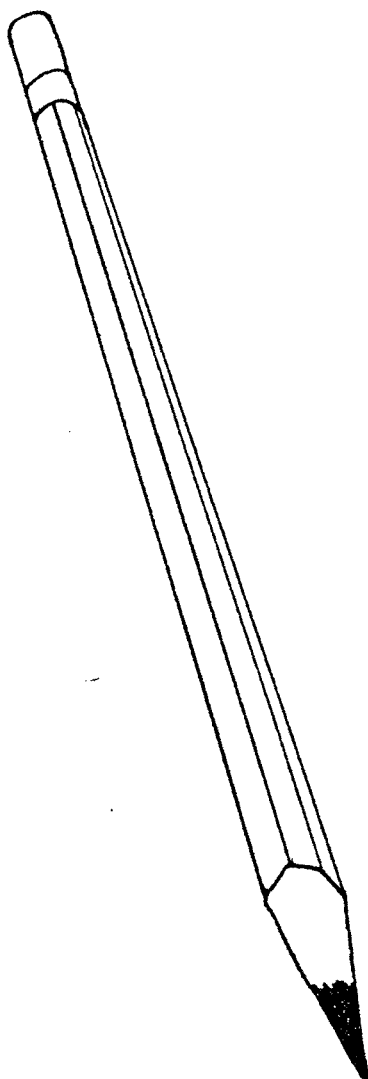
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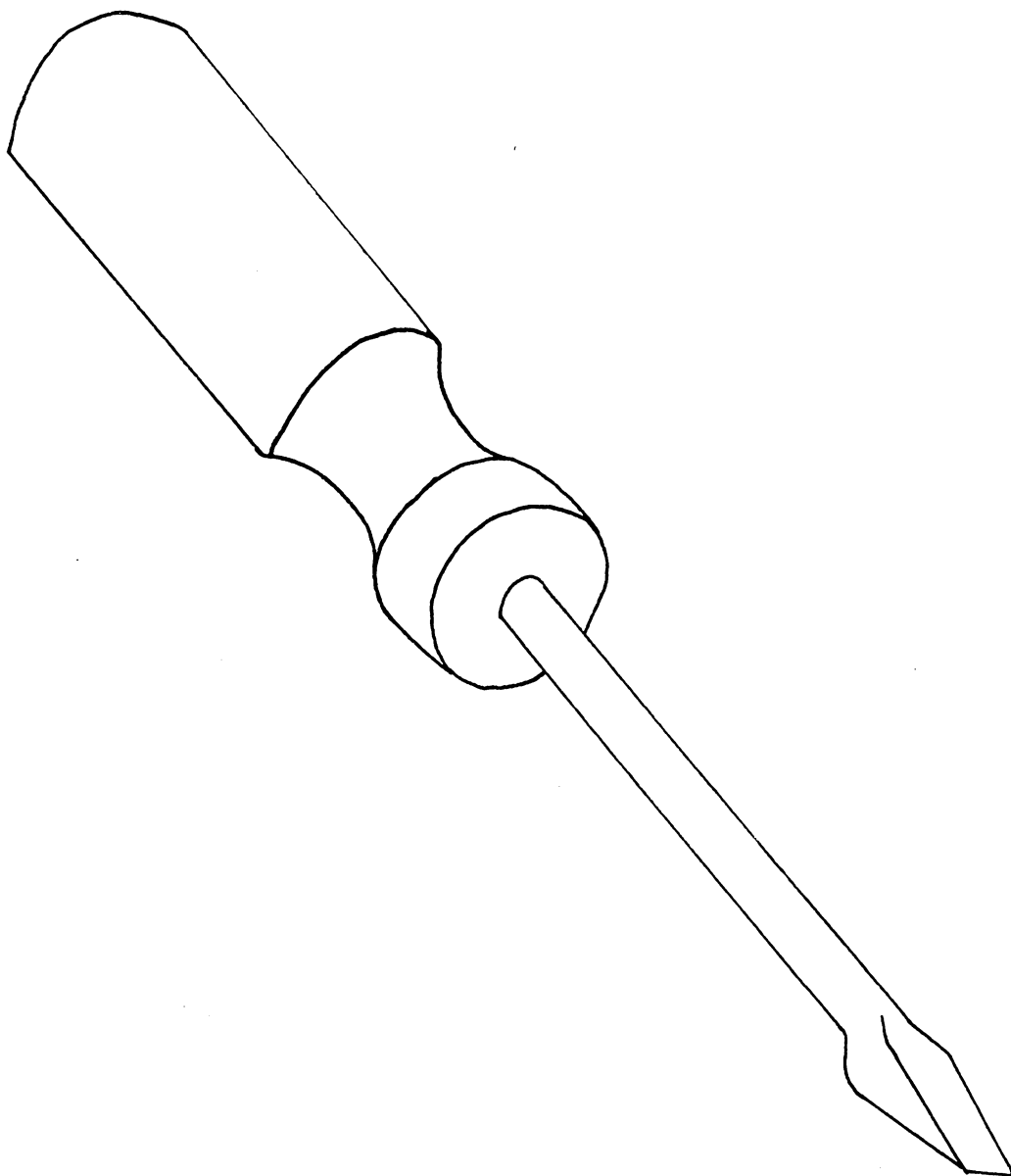
Pattern 1
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Pattern 2
(Actual Size)

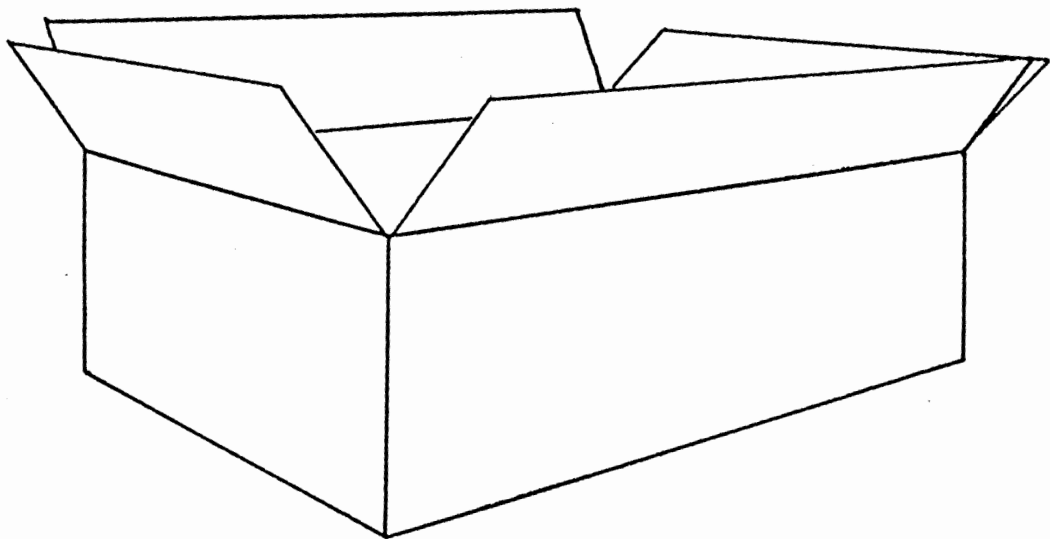


Example
(Actual size)



Uses 1

(Actual Size)



Uses 2

(Actual Size)

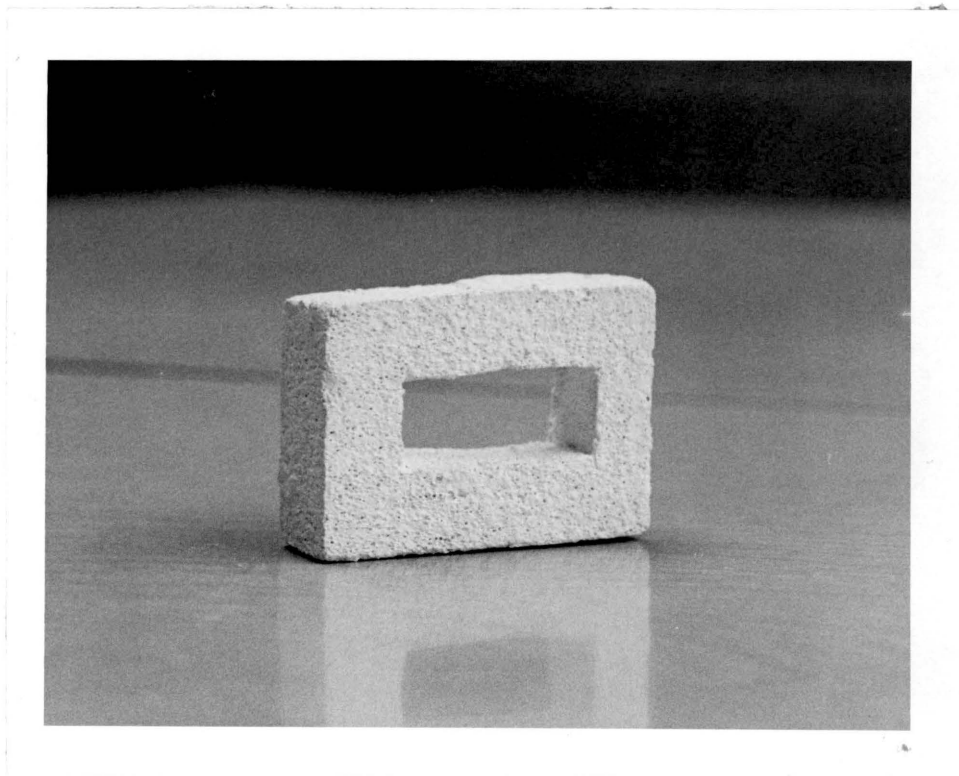
APPENDIX C

Three- dimensional Stimuli

APPENDIX C

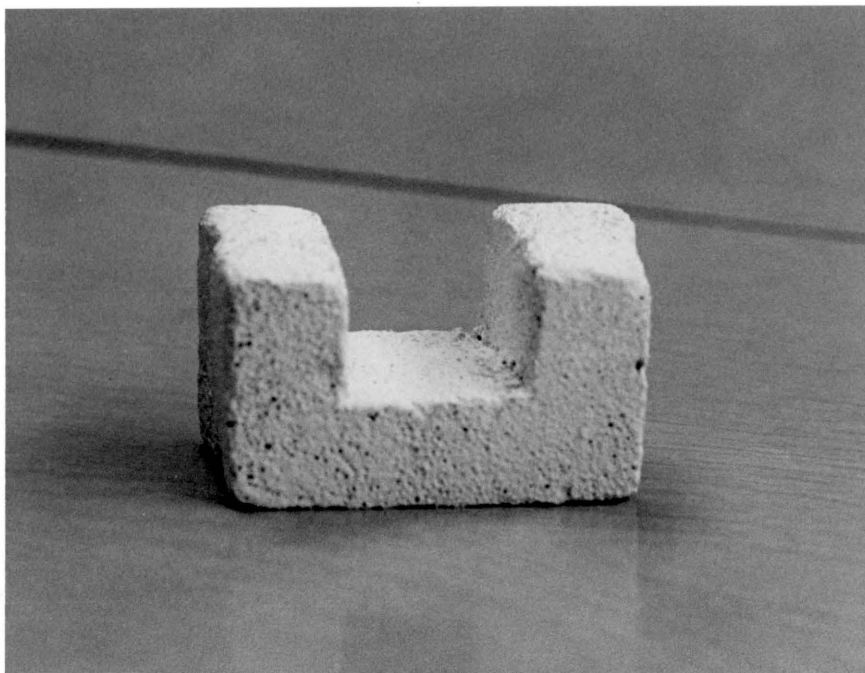
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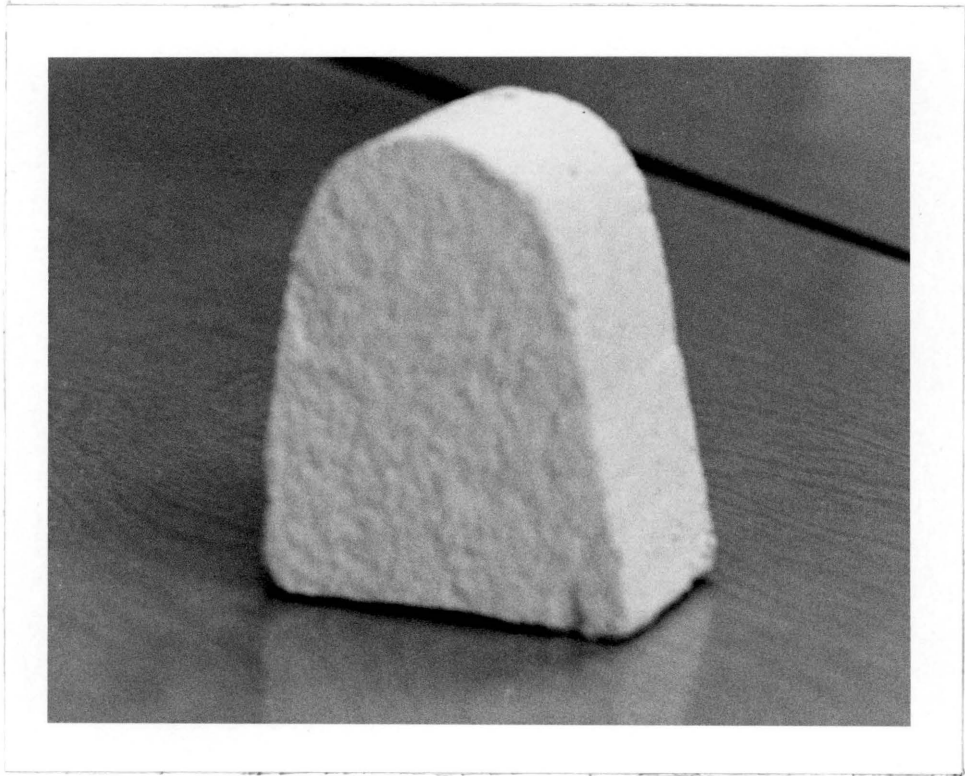
Example

(Actual size - 3.5 x 2.5 x 1.25")



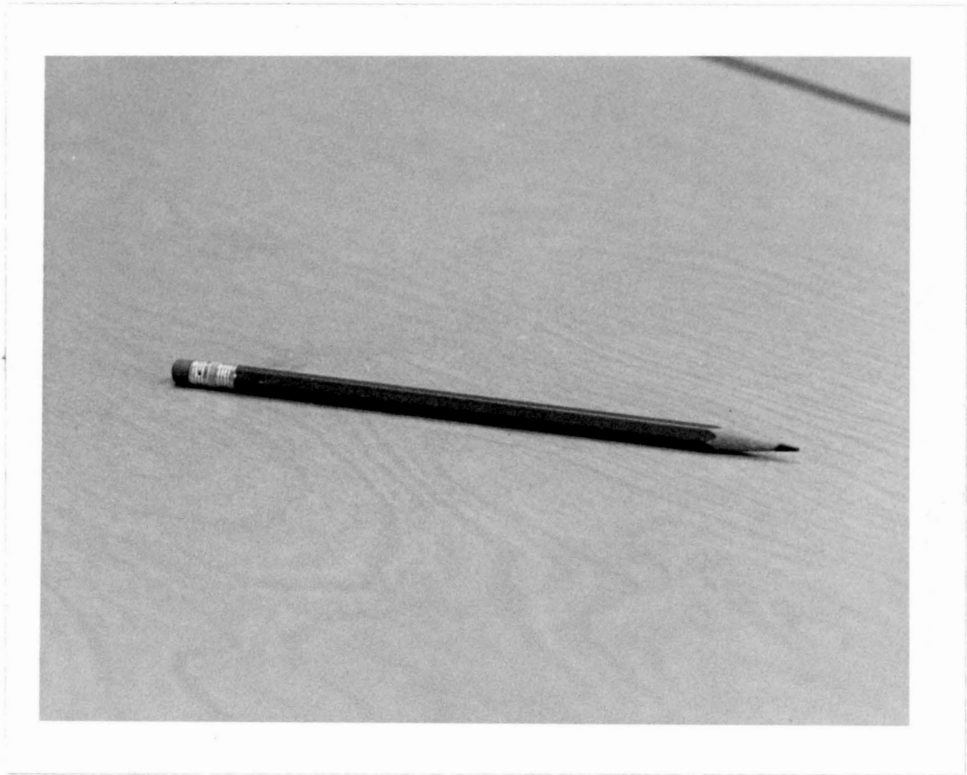
Pattern 1

(Actual size - 4.0 x 2.25 x 2.25")



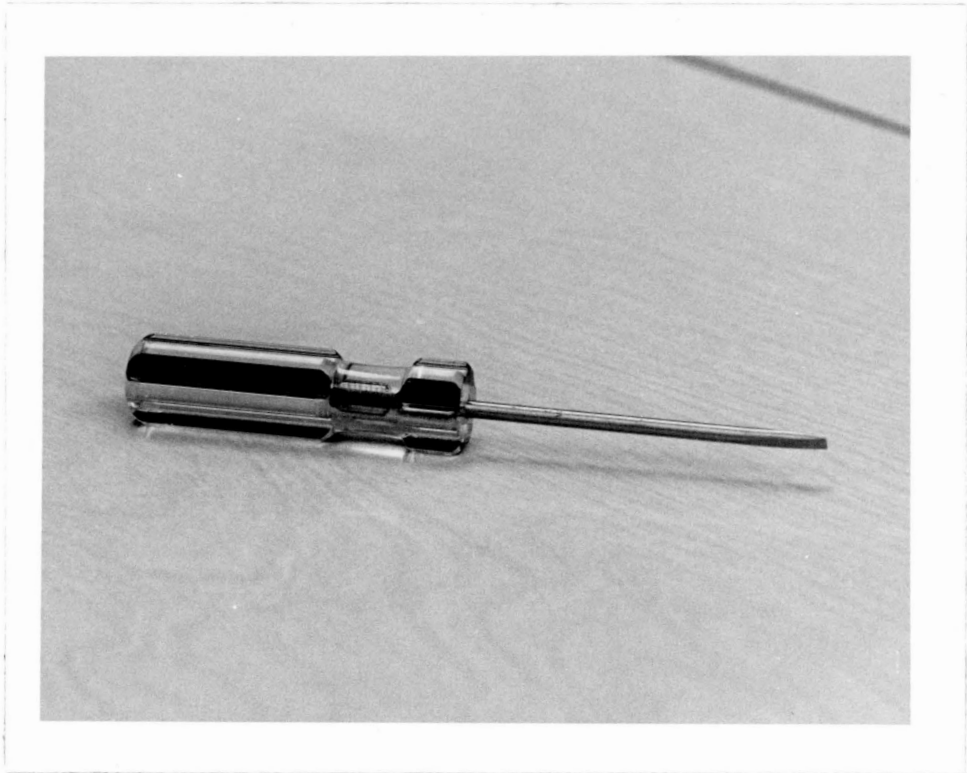
Pattern 2

(Actual size - 3.5 x 4.25 x 2.5")



Example

(Actual size - 7.5")



Uses 1

(Actual size - 7.5")



Uses 2

(Actual size - 12.5 x 5.0 x 6.5")

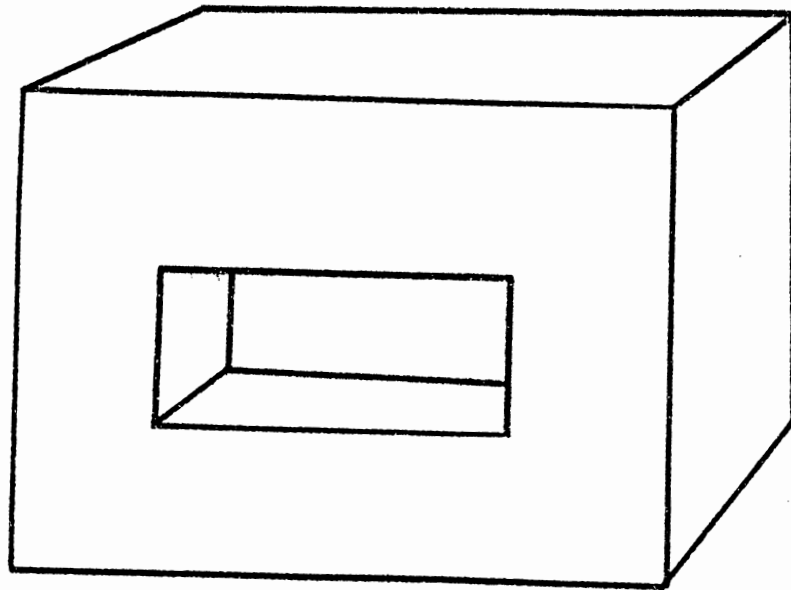
APPENDIX D

Two-dimensional with perspective stimuli

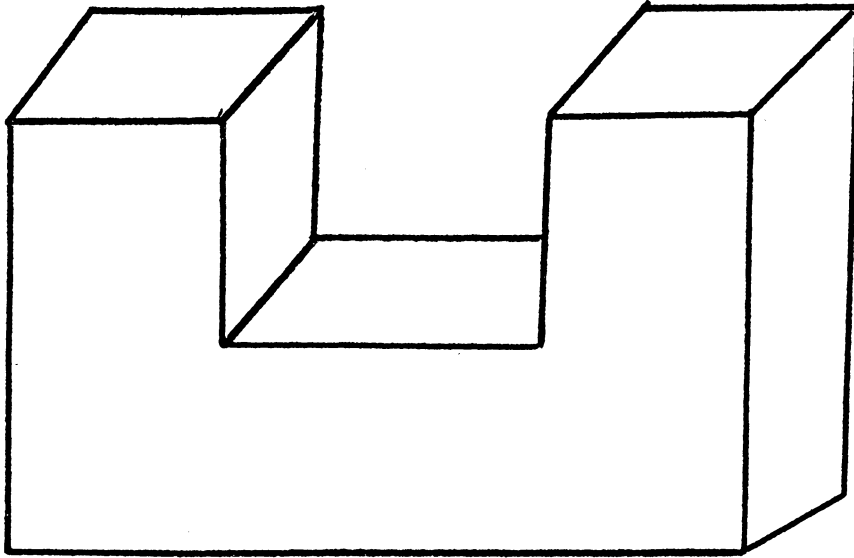
APPENDIX D

Two-dimensional with perspective stimuli

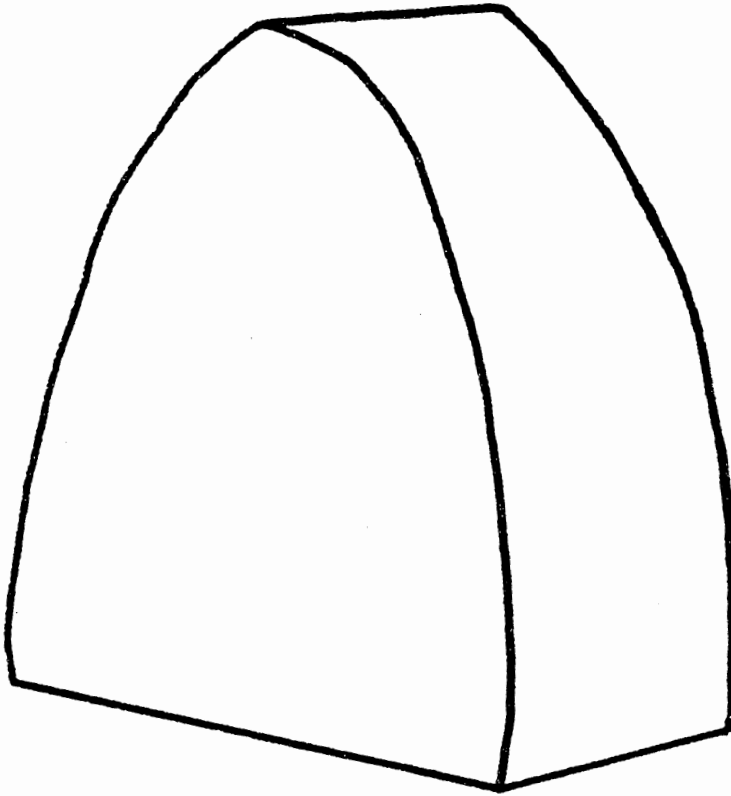
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Example
(Actual size)



Pattern 1
(Actual size)



Pattern 2
(Actual size)

APPENDIX E

Data Collection Form

DATA SHEET

Group # _____ Subject # _____

Location _____

stimulus _____

stimulus _____

| child's responses | code | child's responses | code |
|-------------------|------|-------------------|------|
| | | | |

| | 1st $\frac{1}{2}$ | 2nd $\frac{1}{2}$ | sum |
|----------------|-------------------|-------------------|-----|
| Total popular | | | |
| Total unique | | | |
| Total response | | | |

| | 1st $\frac{1}{2}$ | 2nd $\frac{1}{2}$ | sum |
|----------------|-------------------|-------------------|-----|
| Total popular | | | |
| Total unique | | | |
| Total response | | | |

| USES | 1st $\frac{1}{2}$ | 2nd $\frac{1}{2}$ | sum |
|----------------|-------------------|-------------------|-----|
| Total popular | | | |
| Total unique | | | |
| Total response | | | |

| PATTERNS | 1st $\frac{1}{2}$ | 2nd $\frac{1}{2}$ | sum |
|----------------|-------------------|-------------------|-----|
| Total popular | | | |
| Total unique | | | |
| Total response | | | |

APPENDIX F

Discussion of Findings - Condition V

Discussion of Findings - Condition V

The children in Condition V were shown two-dimensional drawings to which visual depth had been added. They were allowed to both look at and handle the drawings which served as stimuli for the pattern meanings (Appendix D). This form of the stimuli was added to the study to serve as a parallel form for the 3-D stimuli.

Rather than repeat the 2-D stimuli used in Conditions I and II for the unusual uses task, it was decided that only verbal stimuli would be provided for children in Condition V. Wallach and Kogan (1965), Ward (1968), and Busse, et al. (1972) all used verbal stimuli alone for their assessments of the unusual uses task. While Wallach and Kogan worked with older elementary school aged children, Ward and Busse, et al. used a preschool and primary school age sample. Busse, et al. (1972) dropped the uses task from their assessment due to the children's failure to provide meaningful responses.

Referring back to Table 5, it can be noted that Condition V has a higher mean fluency than Condition III. It is particularly interesting to note the differences in mean responses to the pattern meanings and unusual uses tasks from Condition V. Pattern meanings response mean was 5.81, while the uses task mean was 4.56.

Both Piaget and Gibson contend that through experience with and action on the environment the child builds representations of objects. As repeated contact and development occur the child can represent objects mentally. When one child was asked what she could use a

screwdriver for, she replied, "I forget what one looks like." The child could not mentally represent the screwdriver and as a consequence could give neither popular or unique responses. It is not particularly surprising, therefore, that Busse, et al. (1972) working with disadvantaged preschoolers got no "meaningful" responses using only verbal stimuli.

It was thought that the 2-D with perspective pattern meanings stimuli might confuse the children. This does not appear to have been the case. Several children gave answers which involved walking on or sliding down the sides of the drawn objects. These answers were similar to those given by children in the three-dimensional conditions. It seems that the children in Condition V had no problems visualizing the implied depth.

Based on the mean responses given in the pattern meanings task further investigations might substitute the 2-D with perspective stimuli for the "flat" 2-D drawings in the visual as well as the visual plus haptic mode of exploration.

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the scanned document**

THE EFFECT OF STIMULUS VARIATION ON ORIGINAL THINKING

BY PRESCHOOL CHILDREN

by

Gail Bohannon Kelso

(ABSTRACT)

The purpose of this study was to investigate the effects of stimulus dimension and mode of exploration on preschool children's responses to two original thinking tasks. Eighty children from four child care centers ranging in age from 46-65 months comprised the five condition groups: 2-D stimuli for visual exploration only, 2-D stimuli for visual plus haptic exploration, 3-D stimuli for visual exploration only, 3-D stimuli for visual plus haptic exploration. The groups were matched on intelligence, sex, and center attended. IQ scores were extrapolated from the Information and Picture Completion subtests of the Wechsler Preschool and Primary Scale of Intelligence. During the test session the children were shown the stimulus materials in the appropriate dimension and mode of exploration for their condition. The unusual uses task and the pattern meanings task were used to assess original thinking. The children's responses were scored for total fluency and unique responses. Several factors relating to the selection of the optimal method of stimulus presentation were considered in relation to the development of an assessment tool for creativity in young children. Significant relationships were found between the pattern meanings task and unusual uses task

when the 3-D stimuli were used and haptic exploration was allowed. This relationship was much higher for this condition than the correlation of either task to IQ. Three dimensional stimuli and visual plus haptic exploration also had the highest mean fluency of responses although one-way analysis of covariance failed to show significant effects of group and total fluency or unique responses. From these findings the best form of stimulus presentation to assess original thinking in preschool children appears to be three-dimensions with visual plus haptic exploration. Additional investigation is warranted into the effects of dimension and exploration and their interaction on the generation of responses to original thinking tasks in young children.