THE RELATIONSHIP BETWEEN SELECTED MEASURES OF PREFERENCE FOR VISUAL STIMULUS COMPLEXITY AND COGNITIVE ABILITIES IN YOUNG CHILDREN

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PREFACE

The primary purpose of this study is to determine the relationship between the concept of visual stimulus complexity preference and the development of cognitive abilities in young children. Specifically, three measures of visual stimulus complexity are employed and the preference judgements elicited by these instruments are correlated with individual performance on a comprehensive test of cognitive abilities. Eighty children who ranged in age from five to seven years served as subjects for the study.

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

Since the recognition of educational psychology as a unique domain, distinquishable from both general psychology and education, many definitions and descriptions of the nature and purpose of this field of study have been proposed. For example,

> Educational psychology is a study of the processes involved in education . . . [it] seeks to examine, analyze, explain, and guide the processes of education in such a way as to effect a sound and efficient system of education (Witherington, 1946, p. 3).

Educational psychology might be succinctly and functionally defined as an interface between the collective domains of psychology and education. With reference to this position, Trow (1950) describes educational psychology in the following manner:

> The area is an extensive one and the boundaries are not sharply delineated. They contain several more or less loosely connected parts which constitute the subject matter of different courses or disciplines . . . . All together, they embrace what may be called the psychological aspects of educational situations (p. 3).

In their attempts to delineate the content and boundaries of educational psychology, Mathis et al. (1977, p. 26) state that "educational psychology is identified with two disciplines which in themselves are separate fields of study - education and psychology." In a recapitulation of the existing literature regarding the nature and purpose of educational psychology, Seagoe (1960) offers the following definition:

> Educational psychology is concerned with the human factor in learning. It is a field in which concepts derived from experimental work in psychological laboratories are applied to education, but it is also a field in which experimentation is carried out to test the applicability of such concepts to education and to round out the study of topics of crucial interest to teachers (p. 403).

After surveying a multitude of conventional definitions of the area of study identified as educational psychology, Mathis et al. (1977) conclude,

> The single theme which weaves its way through much of the literature is an acceptance that educational psychology represents the intersection of the study of behavior and the process of education (p. 38).

Summarizing the preceding statements, a primary concern of the educational psychologist should be the interrelatedness of the two disciplines - psychology and education - both in theory and in practice. This viewpoint was recognized relatively early in the history of educational psychology by such notable figures as James McKeen Cattell, whose study of individual differences vigorously emphasized the practical implications of research in psychology, and John Dewey, whose educational contributions drew heavily from the disciplines of philosophy and psychology (Watson, 1971).

More specifically, an individual engaged in the study of educational psychology should attempt to maintain a constant awareness of contemporary research in both education and psychology and should ponder the implications of such research with regard to potential practical application in the educational arena. Accordingly, Coladarci (1968) states that ". . . one cannot merely 'take a course in educational psychology,' but that he must constantly keep informed about those developments in this area that are most relevant to his particular concern (p. 21)." In an elaboration of his definition of educational psychology as "psychology applied to education," Trow (1950) remarks:

> Psychological principles and theories derived from experiments in the psychological laboratory are not properly applied if they are taken over intact and used in the educational sphere without further question as to their applicability . . . . Psychological principles and theories require considerable adaptation when applied to educational practice (p. 8).

In support of the transitional psychological - educational approach, Glaser (1973) says that the educational psychologist should assume a position midway between the laboratory and the classroom.

With these comments in mind, the proposed study represents an attempt to examine a concept which has been the subject of extensive research in both experimental and developmental psychology and to explore the potential adaptation and utility of this concept in an educational environment. Specifically, the psychological concept of interest is identified as stimulus complexity. Psychological research is replete with studies pertaining to this concept; however, the application of these research findings in education has been minimal.

The lack of transition between psychological theory and research in stimulus complexity and relevant educational application is concretely evident when one examines the classification of research studies in psychology and education. In psychology, the term "stimulus complexity" is a descriptor ascribed to numerous research studies classified in Psychological Abstracts. A computer search of this data base employing this term yields a lengthy list of journal citations. In contrast, "stimulus complexity" is not used as a descriptor for the educational data base ERIC (Educational Resources Information Center). The ERIC descriptor most nearly being synonymous with "stimulus complexity" appears to be "complexity level"; however, this term is assigned to research studies concerned with task difficulty, grammatic complexity, and a host of other topics, most of which are not pertinent to the study of stimulus complexity.

Research in stimulus complexity has overwhelmingly emphasized the visual aspects of this concept. A limited amount of research regarding auditory stimulus complexity has also been conducted. Although the researcher was initially interested in incorporating the concepts of both auditory and visual stimulus complexity into the proposed research study, exploration of the auditory modality was subsequently abandoned due to the apparent nonexistence of a measurement model of auditory stimulus complexity which had been employed in previous research studies and could be appropriately adapted for the proposed purposes and subjects of this study. Therefore, this study is concerned only with the concept of visual stimulus complexity.

Basically, visual stimulus complexity refers to the amount of perceived visual stimuli which are preferred in one's immediate environment (Berlyne, 1960). Adaptation-level theory provides the crux of the theoretical framework for the development of the notion of stimulus complexity (Helson, 1964). Within the context of this theory, it is hypothesized that every organism has a unique and preferred level of visual stimulus complexity. The organism is motivated to seek out this preferred level of stimulation within the immediate environment. The level of complexity to which the organism is accustomed, or habituated, is defined as the adaptation level; the level slightly more complex than the adaptation level is generally identified as the preferred, or optimal, level of stimulation (Dember and Earl, 1957; Berlyne, 1960). Extreme deviations from the individual adaptation level can be highly aversive or excessively boring to the organism (McClelland et al., 1953). Related theoretical positions are also expressed by Piaget (1947), White (1959), Fiske and Maddi (1961), Hunt (1961), Munsinger and Kessen (1964), and Walker (1964).

Research findings suggest that stimulus complexity preference level is a developmental function of chronological age (Brennan et al., 1966; Block, 1971; Chipman and Mendelson, 1975; Fantz, et al., 1962; Karmel, 1969; Thomas, 1966), environmental experience (Arkes and Boykin, 1971; Bexton et al., 1954; Fantz and Nevis, 1967; Wachs, et al., 1971), and environmental responsiveness (Yarrow et al., 1972). Additionally there is limited evidence which reveals a relationship between stimulus complexity preference and cognitive development (Arkes and Boykin, 1971; Hoats et al., 1963; Munsinger and Kessen, 1964; Turner and Arkes, 1975).

Purpose of the Study

The primary purpose of this study is to conduct an exploratory investigation of the potential relevance of the concept of stimulus complexity to education. Specifically, the relationship between preferred level of visual complexity and cognitive abilities in young children is explored further. Previous research findings have suggested that individuals who prefer greater amounts of stimulus complexity are also functioning at a more advanced level of cognitive development (Arkes and Boykin, 1971; Hoats et al., 1963; Munsinger and Kessen, 1964; Turner and Arkes, 1975). This study attempts to elaborate upon those findings by posing the following general questions:

> What is the potential utility of assessing stimulus complexity preferences within the context of educational evaluation of cognitive abilities? To what extent does expressed <u>preference</u> for visual stimuli reflect levels of <u>performance</u> with regard to selected aspects of cognitive functioning, such as verbal reasoning, perceptual development, understanding of quantitative concepts, gross and fine motor development, and auditory and visual memory skills? What information concerning cognitive abilities can be obtained about those individuals who prefer extremely simple or complex visual stimuli when compared with other children of the same chronological age or sex?

Many methods of measuring stimulus complexity have been utilized in past research studies. Complexity preference has generally been assessed by having an individual view a series of sets or pairs of patterns of differential levels of complexity. Individual preference has been designated primarily by verbally expressed judgement (e.g., Kreitler et al., 1974; Munsinger and Kessen, 1964) or by measurement of the length of visual attending time to stimulus patterns (e.g., Karmel, 1969; Kreitler et al., 1974). In an attempt to clarify which of these methods might prove most effective in educational assessment, three distinct types of measures which have been employed in previous research studies are utilized in this study. Thus, a corollary purpose of this study is to compare the complexity preference judgements generated by each of these selected measures with scores resulting from the assessment of cognitive abilities and to examine the interrelatedness of responses to each measure. The following general questions serve to consider this additional objective:

> Which measure, or combination of measures, of stimulus complexity preference can be distinguished as most reflective of levels of cognitive abilities? How do the responses to stimuli expressed by an individual on one complexity measure relate to his/her preferences expressed on the other measures?

Significance of the Study

The investigation of the relationship between visual stimulus complexity preferences and cognitive abilities essentially represents an exploratory research effort. The study is designed to examine research studies pertaining to stimulus complexity which have been conducted under the auspices of experimental and developmental psychology and to consider the practical applications of these findings within the realm of education. Although the scope of this study is limited to the exploration of the relationship between measures of stimulus complexity and assessment of cognitive abilities, the study itself symbolizes, in a broader sense, a transitional link between past research endeavors and future research directions; between theoretical experimentation and practical application; and between psychological and educational domains. Keeping in mind this broader perspective, it does not seem too presumptuous to ponder future possibilities at this time.

Proposed Implications for Future Research

If a significant relationship between stimulus complexity preference and specific cognitive abilities can be substantiated, individual measurement of complexity preference could potentially become a tool for providing useful information to the classroom teacher. Assessment of stimulus complexity preference could conceivably be viewed as a simple, expeditious screening device which could be utilized as an initial means of acquiring information concerning individual pupil levels of cognitive functioning and readiness or nonreadiness for specific academic instruction. Measures of complexity preference might be beneficial in delineating cognitive strengths and weaknesses in children who perform poorly on more traditional tests.

In establishing complexity preference levels, both motor involvement and verbal exchange are minimal. Additionally, the determination of optimal complexity preference levels bears little resemblance to formal testing procedures and may be especially advantageous in the assessment of children who experience detrimental levels of test anxiety during more formal testing. During the testing procedures the child is not requested to perform any task, but merely to indicate a preference for stimuli. Therefore, concern about "right" or "wrong" responses or quality of judgement or performance should not be a relevant factor in stating preferences.

Noticeably simplistic preference levels expressed by some students might indicate the advisability of further individual evaluation for the purpose of more clearly defining suggested cognitive developmental deficiencies. Students who consistently prefer simplistic visual patterns might differ significantly in various aspects of cognitive development from students who express a distinct preference for exceedingly more complex visual stimuli. Developmental differences with regard to cognitive ability might also be apparent between those children who may not indicate a definite preference for complexity or simplicity--i.e., they may arbitrarily prefer some simple and some complex designs--and those youngsters who manifest systematic preferences for a specific level of visual stimulation. Finally, an established relationship between stimulus complexity preference and certain aspects of cognitive ability might warrant further study of more specific relationships, such as that between stimulus complexity and academic achievement in core subject areas.

Interest might also be stimulated in developing a similar instrument for assessing auditory complexity level preference. The combined administration of the visual and auditory measures might provide more extensive and specific information regarding levels of cognitive functioning or other educationally relevant information.

Existing research studies also imply that individual preference levels can be changed in the direction of increasing complexity through exposure to and familiarity with present complexity adaptation levels (e.g., Dember, Earl, and Paradise, 1957; May, 1963). Activities designed to heighten preference levels for visual stimuli using materials similar to those employed in testing might prove fruitful in enhancing particular areas of cognitive development.

Limitations of the Study

The primary limitation of the study is that the findings are applicable only to the chronological age range represented by subjects in the sample population. The results are not generalizable to children below or beyond the ages of five and six years.

Definition of Terms

For the purposes of this study, the following definitions of variables are utilized:

Visual Stimulus complexity - the amount of perceived visual stimuli which are preferred in one's immediate environment (Berlyne, 1960).

Random Polygons variable - a measurement instrument designed to assess preference for visual stimulus complexity where complexity is determined by the varying numbers of angles (independent turns) present in asymmetrical polygon figures.

Checkerboard Patterns variable - a measurement instrument designed to assess preference for visual stimulus complexity where complexity is determined by the varying number of individual square units integrated into horizontally and vertically symmetrical patterns.

Simple-Complex Designs variable - a measurement instrument designed to assess preference for visual stimulus complexity where complexity is determined by designs representative of the complexity dimensions of homogeneity/heterogeneity of elements, regular/irregular arrangement, amount of material, regularity/irregularity of contour, and congruity/incongruity of elements (Berylne, 1958a; 1960).

Cognitive Ability - those intellectual abilities which are assessed by the McCarthy Scales of Children's Abilities (MSCA), a standardized individually administered instrument designed to evaluate the cognitive development of young children.

Verbal Ability variable - a subscale of the MSCA which assesses the child's ability to express himself verbally and also assesses the maturity of his verbal concepts (McCarthy, 1972).

Perceptual-Performance Ability variable - a subscale of the MSCA which assesses the child's reasoning ability through the manipulation of materials; the child demonstrates imitative skills, logical classification, and visual organization in a variety of spatial, visual-perceptual, and conceptual tasks (McCarthy, 1972).

Quantitative Ability variable - a subscale of the MSCA which assesses the child's facility with numbers and his understanding of quantitative concepts (McCarthy, 1972).

General Cognitive Ability variable - a subscale of the MSCA which assesses the child's comprehensive level of cognitive development and is essentially a weighted composite of scores from the verbal, perceptual-performance, and quantitative subscales (McCarthy, 1972).

Memory Ability variable - a subscale of the MSCA which assesses the child's short-term auditory and visual memory (McCarthy, 1972).

Motor Ability variable - a subscale of the MSCA which assesses the child's coordination as he performs a variety of gross and fine motor tasks (McCarthy).

Summary

Summarizing the intent and the rationale for this study, the research problem, simply stated, is to determine the extent of the relationship between preference for stimulus complexity and cognitive abilities in young children and to identify the measure, or measures, of visual complexity which are the best indicators of levels of cognitive abilities in young children. The significance of the study can be stated as an exploration of the potential usefulness of this concept in educational measurement and evaluation and to illuminate direction for future research.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The purpose of the review of the literature for this study is to integrate selected psychological and learning theories and empirical research findings which pertain to the research problem outlined in the preceding chapter--the investigation of the relationship between preference for varying levels of visual stimulus complexity and the development of cognitive abilities in young children. The initial portion of the literature review is concerned with a discussion of the theoretical foundations applicable to the notion of stimulus complexity. Next, empirical findings which suggest a relationship between levels of complexity preference and cognitive abilities are presented. Finally, measurement difficulties which have been encountered in previous research studies involving stimulus complexity are cited.

Stimulus Complexity Defined

The notion of stimulus complexity was developed within the context of psychological theory which purported to offer an alternative explanation for behavior which was not the apparent result of psychologically based deficiencies. Such behavior, identified as ludic behavior (Berlyne, 1960), refers to both perceptual and intellectual activities which promote arousal and exploratory behavior within the organism.

These activities are theorized as being cultivated solely for their self-reinforcing properties.

Stimulus complexity is classified as one of several "collative variables" (Berlyne, 1960) which are described as having "arousal potential." The additional variables are identified as novelty, uncertainty, and conflict and, collectively, they are termed "collative" because they all involve the collation or comparison of stimulus elements (Berlyne, 1968).

Stimulus complexity was originally defined by D. E. Berlyne (1960, p. 38) in his book, Conflict, Arousal, and Curiosity as the "amount of variety or diversity in a stimulus pattern." Berlyne subsequently enumerated the properties of complexity:

1. Other things being equal, complexity increases with the number of distinguishable elements,

2. If the number of elements is held constant, complexity increases with dissimilarity between elements, and

3. Complexity varies inversly with the degree to which several elements are responded to as a unit (p. 38-39).

Berlyne's theoretical hypothesis implies that perception of environmental stimuli with relatively high degrees of collative variation results in the arousal of incompatible response tendencies involving "implicit identifying responses or diverse expectancies" (Cantor et al., 1963, p. 683). The presence of such response tendencies provokes a mild state of conflict within the organism and both attention to and exploration of the perceived stimuli is maintained until the conflict is resolved. The degree of arousal generated by collative stimulus properties must reach, but not greatly exceed, the organism's adaptive level of arousal or activation. In addition to collative properties, psychophysical and ecological stimulus properties are contributing determinants to this level (Berlyne, 1971).

Additional definitions of stimulus complexity have been posited by other theorists. Dember (1960, p. 352-353) defined stimulus complexity as "the one [more complex stimuli] the individual can do more with; it affords more potential opportunities for responding than does the less complex stimulus." Smock and Holt (1962) proposed the following definition based upon Attneave's work (1954) delineating the principles of perceptual redundancy:

> Complexity of forms may be defined in terms of the absence of redundancy in visual 'information;' e.g., homogeneity of dispersion in the visual field and number of changes in the contour of an object. The greater the complexity, the greater the relative difficulty in achieving clarity of perceptual structuring; thus the greater the ambiguity (p. 633).

Garner (1962) also viewed stimulus complexity as a function of pattern redundancy, the degree of repetition or predictability of a pattern, and uncertainty. Redundancy reduces the relative complexity value of a stimulus pattern; uncertainty increases the complexity content of stimuli. Munsinger and Kessen (1964) defined stimulus complexity as variability in the amount of pattern information. Fantz and Nevis (1967, p. 103) regarded complexity as "the degree of patterning" of a stimulus, but suggest that complexity is frequently indistinguishable from configuration, the "form of patterning contour, arrangement, and orientation of pattern elements."

Theoretical Foundations

Helson's Position

The concept of stimulus complexity is closely linked to adaptation level theory which was originally espoused by Helson (1964). The theory postulates that every organism has a preferred level of perceived, external environmental stimulation which is experientially determined. The organism is motivated to seek out or adjust the environment to closely approximate this individual adaptation level.

Helson's (1964) basic premise is that

> . . . an individual's attitudes, values, ways of structuring his experiences, judgements of physical, aesthetic, and symbolic objects, intellectual and emotional behavior, learning, and interpersonal relations all represent modes of adaptation to environmental and organismic forces (p. 37).

Helson recognizes that perception of even the most simplistic environmental stimuli is a function of both the focal and external contextual attributes of the stimuli and the organism's internal processing of such stimuli. The combination of external and internal aspects of environmental perception, referred to as the "pooled effect" by Helson (1964, p. 37), determines the adaptation level which is fundamental to any form of behavior.

The adaptation process is inherent in the maintenance of a general physiological and psychological (homeostatic) state within the organism. It provides the organism with a mechanism for coping with environmental change. The level of adaptation permits the organism, upon stimulation, to initially receive, react to, and subsequently process the presenting stimuli, thereby reducing the initial effects to a level which is compatible with the adaptive homeostatic state.

According to Helson (1964), level of adaptation and homeostatis do not imply a constant desire for a static, fixed, indifferent state of environmental stimulation. Rather, this term connotes a reference point for understanding the organism's complex interactions with environmental factors. Helson recognizes that individuals are motivated to pursue variety and intensity of stimulation which are associated with increasingly higher levels of adjustment. Helson (1964) exemplifies his position in these words:

> A person strives for $1000 when he has nothing, $10,000 when he has $1000, and $1,000,000 when he has $500,000 not because the larger amount of money will bring equilibrium and quiescence, but because, in his opinion, it holds possibilities for new sources of enjoyment (p. 49).

Piaget's Position

The concept of adaptation is also integral to Piaget's theory of cognitive development. Because this research study is concerned not only with the complexity of environmental stimulation, but also with the development of cognitive abilities in young children, it seems important to recognize Piaget's contribution at this point. Piaget (1947, p. 7) defines intelligence as "the most highly developed form of mental adaptation . . . the indispensable instrument for interaction between the subject and the universe . . . ." The adaptive nature of intelligence encompasses the concepts of assimilation, the cognitive incorporation of perceived environmental events into previously existing "schemes" (Furth, 1969, p. 95) or patterns of behavior, and accomodation, the creation or modification of schemes to accomodate previously unencountered environmental stimuli. Thus, adaptation, in Piagetian terms, is defined as "an equilibrium between assimilation and accomodation, which amounts to the same thing as an equilibrium of interaction between the subject and object" (p. 8).

Fiske and Maddi's Position

A supplemental theoretical position which is equally relevant and essentially compatible with adaptation level theory is the activation theory proposed by Fiske and Maddi (1961). Fiske and Maddi define activation as a neuro-psychological concept relating to the organism's level of alterness, attention, and subjective excitement as well as a level of neural excitation maintained in a postulated specific location in the brain. The customary level of activation is identified by Fiske and Maddi as the level of activation which is actively experienced by an individual over a lengthy period and to which the individual becomes accustomed. Activation level is viewed as a resultant function of impact which is designated as environmental intensity, meaningfulness, and variation and is reminiscent of Berlyne's "collective variables." Fiske and Maddi classify environmental complexity as a form of environmental variation. They also address the originators of organismic stimulation and identify these sources as interoceptive, exteroceptive, and cortical. These sources of stimulation parallel the components of Helson's "pooling effects" model.

Fiske and Maddi believe that the organism is highly motivated to alleviate any discrepancies between the customary and actual levels of activation through impact modifying behavior. If the actual activation level is below the customary level of activation, the individual will employ impact-increasing behavior. Conversely, if the actual level of activation is above the customary level of activation, the organism will engage in impact-decreasing behavior. The greater the disparity between customary and actual levels of activation, the greater the motivation for modification. Such behavior is directed toward the maintenance of an overall homeostatic state.

Walker's Position

Numerous other theorists have elaborated upon issues pertinent to the concept of stimulus complexity. Walker (1964) distinguishes between stimulus complexity, a strictly external characteristics, and psychological complexity, an interactive characteristic of the organism and the event. As the complexity of any stimulus increases, psychological complexity will also increase. Walker also discusses the effects of too much or too little psychological complexity in a manner roughly analogous to Fiske and Maddi's previously cited interpretation.

Hunt's Position

Level of preferred stimulus complexity can also be related to Hunt's discussion of the importance of "match" between environmental situations and the child's assimilated schemata (Hunt, 1961). Discrepancies from the "match" are interpreted in terms of boredom resulting from an exact "match" and avoidance behavior as a function of large discrepancies. Curiosity behavior with the potential of inducing structural accomodation of the schemata and, thus, fostering intellectual growth is the result of small discrepancies between the perceived environment and the individual's existing schemata.

White's Position

White's model of competence motivation would interpret an individual's level of preference for visual complexity as arising from a motive to successfully master a particular level of environmental stimulation. Attention directed toward such stimulation would be maintained until the intrinsic satisfaction derived from the achievement of mastery, or "competence," is attained (White, 1975).

Munsinger and Kessen's Position

Munsinger and Kessen (1964) consider complexity preference in terms of coding and processing levels or cognitive structure. They state that

> . . . the development of structure results from the subject's preference for increasing amounts of stimulus variability . . . . As the person learns to structure variability, he turns toward higher levels of variability (p. 166).

In other words, an increase in preference for stimulus complexity or variability connotes an increase in the individual's capacity for processing information.

McClelland's Position

Discrepancies which vary in magnitude from the individual adaptation level may also be explained in terms of McClelland's discrepancy hypothesis which states that small perceptual or sensory discrepancies from the organism's adaptation level produce positive affect while large discrepancies result in negative affect (McClelland et al., 1953). Minimal discrepancies between anticipated and actual environmental stimulation provoke approach, or exploratory, behavior while more sizable discrepancies reduce avoidance responses. The degree of discrepancy is a combined function of the external environmental stimuli and the organism's internal perception of such stimuli.

Empirical Support

A significant experiment was conducted by Haber (1958) to test McClelland's discrepancy hypothesis. Haber's subjects immersed their hands in buckets of water of varying temperatures. After an initial adaptation level was established, the subjects were requested to indicate their hedonic preference for comparative water temperatures which varied from the original adaptation level temperature. Analysis of the subjects' responses essentially substantiated the discrepancy hypothesis. Slight variations from the water temperature to which the subjects had been adapted were rated as maximally pleasing. However, as deviations from this optimal pleasure level increased, affect ratings decreased in a linear fashion.

Dember and Earl's Position

Regarding the optimal, or preferred, level of stimulation, also defined as optimal arousal level (Berlyne, 1960), optimal psychological complexity level (Walker, 1964), and "ideal" level (Dember, 1960), Dember and Earl (1957) offer a relevant hypothesis which compliments adaptation level theory. The stimuli which are perceived as components of an organism's optimal level of stimulation are slightly more complex than those stimuli which constitute the momentary adaptation level. Dember and Earl concur that stimuli which are exceedingly discrepant from the organism's adaptation level are perceived as boring if they are overly simplified and as potentially aversive and anxiety-evoking if they are extremely complex. The optimal level stimuli are termed "pacers." As commerce with these pacers increases, the organism begins to adapt to this heightened level of stimulus complexity. As long as the environment continues to provide the organism with appropriate pacers and as long as the organism can respond freely to the available stimuli, the optimal preference level will continue to increase in the direction of greater complexity. The limit to the extent of increased complexity perceived in the environment and desired by the organism is perhaps determined by the organism's hereditary endowment (Dember, 1960).

Dember and Earl's hypothesis implies that, in a free choice situation, the organism will always select those stimuli which are slightly more complex than the stimuli which comprise his present level of envi-ronmental adaptation. Stated alternately, an organism's preference for complexity increases monotonically from less complex to more complex perceptual integrations.

Empirical Support

Dember, Earl, and Paradise (1957) demonstrated this position in an experiment designed to determine complexity preference in rats. The rats were allowed to freely explore pathways lined with patterns of varying amounts of visual complexity. The rats initially chose pathways of varying complexity levels, but as their familiarity with these initial choices increased, the visual stimuli which surrounded the pathways became less interesting. The animals subsequently shifted to pathways (pacers) of increased visual stimulation. This statistically significant directional shift toward preference for increased complexity lends support to the "pacer principle" (Arkes and Garske, 1977).

The findings of Dember, Earl, and Paradise have been supported in research studies with young children. May (1963) found that once a baseline adaptation level regarding visual complexity had been established, young children exhibited a significant tendency to select stimuli of greater complexity in situations of free choice. Schlotz

(1974) found that young children's interaction with playground equipment increased as the complexity of the playground apparatus increased. Munsinger and Weir (1967) determined that children's preference for random shapes of varying degrees of complexity was an increasing linear function of stimulus complexity during a successive four-day testing period. In comparing the effects of repeated exposure to figures containing differential amounts of complexity, Hoats et al. (1963) found that normal subjects tended to approach increasingly complex stimuli while institutionalized retarded subjects manifested avoidance tendencies when presented with increasing figural complexity. Results obtained by Vitz (1964) indicate that subjects with interest or experience in art, whom Vitz hypothesized had previously had more exposure to and experience with more complex visual stimuli and, therefore, should express a preference for more complex visual patterns, did indeed manifest a preference for greater amounts of visual complexity than did subjects who had not indicated a special interest or background in art. Vitz also found that, as the experiment progressed, subjects expressed a significant increase in preference for more complex stimulus patterns.

Theoretical Summary

To summarize the theoretical foundations which have been presented on the preceding pages, the research problem defined in this study is related to the selected theoretical positions of Berlyne (1960), Helson (1964), Piaget (1947), Fiske and Maddi (1961), Walker (1964), Hunt (1961), White (1957), Munsinger and Kessen (1964), McClelland (1953), and Dember and Earl (1957). In an attempt to integrate these positions, the following common aspects may be cited:

1. For every organism there is an arbitrary, situation-specific level of stimulation which is critical to the arousal, activation, and motivation of the organism.
2. Deviations from a habitual level of stimulation, regardless of direction, promote varying degrees of pleasant or unpleasant affect.
3. Level of perceived environmental stimulation is a function of both the external stimuli and internal psychophysiological processes.

Empirical Findings

Infant Studies

Developmental changes in preference for increasingly complex visual stimuli in human beings have provided the focus for several research studies with infant subjects. In one study with infants, aged 13 to 20 weeks, Karmel (1969) found that the older infants indicated preferences, when measured by length of visual fixations, for checkerboard patterns containing more individual units and greater amounts of contour than did younger subjects. McCall and Kagan (1967) and Berlyne (1957) also report findings which support infant preferences for greater pattern contour. There is some ambiguity concerning the relationship between contour and complexity; however, if one accepts Fantz and Nevis' position that the "degree" and "form" of patterning are inextricably confounded, then preference for increased contour connotes preference for increased complexity in visual patterns. This view is supported by Karmel (1969, p. 352) who states: "Interpretation of the behavior in terms of 'complexity' and shifts in preferred 'complexity' levels would necessitate use of 'amount of contour' to define 'complexity'."

Fantz, et al. (1962) and Brennan, et al. (1966) report that older infants prefer to fixate on more complex visual patterns than do younger infants. Research by Thomas (1965) generally supports these findings.

Developmental Studies

Several significant studies lend support to the longitudinal development of preference for increased visual complexity throughout childhood and into adolescence and adulthood. Thomas (1966) measured the visual complexity preferences of over four hundred subjects who ranged in age from six to nineteen. Preference was determined by verbally expressed judgement and by length of viewing time. Random polygons with varying numbers of sides and independent turns were used as the criterion measure of complexity preference. The results indicate that there is an increasing preference for more complex visual stimuli through mid-adolescence, after which time there appears to be a systematic shift toward preference for somewhat less complex stimuli. Preference for complexity, when measured by visual attending time, increased monotonically for subjects through age twelve. Complexity preference, when measured by verbally expressed judgement, generally increased monotonically in subjects through age sixteen.

Block et al. (1971) studied the complexity preferences of three and four year olds and found that the four year old group preferred more complex random polygons. One year later the preferred complexity level of the three year old experimental subjects (now four years old) was reevaluated. Subjects showed a more frequent preference for increased complexity at this time.

Chipman and Mendelson (1975) conducted a study to investigate complexity judgements of visual stimuli in children ranging in age from four to ten and in adults. Subjects in this study were asked to select the simpler or the more complex pattern from the simultaneous presentation of pairs of stimuli. Stimuli consisted of structured and unstructured (symmetrical and asymmetrical) checkerboard patterns of varying degrees of contour. Results imply that " . . . sensitivity to visual structure may develop well into school age taking the form of a gradual increase in the number of pattern elements which can be perceived and organized" (p. 411).

Related findings by Forsman (1967) suggest that there is a correlation between age and the development of coding rules necessary for dealing with varying degrees of stimulus complexity. This conclusion is based upon data which indicates that " . . . adults respond to bilateral symmetry and asymmetry as distinctly different classes of form, whereas children show less sensitivity to this property of patterns" (p. 486).

Environmental Experience Studies

Individual preference for visual complexity also appears to be related to early environmental experience. In animal studies, Sackett (1965) demonstrated that monkeys raised in enriched environments exhibited a preference for more complex visual stimuli, when preference was assessed by visual exploration time, than did those animals raised in deprived, semi-isolated environments.

Fantz and Nevis (1967) found that children raised in private homes generally preferred more complex environmental stimuli than did children raised in institutions.

Dember (1960) interprets the observations of anaclitic depression in institutionalized infants (e.g., Spitz, 1945; Dennis, 1960) within the context of deprivation of appropriate amounts of environmental stimulus complexity. The apathetic, listless state of emotional development as well as the subnormal physical and intellectual development of such infants is attributed to the lack of opportunity for the organism to seek out appropriately complex levels of environmental stimulation.

In an initial study regarding the effects of sensory deprivation, Bexton et al. (1954) report that prolonged sensory isolation had a deleterious effect on cognitive functioning. Bexton and associates hypothesize that deprivational levels of environmental complexity inhibit intellectual growth. These researchers also report that the complexity of visual hallucinations increased as the length of deprivation was extended. Bexton et al. conclude that ". . . maintenance of normal, intelligent, adaptive behavior probably requires a continually varied sensory input" (p. 78).

Arkes and Boykin (1971) compared the visual complexity preferences of children entering a Head Start program with those of children attending a regular nursery school and found that nursery school children indicated preferences for significantly more complex visual stimuli than did the Head Start children. Hicks and Dockstader (1968) found that middle-class children preferred more complex stimuli than lower-class children.

Research findings also suggest that mere exposure to sufficiently complex environmental stimuli must be augmented by the organism's recognition of and responsiveness to such stimuli. In an in-depth examination of cognitive functioning in infants, Yarrow et al. (1972)

found a striking relationship between this area of development and infant responsiveness to complex and varied environmental stimulation.

An overload of environmental stimulation may prove detrimental to infant sensorimotor development. Wachs et al. (1971) found that excessive complexity within the immediate environment, which is considerably beyond the amount to which the infant can readily adapt, may significantly impair early development.

If the effects of both environmental stimulus deprivation and overload impair or inhibit intellectual functioning, then it seems reasonable to assume that, in situations where the individual is free to select the level of environmental stimulation to which he exposes himself, he will select a level which is commensurate with his current level of intellectual functioning.

Cognitive Development Studies

Not only does stimulus complexity adaptation level pertain to cognitive growth in infants, but the amount of preferred visual complexity is also indicative of cognitive functioning in young children (Arkes and Garske, 1977). This hypothesis is elaborated upon by Dember's (1960) conjecture that

> . . . the intellectual development of the individual seems closely tied up with his perceptual development. Just as certain levels of stimulus complexity are preferred by individuals, so too are certain levels of 'intellectual complexity.' The laws that govern perceptual complexity and its correlates should apply to cognitive functioning in general (p. 373).

Arkes and Garske's assumption is based upon a study conducted by Arkes and Boykin (1971) to measure the complexity preference levels of Head Start and nursery school children at the onset and the conclusion of a summer pre-school program. Arkes and Garske (1977) describe the following findings:

> At the beginning of the summer, the nursery-school children preferred significantly more complexity than the Head Start children did. By the end of the summer, the complexity preferred by the Head Start children had increased significantly; the two groups' preferences were the same (p. 156).

Arkes and Garske attribute these findings to summer enrichment experiences which facilitated cognitive growth. However, this conclusion is based solely upon gains in scores from pretesting to posttesting sessions. No additional criterion measure of cognitive development was employed in this study.

In another study designed to investigate the relationship between cognitive development and preference for visual complexity, Turner and Arkes (1975) found that stimulus complexity preference was significantly related to Piagetian developmental levels. Turner and Arkes obtained preference judgements for embedded figures of varying amounts of complexity from fifth grade subjects and compared these preferences to performance on Piagetian tasks designed to distinguish preoperational and concrete operational developmental stages. Those students who were functioning at the concrete operational level of development indicated a preference for greater amounts of visual complexity than did subjects who were functioning at the preoperational stage of development. Although Turner and Arkes concluded that preference for more complex embedded figures is significantly correlated with more advanced Piagetian developmental levels, embedded figures are more commonly used to assess field dependent--field independent cognitive style (Witkin et al., 1962) rather than levels of stimulus complexity preference. Although performance on Piagetian tasks was utilized as a dependent measure of cognitive development, these measures are theory-specific and are not representative of a comprehensive assessment of cognitive ability.

Partial support for considering stimulus complexity preference as an indicator of cognitive growth appears in the work of Munsinger et al. (1964). Although these researchers found no significant differences in preferences for random shapes expressed by subjects who ranged from first graders to college students, they did find that older students preferred increasing degrees of auditorily complex stimuli in the form of approximations of English sentences. Munsinger et al. postulated that this preference for more complex phrases resulted from the older subjects' ability to effectively code or process more complex levels of stimuli. The researchers maintained that an individual's preference for complexity approximates his capacity for information-processing and that such capacity is developed by experience with specific types of stimuli.

Several additional studies reflect findings which are pertinent to the relationahip between levels of cognitive abilities and preference for stimulus complexity. Utilizing stimuli which were representative of Berlyne's properties of complexity, Hoats et al. (1963) found that mildly retarded institutionalized male subjects preferred significantly less complex visual stimuli than did the combined groups of subjects with equivalent chronological and mental ages. A significant difference was not observed in the examination of identical groups of female subjects' complexity preferences. The authors state that IQ scores were available for the retarded subjects, but, regrettably, no mention is made of the name of the test which was administered to obtain these scores.

Also, information regarding the test or method used to determine equivalent mental age in supposedly normal subjects is omitted.

Finally, it is not clear whether the subjects in the equivalent chronological age group were simply assumed to possess average intellectual ability or whether an intelligence test was utilized to delineate normal functioning. Further, a fourth group of male subjects--those identified as exhibiting a more marked degree of retardation than the group classified as "mildly retarded"--preferred more complex visual stimuli than the mildly retarded group. Their complexity preference judgements were roughly equivalent to the equal chronological and mental age groups. Hoats et al. suggest the presence of a curvilinear relationship between choice of complex figures and intellectual functioning.

Harter (1977) found that, in free-choice situations, normal children displayed greater pleasure when working with difficult rather than easy puzzles, whereas the preferential trend was reversed for retarded children.

Employing figural drawings of common objects which varied in complexity of detail as stimulus material, Pielstock and Woodruff (1964) failed to find any significant differences in preference for complexity of drawings, as determined by amount of exploratory viewing time, between gifted and normal elementary-aged subjects. Classification of subjects was based upon IQ scores obtained from administration of the Stanford-Binet intelligence test.

Paraskevopoulos (1968) found that preference judgements for various symmetrical and asymmetrical dot patterns paralleled the ability to correctly reproduce such patterns from memory. Paraskevopoulos concluded that "the effects of symmetry on both recall and preference followed similar developmental trends" (p. 261). If one assumes that the symmetrical and asymmetrical dot patterns reflect differential levels of complexity, then one can surmise that the ability to decode and process increasingly complex stimuli corresponds to a developmental trend in preference for increasingly complex visual patterns. Paraskevopoulos ponders "the general question of the relationship between expressed preference and other cognitive behaviors" (p. 263). He also entertains the notion of utilizing a knowledge of individual preferences to predict performance on cognitive tasks which may otherwise be difficult to assess. Paraskevopoulos' findings have received support from recent research conducted by Halford and MacDonald (1977).

Results of Paraskevopoulos' study may be viewed as providing empirical support for Munsinger and Kessen's hypothesis that preference for stimulus complexity is congruent with an individual's capacity for information-processing. Further evidence of a relationship between information-processing preference for complexity is presented by Uselding (1977). For all three age groups participating in this study, those stimuli what were the most difficult to process were also the most preferred. Boykin (1972)) found that individual complexity ratings were influenced by the subject's success in problem solving. Subjects generally preferred (were most interested in) tasks that were the most difficult to successfully perform.

Interim Summary

At this point, the review of literature relating to the topic of interest has attempted to define the concept of stimulus complexity and to illuminate the pertinent elements which comprise the theoretical basis for this notion. Rationale in the form of research findings has been presented to justify the exploration of the relationship between stimulus complexity and cognitive development by illustrating that preference for stimulus complexity is developmentally related to age, level of environmental stimulation or deprivation, and organismic responsiveness to such stimulation. Likewise, cognitive growth advances with increasing chronological age and is influenced by responsiveness to environmental stimulation and variation. This justification is further supported by citing some studies which have dealt directly with visual complexity preference and cognitive development.

Measurement Problems

Focus of the Problems

This section of the literature review will be devoted to the discussion of a dilemma which this study endeavors to clarify--that of measurement of stimulus complexity preference. Two of the paramount problems in comparing the findings of studies regarding stimulus complexity are the diversity of the measuring instruments employed by researchers and the differing response modes utilized for expressing preferential judgement.

Measurement Dimensions

Researchers have tended to design instruments for complexity studies by attempting to conceptualize different dimensions of stimulus complexity. Berlyne (1958b), Hoats et al. (1963), and Hutt and McGrew (1969) employed stimuli which represented the complexity dimensions of heterogeneity of elements, irregularity of arrangement (asymmetry), amount of material, irregularity of shape, and incongruity of elements (incongruous juxtaposition). These dimensions were proposed by Berlyne (1960) when he originally delineated the properties of complexity. Many researchers, including Munsinger and Kessen (1964); Munsinger et al. (1964); Thomas (1966); and Day (1967) have defined visual stimulus complexity as the number of independent turns or sides in randomly constructed two-dimensional polygons. Switzky et al. (1974) employed three-dimensional polygons as their criteria for complexity. Dorfman (1965) Dorfman and McKenna (1966) Brennan et al. (1966) Chipman and Mendelson (1975) and Smith and Dorfman (1975) are among the researchers who have described complexity as the number of units in symmetrical or asymmetrical checkerboard patterns.

Examples of some of the more innovative experimental measures of complexity include "random walks" (Vitz, 1964) jigsaw puzzles (Boykin and Arkes, 1974; Harter, 1977) playground equipment (Schlotz, 1974) stamps (Wohlwill, 1975a) wooden cut-outs (Wohlwill, 1975b) and candy (Unikel and Harris, 1970).

Although complexity measures have sometimes utilized a single dimension to denote varying degrees of complexity, several researchers (Attneave, 1957; Berlyne et al., 1968; Clapp and Eichorn, 1965; Day, 1967) regard complexity as a multidimensional concept and imply that subjective complexity judgements are based upon several perceived characteristics rather than upon one specific quality. After reviewing several studies which examined the intercorrelations among complexity dimensions, Rump (1968, p. 348) summarily states that "reports should specify the variable used instead of using the inappropriate concept preference-for-complexity."

Response Modes

The two predominant response modes utilized in research studies conducted to determine complexity preference are verbally expressed preferential judgements and length of visual attentiveness to stimuli. In many studies (e.g., Hershenson, et al. 1965; Smock and Holt, 1962; Thomas, 1966) it has been presumed that those visual patterns which provoke prolonged viewing are the most preferred stimuli. However, visual attentiveness toward certain stimuli may be reasonably assumed to result from factors other than pattern preference. Accordingly, Hutt and McGrew (1969) state:

> The fact that complex stimuli [i.e., those with more detail] are viewed longer than simple ones may simply mean that an individual needs to fixate or scan these stimuli more in order to identify and categorize them (p. 113).

This assumption was based upon previous research by Berlyne (1958b) and is supported by subsequent research by Wohlwill (1975a). Certain stimuli may elicit visual attending behavior because they are judged more interesting rather than more pleasing. Berlyne (1963), Berlyne and Lawrence (1964), Eisenman (1966), Day (1967), Day and Crawford (1969), and Wohlwill (1975a) have found differences in responses with regard to the "pleasingness" and "interestingness" of stimuli. In general, more complex, asymmetrical patterns correspond to interestingness and pleasingness tend to decrease with familiarity.

Berlyne (1971) attempts to moderate this quandary by commenting

> . . . there are circumstances, and in particular levels of complexity, where relatively high degrees of pleasingness and interestingness coincide. However, interestingness may continue to rise, while pleasingness sharply declines, when moderate degrees of complexity are exceeded (p. 217).

> . . . pleasingness can reflect the arousal value of the initial impact, whereas interestingness has something to do with the perceptual processing that follows the initial impact (p. 219).

With regard to young children Hutt and McGrew (1969) imply that youngsters may not be able to effectively distinguish between the concepts of interestingness and pleasingness. Additionally, they suggest that viewing time is an inadequate indicator of preference for complexity in young children.

Additional Complications

To further complicate the attempts to define complexity within the content of Berlyne's classification of collative variables, it seems entirely possible that the variables identified as complexity, novelty, uncertainty, and conflict are not categorically exclusive. Rump (1968, p. 346) points out that Berlyne acknowledged this dilemma by commenting that "several logically distinct collative variables have generally been confounded."

A notable example of such confounding is the blurred distinction between complexity and novelty. Berlyne (1971, p. 202) concedes that the two concepts are exceedingly similar and states: "It seems likely that familiarization reduces complexity through perceptual processing that imposes organization." He does not, however, subscribe to the interpretation that complexity and novelty are synonymous or interchangeable. Although Berlyne has attempted to distinguish complexity from novelty, both concepts would be subsumed under environmental variation in the Fiske and Maddi paradigm.

Stang (1977), in his review of research on complexity and novelty, proposes a distinction by defining complexity as a spatial concept and novelty as a temporal concept, but suggests that these variables have similar effects upon preference judgements and that it is unnecessary to distinguish one from the other from the viewpoint of the subject. Dember (1960, p. 359) concurs with the position that complexity and novelty are psychologically equivalent and adds that "both have as their basis a discrepancy between expectancy and present stimulation."

If one accepts Stang's position that complexity and novelty are relatively synonymous, then one might assume that studies which indicate that subjects prefer novel, unfamiliar stimuli rather than simple, familiar stimuli (Berlyne, 1950, 1970; Cantor, 1968; Cantor and Cantor, 1964; Cantor and Kubose, 1969; Eisenman, 1968; Endsley, 1967; Eson et al., 1977; Faw and Nunnally, 1968; Hoates et al., 1963; Mendel, 1965; Rabinowitz and Robe, 1968; Ross, 1974; Schlotz, 1974) might also be interpreted as support for preferring complex rather than simple stimuli. Unfortunately, most of the studies concerning preference for novelty have employed stimuli which dichotomize the variable and represent absolute novelty versus absolute familiarity. Therefore, no conclusions regarding the degree of preference for complexity can be formulated from such studies.

Attempts to order varying degrees of novelty along a continuum have been relatively few (Mendel, 1965; Schlotz, 1974). In ordering arrays of toys according to the dimension of novelty, Mendel found that children's preferences for these toys increased as the arrays became more novel. In assigning novelty ratings to three playground apparatus arrangements, Schlotz found that the total amount of subject interaction with playground equipment increased as both novelty and complexity increased.

Representative Research

The previously discussed problems of designing complexity measures and visual versus verbal response indicators of preference were addressed in a representative study by Kreitler et al. (1974) who attempted to clarify the interrelatedness of the dimensions of stimulus complexity and to compare the expression of preference via differing response modes.

Kreitler and associates assembled a comprehensive set of visual stimuli for the purpose of integrating all of Berlyne's properties of complexity into a single assessment instrument. The complexity dimensions represented by the stimulus designs may be summarized as heterogeneity of elements; irregular, or asymmetrical, arrangement; amount of material or number of independent units; irregularity of contour; and incongruity of elements.

In accordance with the purpose of their study, Kreitler et al. compared the relationship between children's preferences for varying dimensions of complexity by measuring visual attending time to various stimuli and by eliciting verbal judgements of preference. Children were presented with pairs of stimuli--one simple and one complex design--representing the same complexity dimension and were instructed to (1) indicate verbally which design they liked best and (2) view either design in the pair for as long as they wished. Significant preferences for complex versus simple stimuli were found for two of the five dimensions of complexity when verbal judgements were analyzed. When visual attending time was considered as the criterion for measuring perference, children preferred complex stimuli for only one of the five complexity dimensions significantly more often.

These results suggest that (1) there is little interrelatedness in preference for varying properties of complexity, a finding which is consistent with results obtained by Smock and Holt (1962) and by Clapp and Eichorn (1965) but contrary to findings by Berlyne (1958a) and (2) there is negligible correlation between visual and verbal response modes. However, the findings of Kreitler et al. should be interpreted with caution due to the extremely limited number of stimulus pairs used to assess each complexity dimension. Only _two_ examples of each of the five dimensions were included in the assessment of both verbal preference and visual attentivenss to designs. The findings imply that perhaps the most valid measure of complexity would include items representative of several complexity dimensions (e.g., Berlyne, 1958b; Hoats et al., 1963; Hutt and McGrew, 1969) with complexity being gauged according to the total number of complex, as opposed to simple, designs preferred by a single subject.

Sex Differences

Sex differences in complexity preference have been identified by several researchers, but the various results are presently inconclusive. Turner and Arkes (1975) found that females prefer more complex designs than males. These conclusions are supported elsewhere in the literature by Eisenman (1967a, 1967b) and DeCato (1971) and in infant studies by Kagan and Lewis (1975) and Caron and Caron (1969). With regard to exploratory behavior, Hoats et al. (1963) found that males exhibited more "perceptual curiosity" for complex figures than did females. Smock and Holt (1962), Mendel (1965), and Coopersmith (1976) report similar findings. Bartol and Pielstock (1972) found that elementary-aged males viewed stimuli designed to elicit visual exploration longer than females of corresponding grade levels. Adult females, however, preferred to view the same ambiguous stimuli longer than their male counterparts. On the basis of these findings, Bartol and Pielstock hypothesize that there may be a developmental trend in visual exploration with an optimal level of such exploratory behavior occurring earlier for males than for females. Kreitler et al. (1974) found no differences between male and female responses to visual stimuli.

Response Correlation

Although several research studies (Smock and Holt, 1962; Clapp and Eichorn, 1965; Kreitler et al., 1974) have failed to find a significant degree of relatedness among the specified dimensions of complexity, the author is unaware of any research which has focused upon comparing individual subject's responses of preference for complexity on more than one independent measure of visual stimulus complexity. Therefore, the results of this study, which will examine individual subject's responses to three complexity preference measures, represents unprecedented information regarding correlation of preference responses to various forms of stimulus complexity.

Summary

The review of the literature has focused upon both theoretical and empirical support which justifies the investigation of the research problem and the subsequent testing of the hypotheses which have been formulated from the research questions. Selected, relevant theoretical positions have been discussed and integrated. Empirical research findings which suggest a relationship between cognitive development and preference for visual stimulus complexity have been presented. Problems which are unique to the operational definition and measurement of stimulus complexity have also been identified. Sex as a variable in complexity preference responses has been recognized. Finally, lack of existing research concerning individual response correlation on various preference measures has been cited. Hopefully, this chapter has presented an adequate foundation for the understanding and execution of the methodology outlined in the following chapter.

CHAPTER III

METHOD AND PROCEDURE

Introduction

This study proposed to expand upon the efforts of past research by exploring the differences in and potential usefulness of various measures of stimulus complexity with regard to a comprehensive criterion measure of cognitive development. Specifically, three measures of complexity preference, which have been frequently utilized in previous research, were employed in this study and the relationship of each measure to a standardized test of cognitive ability was analyzed.

In order to facilitate an intelligible understanding of the methodology for the proposed research, the measurement instruments developed or selected for this study are described initially. These descriptions are followed by explicit procedural guidelines designed to expedite the collection and analysis of research data.

Description of the Measurement Instruments

Stimulus Complexity Measures

Random Polygons. The first measure of stimulus complexity preference consisted of two sets of asymmetrical random polygons with complexity defined as the number of independent turns in each figure. Thus, the stimulus complexity property of amount of material was represented.

Asymmetry was held constant throughout the design series.

The designs used in this series were similar to those used by Munsinger and Kessen (1964) and by Thomas (1966). Each set of designs contained one randomly constructed polygon with 6, 10, 14, 20, 28, and 40 turns (angles), respectively. The varying intervals between polygons of successive complexity were selected because they represent approximately equal logarithmic steps. The method of employing polygons along a continuum of logarithmic steps was utilized in research conducted by Munsinger and Kessen (1964, 1966), Munsinger et al. (1964), and Day (1967). The designs were constructed using a method adapted from Munsinger and Kessen (1964) and Attneave and Arnoult (1956). A six-inch matrix grid was constructed and divided horizontally and vertically at one-half inch intervals. The interior co-ordinates of these divisions within the matrix were randomly assigned numbers from 1 to 121. Numbered co-ordinates were then randomly selected and connected to form the specified shapes. The polygons generated from the matrix were traced on heavy dark paper, cut out, and mounted on a white background. These original designs were then photocopied to produce the actual designs used in the study.

The stimuli were presented in pairs with each design being paired with <u>every other</u> design in the same set. This method of presentation was utilized in several previous research studies involving preference for complexity assessment (e.g., Day, 1967; Dorfman, 1965; Dorfman and McKenna, 1966; Munsinger and Kessen, 1964; Munsinger, Kessen, and Kessen, 1964; Thomas, 1966). Each set consisted of six designs which yielded fifteen possible pairings, and there were a total of thirty presentations for the entire series. The right-left positioning of simple-complex stimuli was counterbalanced to control for the effects of possible directional preference. Each set of paired stimuli was randomly ordered for presentation to each subject.

Scoring was accomplished by assigning equal interval numerical values to each design in a given set. (Interval scale measurement was deemed appropriate because the number of independent turns in each successive polygon was increasing in approximately equal logarithmic steps.) The designs were weighted by using scale values of one through six with higher numerical values denoting increased complexity. Thus, the designs in each of the two sets were assigned the following values:

Number of Independent Turns	Score
6	1
10	2
14	3
20	4
28	5
40	6

A subject's "score" for any given presentation of paired designs was the numerical value assigned to the design for which he indicated a preference. For example, the subject was presented with a pair of polygons consisting of 6 and 28 angles, respectively. The assigned numerical value for the polygon with 6 angles was "1"; the value for the polygon with 28 angles was "5". The subject indicated a preference for the 28-angle figure; therefore, his score for that item was "5". A subject's total score for the Random Polygons complexity measure was obtained by summing the score values assigned to the preferred figure in each of the thirty paired presentations.

To facilitate scoring on the response form (Appendix B), the polygon pairs were identified by assigned numerical values (1-6) rather than by number of independent turns (6-40). To record subject responses, the examiner simply circled the value of the preferred figure in each pair and summed these values to obtain the total raw score.

Directions for the administration of the complexity measures can be found in Appendix A. Replications of the random polygons which comprise this measure and a copy of the answer sheet used to record preference responses can be found in Appendix C.

Checkerboard Patterns. The second measure of stimulus complexity consisted of two sets of symmetrical checkerboard patterns with complexity defined as the number of individual units integrated in each pattern. In this measure, only the amount of material was considered as a determinant of visual complexity. Symmetry of the designs was held constant within each series with one series consisting of bilaterally symmetrical designs and the other being composed of horizontally symmetrical patterns.

The designs were generated in a fashion similar to that employed by Dorfman (1965). A six-inch square was again utilized and was divided into N x N cells with N = 2, 4, 6, 8, 10, 12, and 14 units. Each cell within one-half of the matrix was randomly assigned a number and cells were randomly selected for inclusion in the designs. One-half of the matrix field contained darkened units (design) and the remaining one-half of the field was white (background). The design generated in one-half of the matrix grain was replicated in the other half and positioned horizontally or vertically to achieve the desired symmetrical balance.

Again, the designs were presented in pairs with each design being paired with every other design in the same set. Each set consisted of fifteen pairings and there were thirty pairings in the total series. The right-left positioning of simple-complex stimuli was counterbalanced in order to control for the possibility of systematic directional response preference. Each set of paired stimuli was randomly ordered for presentation for each subject.

The checkerboard designs were scored in the same manner as the random polygons. Designs in each of the two sets were assigned an equal interval numerical value from one through six with higher values signifying increased complexity. (Interval scale measurement was appropriate because the number of matrix cells in each successive pattern was increasing in a systematic fashion.) Thus, the checkerboard patterns consisting of varying cell units were assigned the following values:

Number of Matrix Cells	Score
4 x 4	1
6 x 6	2
8 x 8	3
10 x 10	4
12 x 12	5
14 x 14	6

A subject's "score" for any given pair of designs was the numerical value assigned to the pattern of his preference. For example, if a subject was presented with a pair of checkerboard patterns consisting of 8 x 8 (score value "3") and 12 x 12 (score value "5") matrix cells, respectively, and he indicated a preference for the 8 x 8 matrix unit design, his score for that pair was "3".

A subject's total score for the Checkerboard Pattern complexity measure was determined by summing the numerical values assigned to the preferred design in each of the thirty possible pairs.

To facilitate scoring on the response form, the checkerboard designs were identified by assigned numerical values (1-6) rather than by number of matrix cells (4-14) in a row or column. To record subject responses, the examiner simply circled the score value of the preferred design in each pair and summed these values to obtain the total raw score.

By assigning the same range of arbitrary numerical values to both the random polygons and the checkerboard patterns, scores from the two measures were directly comparable for each subject. This simplified the procedure for determining the relationship among subjects' responses to the three measures.

Direction for the administration of the complexity measures can be found in Appendix A. Replications of the checkerboard patterns which were generated for this complexity measure and a copy of the answer sheet used for recording preferential judgements can be found in Appendix D.

Simple-Complex Designs. The third measure of visual complexity was adapted from the study by Kreitler et al. (1974). The same stimulus designs and pairings were used but the series of items was expanded from twenty to thirty pairs to increase the reliability of measurement and to equalize the length of all three measures. The additional designs to be included were either selected from the referenced studies cited by Kreitler et al. (Berlyne, 1958a, 1958b, 1963; Cantor et al., 1963; Hoats et al., 1963; Smock and Holt, 1962) or designed by the researcher with careful consideration given to the existing examples. With thirty total items, there were six examples of each complexity dimension - homogeneity/heterogeneity of elements, regular/irregular arrangement, amount of material, regularity/irregularity of contour, and congruity/incongruity of elements. The right-left positioning of the simple-complex stimuli was again counterbalanced to control for the possibility of a response bias based on directional preference. Each of the six sets of five pairs of stimuli, with each pair representing a different complexity dimension, was initially randomly ordered for presentation. The six sets were then randomly ordered collectively for each subject to determine the final order of presentation. In other words, pairs of stimuli were first randomly ordered within sets and the sets themselves were randomly ordered for presentation to each subject.

The designs were coded on the response form in the following manner:

	Complexity Dimension
1	Homogeneity/heterogeneity of elements
2	Regular/irregular arrangement
3	Amount of material
4	Regularity/irregularity of contour
5	Congruity/incongruity of elements

S - simple; C - complex

For example, all pairs of designs labeled 1S - 1C (or 1C - 1S) were designs representing the complexity dimension of homogeneity/heterogeneity of elements. All pairs of designs coded 2S - 2C (or 2C - 2S) were designs representative of the complexity dimension regular/irregular arrangement.

To facilitate scoring on the response form, the examiner simply circled the code for the preferred design in each pair. The total raw score for each subject was obtained by summing the C (complex) selections.

Directions for the administration of the complexity measures can be found in Appendix A. The simple-complex figures which were included in this measure and a copy of the answer sheet used to record preference responses can be found in Appendix E. Sources for each pair of designs utilized in this measure are cited in Appendix F.

Pilot Study. In order to determine the most effective method for presenting and scoring the first two sets of designs (random polygons and checkerboard patterns), a preliminary pilot study was conducted. The eleven subjects, five boys and six girls, participating in the study ranged in chronological age from 5-2 years to 6-11 years. Thus, their ages fell within the range stipulated for subjects in the actual study.

Two methods of presentation of the sets of patterns were tested. The first method consisted of presenting the sets of stimuli in accordance with the method of paired comparisons, i.e., each design in a given set was paired and presented with every other design in the same set. As each stimulus pair was presented, the child was asked to indicate which of the two designs he liked best. The second method involved the simultaneous presentation of the six stimulus patterns comprising each set and asking the child to select the one design that he liked best. Six sets of random polygons and checkerboard patterns were represented in this manner.

On the basis of the results from the pilot study, the decision was made to present the stimuli in pairs rather than in groups of six. Several children became seemingly overwhelmed at the sight of six designs and did not appear to attend to the salient features of each design before indicating a preference. The paired comparisons method of presentation did not prove too lengthy for subjects of this age and each participant in the pilot study maintained an ongoing interest in the activity until all of the pairs had been presented.

Two methods of scoring were considered for quantifying subjects' preference judgements. The first method was the scaling technique outlined by Edwards (1957) which is adaptable to the paired comparisons method of presentation. The second method was the arbitrary assignment of numerical values of equal intervals to each design, with higher numerical values denoting greater complexity.

After observing subjects' performance during the pilot study, the decision to assign arbitrary numerical values to the designs was made. This decision was based upon some inconsistencies which appeared in subjective preference judgements.

To exemplify response consistency and inconsistency, consider the following three design pairings:

1. 4 - 3 2. 2 - 4 3. 4 - 1

Subject A prefers the following designs in each pair:

1. 4 2. 4 3. 4

Subject A has responded <u>consistently</u> to the complexity characteristics - he prefers the <u>more</u> complex design in each pair.

Subject B has indicated a preference for the following designs in each pair:

1. 4 2. 4 3. 1

Subject B has responded inconsistently to the complexity dimensions - he prefers the more complex design in the first two pairings, but the less complex design in the third pairing. Based upon his preference responses to the first two pairs, his anticipated selection in the third pair would be "4" (more complex design) since the less complex design in this pair is simpler than the less complex members of items #1 and #2.

Cognitive Ability Measure

Definition. For the purposes of this study, cognitive ability was defined in terms of those abilities measured by the McCarthy Scale of Children's Abilities which was the criterion measure of cognitive ability selected for use in this study. This instrument was chosen for several reasons: (1) it is a recently developed test with potential for widespread usefulness in a school setting, (2) it yields scores for six subscales which allows for a more detailed analysis of the data than does the Stanford-Binet, which provides a single index of ability, or the Wechsler Pre-School and Primary Scale of Intelligence, which yields three composite scores, (3) it is not defined as an "IQ" test and, therefore, would not likely be subject to the current controversy concerning the interpretation of "IQ", and (4) reliability, validity, standardization, and scoring procedures appear to be satisfactory.

The McCarthy Scales of Children's Abilities (MSCA) were authored by Dorthea McCarthy and published by the Psychological Corporation in 1962. The MSCA was designed for the expressed purpose of providing psychologists with an alternative instrument for evaluating the general intellectual level and identifying specific strengths and weaknesses in young children, ages 2 1/2 to 8 1/2 (McCarthy, 1972).

Scope of the Instrument. McCarthy selected a wide variety of tasks involving language, numerical concepts, motor coordination, and perceptual skills for inclusion in the test battery. The MSCA consists of eighteen subtests which are grouped into six subscales: Verbal, Perceptual-Performance, Quantitative, General Cognitive, Memory, and Motor. A factor analytic study was conducted to determine the nature of subtest groupings and the results of this study were generally consistent with the author's intuitive and functional method of proposed grouping. The first three scales were combined to form the General Cognitive Scale which provides an index of the child's comprehensive cognitive development and is analogous to the deviation intelligence quotient employed by traditional individual intelligence tests such as the Stanford-Binet and the Wechslers. Although the General Cognitive Index is essentially a measure of intellectual ability, the author has purposely avoided the use of the term "IQ" in the discussion of the MSCA because of the "many misinterpretations of that concept and the unfortunate connotations that have become associated with it" (McCarthy, 1972, p. 5).

Description of the Subtests. The additional five subscales and the subtests which comprise each scale are described as follows:

Verbal Scale - This scale assesses the child's ability to express himself verbally and also assesses the maturity of his verbal concepts. It includes the following subtests:

Pictorial Memory - child recalls names of objects pictured on a card.

Word Knowledge - child identifies common objects and defines words.

Verbal Memory - child repeats word series and sentences and recalls story read by examiner.

Verbal Fluency - child names as many articles as he can within a given category during a specified time period.

Opposite Analogies - child completes sentences by providing opposites.

Perceptual-Performance Scale - This scale assesses the child's reasoning ability through the manipulation of materials; the child demonstrates imitative skills, logical classification, and visual organization in a variety of spatial, visual-perceptual, and conceptual tasks. The subtests which comprise this scale are:

Block Building - child copies block structures from examiner's models.

Puzzle Solving - child assembles cut-up pictures of common objects.

Tapping Sequence - child copies sequences of notes tapped by the examiner on a xylophone.

Right-Left Orientation - child demonstrates understanding of "right" and "left".

Draw-A-Design - child copies geometric designs.

Draw-A-Child - child draws a picture of a child of his same sex.

Conceptual Grouping - child classifies blocks on the basis of size, color, and shape.

Quantitative Scale - This scale assesses the child's facility with numbers and his understanding of quantitative concepts. The following subtests are included:

Number Questions - child answers questions concerning number information and computation.

Numerical Memory - child repeats series of digits in the order presented by the examiner.

Counting and Sorting - child is asked to count and sort blocks into groups.

Memory Scale - This scale assesses the child's short-term auditory and visual memory. It includes the Pictorial Memory, Tapping Sequence, Verbal Memory, and Numerical Memory subtests which have already been described.

Motor Scale - This scale assesses the child's coordination as he performs a variety of gross and fine motor tasks. The following subtests constitute this scale:

Leg Coordination - child performs motor tasks which involve the lower extremities.

Arm Coordination - child bounces and catches ball and throws beanbag at target.

Imitative Action - child copies simple movements demonstrated by the examiner.

The Motor Scale also includes the Draw-A-Person and Draw-A-Design subtests which have already been described (McCarthy, 1972).

Standardization. The MSCA was standardized by using a stratified sample group of 1032 children which was representative of the 1970 U.S. census with regard to race, geographical region, and father's occupation. Urban-rural residence was not a strict stratification variable and was based upon data from the 1960 census. (Data from the 1970 census was not available for this variable.) Approximately two-thirds of the sample group were urban residents; the remaining one-third were from rural areas. At least 100 children were included at each one-half year interval from ages 2 1/2 to 8 1/2. Some mentally retarded children were included in the standardization sample; however, children with severe handicaps and non-English speaking children were excluded.

Scoring. Raw scores are obtained for each subtest and component subtest scores are summed to obtain the six subscale scores. The raw scores are then converted to scaled scores using the age-appropriate tables in the manual. A graphic representation of the scores can be obtained by plotting the scaled scores on the MSCA profile chart which is found on the record form. The mean scaled score for all of the scales, excluding the General Cognitive Scale, is 50 and the standard deviation is 10. The mean scaled score for the General Cognitive Scale is 100 and the standard deviation is 16. A table for converting the scaled scores to percentile ranks is included in the manual.

Reliability. Reliability coefficients for each of the subscales were obtained by split-half reliability measurements, or, when this method was not appropriate (for example, with the Draw-A-Person subtest), by test-retest reliability measures. The reliability coefficient for the General Cognitive Scale, based on data for all age groups, is .93; the averages for the other scales ranged from .79 to .88. The standard error of measurement for the General Cognitive Scale is approximately four points; for the other subscales, it varies slightly. Stability coefficients were determined by using test-retest data from 125 subjects. The interval between testings was one month. The average obtained coefficient for the General Cognitive Scale was .90; the mean coefficient for the subscales ranged from .69 to .89. Subsequent stability studies (Bryant and Roffe, 1978; Davis and Slettedahl, 1976) provide further support for the initial findings presented in the MSCA manual.

Validity. Correlation coefficient for the MSCA with the Stanford-Binet and the Wechsler Pre-School and Primary Scale of Intelligence were initially obtained by administering the three instruments to 35 six year olds within the period of a few weeks. The resulting correlation of the MSCA General Cognitive Scale and the Wechsler Pre-School and Primary Scale of Intelligence (WPPSI) - Full Scale IQ was .71. The latter correlation may have been somewhat lowered due to the restriction of range of the WPPSI at this age level (Kaufman, 1973). Additional evidence of favorable correlation between the Stanford-Binet and the MSCA was obtained by Davis (1975), Davis and Rowland (1974), and Gerken et al. (1978). Davis and Walker (1977) found that the correlations between the General Cognitive Index of the MSCA and the verbal, performance, and full scale scores from the Wechsler Intelligence Scale for Children - Revised were .65, .62, and .75, respectively.

The predictive validity of the MSCA was ascertained by administering the Metropolitan Achievement Test as a criterion of first grade achievement to 31 of the 35 children participating in the study described in the preceeding paragraph. Correlations which were significant at the .01 level were obtained for the MSCA General Cognitive Index and the Metropolitan Total Raw Score (.49) and for the MSCA General Cognitive Index and the Metropolitan Mathematics (.54). Correlations which were significant at the .05 level were found for the MSCA General Cognitive Index and the Metropolitan Reading (.44) and the MSCA General Cognitive Index and the Metropolitan Total Reading (.45) (Kaufman, 1973).

Critique of the Instrument. Comments by test reviewers elucidate the advantages and potential usefulness of the MSCA.

> . . . the McCarthy has great potential because it provides a profile of abilities which may be particularly useful in evaluating children with learning disabilities . . . . In addition, the manual is convenient to use, the general guidelines for testing are thorough, the materials are well-constructed, and the tasks are likely to appeal to children . . . a very promising tool for assessing the cognitive . . . abilities of young children and therefore deserves serious consideration (Jerome M. Sattler from Buros *Mental Measurements Yearbook*, 1978, p. 311).

> This is probably the best test that has been devised so far for testing the mental ability of individual young children . . . Most of the technical aspects are beyond reproach . . . The principal criticism is the universal uncertainty concerning the overall construct of mental ability or intelligence (Davis, 1974, as summarized by Buros, 1978, p. 317).

> . . . it probably represents an improvement over many other available instruments with regard to content appropriate for various ethnic and socio-economic groups . . . . Overall, many clinicians will welcome the test (Hufano and Hoepfner, 1974, as summarized by Buros, 1978, p. 315).

> The MSCA is being used to an increasing extent in school systems and children's clinics. It seems to combine the advantages of the tests commonly used with children in this age range without the usual drawbacks. It provides a variety of tasks that hold the children's interest. It provides for more information than does the Stanford-Binet and is less "school-like" than the Wechslers. It has more tasks that are applicable to non-majority children. In summary, it is well worth exploring as a means to assess the cognitive ability of primary children (Krichev, 1974, as summarized in Buros, 1978, p. 316).

Methodology

Subjects

The subjects for the study consisted of eighty children who ranged in chronological age from five years to seven years. The total number of subjects was subdivided in the following manner:

Males, ages	5 years 0 months to 5 years 11 months	20 subjects
Females, ages	5 years 1 months to 5 years 11 months	20 subjects
Males, ages	6 years 0 months to 6 years 11 months	20 subjects
Females, ages	6 years 0 months to 6 years 11 months	20 subjects

The subjects were selected from kindergarten and first grade classes in Broken Arrow, Oklahoma, school system.

Permission to conduct the study in the Broken Arrow elementary schools was solicited by the author and subsequently granted by the Broken Arrow School Board. A copy of the formal letter requesting permission for research can be found in Appendix G. The author worked directly with the Director of Special Services for the Broken Arrow school system who coordinated the project within the system.

Twenty-two of the eighty children who participated as subjects in the study were selected by the Director of Special Services. The remaining fifty-eight subjects were suggested by the elementary principals, teachers, and counselors. The school personnel were requested to refer the names of children who, in their estimation, exhibited a broad range of intellectual abilities and academic functioning in a regular classroom environment. Students enrolled in special education classes were purposely excluded. Collectively, the participants in the study encompasses a comprehensive range of measurable cognitive abilities. The General Cognitive Index scores obtained on the McCarthy Scales of Children's Abilities ranged from a low of 69 to a high of 143.

In order to obtain workable data from eighty representative subjects, a total of ninety-one children were evaluated. Data from eleven subjects was subsequently excluded from the study at the discretion of the author for the following reasons: two of the subjects had suspected visual acuity problems which noticeably affected test performance and preference judgements; one subject had residual gross and fine motor impairment resulting from a stroke which restricted performance on portions of the MSCA; one subject became emotionally upset during the administration of the MSCA and her performance on the remainder of the test was not, in the author's judgement, a realistic reflection of her abilities; and seven children did not discriminate between pairs of designs in their expressed preference judgements on a portion of one or more of the stimulus complexity measures; i.e., they systematically indicated a preference for polygon or checkerboard designs positioned on the right (or on the left) throughout an entire set.

Testing Preparation

Because the administration of the MSCA could be construed as an individual evaluation of intellectual ability, written parental permission was obtained prior to the evaluation of each subject. A letter explaining the nature and purpose of the testing was sent home with each prospective subject. A detachable permission form, which was to be signed by the parent and returned to the school, was included at the bottom of the letter. A copy of this letter to parents can be found in Appendix H.

Permission for testing was requested for 98 children. Written permission forms were returned for 94 children. Three of these 94 children were not evaluated because their permission slips were returned after the necessary number of subjects had been scheduled for testing.

Preparation of the Response Forms--Stimulus Complexity Measures. The randomization procedures and preparation of the complexity response forms were completed before testing was initiated. The three response forms were stapled together in the following uniform order for all subjects:

Page # 1 - Random Polygons Response Form

Page # 2 - Checkerboard Patterns Response Form

Page # 3 - Simple-Complex Designs Response Form

A numerical order of presentation for the complexity measures was recorded in the upper right corner of the first page of each stapled set of response forms. The presentation orders were denoted by the numerals 1, 2, and 3 which corresponded to the page numbers of the stapled response sets. For example, the presentation order 1 - 3 - 2 indicated the following order of presentation:

First - (1) Random Polygons

Second - (3) Simple-Complex Designs

Third - (2) Checkerboard Patterns

The order of presentation of the three stimulus complexity measures was counterbalanced to control for the effects of order of administration. Each of the six possible orders of presentation (1-2-3, 1-3-2, 2-1-3, 2-3-1, 3-1-2, 3-2-1) was administered an approximately equal number of times.

After all of the presentation orders of stimulus complexity measures had been determined, the response forms were then thoroughly shuffled. Random numerical orders for the presentation of items were then recorded on each response form. Each of the two sets of fifteen pairs of polygons and checkerboard designs were randomly ordered for each subject using a computerized listing of randomly ordered descriptions for fifteen items. The six sets of simple-complex designs were randomized for presentation to each subject by employing a computerized listing of randomly ordered descriptions for six items. A sample of a prepared response form for a subject can be found in Appendix I.

Each of the stapled response forms was inserted in a response booklet for the McCarthy Scales of Children's Abilities to form a complete response packet for each child. Subjects were then randomly assigned to response packets which designated the order of presentation of both complexity items and measures.

Testing Location

Testing was done in the elementary school where the child was enrolled. An empty office or available classroom was generally utilized. Thus, the test surroundings were not uniform for all subjects but each test environment was quiet, well lighted, well ventilated, not overly stimulating, and generally quite adequate for the intended purpose in the judgement of the examiner. The children were excused from their individual classrooms during the school day for their participation in the study.

Testing Procedure

Each subject was tested individually during two separate sessions. During the first session, two measures of stimulus complexity preference were administered and were followed by the first nine subtests from the

McCarthy Scales of Children's Abilities. During the second session, the third measure of stimulus complexity preference was given and was followed by the remaining nine subtests from the MSCA. The testing was divided in this manner to attempt to reduce the possible tedium factor involved in responding to all of the measures of stimulus complexity in one session.

The first session began with a short "get acquainted" period lasting approximately five minutes. The purpose of this initial conversation was three-fold: (1) to alleviate any initial anxiety provoked by the testing situation, (2) to establish a basis for positive rapport between the examiner and the child, and (3) to effect some control over pretesting activities. Studies by Arkes and Clark (1975) and by Berlyne and Crozier (1971) have revealed that activity immediately preceding assessment of stimulus complexity preference can influence a subject's expressed preferences. During the "get acquainted" period the child was told that he or she would be helping the examiner by looking at some designs and by participating in some other interesting activities. The child was subsequently asked a few general questions regarding family, pets, and favorite activities. Explicit directions pertaining to testing procedures were then given and testing commenced.

During the second testing session a few minutes was spent in conversation with the child to reestablish rapport. Directions pertaining to testing procedures were again stated and testing resumed.

The total time involved in testing each subject was approximately fifty minutes. All of the testing was done by the author.

Each child's scores on the McCarthy Scales of Children's Abilities were made available to the Broken Arrow School system through the

Director of Special Services. A brief written report was also prepared and sent to the parent(s) of each subject.

Analysis of the Data

After testing was completed, each instrument was scored. The raw data obtained for all subjects is presented in Appendix J. The data was analyzed using various statistical analyses appropriate for testing the null hypotheses stated at the end of this chapter. Each statistical technique utilized in the study is described in detail in the following chapter.

Research Questions

This study attempted to answer the following research question, paraphrased from the more general questions stated in the introductory chapter:

1. What is the relationship between verbally expressed preference for visual stimulus complexity and various aspects of cognitive development as measured by the McCarthy Scales of Children's Abilities in young children?
2. Which of the measures, or combination of measures, of stimulus complexity correlate most highly with various aspects of cognitive ability as measured by the McCarthy Scales of Children's Abilities?
3. What are the differences in males' and females' preferences for visual stimulus complexity?
4. What are the relationships among individual preference-for-complexity responses on the three measures of visual

complexity?

5. What are the relationships between chronological age of subjects and complexity preferences?

Hypotheses

In accordance with the research questions, the following statistical hypotheses were proposed:

$H_0 1$: There will be no relationship between preference for visual stimulus complexity and specific aspects of cognitive ability as assessed by the McCarthy Scales of Children's Abilities in young children.

$H_0 2$: There will be no differences in the relationship between the three independent measures or any combination of measures of visual complexity preferences and specific aspects of cognitive development as measured by the McCarthy Scales of Children's Abilities in young children.

$H_0 3$: There will be no differences between male and female complexity preferences.

$H_0 4$: There is no relationship among individual responses indicating preference for visual complexity on the three independent measures of complexity.

$H_0 5$: There is no relationship between chronological age and preference for visual complexity assessed by the three independent measures of complexity.

Summary

This chapter has described the instrumentation and methodology necessary to enact the proposed study. The procedure for the development, administration, and scoring of the three measures of visual stimulus complexity has been outlined. The rationale for the choice of the criterion measure of cognitive ability, the McCarthy Scales of Children's Abilities, has been established. Significant aspects of the MSCA have been described in detail. The method for collecting the data, including the definition of participating subjects, the testing procedure, and the analysis of the data, has been explained. Five research questions were stated and, from these, five statistical hypotheses were constructed to test the questions of interest.

CHAPTER IV

ANALYSIS OF THE DATA

Introduction

The purpose of this chapter is to present the results of the statistical analyses which were employed to test each of the five null hypotheses formulated in the preceding chapter. The null hypotheses were constructed to parallel the research questions posed by this study and to encompass the proposed relationship of visual stimulus complexity preference judgements and specific cognitive abilities. The results of the statistical analyses yield the necessary information for determining (1) the relationship between each of the three measures of stimulus complexity preference and specific cognitive abilities, (2) the effects of both age and sex upon these relationships, and (3) the correlations among each of the separate measures of stimulus complexity preference.

Discussion of the Results

Descriptive statistics for all eighty subjects, including the mean and standard deviation, for each of the three stimulus complexity variables and the six cognitive ability variables are presented in Table I.

To facilitate interpretation of the statistical analyses presented in this chapter, each statistical hypothesis is reiterated and is subsequently followed by a discussion of relevant statistical findings.

TABLE I

DESCRIPTIVE STATISTICS FOR STIMULUS COMPLEXITY AND COGNITIVE ABILITY VARIABLES
(n=80)

	$\overline{X}$	SD
<u>Stimulus Complexity Measures</u>		
Random Polygons	109.21	14.22
Checkerboard Patterns	104.1	14.6
Simple-Complex Designs	12.66	4.48
<u>Cognitive Ability Measures</u>		
MSCA - Verbal	54.53	10.11
MSCA - Perceptual/Performance	55.89	10.6
MSCA - Quantitative	48.44	8.87
MSCA - General Cognitive Index	107.21	16.48
MSCA - Memory	50.64	8.89
MSCA - Motor	52.11	10.54

Null Hypothesis One

> There is no relationship between preference for visual stimulus complexity and specific aspects of cognitive ability as assessed by the McCarthy Scales of Children's Abilities in young children.

In order to determine the relationships between the stimulus complexity and cognitive ability variables, Pearson product-moment correlation coefficients were computed for all variables utilizing data from all subjects. The product-moment correlational technique was deemed appropriate for the analysis because interval level measurement was utilized in each measurement instrument, and the relationship between any given pair of variables was assumed to be linear. The obtained product-moment correlation coefficients and the probability levels are presented in Table II. Exact probability levels for each correlation coefficient are included in order that the reader may more efficiently evaluate the importance of the relationship between any two given variables.

Inspection of the correlation coefficients presented in Table II reveals that all correlations between stimulus complexity and cognitive ability measures are positive, suggesting a direct relationship between preference for visual complexity and development of cognitive abilities for at least eleven of the eighteen relationships when the .05 level of probability is utilized as a criteria level.

The range of correlations between the Random Polygons complexity preference measure and the cognitive ability variables was .16 to .28 with a mean correlation of .20. Correlations which were significant at the .05 level of probability were obtained for preference for complexity

TABLE II

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND LEVELS OF PROBABILITY FOR STIMULUS COMPLEXITY AND COGNITIVE ABILITY VARIABLES FOR ALL SUBJECTS
(n=80)

	Cognitive Ability Variables					
	MSCA Verbal	MSCA Perc./Perf.	MSCA Quant.	MSCA General Cognitive Index (GCI)	MSCA Memory	MSCA Motor
Stimulus Complexity Variables						
Random Polygons	r = .17 p = .061	r = .28 p = .006	r = .29 p = .046	r = .26 p = .011	r = .16 p = .084	r = .16 p = .081
Checkerboard Patterns	r = .22 p = .027	r = .32 p = .002	r = .29 p = .004	r = .31 p = .003	r = .35 p = .001	r = .15 p = .089
Simple-Complex	r = .17 p = .068	r = .19 p = .049	r = .29 p = .005	r = .23 p = .021	r = .18 p = .060	r = .14 p = .111

of polygons and Perceptual-Performance Ability, Quantitative Ability, and General Cognitive Ability.

The correlations between the Checkerboard Patterns complexity measure and the cognitive ability scales ranged from .15 to .35 with a mean correlation of .27. Correlations which equaled or exceeded the .05 level of significance were obtained for preference for complexity of checkerboard designs and Verbal Ability, Perceptual-Performance Ability, Quantitative Ability, General Cognitive Ability, and Memory Ability. Of the three complexity measures, the Checkerboard Patterns preference score was most highly numerically correlated with overall cognitive development.

The correlations between the Simple-Complex Designs complexity measure and the cognitive ability variables ranged from .14 to .29 with a mean correlation of .20. Correlations which were significant at or beyond the .05 level of probability were obtained for preference for complexity of designs and Perceptual-Performance Ability, Quantitative Ability, and General Cognitive Ability.

Correlation coefficients and levels of probability for stimulus complexity and cognitive ability variables for male and female subpopulations are presented in Table III. All but two of the obtained coefficients were positive and a significant relationship between stimulus complexity preference and cognitive development was suggested for thirteen of the thirty-six relationships at the .05 level of probability. Negative correlations were obtained for two of the relationships, but these correlations were not of sufficient numerical magnitude to suggest an existing inverse relationship between the respective variables.

For males, the correlation coefficients for the Random Polygons variable and the cognitive ability measures ranged from .23 to .43 with

TABLE III

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS AND LEVELS OF PROBABILITY FOR STIMULUS COMPLEXITY AND COGNITIVE ABILITY VARIABLES FOR MALE AND FEMALE SUBPOPULATIONS
(n=40)

	Verbal	Perceptual/ Performance	Quantitative	General Cognitive	Memory	Motor
Random Polygons						
Male	$r = .34$	$r = .42$	$r = .25$	$r = .41$	$r = .23$	$r = .43$
	$p = .016$	$p = .003$	$p = .058$	$p = .004$	$p = .076$	$p = .003$
Female	$r = .02$	$r = .15$	$r = .13$	$r = .13$	$r = .10$	$r = -.10$
	$p = .443$	$p = .185$	$p = .204$	$p = .213$	$p = .278$	$p = .261$
Checkerboard Patterns						
Male	$r = .11$	$r = .47$	$r = .24$	$r = .31$	$r = .45$	$r = .48$
	$p = .243$	$p = .001$	$p = .067$	$p = .006$	$p = .002$	$p = .001$
Female	$r = .33$	$r = .25$	$r = .34$	$r = .35$	$r = .31$	$r = -.09$
	$p = .019$	$p = .060$	$p = .017$	$p = .015$	$p = .024$	$p = .287$
Simple-Complex Designs						
Male	$r = .10$	$r = .05$	$r = .21$	$r = .15$	$r = .08$	$r = .16$
	$p = .276$	$p = .376$	$p = .093$	$p = .181$	$p = .310$	$p = .160$
Female	$r = .20$	$r = .26$	$r = .35$	$r = .26$	$r = .21$	$r = .07$
	$p = .105$	$p = .052$	$p = .013$	$p = .052$	$p = .097$	$p = .330$

a mean correlation of .35. For females, the range for corresponding variables was −.10 to .15 with a mean correlation of .07. Correlation coefficients which were significant at or beyond the .05 level of probability were obtained for random polygons complexity preference and Verbal, Perceptual-Performance, General Cognitive, and Motor Ability for males. None of the correlations between preference for complex random polygons and cognitive abilities were significant ($p > .05$) for females. The correlations between the Random Polygons variable and all of the cognitive ability variables was noticeably numerically higher for males than for females.

For males, the correlation coefficients for the Checkerboard Patterns variable and the cognitive ability variables ranged from .11 to .48 with a mean correlation of .34. For females, the corresponding correlations ranged from −.09 to .35 with a mean correlation of .25. Correlation coefficients which equaled or exceeded the .05 level of probability were found for checkerboard patterns complexity preferences and Perceptual-Performance, General Cognitive, Memory, and Motor Ability for males. Significant correlations ($p > .05$) for females were found for preference for complex checkerboard patterns and Verbal, Quantitative, General Cognitive, and Memory Ability.

For males, the correlation coefficients for the Simple-Complex Designs variable and the cognitive ability measures ranged from .05 to .21 with a mean correlation of .13. For females, the correlations for corresponding variables ranged from .07 to .35 with a mean correlation of .23. For males, no significant correlations ($p > .05$) between preference for complex designs and cognitive abilities were found. For females, correlations which were significant at or beyond the .05 level of probability were found for preference for complex designs and Perceptual-Performance, Quantitative, and General Cognitive Ability.

With regard to the null hypothesis, numerous significant positive correlations between preference for complex visual stimuli and development of cognitive abilities leads to the rejection of the assumption stated by the hypothesis, and indicates that each of the measures of preference for stimulus complexity is significantly related to selected specific cognitive abilities.

Null Hypothesis Two

> There are no differences in the relationship between the three independent measures, or any combination of measures, of visual complexity preferences and specific aspects of cognitive development as measured by the McCarthy Scales of Children's Abilities in young children.

To determine if the variance among correlation coefficients obtained for each of the three stimulus complexity measures and the cognitive ability measures was significantly different beyond chance variation, Hotelling's t-test was utilized. This statistical technique is employed when testing for significant differences between correlation coefficients which are correlated, or obtained from the same sample of subjects. The formula for Hotelling's t-test is

$$t_{d_r} = (r_{y.1} - r_{y.2}) \sqrt{\frac{(N-3)(1+r_{1.2})}{2(1-r_{1.2}^2-r_{y.1}^2-r_{y.2}^2+2r_{1.2}r_{y.1}r_{y.2})}}$$

where y = dependent variable

x_1, x_2 = independent variables (Guilford and Fruchter, 1973, p. 167)

A critical value equal to or exceeding ±1.99 must be obtained in order for the differences between correlation coefficients to be significant at the .05 level of probability. The results of Hotelling's t-test are presented in Table IV. None of the calculated t-values was significant at the .05 level of probability and indicates that for any given pair of correlation coefficients obtained for stimulus complexity and cognitive ability variables, one coefficient is not significantly higher than the other. For example, the correlation between Random Polygons-Verbal Ability was .17 and the correlation obtained for Checkerboard Patterns-Verbal Ability was .22 for all subjects. The correlation between Random Polygons and Checkerboard Patterns was .4103. Entering these values into the Hotelling formula, a t-value of -.3517 for differences between correlation coefficients was found. This t-value, which was not significant, indicates that there was not a significant difference in magnitude between the Random Polygons-Verbal Ability and the Checkerboard Patterns-Verbal Ability correlations.

To determine whether the correlation for one stimulus complexity variable with a given cognitive ability variable was significantly higher than the correlation for another stimulus complexity variable with the same cognitive ability variable for male and female subpopulations, Hotelling's t-test was again utilized. For these subgroups, a critical value equal to or exceeding $\pm$ 2.02 must be obtained for significance at the .05 level of probability. The results of Hotelling's t-test for male and female subgroups are presented in Table V. For males, the following correlations were significant:

1. The correlation obtained for Random Polygons - Perceptual-Performance Ability was significantly higher ($p > .05$) than the

TABLE IV

RESULTS OF HOTELLING'S T-TEST FOR SIGNIFICANT DIFFERENCES BETWEEN PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS FOR ALL SUBJECTS
(n=80)

	Verbal	Perceptual/ Performance	Quantitative	General Cognitive	Memory	Motor
Random Polygons						
Checkerboard Patterns	$td_r = -.3517$	$td_r = -.3932$	$td_r = -.8575$	$td_r = -.4383$	$td_r = -1.6545$	$td_r = .0477$
Random Polygons						
Simple-Complex Designs	$td_r = .0455$	$td_r = .6588$	$td_r = -.7220$	$td_r = .0625$	$td_r = -\ .1505$	$td_r = .1436$
Checkerboard Patterns						
Simple-Complex Designs	$td_r = .3511$	$td_r = 1.0564$	$td_r = .0429$	$td_r = .6212$	$td_r = 1.3606$	$td_r = .1029$

$p > .05$; df = 78(80)-1.99; $p > .01$; df = 78(80)-2.63

TABLE V

RESULTS OF HOTELLING'S T-TEST FOR SIGNIFICANT DIFFERENCES BETWEEN PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS FOR MALE AND FEMALE SUBPOPULATIONS (n=40)

	Verbal	Perceptual/ Performance	Quantitative	General Cognitive	Memory	Motor
Random Polygons - Checkerboard Patterns						
Male	td_r = 1.45	td_r = -.35	td_r = .06	td_r = .66	td_r = -1.45	td_r = -.35
Female	td_r = -1.77	td_r = -.55	td_r = -1.17	td_r = -1.26	td_r = -1.18	td_r = -.06
Random Polygons - Simple-Complex Designs						
Male	td_r = 1.33	td_r = 2.13*	td_r = .22	td_r = 1.48	td_r = .80	td_r = 1.55
Female	td_r = -.90	td_r = -.56	td_r = -1.15	td_r = -.66	td_r = -.55	td_r = -.77
Checkerboard Patterns - Simple-Complex Designs						
Male	td_r = .05	td_r = 2.13*	td_r = .22	td_r = .76	td_r = 1.66	td_r = 1.67
Female	td_r = .84	td_r = -.06	td_r = -.07	td_r = .72	td_r = .64	td_r = -.85

$p > .05$; df = 38(40)-2.02; $p > .01$; df = 38(40)-2.70

correlation between Simple-Complex Designs - Perceptual-Performance Ability.

2. The correlation between Checkerboard Patterns - Perceptual-Performance Ability was significantly greater ($p > .05$) than that obtained for Simple-Complex Designs - Perceptual-Performance Ability.

For females, none of the calculated t-values for differences between correlation coefficients was significant.

To determine whether some correlation coefficients obtained for stimulus complexity variables and cognitive ability measures were significantly higher than others when comparing male and female subpopulations, Fisher's z transformation statistical technique was utilized. Fisher's z transformation was appropriate for this analysis because the correlations for each of the variables were obtained from independent groups. The formula for Fisher's z transformation is

$$^{0}d_z = \frac{r_1 - r_2}{\sqrt{\frac{1}{N_1-3} + \frac{1}{N_2-3}}}$$

(Guilford and Fruchter, 1973, p. 166)

Rather than computing a z score for each pair of correlation coefficients, a critical difference denoting significance at the .05 level of probability (n=40) was calculated from the formula. This diffeence was found to be ±.3804. The critical difference for the .01 level of probability was computed to be ±.5417. Differences between correlation coefficients were then calculated to determine significant differences in the magnitude of correlations. The results of the differences in correlations are presented in Table VI. Inspection of Table VI reveals

TABLE VI

DIFFERENCES BETWEEN PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS FOR STIMULUS COMPLEXITY AND COGNITIVE ABILITY VARIABLES FOR MALE AND FEMALE SUBPOPULATIONS COMPUTED FROM FISHER'S Z TRANSFORMATION
(n=40)

	Difference Between Male and Female Correlations
<u>Verbal</u>	
Random Polygons	.32
Checkerboard Patterns	-.22
Simple-Complex Designs	-.10
<u>Perceptual/Performance</u>	
Random Polygons	.27
Checkerboard Patterns	.22
Simple-Complex Designs	-.21
<u>Quantitative</u>	
Random Polygons	.12
Checkerboard Patterns	-.10
Simple-Complex Designs	-.14
<u>General Cognitive</u>	
Random Polygons	.28
Checkerboard Patterns	-.04
Simple-Complex Designs	-.11
<u>Memory</u>	
Random Polygons	.13
Checkerboard Patterns	.14
Simple-Complex Designs	-.13
<u>Motor</u>	
Random Polygons	.53*
Checkerboard Patterns	.57**
Simple-Complex Designs	.09

*p > .05 - ±.38; **p > .01 - ±.54

the following significant findings:

1. The correlation between Random Polygons and Motor Ability was significantly higher ($p > .05$) for males than for females.
2. The correlation between Checkerboard Patterns and Motor Ability was significantly higher ($p > .01$) for males than for females.

(With eighteen total comparisons, one would expect approximately one error in the identification of significant correlations using the .05 level of probability as a criterion.)

The multiple correlations of stimulus complexity variables with cognitive ability variables for all subjects were calculated by utilizing step-wise multiple regression statistical analysis. The stimulus complexity measures were utilized as predictor variables and the cognitive ability measures served as criterion variables in the analysis. For each of the six cognitive ability variables, the orders of entrance of the stimulus complexity variables into the multiple regression equation were specified. This was done so that each of the predictor variables could be entered as the first-step variable in the equation. The results of the multiple regression analysis and the F-tests for the significance of entrance of the stimulus complexity variables for each of the cognitive ability variables are summarized in Table VII, VIII, IX, X, XI, and XII.

<u>Verbal Ability</u>

Examination of Table VII indicates that the three stimulus complexity variables had a multiple correlation of .25667 with Verbal Ability. None of the stimulus complexity variables was significantly correlated with Verbal Ability when entered as first-steps in the multiple

TABLE VII

SUMMARY TABLE OF MULTIPLE REGRESSION ANALYSIS OF F-TESTS FOR SPECIFIED ORDERS OF ENTRANCE OF STIMULUS COMPLEXITY VARIABLES AND VERBAL ABILITY FOR ALL SUBJECTS
(n=80)

	R	R^2	R^2 Chg.	r	Overall F	Sequential F
Order 1						
R.P.	.17456	.03047	.03047	.17456	2.45[1]	
C.P.	.23635	.05586	.02539	.21694		
S.C.	.25667	.06588	.01002	.16841	1.79[2]	2.07[3]
Order 2						
C.P.	.21694	.04706	.04706	---	3.85[1]	
R.P.	.23635	.05586	.00880	---		
S.C.	.25667	.06588	.01002	---	1.79[2]	.718[3]
Order 3						
S.C.	.16841	.02836	.02836	---	2.27[1]	
R.P.	.21703	.04710	.01874	---		
C.P.	.25667	.06588	.01878	---	1.79[2]	1.51[3]

[1]df = 1, 78(80) $p \geqslant .05 - 3.96$; $p \geqslant .01 - 6.96$

[2]df = 3, 76(80) $p \geqslant .05 - 2.72$; $p \geqslant .01 - 4.04$

[3]df = 1, 77(80) $p \geqslant .05 - 3.96$; $p \geqslant .01 - 6.96$

TABLE VIII

SUMMARY TABLE OF MULTIPLE REGRESSION ANALYSIS AND F-TESTS FOR SPECIFIED ORDERS OF ENTRANCE OF STIMULUS COMPLEXITY VARIABLES AND PERCEPTUAL/PERFORMANCE ABILITY FOR ALL SUBJECTS
(n=80)

	R	R^2	R^2 Chg.	r	Overall F	Sequential F
Order 1						
R.P.	.27770	.07712	.07712	.27770	6.52[1]*	
C.P.	.36015	.12971	.05259	.32308		
S.C.	.36856	.13584	.00613	.18646	3.98[2]*	4.65[3]*
Order 2						
C.P.	.32308	.10438	.10438	---	9.09[1]**	
R.P.	.36015	.12971	.02533	---		
S.C.	.36856	.13584	.00613	---	3.98[2]*	2.24[3]
Order 3						
S.C.	.18646	.03477	.03477	---	2.81[1]	
R.P.	.30294	.09178	.05701	---		
C.P.	.36856	.01358	.04406	---	3.98[2]*	4.83[3]*

[1]df = 1, 78(80) $p \geq .05$ - 3.96; $p \geq .01$ - 6.96

[2]df = 3, 76(80) $p \geq .05$ - 2.72; $p \geq .01$ - 4.04

[3]df = 1, 77(80) $p \geq .05$ - 3.96; $p \geq .01$ - 6.96

TABLE IX

SUMMARY TABLE OF MULTIPLE REGRESSION ANALYSIS AND F-TESTS FOR SPECIFIED ORDERS OF ENTRANCE OF STIMULUS COMPLEXITY VARIABLES AND QUANTITATIVE ABILITY FOR ALL SUBJECTS (n=80)

	R	R^2	R^2 Chg.	r	Overall F	Sequential F
Order 1						
R.P.	.18977	.03601	.03601	.18977	2.91[1]	
C.P.	.30107	.09064	.05463	.29101		
S.C.	.36410	.13257	.04193	.28555	3.87[2]*	4.63[3]*
Order 2						
C.P.	.29101	.08469	.08469	---	7.22[1]**	
R.P.	.30107	.09064	.00595	---		
S.C.	.36410	.13257	.04193	---	3.87[2]*	0.50[3]
Order 3						
S.C.	.28555	.08154	.08154	---	6.92[1]**	
R.P.	.31070	.09653	.01500	---		
C.P.	.36410	.13257	.03603	---	3.87[2]*	1.28[3]

[1]df = 1, 78(80) p ≥ .05 - 3.96; p ≥ .01 - 6.96

[2]df = 3, 76(80) p ≥ .05 - 2.72; p ≥ .01 - 4.04

[3]df = 1, 77(80) p ≥ .05 - 3.96; p ≥ .01 - 6.96

TABLE X

SUMMARY TABLE OF MULTIPLE REGRESSION ANALYSIS AND F-TESTS FOR SPECIFIED ORDERS OF ENTRANCE OF STIMULUS COMPLEXITY VARIABLES AND GENERAL COGNITIVE ABILITY FOR ALL SUBJECTS
(n=80)

	R	R^2	R^2 Chg.	r	Overall F	Sequential F
<u>Order 1</u>						
R.P.	.25765	.06638	.06638	.25765	5.55[1]*	
C.P.	.34042	.11588	.04950	.30862		
S.C.	.36405	.13253	.01665	.22842	3.87[2]*	4.31[3]*
<u>Order 2</u>						
C.P.	.30862	.09524	.09524	---	8.21[1]**	
R.P.	.34042	.11588	.02064	---		
S.C.	.36405	.13253	.01665	---	3.87[2]*	1.80[3]
<u>Order 3</u>						
S.C.	.22842	.05217	.05217	---	4.29[1]*	
R.P.	.30843	.09513	.04295	---		
C.P.	.36405	.13253	.03741	---	3.87[2]*	3.66[3]

[1]df = 1, 78(80) p ≥ .05 - 3.96; p ≥ .01 - 6.96

[2]df = 3, 76(80) p ≥ .05 - 2.72; p ≥ .01 - 4.04

[3]df = 1, 77(80) p ≥ .05 - 3.96; p ≥ .01 - 6.96

TABLE XI

SUMMARY TABLE OF MULTIPLE REGRESSION ANALYSIS AND F-TESTS FOR SPECIFIED ORDERS OF ENTRANCE OF STIMULUS COMPLEXITY VARIABLES AND MEMORY ABILITY FOR ALL SUBJECTS (n=80)

	R	R^2	R^2 Chg.	r	Overall F	Sequential F
Order 1						
R.P.	.15539	.02415	.02415	.15539	1.93[1]	
C.P.	.34772	.12091	.09677	.34744		
S.C.	.35748	.12779	.00688	.17567	3.71[2]*	8.48[3]**
Order 2						
C.P.	.34744	.12071	.12071	---	10.7[1]**	
R.P.	.34772	.12091	.00020	---		
S.C.	.35748	.12779	.00688	---	3.71[2]*	0.02[3]
Order 3						
S.C.	.17567	.03086	.03086	---	2.48[1]	
R.P.	.21010	.04414	.01328	---		
C.P.	.35748	.12779	.08365	---	3.71[2]*	1.07[3]

[1]df = 1, 78(80) $p \geq .05$ - 3.96; $p \geq .01$ - 6.96

[2]df = 3, 76(80) $p \geq .05$ - 2.72; $p \geq .01$ - 4.04

[3]df = 1, 77(80) $p \geq .05$ - 3.96; $p \geq .01$ - 6.96

TABLE XII

SUMMARY TABLE OF MULTIPLE REGRESSION ANALYSIS AND F-TESTS FOR SPECIFIED ORDERS OF ENTRANCE OF STIMULUS COMPLEXITY VARIABLES AND MOTOR ABILITY FOR ALL SUBJECTS
(n=80)

	R	R^2	R^2 Chg.	r	Overall F	Sequential F
Order 1						
R.P.	.15792	.02494	.02494	.15792	2.00[1]	
C.P.	.18466	.03410	.00916	.15207		
S.C.	.20334	.04135	.00725	.13816	1.09[2]	0.73[3]
Order 2						
C.P.	.15207	.02313	.02313	---	1.85[1]	
R.P.	.18466	.03410	.01097	---		
S.C.	.20334	.04135	.00725	---	1.09[2]	0.88[3]
Order 3						
S.C.	.13816	.01909	.13816	---	1.52[1]	
R.P.	.18801	.03535	.15792	---		
C.P.	.20334	.04135	.15207	---	1.09[2]	1.30[3]

[1] df = 1, 78(80) $p \geqslant .05 - 3.96$; $p \geqslant .01 - 6.96$

[2] df = 3, 76(80) $p \geqslant .05 - 2.72$; $p \geqslant .01 - 4.04$

[3] df = 1, 77(80) $p \geqslant .05 - 3.96$; $p \geqslant .01 - 6.96$

regression equations. No combined orders of two or three variables were significantly related to Verbal Ability.

Perceptual-Performance Ability

The data provided in Table VIII shows that the three stimulus complexity variables had a multiple correlation of .36856 ($p \geqslant .01$) with Perceptual-Performance Ability. When the Random Polygons variable was entered as the first-step in the multiple regression equation, it was found to be significantly correlated ($p \geqslant .05$) with Perceptual-Performance Ability with an F-value of 6.52. The addition of a second variable, Checkerboard Patterns, significantly increased ($p > .05$) the correlation between stimulus complexity preference and the Perceptual-Performance Ability with a sequential F-value of 4.65. When the third variable, Simple-Complex Designs, was added to the equation, it represented a significant increase ($p \geqslant .05$) in the multiple correlation and yielded an overall F-value of 3.98.

When the Checkerboard Patterns variable was entered as the first variable in the equation, it was found to be significantly correlated ($p > .01$) with Perceptual-Performance Ability with an F-value of 9.09. The entrance of a second variable, Random Polygons, did not significantly increase the correlation. However, when the Simple-Complex Designs score was added, the overall F-value (3.98) was significant at the .05 level of probability.

When the Simple-Complex Designs measure was entered as the first variable in the equation, it was not significantly correlated with Perceptual-Performance Ability. Addition of a second variable, Random Polygons, and a third variable, Checkerboard Patterns, resulted in significant increases in the multiple correlations ($p > .05$) with the Perceptual-Performance measure. The sequential F-value for the addition of the Random Polygons variable was 4.83 and the overall F-value (3.98) for the entrance of all three variables was significant at the .05 level of probability.

In summary, when Random Polygons was entered into the equation first, the addition of both the Checkerboard Patterns and the Simple-Complex Designs variables resulted in a significant increase in the multiple correlation with Perceptual-Performance Ability. When Checkerboard Patterns was entered as a first-step, only the entrance of Simple-Complex Designs increased the multiple correlation significantly. When Simple-Complex Designs was entered initially, the addition of both the Random Polygons and the Checkerboard Patterns variables resulted in significant increases in the multiple correlation.

Quantitative Ability

Inspection of Table IX indicates that the stimulus complexity variables had a combined correlation of .36410 ($p \geqslant .01$) with Quantitative Ability. When the Random Polygons variable was entered as a first-step in the multiple regression equation, it was not significantly correlated with Quantitative Ability. The addition of a second variable, Checkerboard Patterns, resulted in a significant increase in the multiple correlation ($p \geqslant .05$) with a sequential F-value of 4.63. The addition of the third variable, Simple-Complex Designs, also represented a significant increase ($p > .05$) in the prediction of quantitative skills with an overall F-value of 3.87 for the multiple correlation.

When the Checkerboard Patterns measure was entered initially into the equation, the relationship with Quantitative Ability was significant ($p > .01$) with an obtained F-value of 7.22. The addition of a second variable, Random Polygons, did not significantly increase the multiple relationship, however, the entrance of the third variable, Simple-Complex Designs, resulted in a significant increase ($p > .05$) in the multiple correlation.

When the Simple-Complex Designs variable was entered as the first-step in the multiple regression equation, it, too, resulted in a significant correlation ($p > .01$) with Quantitative Ability with an F-value of 6.92. The entrance of a second variable, Random Polygons, was not significant. The entrance of Checkerboard Patterns added significantly ($p > .05$) to the prediction of Quantitative Ability.

In summary, when Random Polygons was entered as the initial variable, it was not significantly related to the criterion variable. The addition of each of the other two variables resulted in a significant increase in the multiple correlation with Quantitative Ability. When Checkerboard Patterns was entered into the multiple regression equation first, it was significantly correlated with Quantitative Ability. The entrance of Simple-Complex Designs accounted for a significant increase in the prediction of Quantitative Ability. When Simple-Complex Designs was entered initially, it was a significant predictor of Quantitative Ability. The addition of Checkerboard Patterns resulted in a significant increase in the multiple correlation.

General Cognitive Ability

Table X shows that the three stimulus complexity measures had a multiple correlation of .36405 ($p > .01$) with General Cognitive Ability.

When Random Polygons was the first variable entered into the equation, the obtained F-value of 5.55 was significant at the .05 level of probability. The addition of a second variable, Checkerboard Patterns, and a third variable, Simple-Complex Designs, each significantly increased ($p > .05$) the multiple correlation with resulting F-values of 4.31 and 3.87, respectively.

When entered as a first-step in the multiple regression equation, Checkerboard Patterns alone was significant ($p > .01$) in predicting General Cognitive Ability with an obtained F-value of 8.21. Although the entrance of Random Polygons was not significant, the addition of Simple-Complex Designs resulted in a significant increase ($p > .05$) in the overall F-value.

Simple-Complex Designs, when entered as the initial variable, was significantly correlated with General Cognitive Ability at the .05 level of probability with an obtained F-value of 4.29. Once again, the addition of the Random Polygons variable did not contribute significantly to the multiple correlation. When the Checkerboard Patterns measure was added, however, the prediction to General Cognitive Ability was significantly increased ($p > .05$).

Memory Ability

Table XI presents the results of the multiple regression analysis for stimulus complexity measures and Memory Ability. The multiple correlation of stimulus complexity variables with memory skills was .35748 ($p > .01$). When the Random Polygons variable was entered as the first-step in the equation, it was not significantly correlated with Memory Ability. However, the addition of Checkerboard Patterns resulted in a significant variable at the .01 level of probability with an obtained F-value of 10.7. The addition of the Random Polygons variable was not significant; however, the inclusion of the third variable, Simple-Complex Designs, accounted for a significant increase ($p > .05$) in the multiple correlation.

When the Simple-Complex Designs variable was entered as the first step in the multiple regression equation, it was not found to be significantly correlated with Memory Ability. The entrance of a second variable, Random Polygons, did not result in a significant increase in the prediction of the criterion measure. The entrance of the third stimulus complexity measure, Checkerboard Patterns, resulted in a significant increase in the multiple correlation with Memory Ability.

Motor Ability

Table XII presents the results of the multiple regression analysis for stimulus complexity variables and Motor Ability. The correlation of the three stimulus complexity variables alone or in combination were not significantly related to Motor Ability when entered into the multiple regression equation.

Multiple Regression Summary

Summarizing the multiple regression analysis collectively, significant multiple correlations for stimulus complexity preference and four cognitive abilities were found, suggesting that, for all subjects, the combined stimulus complexity measures offered more effective predictions to Perceptual-Performance, Quantitative, General Cognitive, and Memory Ability than the scores from any single stimulus complexity measure.

In reference to the null hypothesis, the failure to find any significant differences between pairs of stimulus complexity-cognitive ability correlation coefficients utilizing Hotelling's t formula fails to reject the null hypothesis for all subjects and for the female subgroup. The two significant differences found for males rejects the null hypothesis for this subgroup. Two significant differences were found when correlation coefficients for stimulus complexity and cognitive ability variables for independent male and female subpopulations were compared by means of differences obtained from Fisher's z transformation. For all subjects, the significant multiple correlations found for the stimulus complexity variables and Perceptual-Performance, Quantitative, General Cognitive, and Memory Ability rejects the hypothetical assumption that combinations of two or three stimulus complexity variables are no different from a single stimulus complexity variable in predicting these specific cognitive abilities. The multiple correlations for stimulus complexity variables with Verbal and Motor Ability were not significant; therefore, the null hypothesis is not rejected for these relationships.

Null Hypothesis Three

There are no differences between male and female complexity preferences.

To evaluate this hypothesis, the t-test for uncorrelated means was employed to determine differences in mean scores of male and female complexity preferences on each of the three complexity measures. The results of the t-tests are summarized in Table XIII. The obtained t values indicate that there was no difference in male and female complexity preferences on the Random Polygons or the Checkerboard Patterns

TABLE XIII

DESCRIPTIVE STATISTICS (MEANS AND STANDARD DEVIATIONS) AND T-TESTS OF STIMULUS COMPLEXITY VARIABLES FOR MALE AND FEMALE SUBPOPULATIONS

	Males (n=40)		Females (n=40)			
	$\overline{X}$	SD	$\overline{X}$	SD	t	F
Random Polygons	109.95	14.52	108.48	14.06	.462	.213
Checkerboard Patterns	106.4	13.42	101.8	15.53	1.42	2.01
Simple-Complex Designs	11.63	3.99	13.7	4.75	2.12*	4.49*

*p > .05

measure. However, differences with regard to sex were found for the Simple-Complex Designs complexity measure ($t = 2.2$; $F = 4.49$) with females preferring a significantly greater number ($p > .05$) of complex designs than males.

The null hypothesis, therefore, fails to be rejected for the Random Polygons and Checkerboard Patterns measures, but is rejected for the Simple-Complex Designs measure.

Null Hypothesis Four

> There is no relationship among individual responses indicating preference for visual complexity on the three independent measures of complexity.

In order to test this hypothesis, Pearson product-moment correlation coefficients were calculated to examine intercorrelations among responses to the three complexity measures. Correlation coefficients and levels of probability are presented in a correlation matrix for all subjects in Table XIV. The same information for male and female subjects is summarized in Table XV.

For all subjects, each of the intercorrelations between the three stimulus complexity variables was significant at or beyond the .01 level of probability. Correlation coefficients indicate a relatively moderate positive relationship between preference for complex polygons and preference for complex checkerboard patterns. There were relatively low positive relationships between expressed preference for complex polygons and preference for complex designs (Simple-Complex Designs measure) and between preference judgements for complex checkerboard patterns and complex designs (Simple-Complex Designs measure).

TABLE XIV

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS AND LEVELS OF PROBABILITY FOR INTERCORRELATIONS AMONG STIMULUS COMPLEXITY VARIABLES FOR ALL SUBJECTS
(n=80)

	Checkerboard Patterns	Simple-Complex Designs
Random Polygons	r = .41	r = .25
	p = .001	p = .013
Checkerboard Patterns	***	r = .27
		p = .007

TABLE XV

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS AND LEVELS OF PROBABILITY FOR INTERCORRELATIONS AMONG STIMULUS COMPLEXITY VARIABLES FOR MALE AND FEMALE SUBPOPULATIONS
(n=40)

	Checkerboard Patterns		Simple-Complex Designs	
	Males	Females	Males	Females
Random Polygons	r = .47	r = .35	r = .31	r = .23
	p = .001	p = .013	p = .024	p = .075
Checkerboard Patterns	***	***	r = .08	r = .49
			p = .314	p = .001

When subjects were subdivided by sex, four of the six intercorrelations between complexity variables were significant of beyond the .05 level of probability. The most marked numerical difference in intercorrelations for male and female complexity preferences was indicated in the relationship between the Checkerboard Patterns and the Simple-Complex Designs complexity measures. For males, there was a very low positive correlation between preference for complex checkerboard patterns and preference for complex designs in the simple-complex pairings. For females, however, there was moderate positive correlation between preferred complexity in checkerboard patterns and simple-complex pairings.

The numerous significant intercorrelations between the stimulus complexity variables for all subjects and for male and female subpopulations leads to the rejection of the assumption stated by the fourth null hypothesis.

Null Hypothesis Five

> There is no relationship between chronological age and preference for visual complexity assessed by the three independent measures of complexity.

To test this hypothesis, Pearson product-moment correlation coefficients and levels of probability were calculated to determine the relationship between chronological age (converted to months) and the three stimulus complexity variables. The results for all subjects and for male and female subpopulations are presented in Table XVI.

Inspection of the results reveals that all correlations are positive and indicates a direct relationship between chronological age and

TABLE XVI

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS AND LEVELS OF PROBABILITY FOR CHRONOLOGICAL AGE AND STIMULUS COMPLEXITY VARIABLES FOR ALL SUBJECTS AND FOR MALE AND FEMALE SUBPOPULATIONS

	Chronological Age		
	All Subjects (n=80)	Males (n=40)	Females (n=40)
Random Polygons	$r = .35$	$r = .39$	$r = .31$
	$p = .001$	$p = .006$	$p = .025$
Checkerboard Patterns	$r = .18$	$r = .23$	$r = .15$
	$p = .051$	$p = .078$	$p = .17$
Simple-Complex Designs	$r = .19$	$r = .04$	$r = .34$
	$p = .046$	$p = .402$	$p = .017$

preference for visual stimulus complexity for six of the nine calculated correlations when the .05 level of probability for all subjects and for males, chronological age was most highly numerically correlated with scores on the Random Polygons complexity measure. For females, chronological age was most highly numerically correlated with scores on the Simple-Complex Designs complexity measure.

The t-test for uncorrelated means was also conducted to determine differences in mean complexity preference scores for five- and six-year-old subjects on each of the three complexity measures. The results of the t-tests are summarized in Table XVII. The obtained t-values indicate that there were significant differences between five- and six-year-old complexity preference on both the Random Polygons ($t = 2.46$; $F = 6.04$; $p > .05$) and the Simple-Complex Designs ($t = 2.53$; $F = 6.54$; $p > .01$) complexity measures with six year olds preferring more complex designs on both measures. No significant differences in complexity preferences for five and six year olds were found for the Checkerboard Patterns complexity variable.

The numerous significant correlations which were found for chronological age and stimulus complexity variables and the significant differences in complexity preferences for five and six year olds on two of the three stimulus complexity measures leads to the rejection of the assumption stated by the fifth null hypothesis.

Summary

This chapter has presented the results of the statistical analyses utilized to evaluate the five null hypotheses initially stated in the preceding chapter. To reiterate the important findings, each of the

TABLE XVII

DESCRIPTIVE STATISTICS (MEANS AND STANDARD DEVIATIONS) AND T-TESTS OF STIMULUS COMPLEXITY VARIABLES FOR 5- AND 6-YEAR-OLD SUBPOPULATIONS

	5 yr. olds (n=40)		6 yr. olds (n=40)			
	$\overline{X}$	SD	$\overline{X}$	SD	t	F
Random Polygons	105.43	13.08	113.0	14.46	2.46*	6.04*
Checkerboard Patterns	102.03	13.86	106.18	15.2	1.28	1.63
Simple-Complex Designs	11.43	4.08	13.9	4.56	2.53**	6.54**

*p > .05

**p > .01

three visual stimulus complexity variables was found to be positively and significantly correlated with some specific cognitive abilities assessed by the McCarthy Scales of Children's Abilities, when correlation coefficients for all subjects and male and female subjects were inspected. Two significant differences between pairs of stimulus complexity-cognitive ability correlation coefficients were found for males, but none were identified for all subjects or for females. Two significant differences were found when comparing corresponding stimulus complexity-cognitive ability correlation coefficients for independent male and female subpopulations. The combined stimulus complexity variables resulted in a significant multiple correlation for four of the six cognitive ability variables. When sex differences in complexity preferences were examined, females were found to prefer significantly more complex designs on the Simple-Complex Designs measure than males. No significant differences between sex preferences were found for the other two measures. Numerous significant intercorrelations between stimulus complexity preferences were found for all subjects and for male and female subgroups. Significant differences between complexity preferences of five- and six-year-old judgements were found for two of the three complexity measures.

Summarily, each of the five null hypotheses formulated for the study is either partially or completely rejected.

CHAPTER V

SUMMARY AND CONCLUSIONS

Introduction

The purpose of this chapter is to present a general review of the study and an interpretive analysis of the significant findings. General conclusions based upon the results of the research are discussed. Recommendations for future research endeavors in related areas are stated. The chapter concludes with remarks which attempt to provide an appropriate perspective for the comprehensive research effort.

Overview of the Study

This study represented an attempt to explore the potential practical utility of the concept of visual stimulus complexity preference, which had originated under the auspices of experimental and developmental psychology, in an educational environment. In a broader context, the study exemplified a transitory bridge between experimental research implications and practical educational application.

The general research problem addressed by the study was the investigation of the relationship between preference for varying amounts of visual stimulus complexity and specific aspects of cognitive development in young children. Visual stimulus complexity was defined parsimoniously as "the amount of perceived visual stimuli which is preferred in one's immediate environment." The concept was related to selected theoretical positions which imply that every organism has adapted to an arbitrary level of environmental stimulation, that slight deviations from this adaptation level are optimally motivating to the organism, and that perceived environmental stimulation is an interactive function of the external environment and internal psychophysiological processes.

Research findings pertinent to the proposed relationship between stimulus complexity preference and development of cognitive abilities were reviewed. Previous research suggested that preference for complex visual stimulation increases with age and is related to the amount of previous environmental stimulation encountered by the organism and the responsiveness of the organism to such stimulation. Specific problems related to the measurement of preference for visual stimulus complexity were cited. Preference judgements had been expressed both verbally and non-verbally in response to a variety of measurement devices in past research studies. The diversity of methodology made previous findings extremely difficult to interpret and compare. In many research studies, the notion of stimulus complexity had been confounded with a related concept--environmental novelty. Previous research findings of sex differences with regard to preference for complexity were also inconclusive.

Three measures of visual stimulus complexity were designed for the study and represented modifications of measures which were predominant in the existing literature. These measures were designated Random Polygons, Checkerboard Patterns, and Simple-Complex Designs. Each measure consisted of thirty paired designs which represented varying degrees of visual stimulus complexity or specifically defined dimensions of the concept. Subjects responded verbally to indicate their preference for each pair of designs presented.

Cognitive ability was evaluated with the McCarthy Scales of Children's Abilities (MSCA). The MSCA is an individually administered instrument appropriate for the assessment of cognitive development in young children. The six scales which comprise the test provide information regarding the development of verbal, perceptual-performance, quantitative, general cognitive, memory, and motor abilities.

Eighty subjects, forty males and forty females, participated in the study. All participants were between the chronological ages of 5 years 0 months and 6 years 11 months and attended elementary schools in the Broken Arrow, Oklahoma, public school system. The McCarthy Scales and the three stimulus complexity preference measures were administered to each subject.

The study was essentially a correlational study designed to determine the relationship between responses to the three stimulus complexity measures and scores on the six MSCA scales. The statistical techniques employed to analyze the data included the computation of Pearson product-moment correlation coefficients and the utilization of the t-test for uncorrelated means, Hotellings t-test, Fisher's z transformation, and multiple regression analysis.

The five research questions which encompassed the research problem and which generated the null hypotheses stated in the study are listed subsequently:

1. What is the relationship between verbally expressed preference for visual stimulus complexity and various aspects of cognitive ability as measured by the McCarthy Scales of Children's Abilities?

2. Which of the measures, or combination of measures, of stimulus complexity, correlate most highly with various aspects of cognitive ability as measured by the McCarthy Scales of Children's Abilities?
3. What are the differences in males' and females' preferences for visual stimulus complexity?
4. What is the relationship among individual preference-for-complexity responses on the three measures of visual complexity?
5. What is the relationship between chronological age of subjects and complexity preferences?

Interpretation of Findings

With reference to the research questions and the statistical techniques employed to test the related null hypotheses, the following conclusions can be drawn:

Question One

When data for all subjects was considered, there was a numerically positive and, in many cases, a significant relationship between scores on the three stimulus complexity measures and each of the cognitive ability measures. Subjects who indicated a preference for more complex polygons, checkerboard patterns, and/or miscellaneous complex designs also exhibited significantly more advanced verbal, perceptual-performance, quantitative, general cognitive, and/or memory development. No significant relationship was found for any of the three stimulus complexity preference measures and motor development. These findings were generally support ive of results obtained by Arkes and Garske (1971) and Turner and Arkes (1975) who identified a global relationship between preference for visual complexity and cognitive development. However, the results of this research delineate the relationships between specific measures of stimulus complexity preference and aspects of cognitive development much more vividly.

In a further analysis of the significant correlations, all three complexity measures were significantly correlated with Perceptual-Performance, Quantitative, and General Cognitive Ability. One of the complexity measures (Checkerboard Patterns) was significantly correlated with Verbal and Memory Ability.

It is surmised that significant relationships for all stimulus complexity measures with Perceptual-Performance, Quantitative, and General Cognitive Ability were obtained because the determination of preference for complexity in visually presented designs and the various activities which comprise the perceptual-performance, quantitative, and general cognitive subscales of the MSCA shared more fundamental common elements. The processes involved in the comparisons of the other relationships (i.e., stimulus complexity preference and Motor Ability) were less similar.

The perceptual-performance and quantitative tasks which contribute to the respective subscales all involved some form of auditory or visual perception, the restructuring of auditory and visual stimuli, and the ability to accomodate abstractions. These processes were also charateristic of those involved in the selection of preferred designs. For example, the MSCA subtests which form the perceptual-performance scale included Right-Left Orientation, which requires visual and auditory perception, understanding of the concept of directionality, and possible restructuring of the stimuli for identification; Conceptual Grouping, which involves visual and auditory perception, relative understanding of the abstract concepts of size, shape, and color, and restructuring of stimuli in order to identify relationships; and Draw-A-Design, which relies upon primarily visual perception and accurate reproduction of abstract figures. The quantitative scale includes activities which assess the understanding of one-to-one correspondence in counting, the conceptual understanding of "more than," "less than," and "equal to," and the ability to apply abstract numerical concepts and operations to simple hypothetical situations. The general cognitive scale, which is an aggregate of the verbal, perceptual-performance, and quantitative scales is naturally reflective of the processes pertinent to the items on the inclusive perceptual-performance and quantitative scales which have already been exemplified.

Both Verbal and Memory Ability were significantly related to Checkerboard Patterns preference judgements for all subjects. However, a significant relationship was not identified for the other two complexity measures and these areas of cognitive development. The reconstructive memory ability of some children may have been an integral factor in the Checkerboard Patterns-Memory Ability and the Checkerboard Patterns-Verbal Ability relationships. The researcher observed that children who were able to "label" the checkerboard designs and consistently recognized and identified them by this label each time they were presented in the design series subjectively appeared to have more highly developed auditory and visual memory ability. (This tendency to label and classify stimulus designs was not so overtly apparent in responses to the

Random Polygons and the Simple-Complex Designs preference measures.)

Both the MSCA memory and verbal scales contain subtests which assess the proficiency of short-term rote memory. The Pictorial Memory, Verbal Memory I, and Verbal Memory II subtests are components of both the verbal and memory scales. Additionally, the memory scale includes assessment of memory for digits in reverse order which is dependent upon auditory perception and internal restructuring of stimuli, processes which have already been identified as associated with the determination of complexity preference. The verbal scale also includes activities such as defining vocabulary words and expressing verbal fluency which are related to classification or the identification of descriptive properties. The labeling of the checkerboard designs could seemingly be interpreted as a method of classifying the designs on the basis of salient visual properties and, thus, proficiency in classifying stimuli could provide an additional common link between preference for Checkerboard Patterns and Verbal Ability.

In the author's judgement, no relationship was found between stimulus complexity preference judgements and motor development for all subjects because the processes involved in responding to the items which comprise these measures are largely unrelated. The motor tasks generally involved imitative actions and proficiency demonstrations of gross motor movements. These skills were primarily extraneous to the determination of preference for stimulus complexity.

The differences in significant correlation coefficients for males and females suggests that these relationships are partially determined by sex-specific characteristics and past environmental experiences. (These differential perspectives for males and females are subsequently alluded to in greater detail in the discussion of other findings.) For example, when one examines the significant correlation between Checkerboard Patterns and cognitive ability for males and females, one notes that the relationship is significant for Checkerboard Patterns-Perceptual-Performance Ability and for Checkerboard Patterns-Motor Ability for males but not for females. The relationship between Checkerboard Patterns-Verbal Ability is significant for females but not for males. These differences suggest that males and females internally structured the checkerboard designs on the basis of differential salient properties. Boys seemingly tended to structure the Checkerboard Patterns on the basis of spatial proximity. Understanding of spatial relationships would also be an apparent factor in perceptual-performance and motor activities. Girls apparently structured the Checkerboard Patterns designs differently, possibly by attempting to categorize or label the designs verbally. Categorization or labeling of designs would likely be more closely associated with verbal proficiency.

In the interpretations of the correlations between stimulus complexity preference and cognitive ability, one should be aware of the overlap in subtest content of the various MSCA subscales. The composition of the general cognitive scale has already been discussed. With regard to the memory scale, all of the subtests which comprise this measure are also included on the verbal, perceptual-performance, or quantitative scales. Thus, the memory scale is not an independent subscale, but a conglomerate of subtests which are also integrated into three other scales. This makes the interpretation of the stimulus complexity preference-memory correlations more difficult because there is some degree of confounding of the shared variance from the verbal, perceptual-performance, and quantitative scales.

The researcher also found it interesting to note that the subtests from the motor scales are not included in the evaluation of general cognitive ability. The subtests from the four other specific MSCA scales, all of which were significantly correlated with at least one measure of stimulus complexity preference for all subjects, contribute either directly or indirectly to the General Cognitive Index. Thus, in the construction of the McCarthy, the motor subtests have been purposely separated and excluded from contribution to the indicator of general intellectual development. It may be inferred that stimulus complexity preference judgements are more likely to be significantly related to more direct contributors to overall cognitive development rather than to areas of development which are not as relevant to the components of intellectual functioning.

The Checkerboard Patterns complexity preferences were the most highly correlated with overall cognitive development for all subjects. The Checkerboard Patterns variable represents perhaps the most relevant measure in terms of the cognitively-related experiences of young children. In addition to lending themselves to structuring and labeling, the checkerboard designs may be reminders of shape discrimination, block-building, and pattern reproduction activities which are incorporated into pre-school, kindergarten, and early elementary curriculums. Because young children likely have had varying amounts of expe-rience with such related activities, the Checkerboard Patterns measure may have provided for the finest discrimination in preference judgements. The randomly constructed polygons were highly abstract and unfamiliar to the children and many appeared to have difficulty structuring them effectively. The Simple-Complex Designs were so diverse that it was difficult to pinpoint a single central dimension which may have influenced preference judgements in most subjects.

Question Two

Although there was considerable variation in the magnitudes of correlation coefficients obtained for stimulus complexity and cognitive ability variables, none of the three stimlus complexity measures was found to be a significantly better predictor of a specific cognitive ability for all subjects and for females. For males, however, scores from both the Random Polygons and Checkerboard Patterns measures were significantly more effective in predicting Perceptual-Performance Ability than were scores from the Simple-Complex Designs measure. If one interprets this finding within the context of past environmental experiences and their importance in determining present levels of preferred stimulation, it seems plausible that the differential, experiential backgrounds of male and female children, as well as the recognized superiority of males in dealing with abstract, spatial relationships, could partially account for this difference.

During the early formative years of infancy and childhood, children receive both subtle and obvious forms of social approval for engaging in play activities which are associated with and acceptable for their given gender. Boys are likely to be encouraged to partake of activities which are more spatially and abstractly oriented while girls are channeled toward activities which are more related to other areas of development. This social encouragement afforded to males in the development of spatially-related abilites coupled with an apparent neurological propensity toward accelerated development of such abilities may be fundamental in the significant difference between the Random Polygons and Checkerboard Patterns correlations with Perceptual-Performance Ability and the correlation between Simple-Complex Designs - Perceptual-Performance Ability. Both the assessment of perceptual-performance development and the determination of preference for complex, abstract geometric forms, such as polygons and checkerboard designs, seem to be related to an understanding of spatial relationships. The Simple-Complex Designs measure on the other hand, contains many concrete designs portraying familiar objects and it is seemingly not as spatially and abstractly oriented. Since young boys seem to have more extensive environmental experiences with spatially-related activities and exhibit a general tendency toward more accelerated development of spatially-related abilities, it is possible that their collective complexity preferences are significantly more precise and consistent than those for girls, and, thus, they effect a significantly greater correlation with Perceptual-Performance Ability. Fewer environmental experiences plus generally less adeptness with spatially oriented tasks may result in more random, unsystematic complexity preference judgements of polygons and checkerboard designs in females and may yield significantly lower correlations for the Random Polygons - Perceptual-Performance Ability and the Checkerboard Patterns - Perceptual-Performance Ability variables for this subgroup.

When comparing the correlations between stimulus complexity and cognitive ability variables for males and females, Random Polygons and Checkerboard Patterns were found to be significantly more effective in predicting Motor Ability for males than for females. Again, previous environmental experiences and differential aptitudes of males and females may provide the rationale for this finding. Boys seemingly have more opportunities and encouragement to engage in play activities which are more directly related to both spatial orientation and gross motor development and, therefore, may be more consistent and precise in their preference judgements and in their demonstration of motor proficiency than girls. Girls, who have likely not been encouraged to participate in spatially-related or gross motor activities to the extent that boys have, may lack the experiential background to make consistent complexity preference judgements of abstract polygons and checkerboard designs. Their preference judgements, as well as their performance of motor activities, may tend to be more sporadic and may lower the correlation between preference-for-complexity and motor development.

A further possible explanation for the more precise discrimination of male preference judgements on the Random Polygons and the Checkerboard Patterns measures, but not on the Simple-Complex Designs measure may be related not only to past environmental experiences and differential aptitudes, but also to the difference in the construction of the three complexity measures. The more exposure to certain related activities that a group of children experience, the more differentiated their collective range of proficiency with those activities becomes. If males have had more extensive experiences relative to the development of spatial ability than their female counterparts, one would expect them to demonstrate a greater range of proficiency with spatially related activities. These various levels of spatial ability may be reflected more precisely in the quantified gradation of complexity in the polygon and checkerboard series, with six levels of complexity represented in each measure, by allowing for more precise determination of preferred levels of complexity. In the Simple-Complex Designs measure, designs were designated only as "simple" or "complex" with no attempt to rate the relative amount of simplicity or complexity, thereby indicating more general preferences for simple or complex visual stimuli.

For all subjects, the combined scores from the three stimulus complexity measures were significantly related to selected specific cognitive abilities. Students who obtained higher total scores on the complexity measures also exhibited more advanced levels of perceptual-performance, quantitative, general cognitive, and memory development. The conjecture regarding the rationale for these relationships has been elaborated upon in response to the first question where simple correlations between stimulus complexity preference and cognitive abilities were discussed. To review these suppositions briefly, the determination of complexity preferences and the measurement of perceptual-performance, quantitative, general cognitive, and memory abilities seemingly involve many common mental processes. These common processes would logically be contributing factors to the multiple correlations as well as to the simple correlations.

Question Three

Females preferred significantly more visual complexity on the Simple-Complex Designs measure than males. No differences in sex preferences were found for the other two stimulus complexity measures. Differences in sex preferences for complexity appear to be related to the type of visual stimuli encompassed by each measuring instrument which elicited differential responses on the basis of past experiences. It is likely that females have more extensive environmental experiences which are more directly related to the complexity dimensions incorporated into the Simple-Complex Designs measure and, thus, they prefer a greater number of complex, as opposed to simple, miscellaneous designs. It has already been pointed out that the Simple-Complex Designs measure seems to contain fewer abstract geometric designs than the other two measures. However, the diversity of designs included in the measure makes it difficult to pinpoint a specific dimension which may have contributed considerably to the differences in sex preferences. The female preference for more complex designs on the Simple-Complex Designs measure may be reflective of a general tendency for girls to be exposed more extensively to various forms of printed visual stimuli. Girls are encouraged to engage in sedate, feminine activities related to the perception of designs, such as drawing, tracing, coloring, and looking at books. More frequent participation in activities of this nature may conceivably account for girls' preference for significantly more complex designs representative of several dimensions of complexity.

The interpretation that sex differences in preference for stimulus complexity are specific to the type of visual stimuli utilized to assess preference for complexity provides an explanation for the conflicting findings regarding sex differences cited in past research studies (Bartol and Pielstock, 1972; Caron and Caron, 1969; Coopersmith, 1976; DeCato, 1971; Eisenman, 1967a, 1967b; Hoats et al., 1963; Kagan and Lewis, 1975; Mendel, 1965; Smock and Holt, 1962).

Question Four

There was a significant relationship among preference responses to the three stimulus complexity measures for all subjects. Subjects who tended to prefer more complex polygons also preferred more complex checkerboard patterns and a greater number of complex miscellaneous designs. When subjects were subdivided by sex, this tendency was found for some, but not all, comparisons of responses.

The highest numerical intercorrelation found for males was for the Random Polygons and Checkerboard Patterns measures. As cited earlier in this chapter, it subjectively appears that these two measures are both composed of designs which are abstract, geometric, and contain varying amounts of material. The superior spatial orientation of males, in comparison to females, and the suspected diversity of environmental experiences might be contributing factors which make it possible for males to more easily identify these similar salient features and respond more consistently to them.

The highest numerical intercorrelation found for females was for the Checkerboard Patterns and Simple-Complex Designs measures. Perhaps the common element which females extracted from these two measures was the labeling of designs. As mentioned previously, the checkerboard designs were frequently identified with verbal labels during the presentation of the design series. Many of the figures in the Simple-Complex Designs measures are concrete objects, which could also be easily identified or classified verbally, rather than highly abstract designs. While males may have been able to tolerate the abstract nature of many of the designs, girls, because of their uniquely feminine frame of reference, may have needed to structure the designs from these two measures in a more tangible, concrete way. Additionally, because five- and six-year-old females generally exhibit more fluent verbal expression than males of corresponding chronological age, they may have tended to provide verbal labels for the abstract designs more frequently.

The findings regarding the intercorrelations of the three complexity measures suggest that each measure was tapping a significant degree of a common general determinant of preferred levels of visual stimulus complexity.

Question Five

When all subjects were considered, older children indicated a preference for significantly more complex polygons and checkerboard patterns and a greater number of complex miscellaneous designs. These findings are generally supportive of research conducted by Karmel (1969), Fantz et al. (1962), Brennan et al. (1966), Thomas (1965, 1966), Block (1971), Chipman and Mendelson (1975), and Forsman (1967) which found that, as intensity and variety of environmental experiences increases with age, so, too, does preference for amounts of visual stimulus complexity which are optimally preferred in one's immediate environment.

When subjects were arbitrarily divided by age into five- and six-year-old age groups, six year olds were found to prefer significantly more complex designs in the Random Polygons and Simple-Complex Designs measures. These findings may be explained by the supposition that older children have had more depth and diversity of environmental experiences which are relevant to the visual stimuli contained in the Random Polygons and Simple-Complex Designs measures and subsequently prefer significantly more complexity in these measures.

General Conclusions

Within the context of this study, the following general conclusions can be drawn:

1. Complexity preference judgements are related to performance levels of cognitive abilities. Specifically, the relationship exists between those cognitive abilities which directly contribute to overall cognitive ability as defined by the McCarthy Scales of Children's Abilities, such as verbal, perceptual-performance, quantitative, and memory ability. When all subjects are considered, complexity preference judgements are not indicative of performance in areas such as motor development which are less directly related to general cognitive development.
2. While the relationship between certain visual stimulus complexity measures and some specific cognitive abilities was found to be statistically significant, the practical significance of the relationships is uncertain. No simple or multiple correlations between stimulus complexity and cognitive ability measures utilized in this study were of sufficient magnitude to suggest that the evaluation of preference for visual stimulus complexity alone may be a reliable substitute for more direct assessment of specific cognitive abilities.
3. No measure of stimulus complexity preference was found to be universally best for predicting levels of cognitive development in young children; however, the combined scores from the three measures resulted in significant multiple correlations for four of the six cognitive abilities which were assessed. This

suggests that perhaps items from all three measures could be integrated into one instrument to achieve optimal correlations with many measurable cognitive abilities.

4. Differences in complexity preferences for the five- and six-year-old age group did not appear to be based strictly on the dimension of complexity-simplicity. A subjective observation of the researcher was that some children were able to systematically structure the designs in some meaningful fashion and could therefore respond with more consistent preference judgements. Other children seemed unable to structure, or label, the designs and their responses were random and unsystematic. Furthermore, for those children who appeared to structure the designs, it is suspected that the process of internal structuring was different for male and female subjects and that these differences were a function of past sex-related environmental experiences and differential aptitudes. Although the standardized directions given to each child prior to the administration of the complexity measures explicitly stated that the child did not have to figure out what the designs looked like, the majority of the children manifested an obvious desire to construe the designs in some meaningful way. Once these children were able to categorize the designs according to their own personal schemes, they appeared to be exceedingly more comfortable with the activity.

The children who seemed unable to structure the visual stimuli systematically and meaningfully were primarily the younger subjects. The inclusion of five-year-old children in the study, some of whom responded with obviously random judgements, may have spuriously lowered the obtained stimulus complexity-cognitive ability correlations. The correlations for the variables of interest in this study could have conceivably been higher if older children had been included in the sample group and the five year olds had been omitted.

5. Chronological age, specific sex-related environmental experiences, and differential aptitudes of males and females are important determinants in preference for complexity of visual stimuli contained in the three visual stimulus complexity preference measures utilized in this study and their relation to cognitive development.

Recommendations

Based upon the completion of this study, the following recommendations are proposed. These recommendations could conceiveably by paraphrased to generate research questions for future research endeavors:

1. The study should be replicated in order to cross-validate the initial findings.
2. The age range of subjects should be expanded upward to determine the relationship between stimulus complexity and cognitive ability in older subjects.
3. The short-term stability of complexity preference judgements should be ascertained by means of a test-retest procedure. Based upon the findings of this research and other previously conducted studies, one would expect a young child's preference for environmental complexity to increase automatically over an

extended length of time as a developmental function of age. In evaluating test-retest reliability, some adjustment may have to be made for the shift in complexity preferences as a result of increased exposure to the designs. When children become routinely familiar with a given level or form of visual stimulus complexity, they begin to seek out, attend to, and express a preference for stimuli which are novel and unfamiliar to them.

4. The complexity "ceilings" for both the Random Polygons and the Checkerboard Patterns measures should be raised to include more complex designs. The correlations obtained for these measures may be spuriously low as a result of the restricted range of the stimulus complexity variables. Three subjects obtained maximum complexity scores of 140 on either the Random Polygons or the Checkerboard Patterns complexity measures. Five students obtained near-maximum complexity scores of 135 or higher on these measures. Expanding the upper limits of complexity would be especially important in the assessment of preferences in older children.
5. Future assessments of complexity preferences of young children under six years of age should utilize more concrete visual stimuli. This would hopefully minimize the random responses of young subjects which were the apparent result of an inability to structure more abstract stimuli. Hopefully, the suggested revisions would provide a more valid measure of the simplicity-complexity dimensions in young subjects.
6. For significant findings involving the Simple-Complex Designs

variable, responses to this variable might be further analyzed to determine which of the five represented complexity dimensions is accounting for or contributing heavily to the significance of the relationship.

7. Stimulus complexity preference scores might be correlated with individual subtest, rather than subscale, scores on the MSCA in order to determine if one or two specific subtests are accounting for a considerable proportion of the shared variance in the complexity preference-cognitive ability relationships. These correlations should be utilized for research purposes only as the MSCA manual cautions that generalized interpretation of a single subtest extracted from a subscale cluster is of questionable validity.

8. Confounding of complexity with novelty might be reduced on the Random Polygons and Checkerboard Patterns measures by including six different designs which contain the same number of angles or units instead of exposing the same six designs several times in one series. By doing this, thirty different designs, representing six levels of complexity, would be utilized and each design would be presented only once, thereby equalizing the effects of novelty-familiarity.

9. Subjects might be grouped according to whether or not they overtly structured (verbally labeled) their complexity preference responses. Correlations with cognitive abilities and differences in cognitive development might be determined.

10. Visual stimulus complexity measures might be paired with an instrument designed to assess preference for auditory

complexity and the multiple correlations of these measures with cognitive ability could be determined.

11. The sex differences regarding responses to the complexity measures should be investigated further with emphasis upon differential mental functioning of males and females. If a single instrument for the measurement of stimulus complexity preference was developed from the three measures utilized in this research, potential sex-biased response patterns should be considered.

12. Complexity preferences of exceptional young children (i.e., learning disabled youngsters) could be assessed and compared with those of normal children. Perhaps distinct response patterns might emerge for such special students which would make the assessment of stimulus complexity preference an advantageous tool in special education diagnosis and evaluation.

13. A longitudinal study of those unconventional students who make systematic, directional preference judgements of complexity items could be conducted to determine whether these students manifest similar educational strengths and weaknesses in the future.

Concluding Remarks

Several statistically significant findings were reported in this study and, in that respect, the study represented a fruitful endeavor. In the opinion of the author, the study also accomplished the broader purpose stated in the introductory chapter of spanning the distance between the entities of experimental and educational psychology through the meaningful adaptation of experimental research implications to the educational realm.

This study represents an <u>initial</u> attempt to utilize the measurement of the concept of visual stimulus complexity preference in an educationally relevant way. The completion of this research undertaking enables the researcher to speculate more realistically with regard to the proposed implications for future research which were postulated in Chapter I (p. 9-11). The findings from this study provide some essential information about the relationship between stimulus complexity preference and cognitive development. However, before the measurement of stimulus complexity preference can truly become an enlightening source of information in individual educational assessment, the measurement instruments must be revised, and these revisions must result in somewhat higher correlations with cognitive abilities. Perhaps these revisions might include selecting some stimuli from the three stimulus complexity preference measures integrated in this study and supplementing them with discriminating concrete designs or combining a refined visual measure with a complimentary device for evaluating auditory stimulus complexity preference. Additionally, the correlations between stimulus complexity preference and cognitive development must be of a sufficiently reliable magnitude for a broader age range of children. If the refinement of an instrument for assessing complexity preferences resulted in appreciably higher correlations between preference for complexity and specific cognitive abilities for an expanded age range, it could potentially be utilized as a screening device to provide initial information regarding abilities which are components of general cognitive development.

Students who obtained significantly low scores might be reliably referred for further testing. Such an instrument might also be employed to gain additional information about a child if the results from more traditional testing procedures were ambiguous or inconclusive.

Many of the suspected merits of the assessment of complexity preference were subjectively substantiated through the researcher's observations during the collection of data for this study. Assuming the availability of a more reliable instrument for determining preference judgements which could be administered and scores in essentially the same manner as the instruments employed in this research, indicative assessment of visual stimulus complexity preference could easily be accomplished through nonverbal response modes. For example, the child could simply point to the preferred stimuli. This alternative method of responding would be potentially advantageous in the determination of specific levels of cognitive functioning in children who are developmentally aphasic, speech impaired, extremely withdrawn, verbally impoverished, or not exceptionally fluent in English. The author's personal experience also suggested that the evaluation of preference for visual complexity is a nonthreatening method of individual assessment. It is easy and quick to administer and score the complexity measures used in this research and young children seem to enjoy the opportunity to scrutinize the items and select the more favored designs. Emphasizing the concept of "favorite" or "like best" in preference judgement activities also helps to promote a positive atmosphere for subsequent testing.

With the availability of a more reliable instrument for determining preferences, further investigation might be conducted to determine differences in academic achievement, learning styles, or personality factors between groups of students within a specified chronological age range who exhibit preference for exceedingly complex or noticeably simple visual stimuli. Finally, because a relationship between visual stimulus complexity and specific cognitive abilities has been identified in this study, it might be fruitful to develop some experimental activities designed to enhance preference for visual complexity through repeated exposure of progressively more complex visual stimuli and determine any identifiable effects upon changes in levels of cognitive functioning.

The suggestions presented in the preceding paragraphs are reflective of the speculative conjecture of the researcher. Future research studies directed toward the investigation of these suggestions must be undertaken to provide empirical evidence to support or refute these speculations.

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APPENDICES

APPENDIX A

DIRECTIONS FOR THE ADMINISTRATION OF THE

STIMULUS COMPLEXITY MEASURES

Before introducing the first set of complexity designs, the examiner says:

"I am going to show you some designs. I would like you to look at each card carefully and tell me which design you like best. Do not try to figure out what the designs look like. Just tell me which one you like best."

(Examiner presents the first sample card.) After a short pause, the examiner asks:

"Which design do you like best?"

There is no time limit for subject responses. The child may indicate his preference by either pointing or by stating his choice verbally.

The procedure for the first sample card is repeated for the remaining two examples. (Sample designs can be found in Appendix B.) If the subject appears to understand the testing procedure after the sample presentations, the examiner says:

"That's the idea. Now let's look at these designs."

(Examiner proceeds to administer the first measure of complexity preference.) It is not necessary to ask 'which (one) do you like best?' for each card presented if the child understands the directions. This question might be interjected periodically or stated as a reminder if the child becomes distracted.

If the child does not seem to comprehend the nature of this activity after the presentation of the three sample cards, the samples may be presented <u>again</u> with appropriate assistance from the examiner to facilitate understanding. If the child still does not appear to understand what he is to do after the second presentation of sample stimuli, testing should be discontinued at this point.

The presentation of the remaining two complexity measures should be prefaced by the following directions: "Here are some more designs that I want you to look at carefully. Again, I want you to tell me which design you like best on each card. Here's the first one."

Questions or reminders should be used when deemed necessary by the examiner.

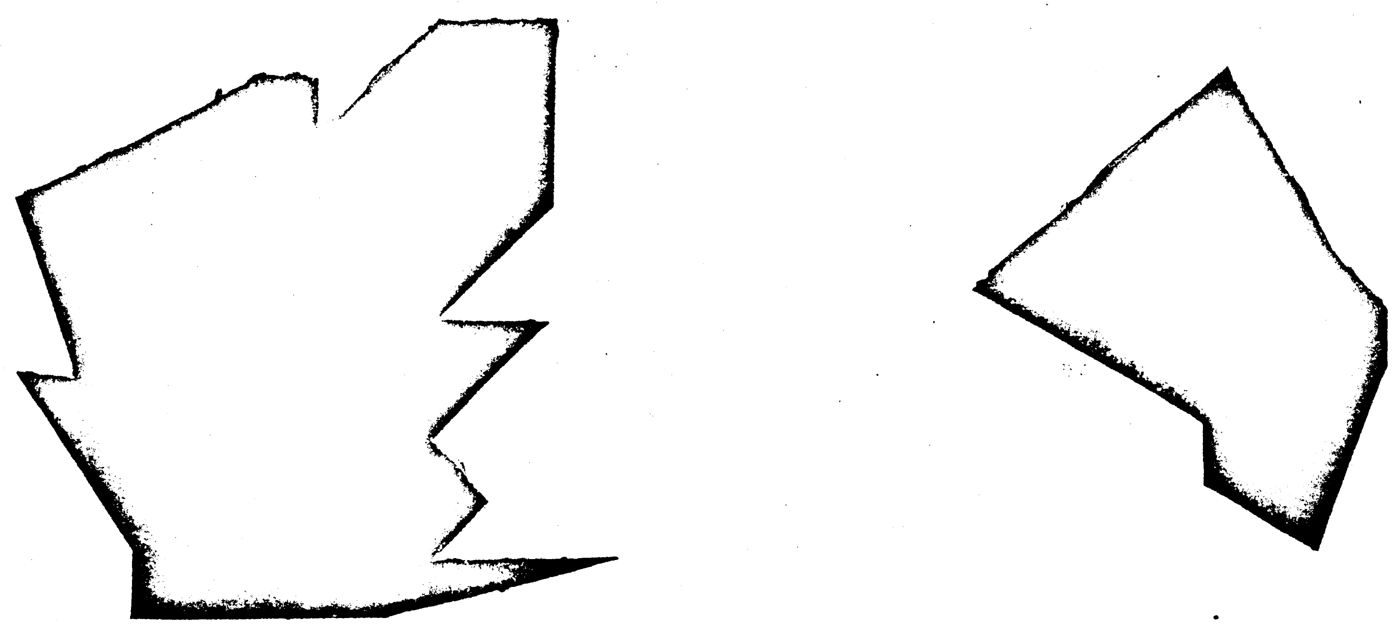
Subject responses to each item should be immediately recorded on the appropriate response form.

Note: In this study, no attempt to differentiate between the dimensions of "interestingness" and "pleasingness" in the determination of individual preference for stimulus complexity was made. This position was based upon the assumption by Hutt and McGrew (1969) which was cited in Chapter II and implied that young children may have difficulty distinguishing between the concepts of interesting and pleasing. The phrase "like best" was incorporated into the directions because it denoted a request for preference in language which was seemingly commensurate with the young child's present level of understanding.

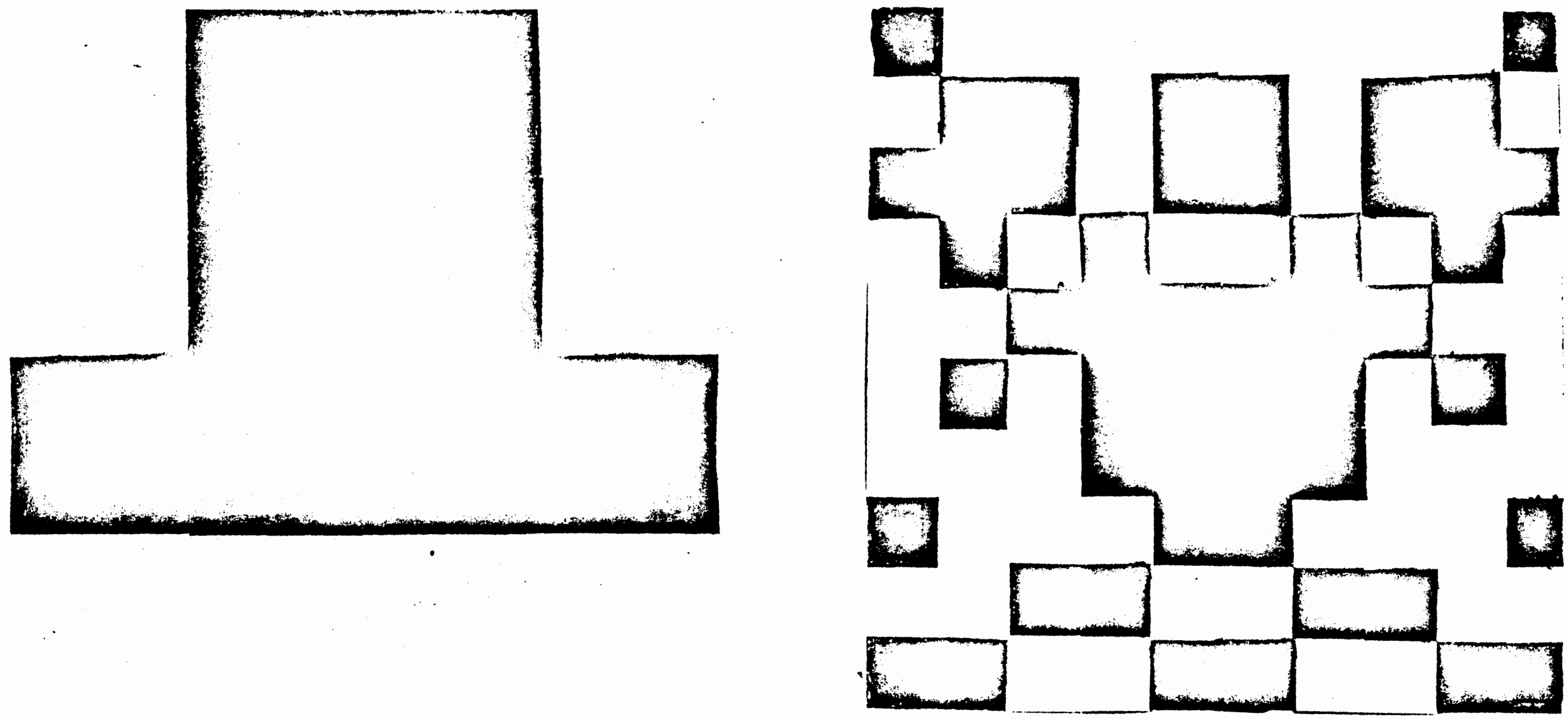
APPENDIX B

SAMPLE VISUAL STIMULUS COMPLEXITY DESIGNS

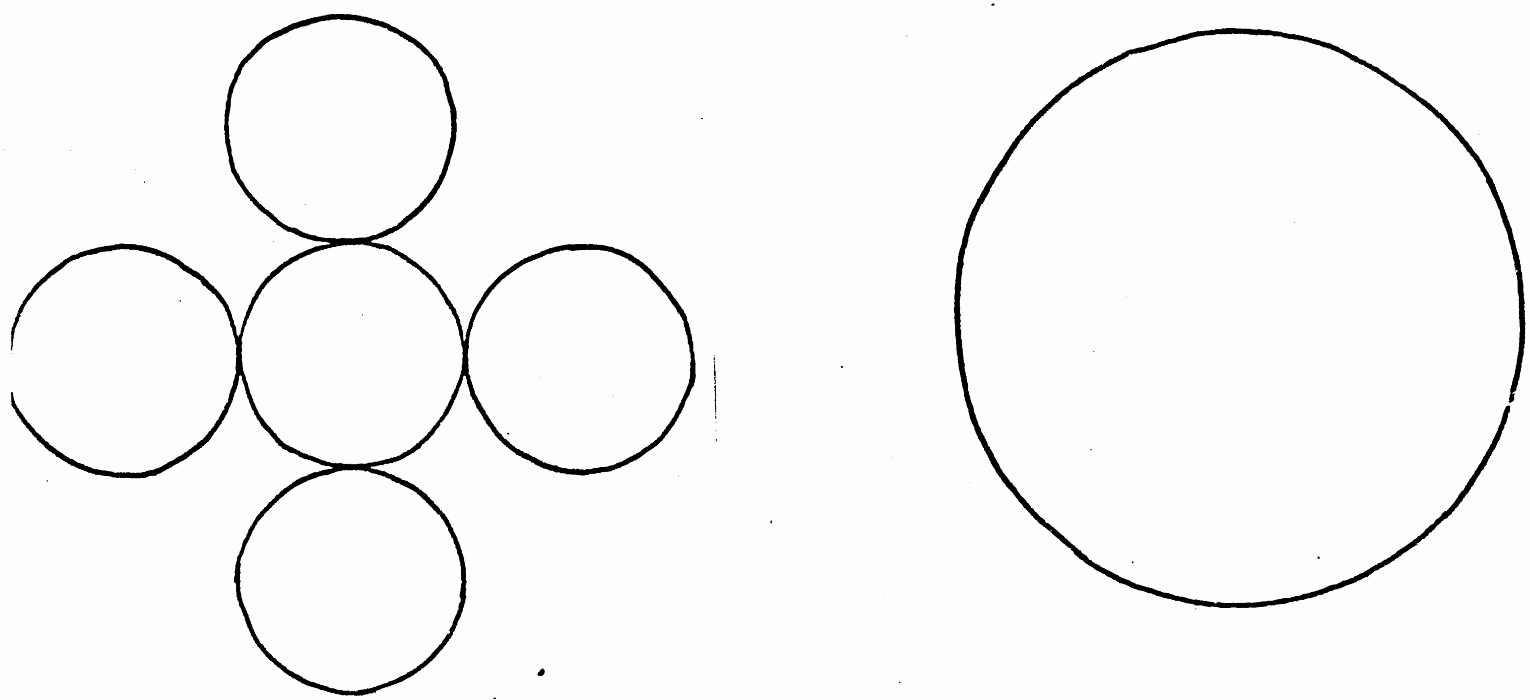
These designs were shown to each subject prior to the administration of the first stimulus complexity measure in order to familiarize him/her with the testing materials and procedure.



Random Polygons



Checkerboard Patterns



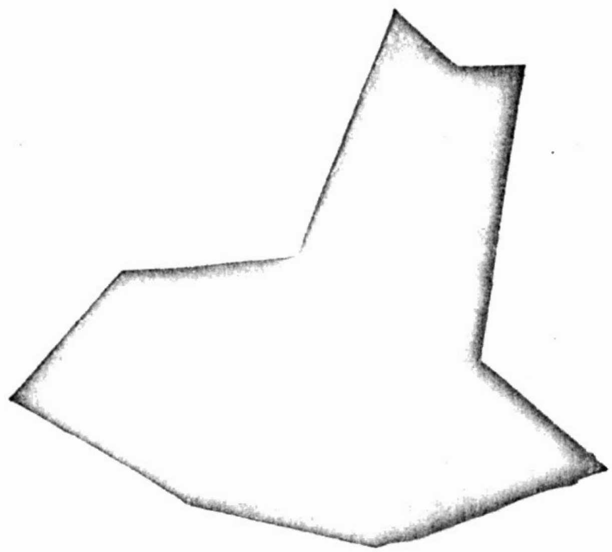
Simple-Complex Designs

APPENDIX C

VISUAL STIMULUS COMPLEXITY MEASURE #1 RANDOM

POLYGON DESIGNS AND RESPONSE FORM

Set 1 (blue)



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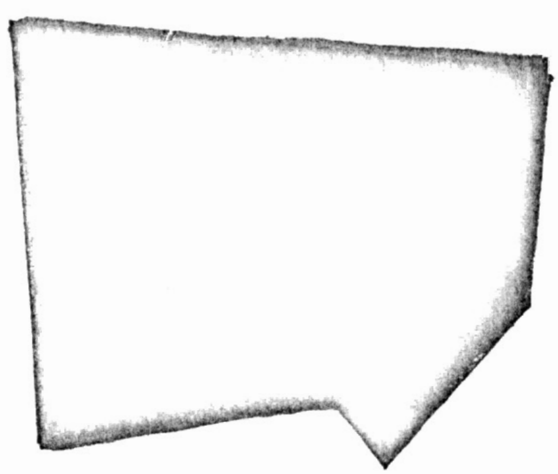
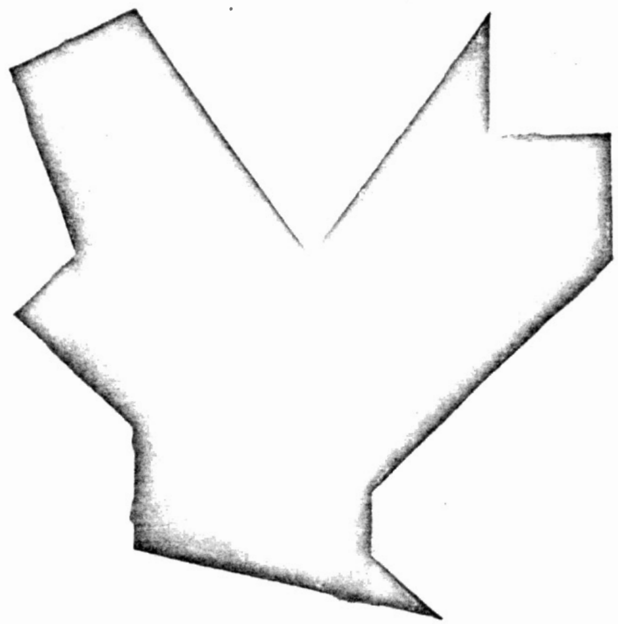
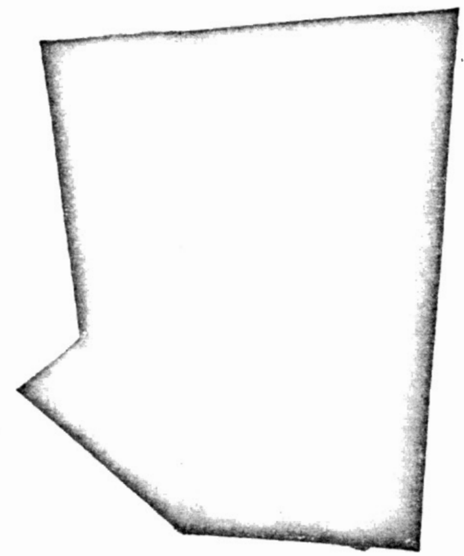


Number of Turns - 6; Score Value - 1



Number of Turns - 14; Score Value - 3



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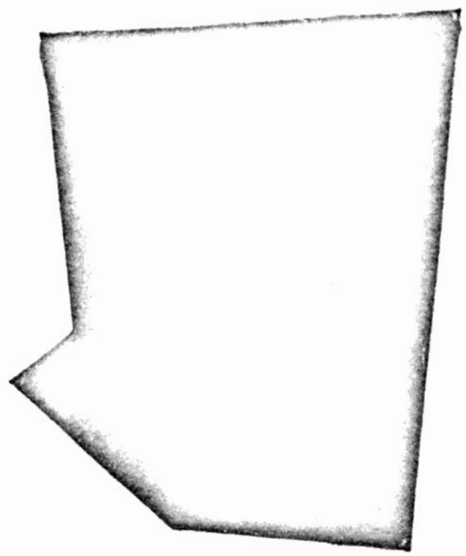

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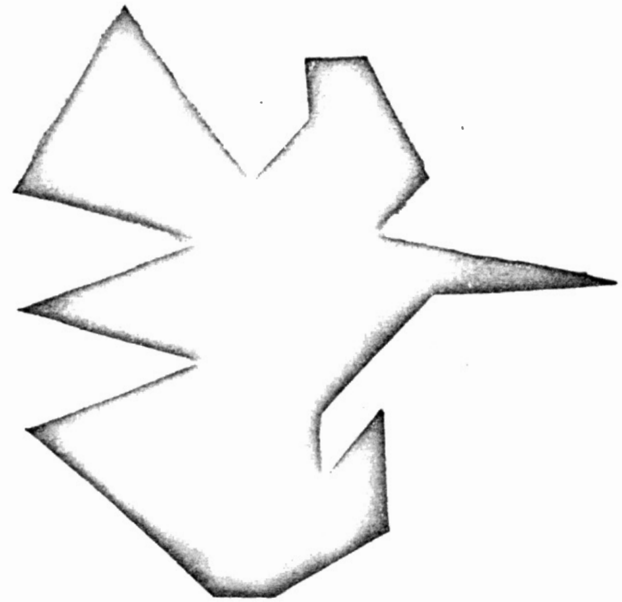
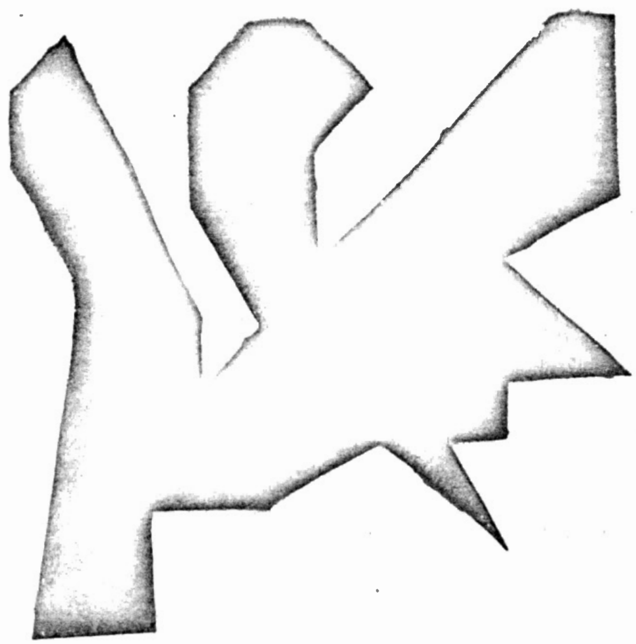


Number of Turns - 20; Score Value - 4



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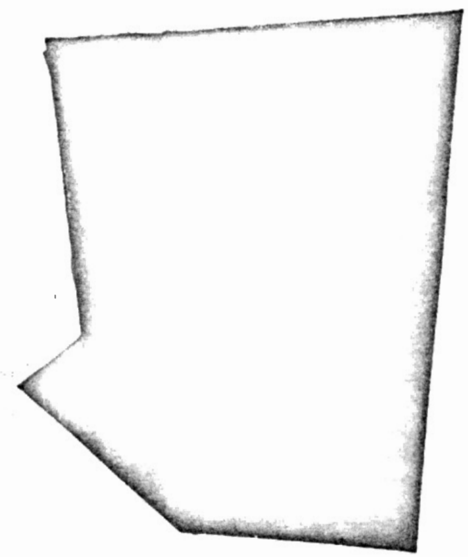

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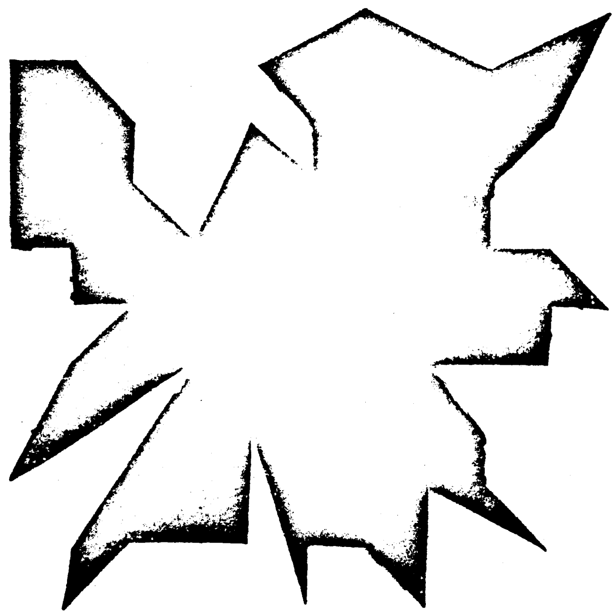

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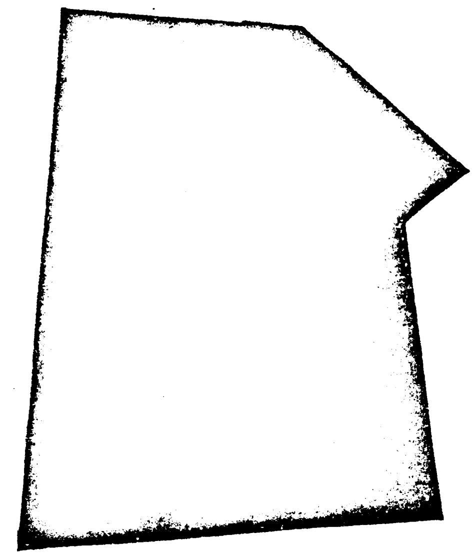
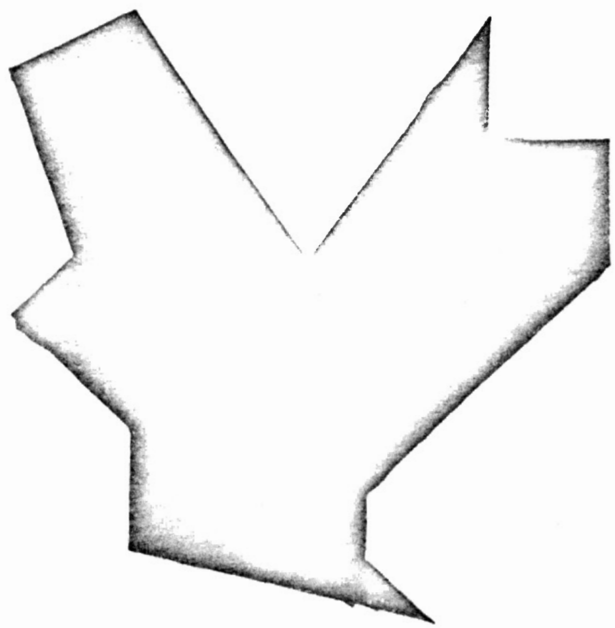
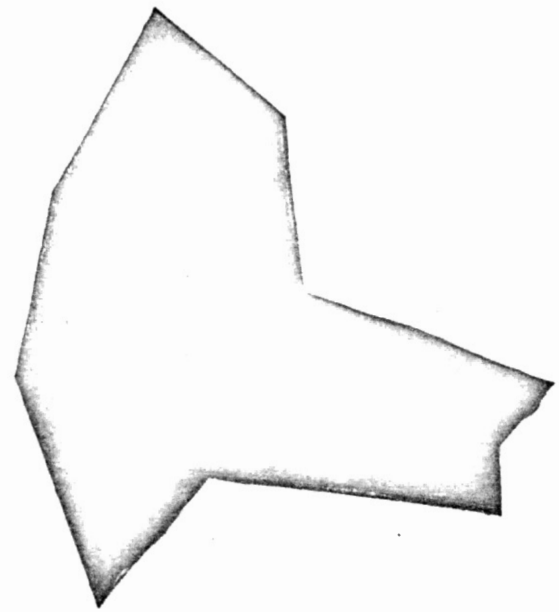


Number of Turns - 40; Score Value - 6



Number of Turns - 14; Score Value - 3



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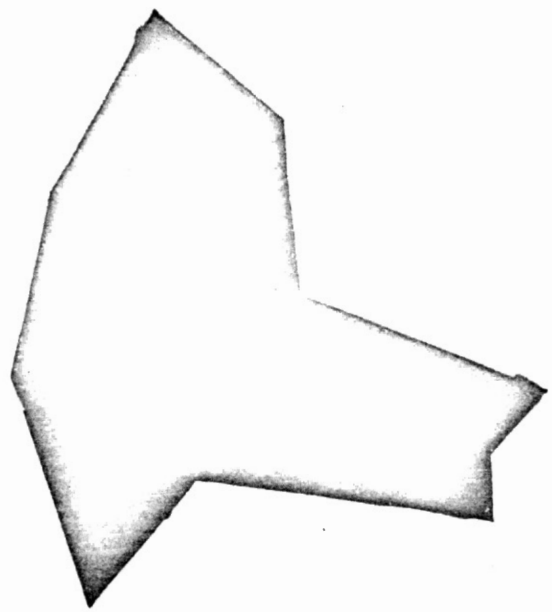

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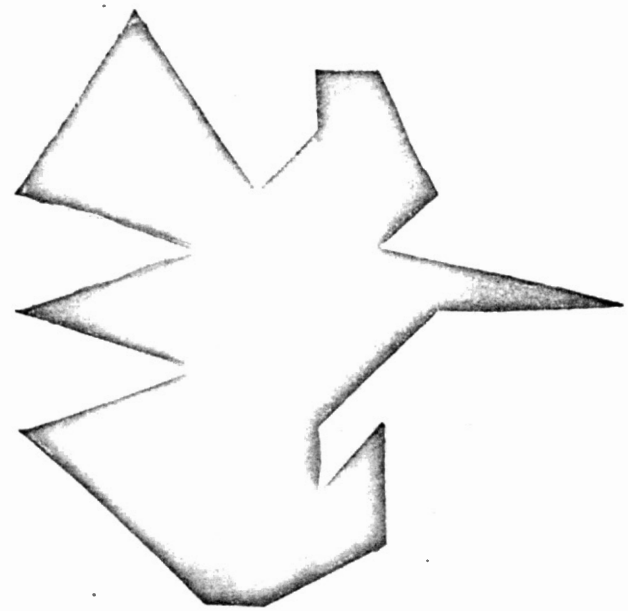

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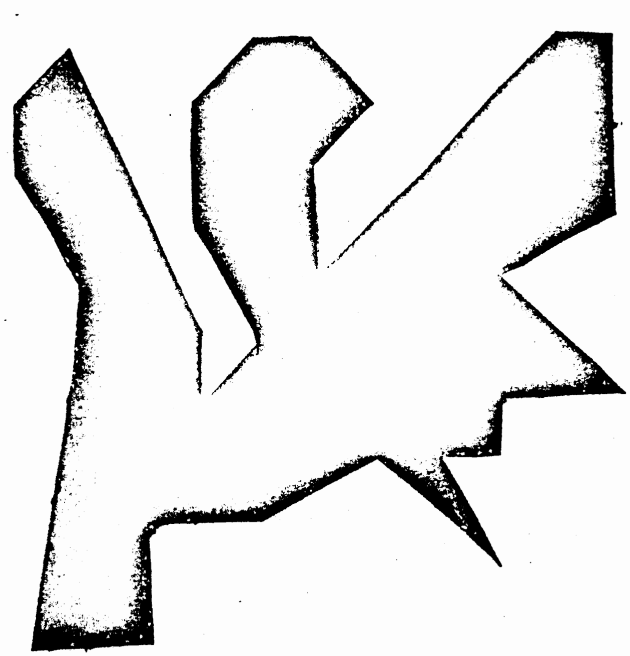

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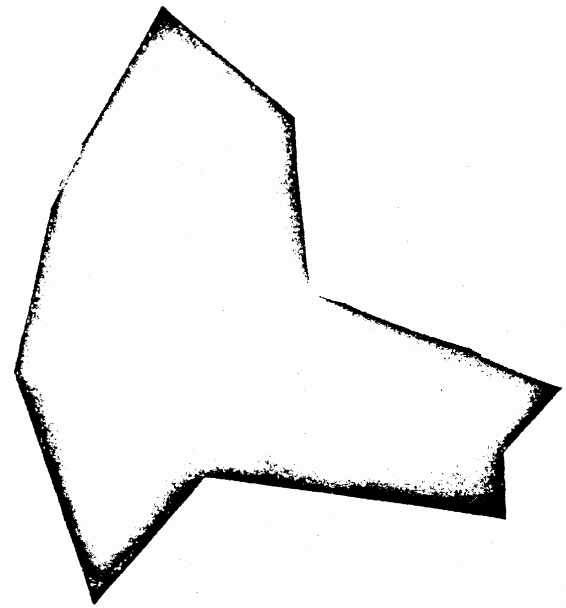

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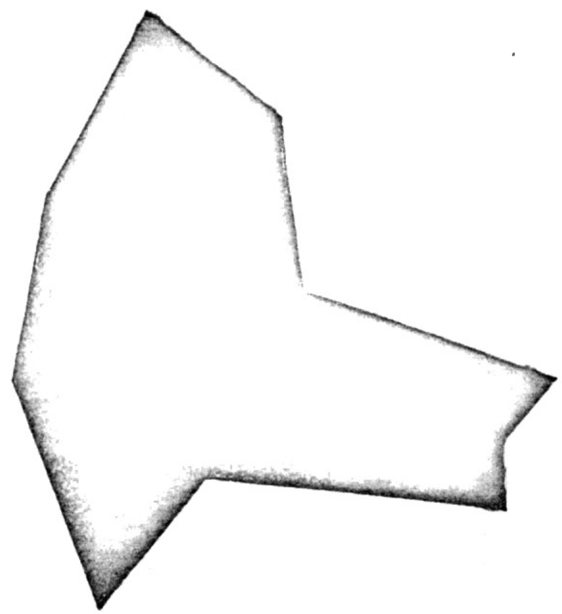

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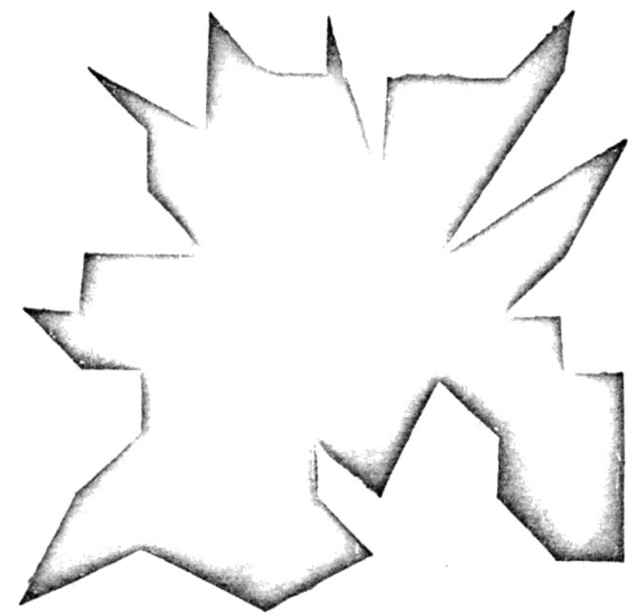

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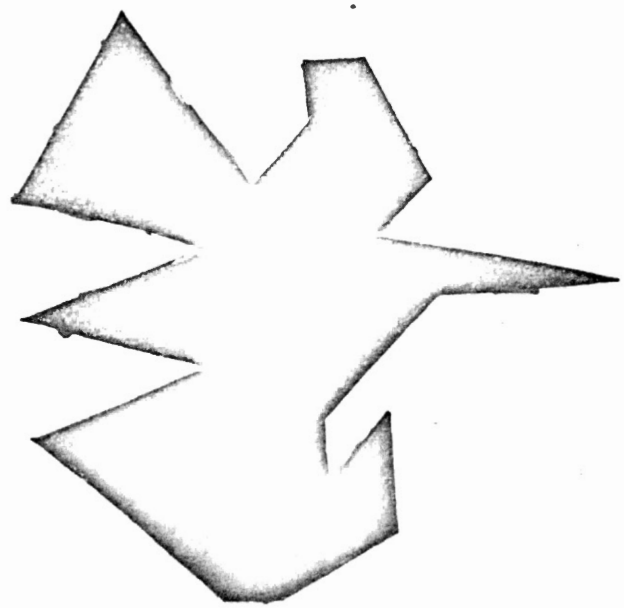

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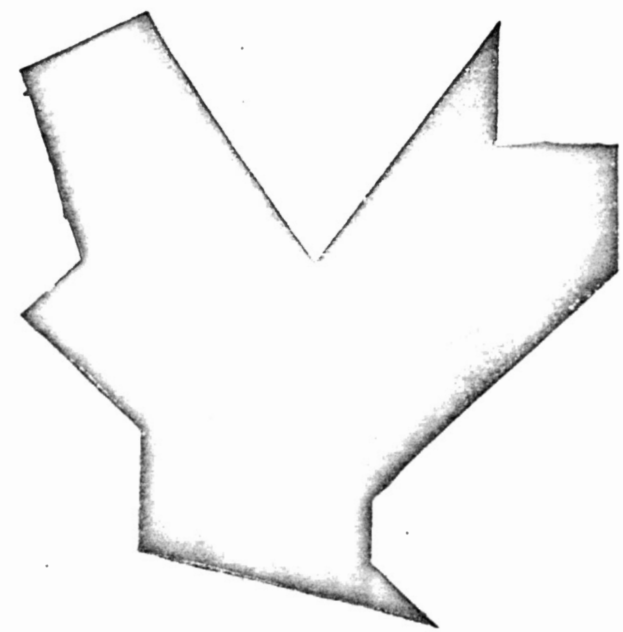

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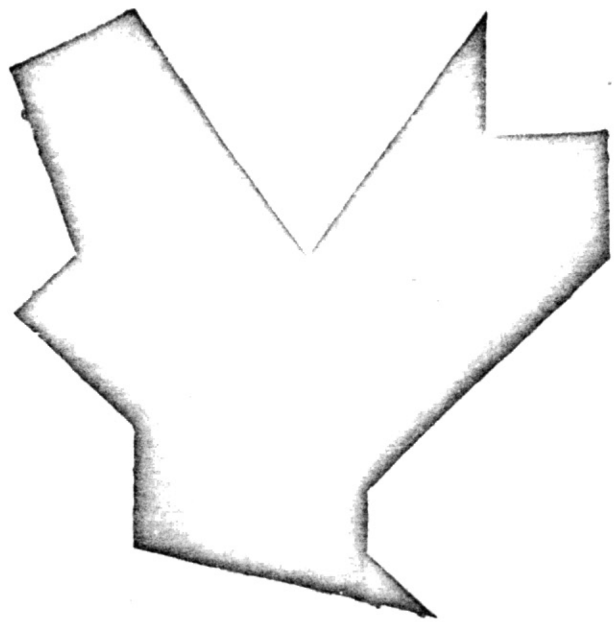

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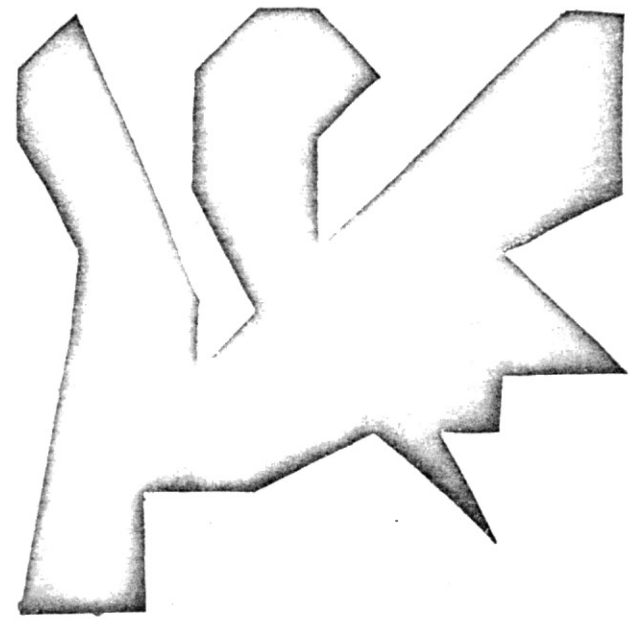

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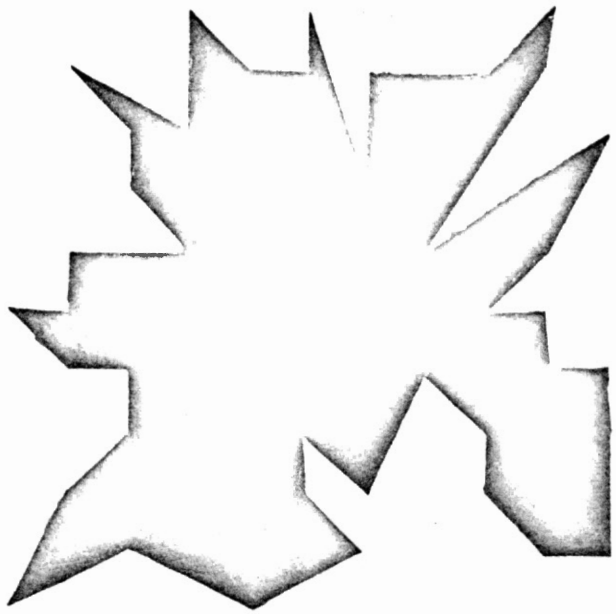

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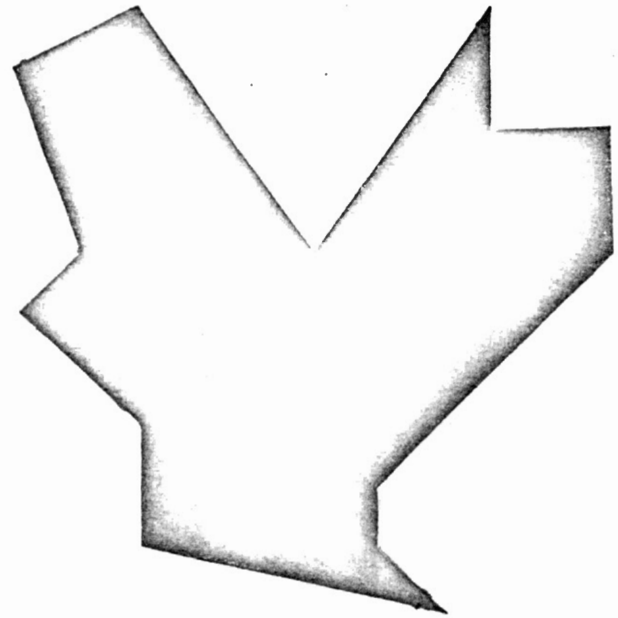
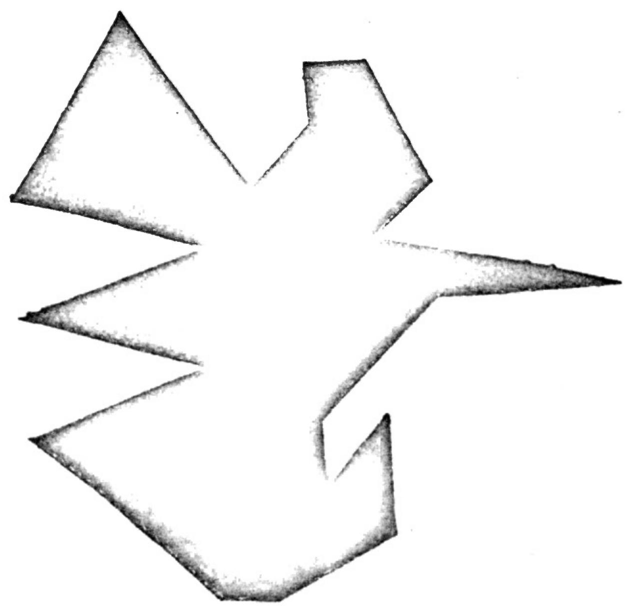
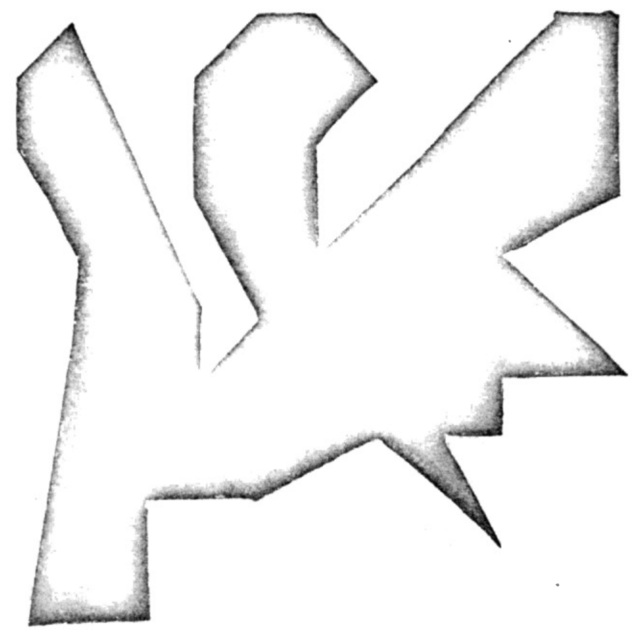


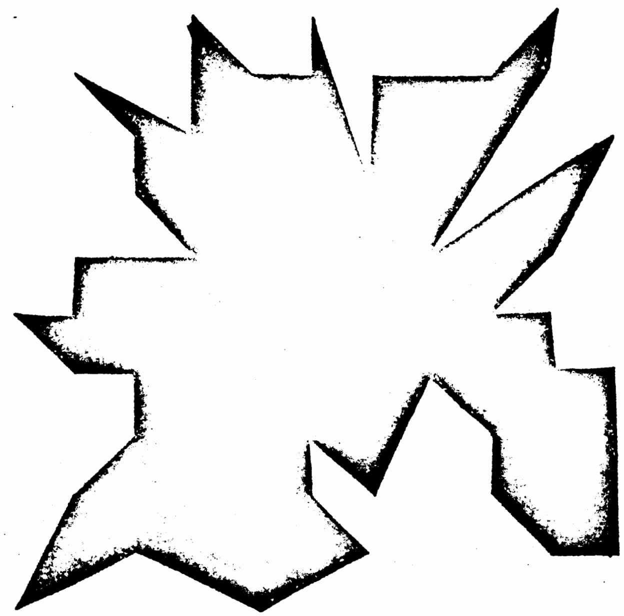
Number of Turns - 14; Score Value - 3



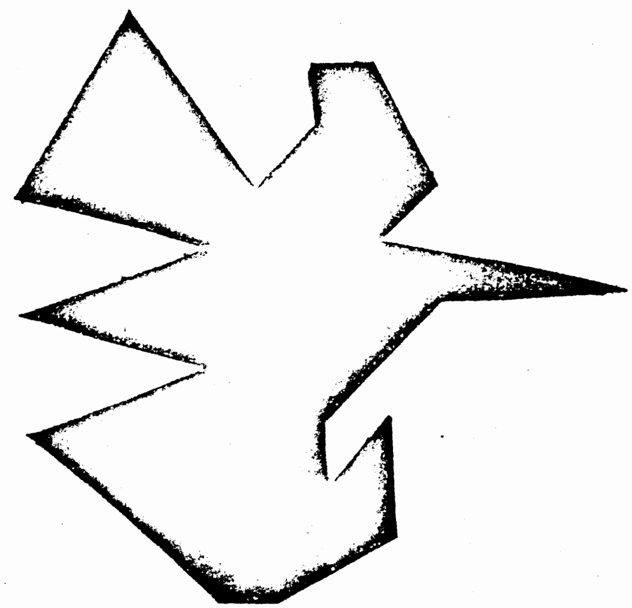
Number of Turns - 20; Score Value - 4



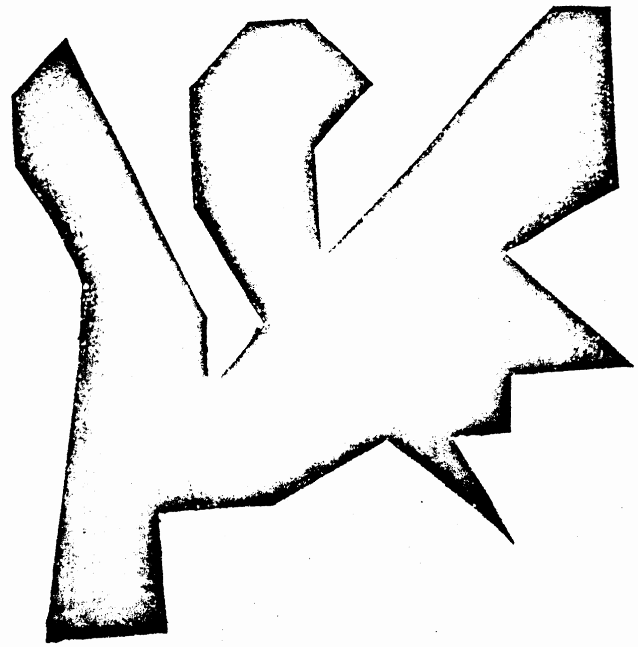
Number of Turns - 28; Score Value - 5



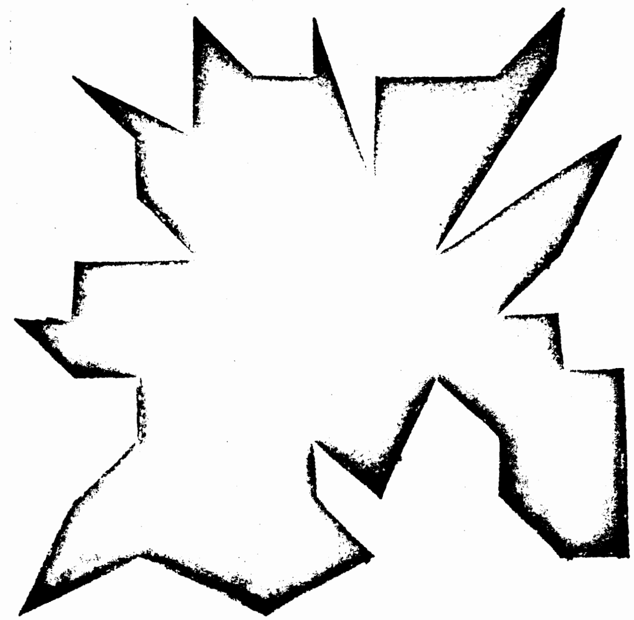
Number of Turns - 40; Score Value - 6



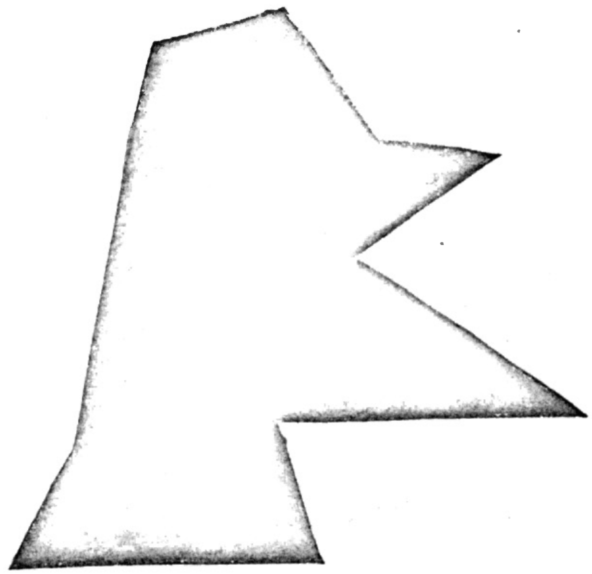
Number of Turns - 20; Score Value - 4



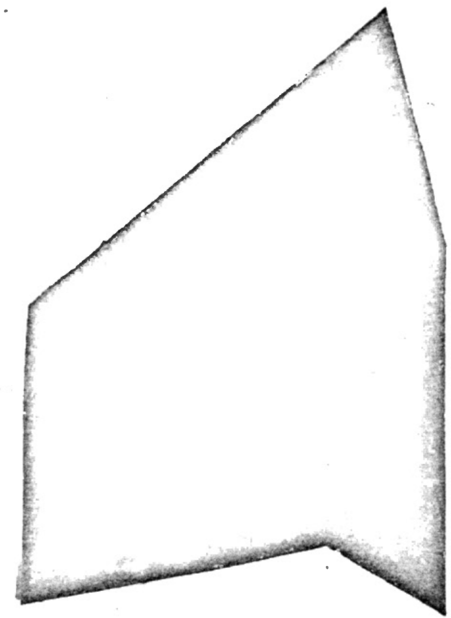
Number of Turns - 28; Score Value - 5



Number of Turns - 40; Score Value - 6

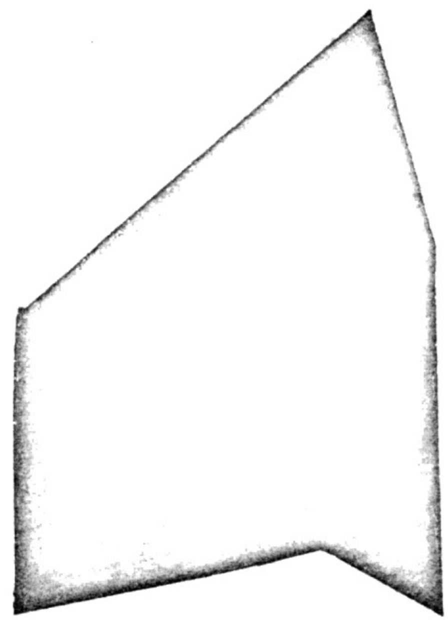


Number of Turns - 10; Score Value - 2

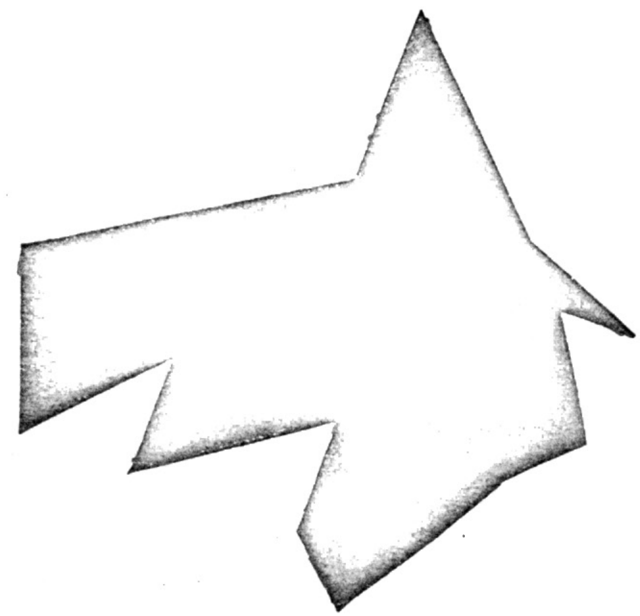


Number of Turns - 6; Score Value - 1

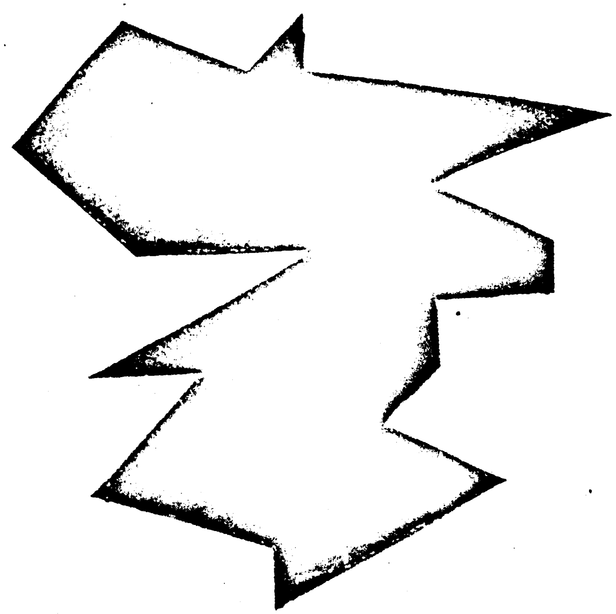
Set 2 (red)



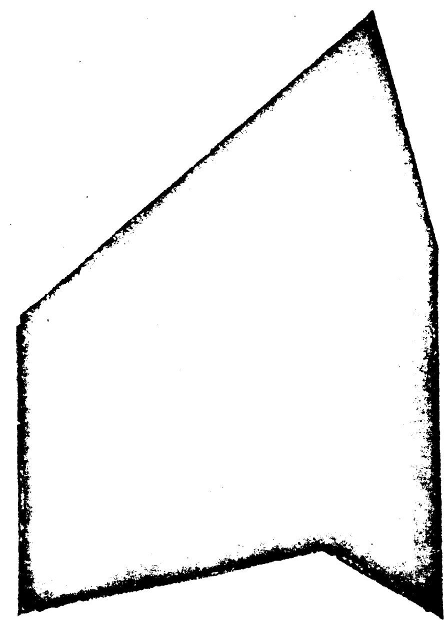
Number of Turns - 6; Score Value - 1



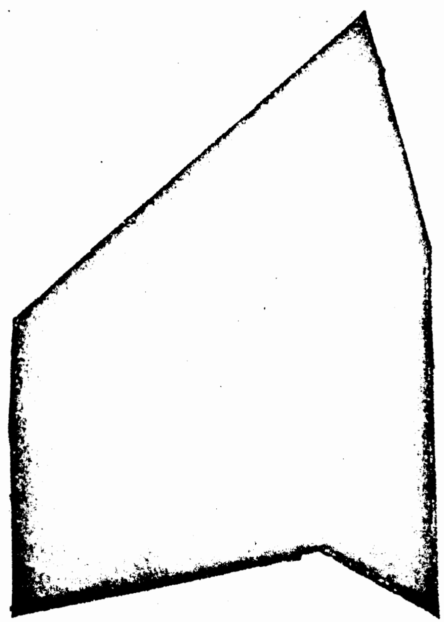
Number of Turns - 14; Score Value - 3



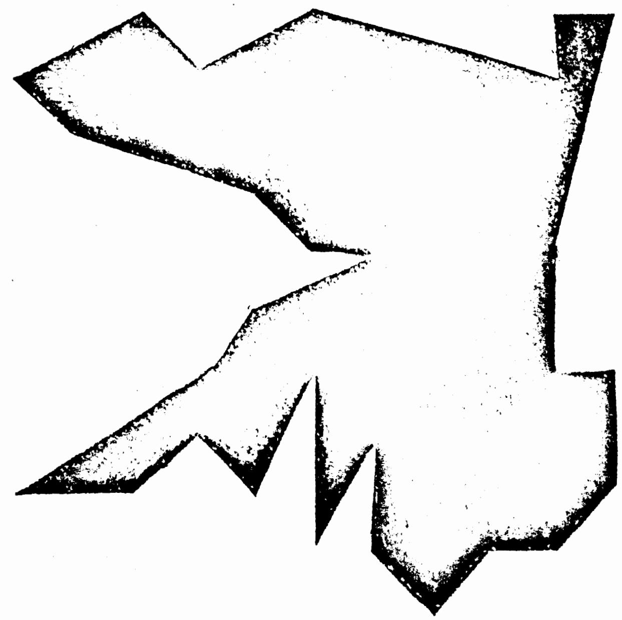
Number of Turns - 20; Score Value - 4



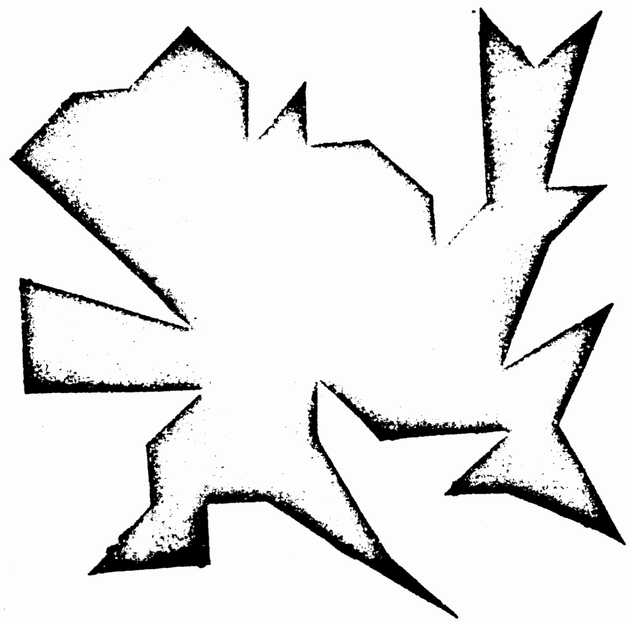
Number of Turns - 6; Score Value - 1



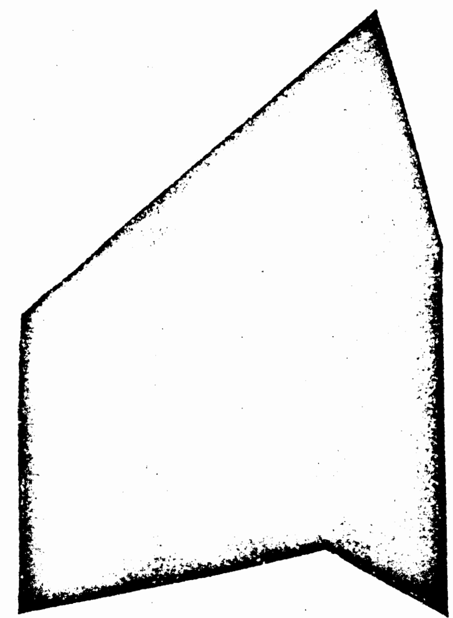
Number of Turns - 6; Score Value - 1



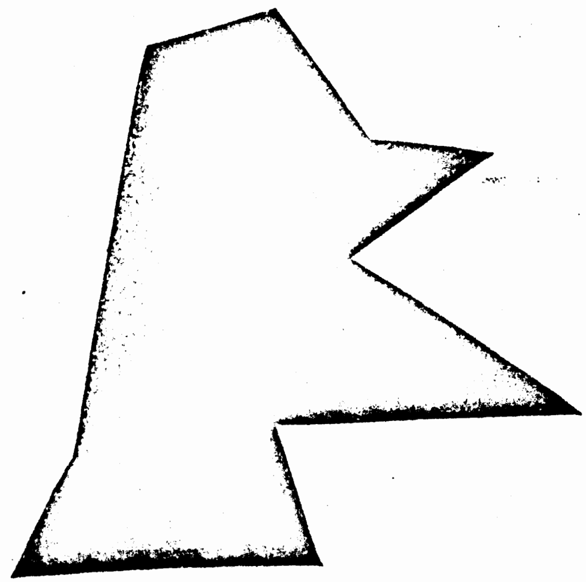
Number of Turns - 28; Score Value - 5



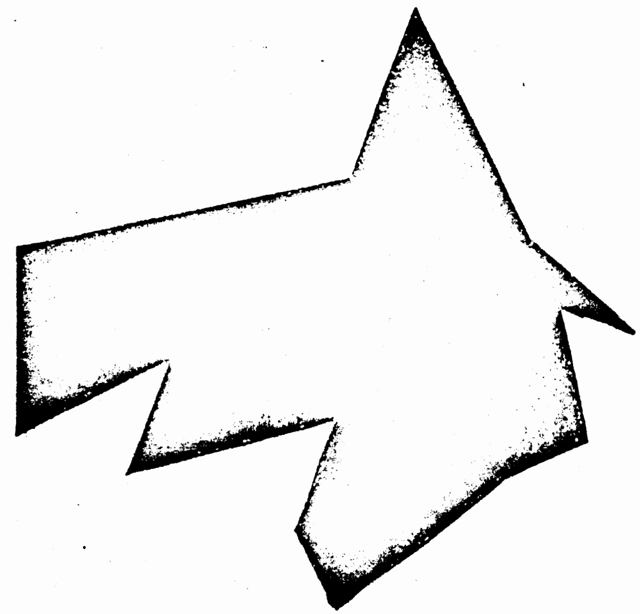
Number of Turns - 40; Score Value - 6



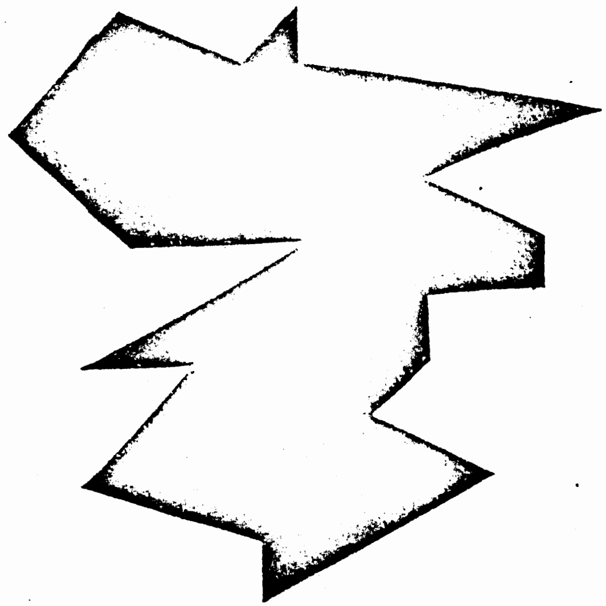
Number of Turns - 6; Score Value - 1



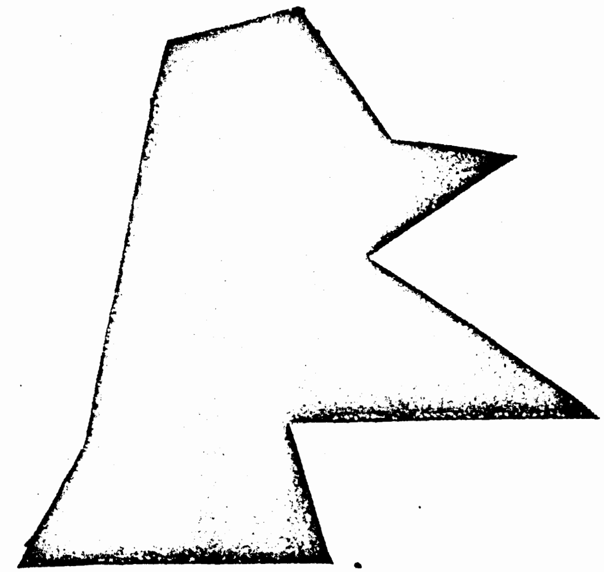
Number of Turns - 10; Score Value - 2



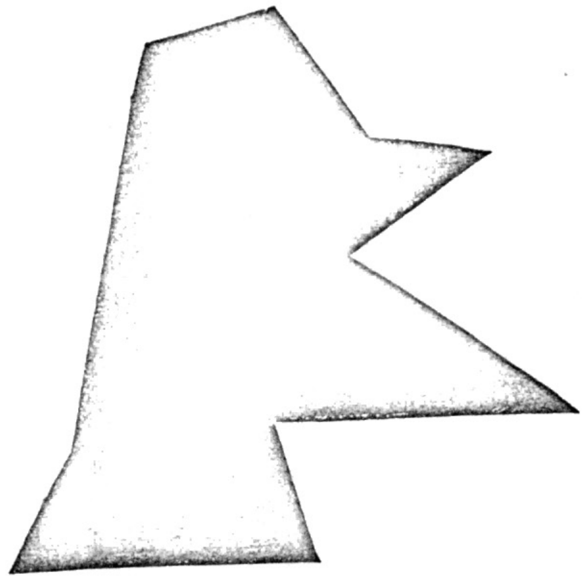
Number of Turns - 14; Score Value - 3



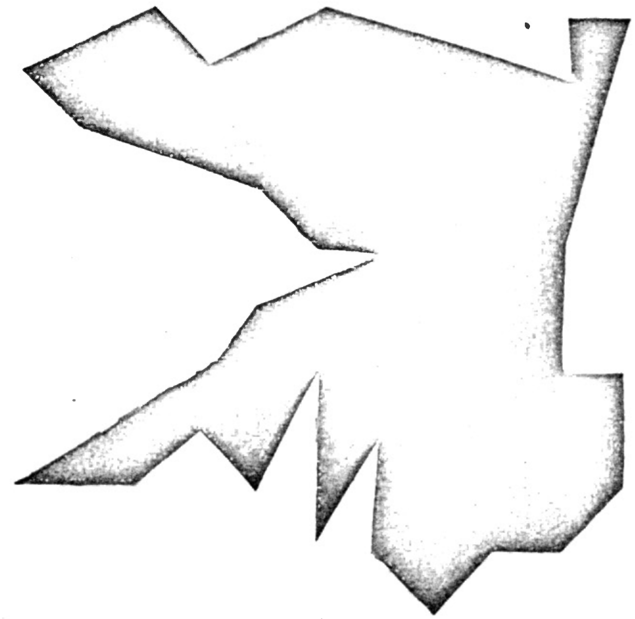
Number of Turns - 20; Score Value - 4



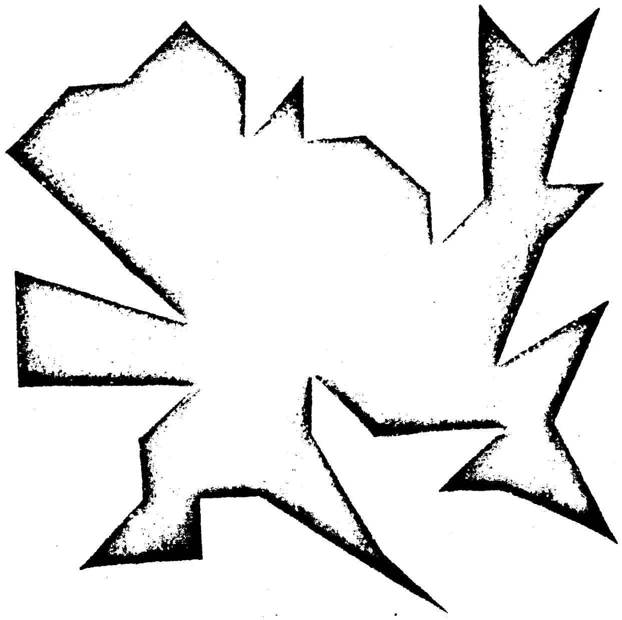
Number of Turns - 10; Score Value - 2



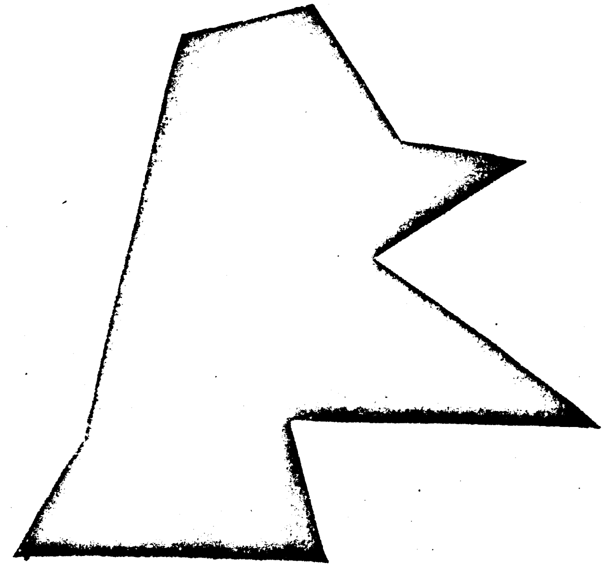
Number of Turns - 10; Score Value - 2



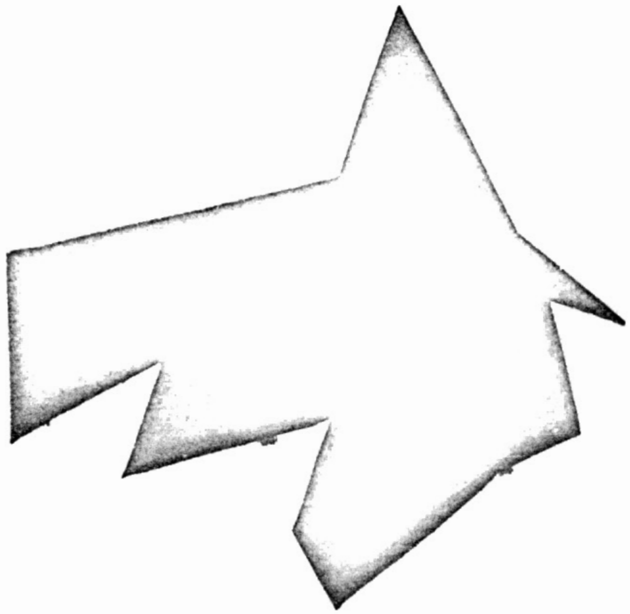
Number of Turns - 28; Score Value - 5



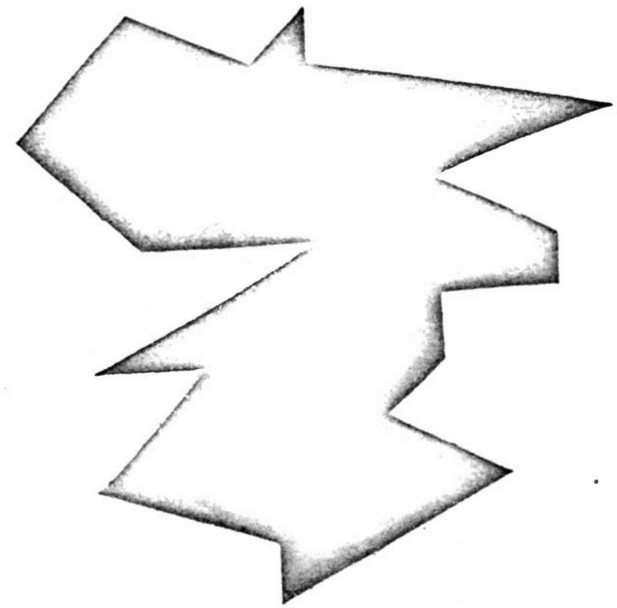
Number of Turns - 40; Score Value - 6



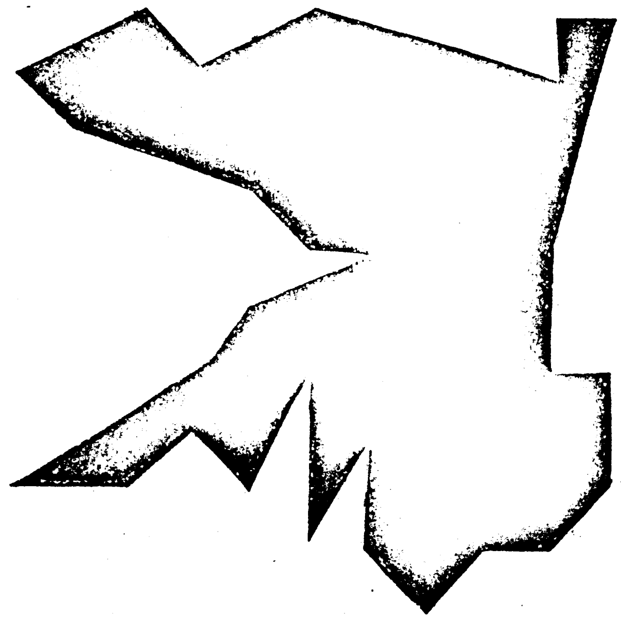
Number of Turns - 10; Score Value - 2



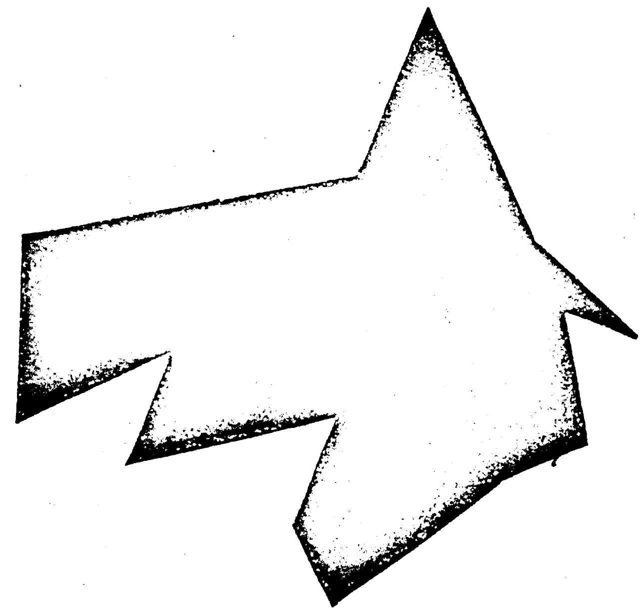
Number of Turns - 14; Score Value - 3



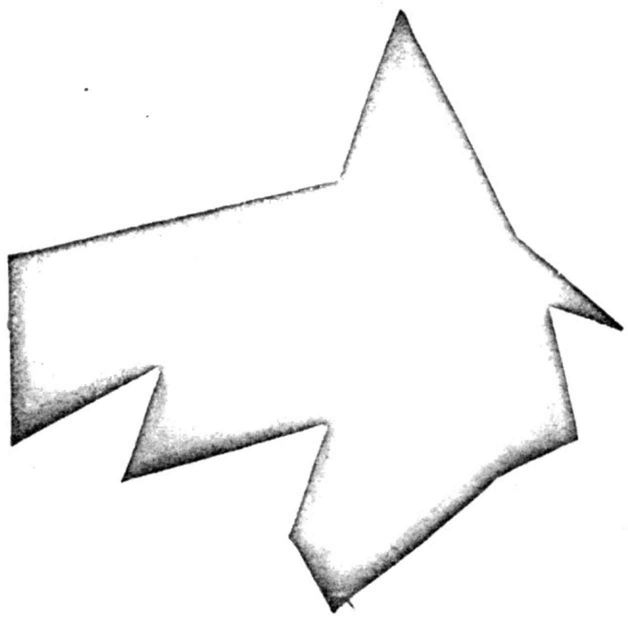
Number of Turns - 20; Score Value - 4



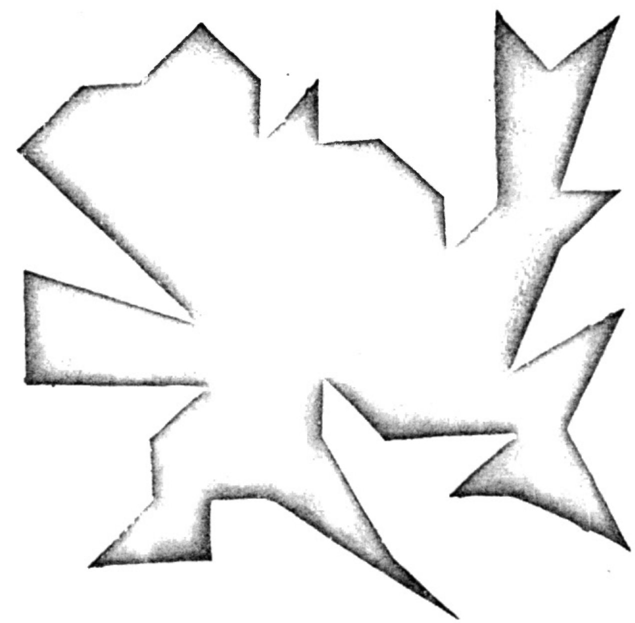
Number of Turns - 28; Score Value - 5



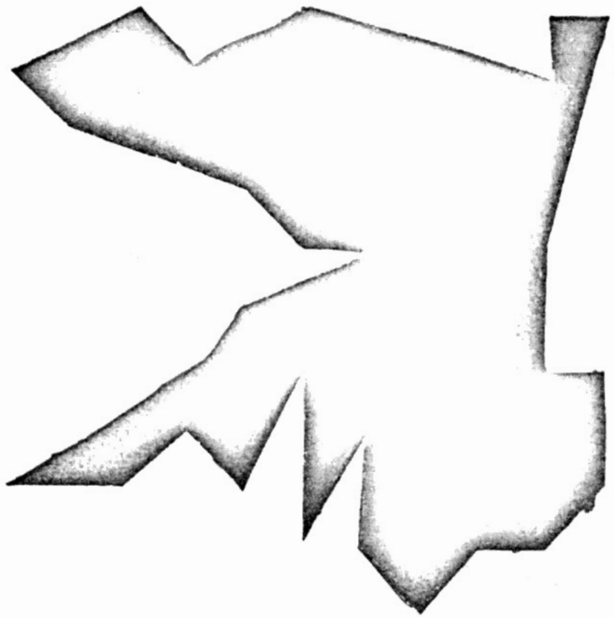
Number of Turns - 14; Score Value - 3



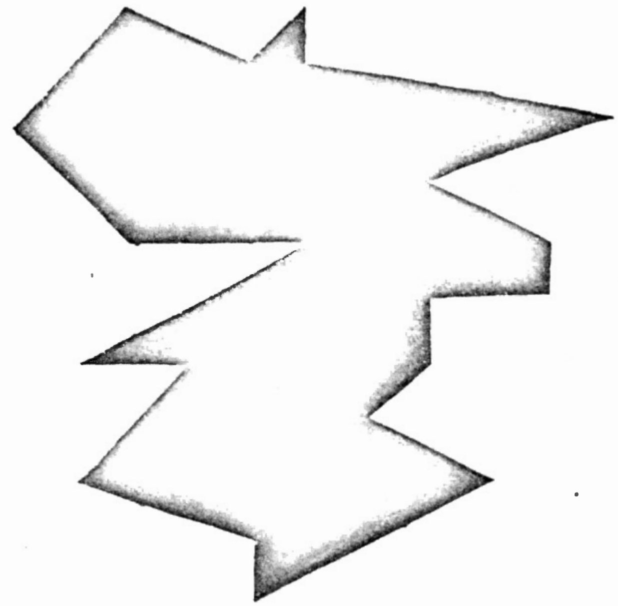
Number of Turns - 14; Score Value - 3



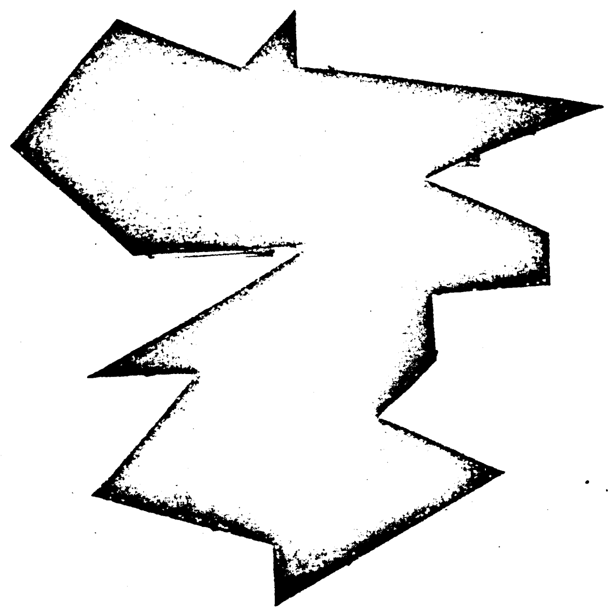
Number of Turns - 40; Score Value - 6



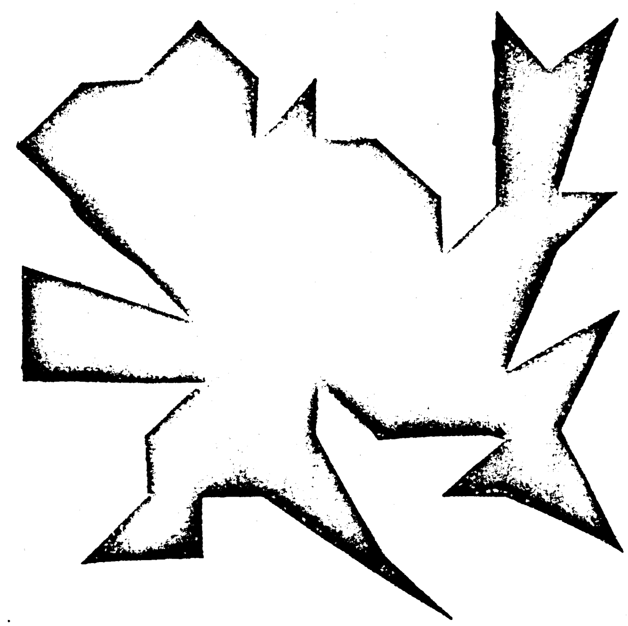
Number of Turns - 28; Score Value - 5



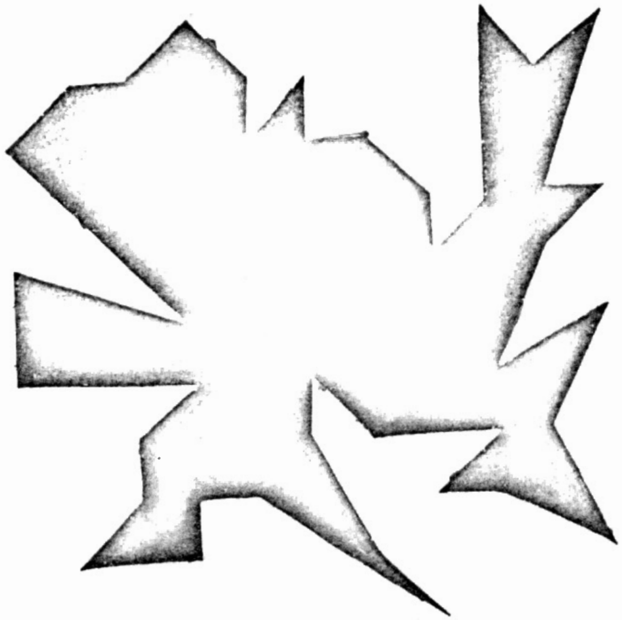
Number of Turns - 20; Score Value - 4



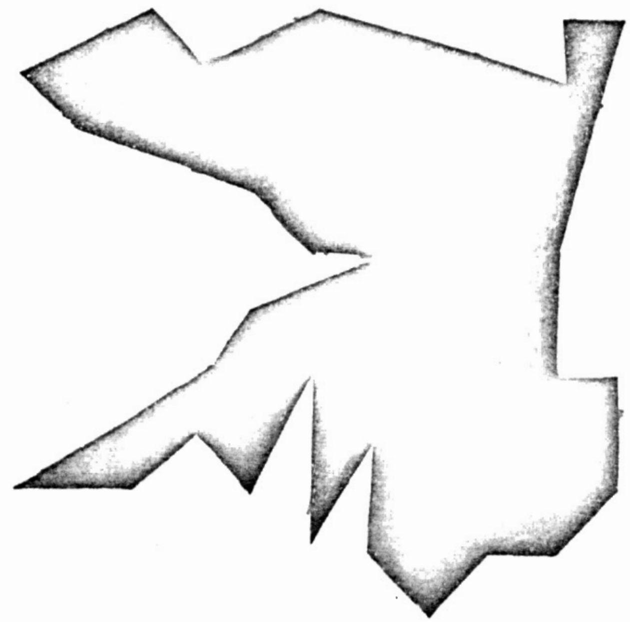
Number of Turns - 20; Score Value - 4



Number of Turns - 40; Score Value - 6



Number of Turns - 40; Score Value - 6



Number of Turns - 28; Score Value - 5

RANDOM POLYGONS RESPONSE FORM

Child's Name________________________________ Birthdate__________________

Sex________ Age_______ School____________________________ Grade_________

Set 1 (blue)		Set 2 (red)	
1.	1 - 2	1.	2 - 1
2.	3 - 1	2.	1 - 3
3.	1 - 4	3.	4 - 1
4.	5 - 1	4.	1 - 5
5.	1 - 6	5.	6 - 1
6.	3 - 2	6.	2 - 3
7.	2 - 4	7.	4 - 2
8.	5 - 2	8.	2 - 5
9.	2 - 6	9.	6 - 2
10.	4 - 3	10.	3 - 4
11.	3 - 5	11.	5 - 3
12.	6 - 3	12.	3 - 6
13.	4 - 5	13.	5 - 4
14.	6 - 4	14.	4 - 6
15.	5 - 6	15.	6 - 5

Set 1 Score _______ Set 2 Score _______

Scoring Key

Number of Angles	Score Value
6	1
10	2
14	3
20	4
28	5
40	6

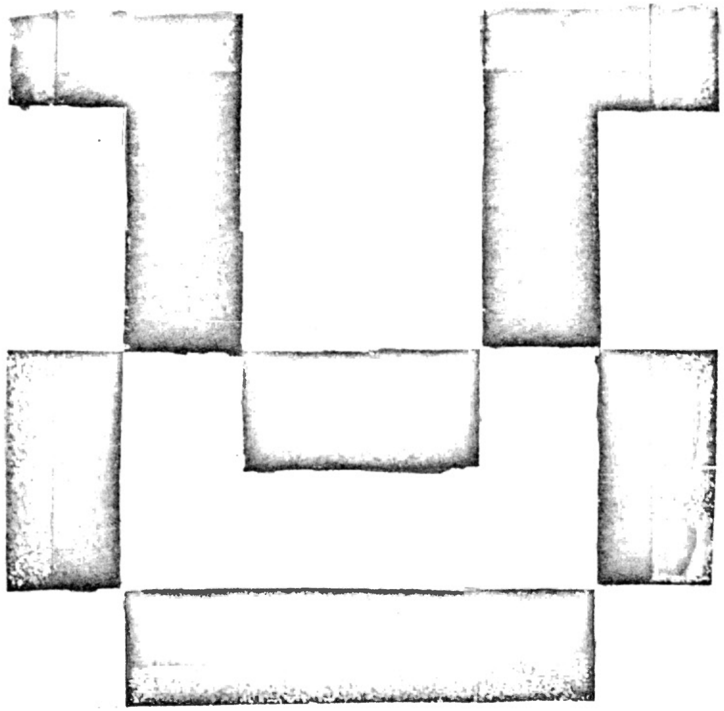
Comments:

Total Score____________

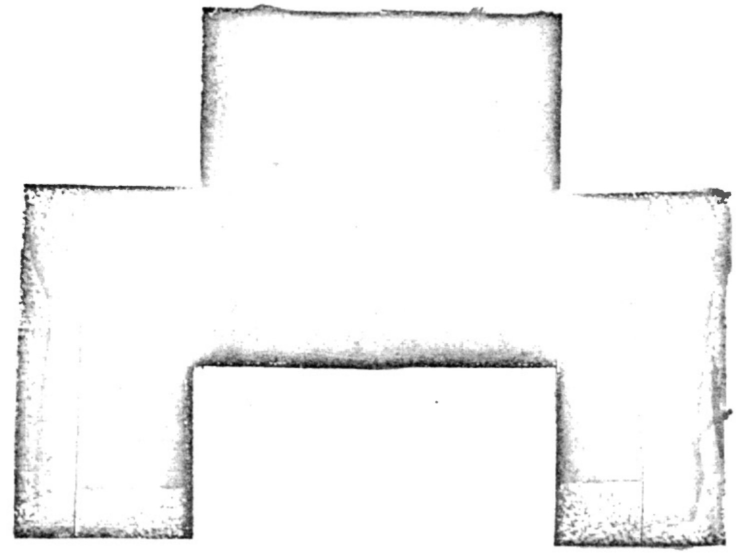
APPENDIX D

VISUAL STIMULUS COMPLEXITY MEASURE #2 CHECKERBOARD PATTERNS AND RESPONSE FORM

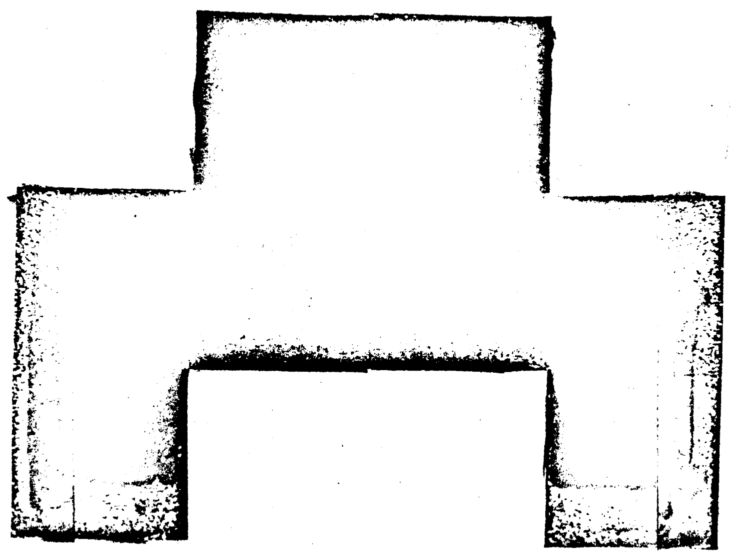
Set 1 (blue)
Vertical Symmetry



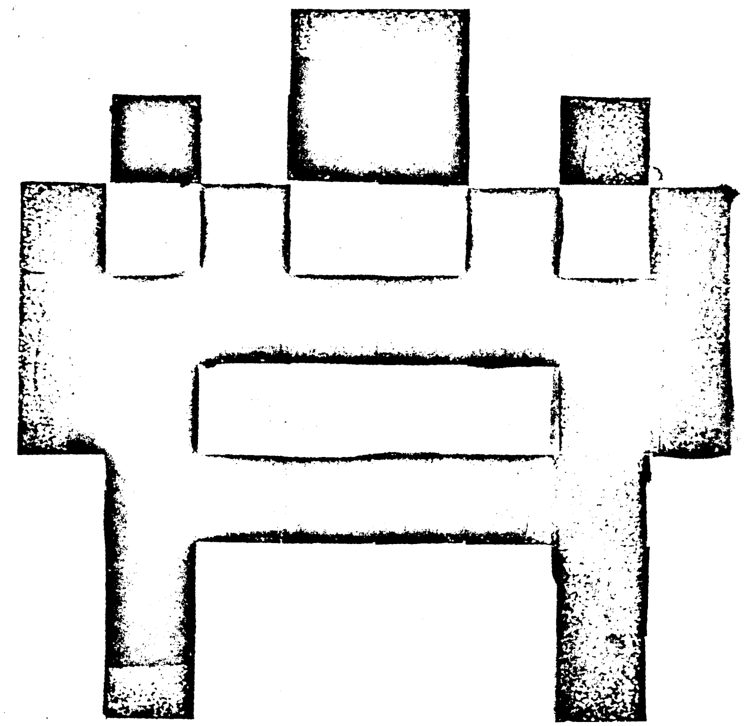
Number of Cells - 6x6; Score Value - 2



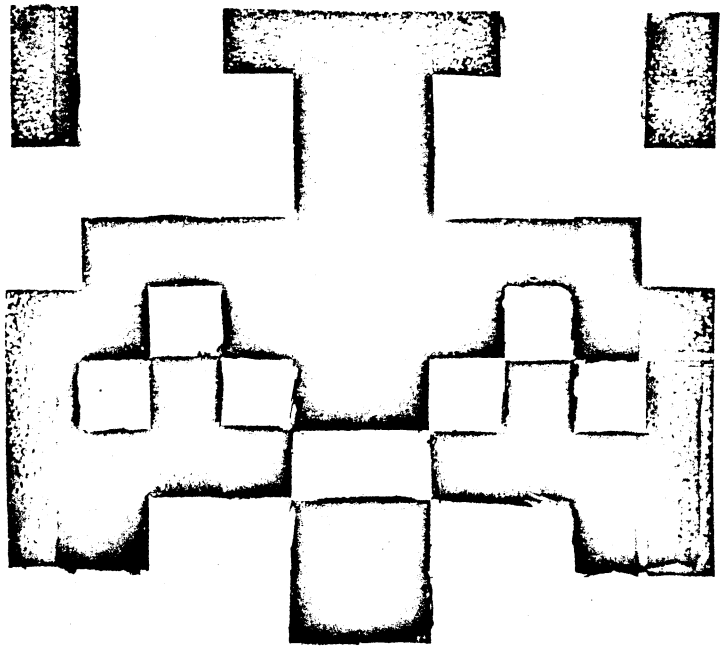
Number of Cells - 4x4; Score Value - 1



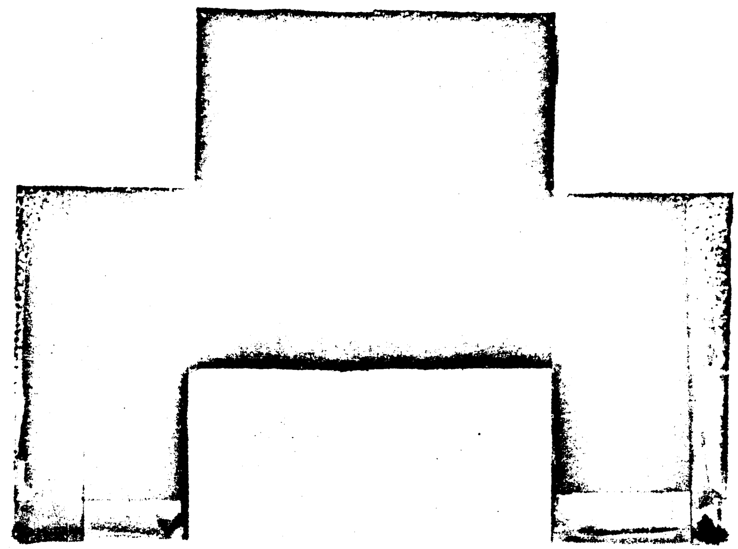
Number of Cells - 4x4; Score Value - 1



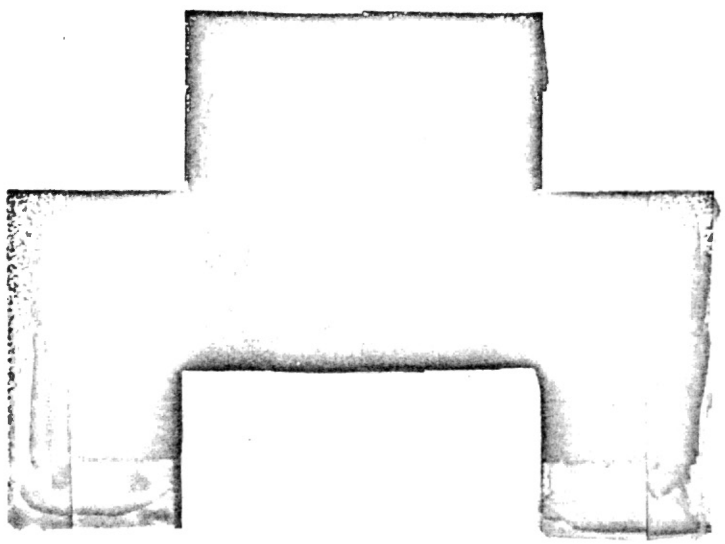
Number of Cells - 8x8; Score Value - 3



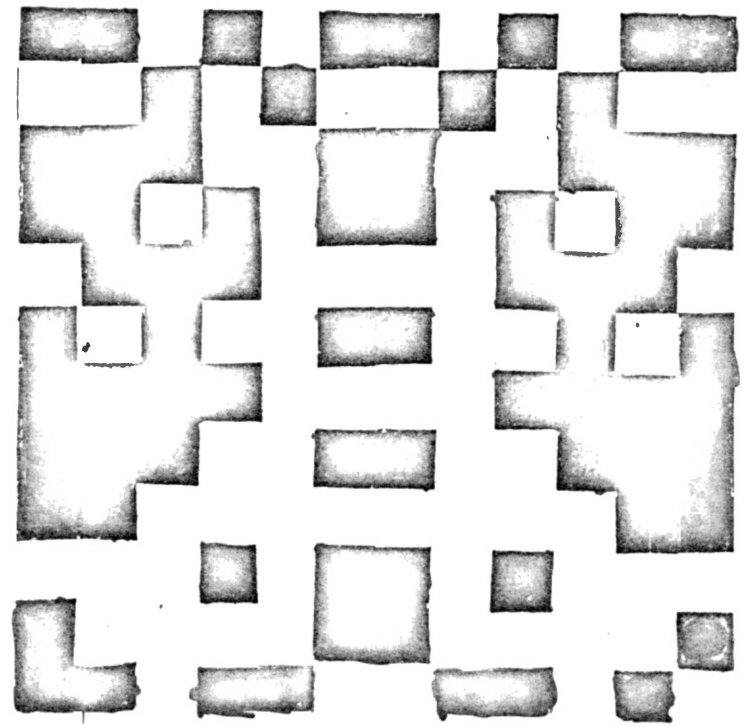
Number of Cells - 10x10; Score Value - 4



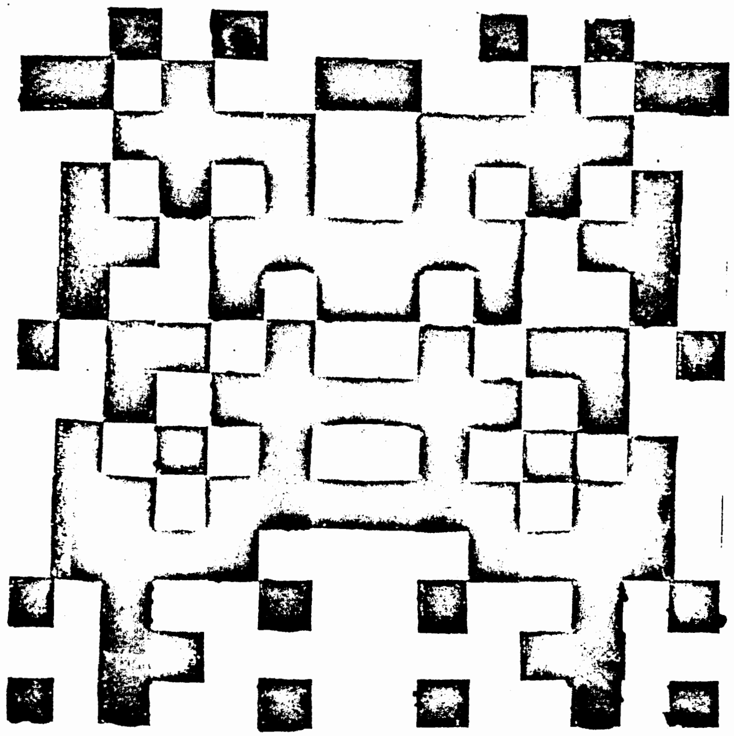
Number of Cells - 4x4; Score Value - 1



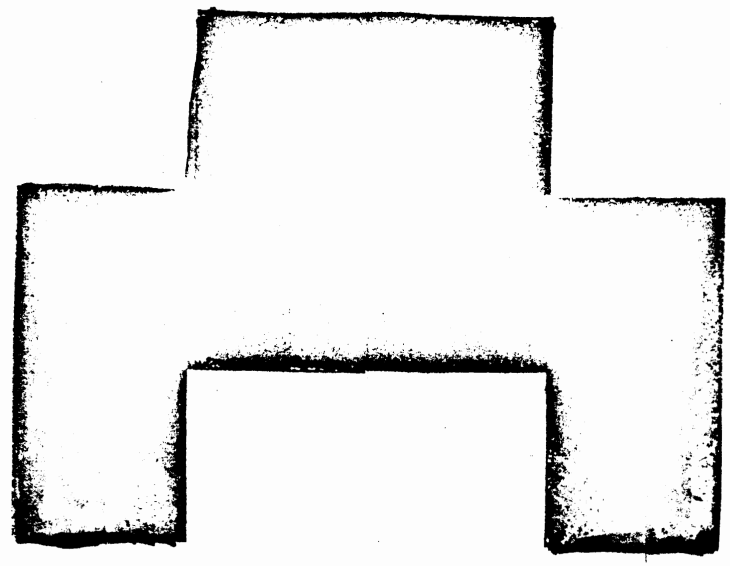
Number of Cells - 4x4; Score Value - 1



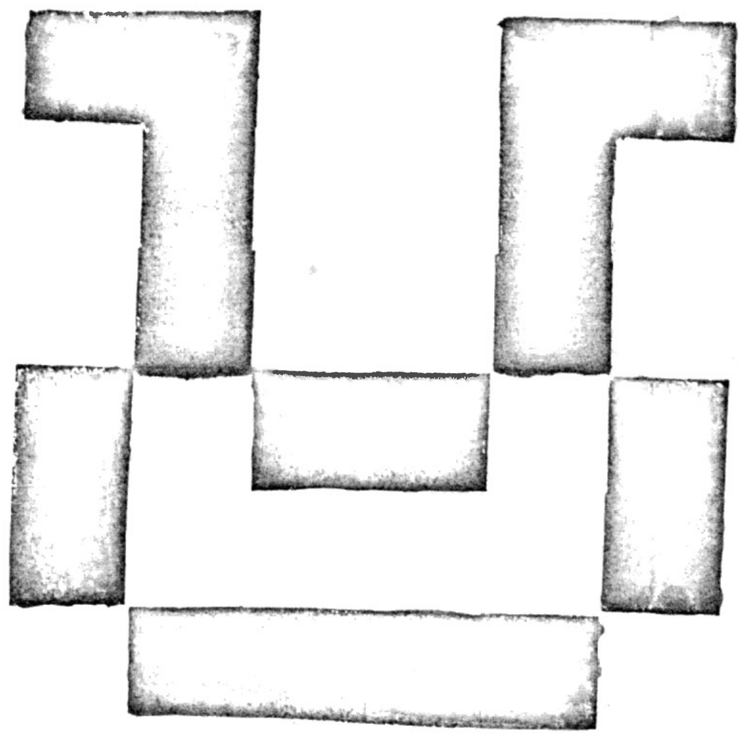
Number of Cells - 12x12; Score Value - 5



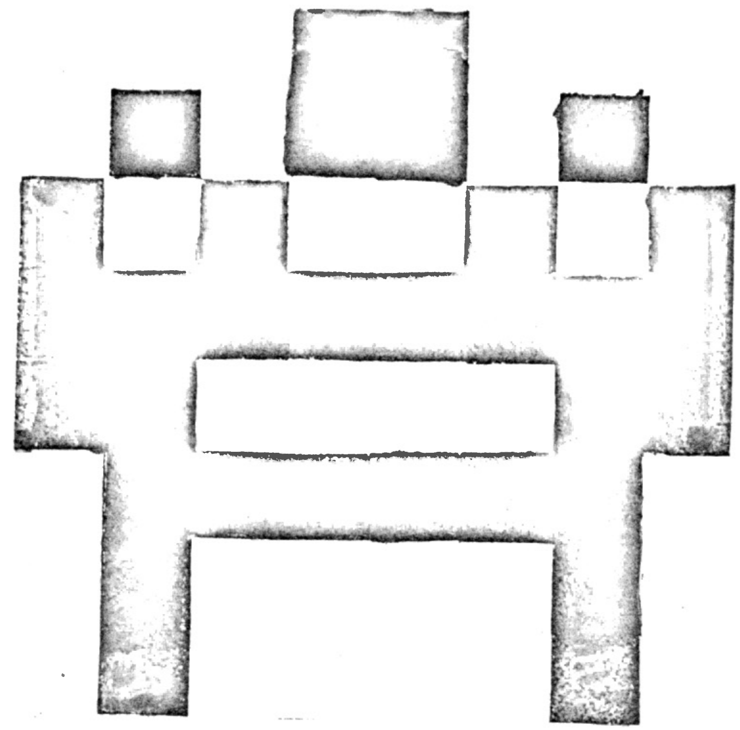
Number of Cells - 14x14; Score Value - 6



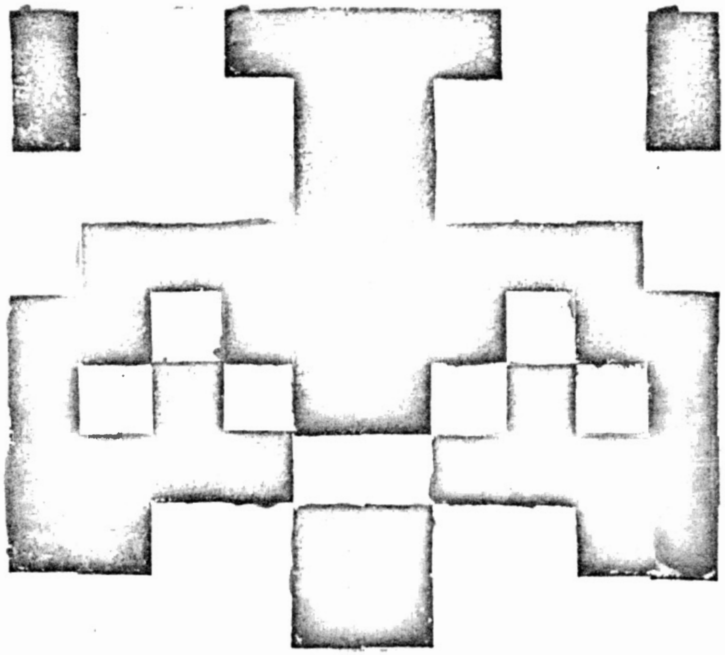
Number of Cells - 4x4; Score Value - 1



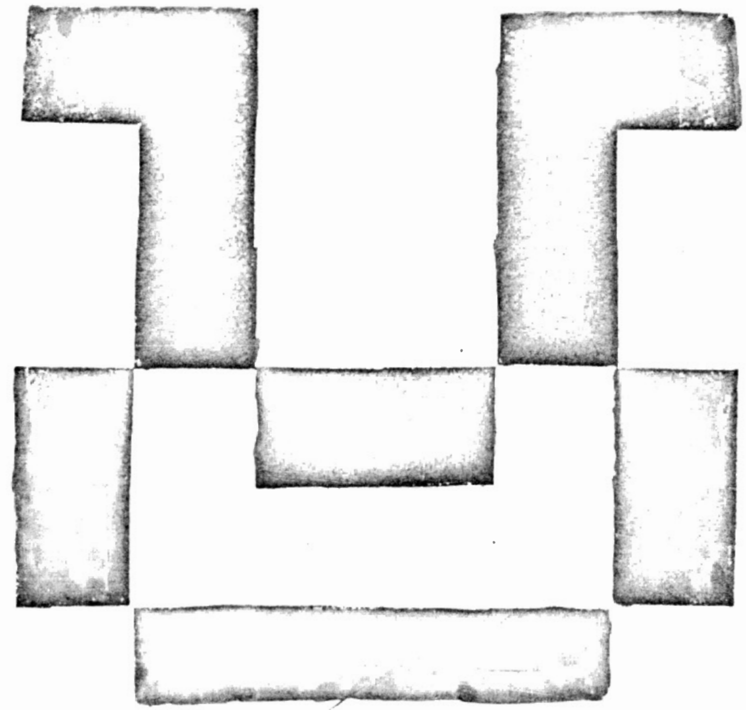
Number of Cells - 6x6; Score Value - 2



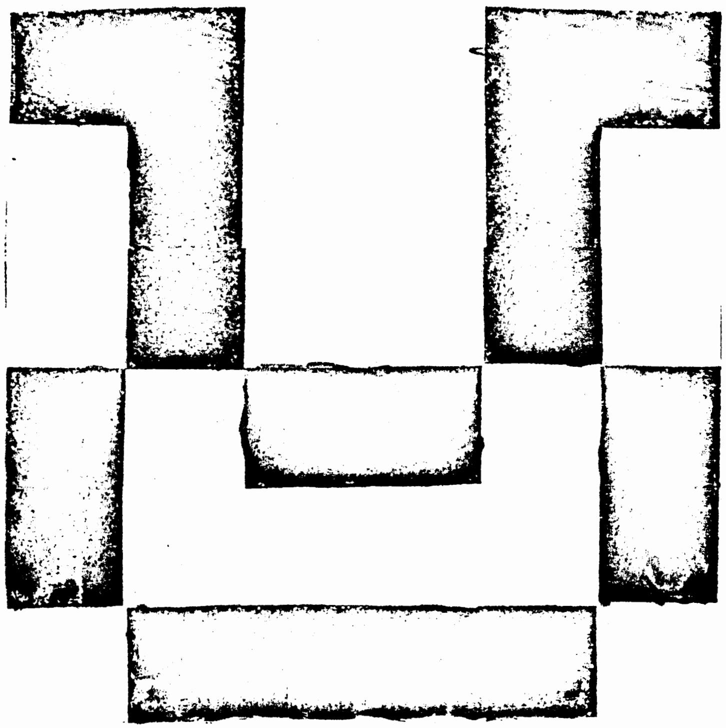
Number of Cells - 8x8; Score Value - 3



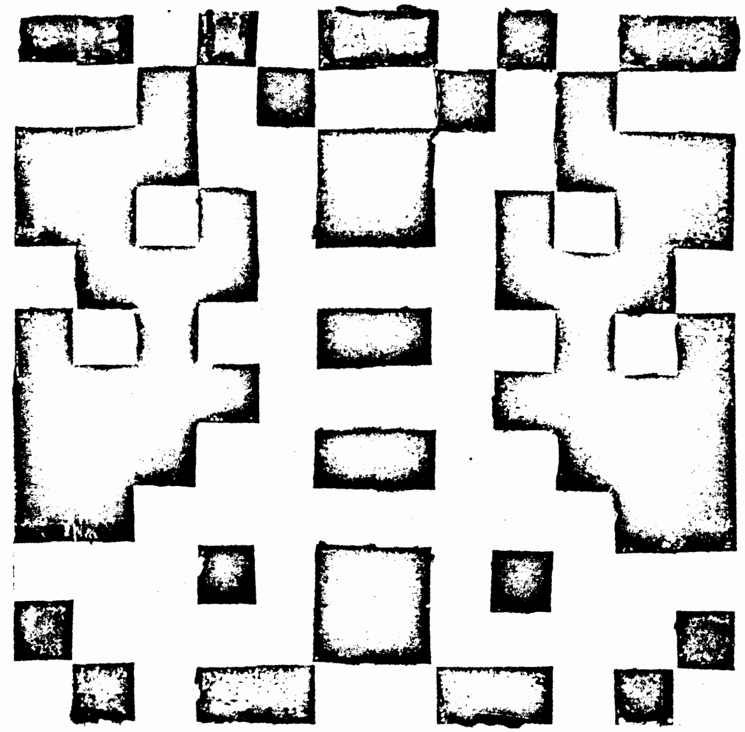
Number of Cells - 10x10; Score Value - 4



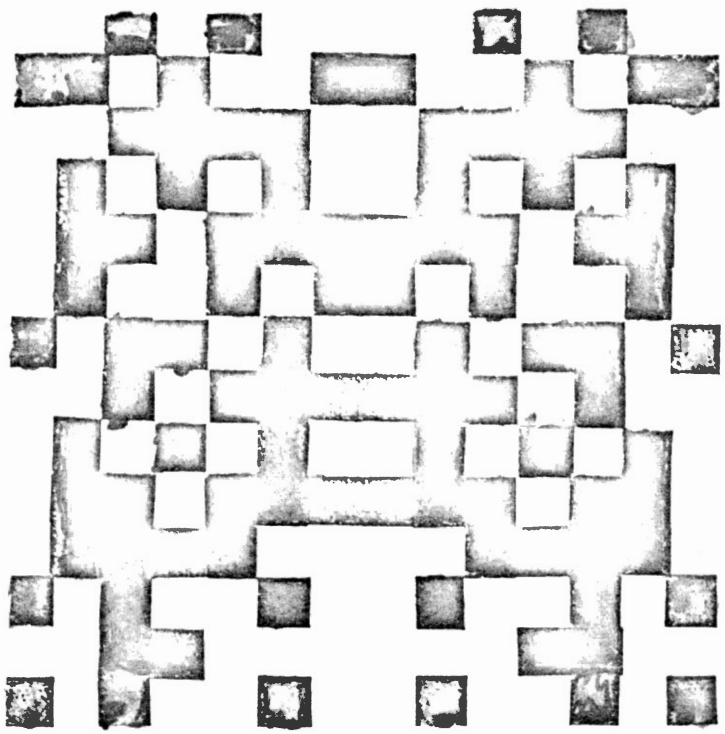
Number of Cells - 6x6; Score Value - 2



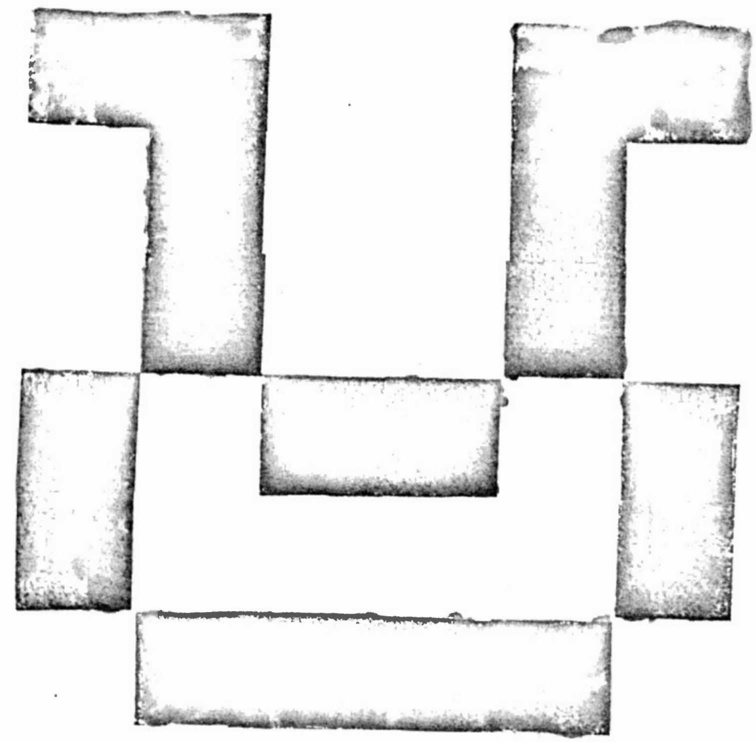
Number of Cells - 8x8; Score Value - 3



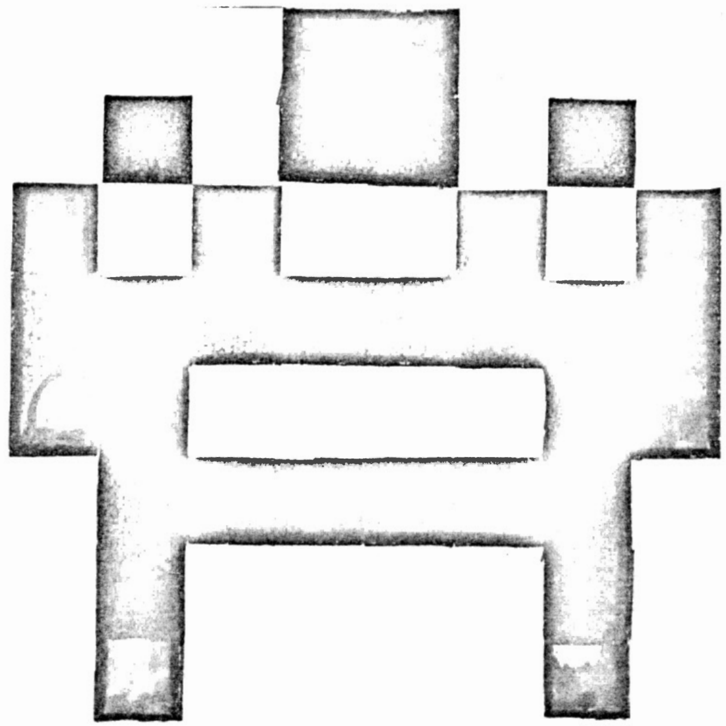
Number of Cells - 12x12; Score Value - 5



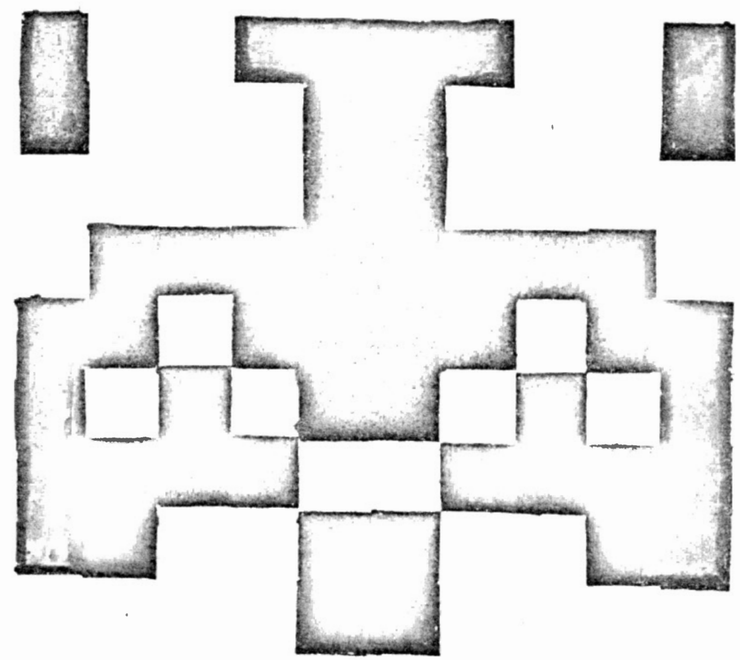
Number of Cells - 14x14; Score Value - 6



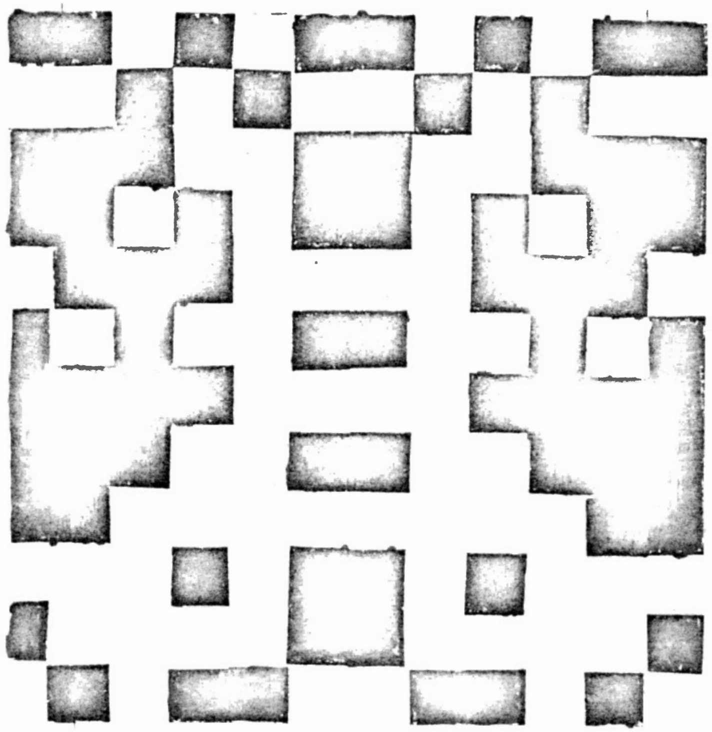
Number of Cells - 6x6; Score Value - 2



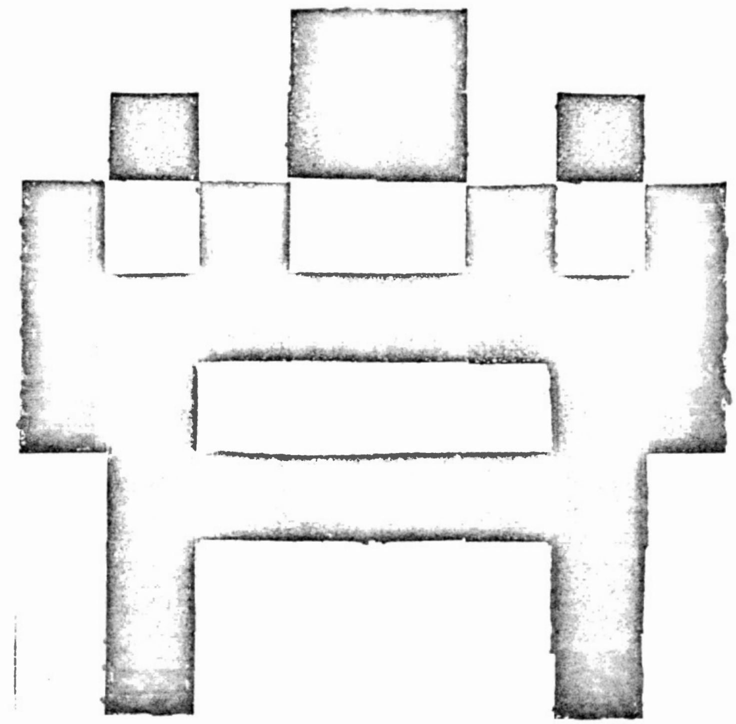
Number of Cells - 8x8; Score Value - 3



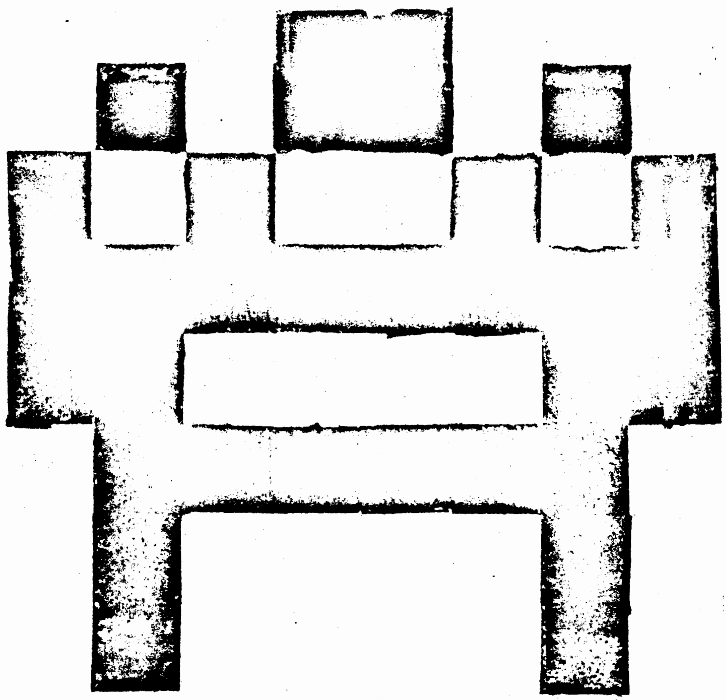
Number of Cells - 10x10; Score Value - 4



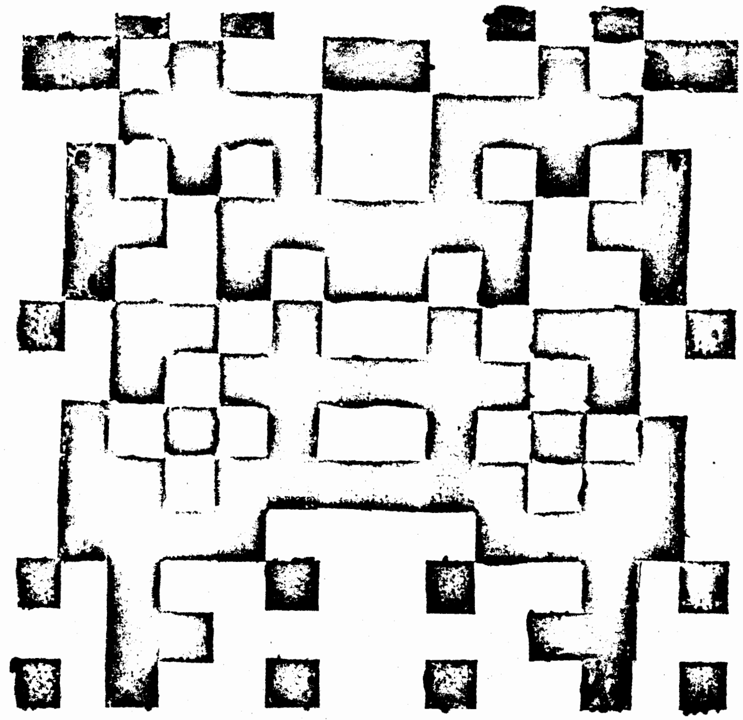
Number of Cells - 12x12; Score Value - 5



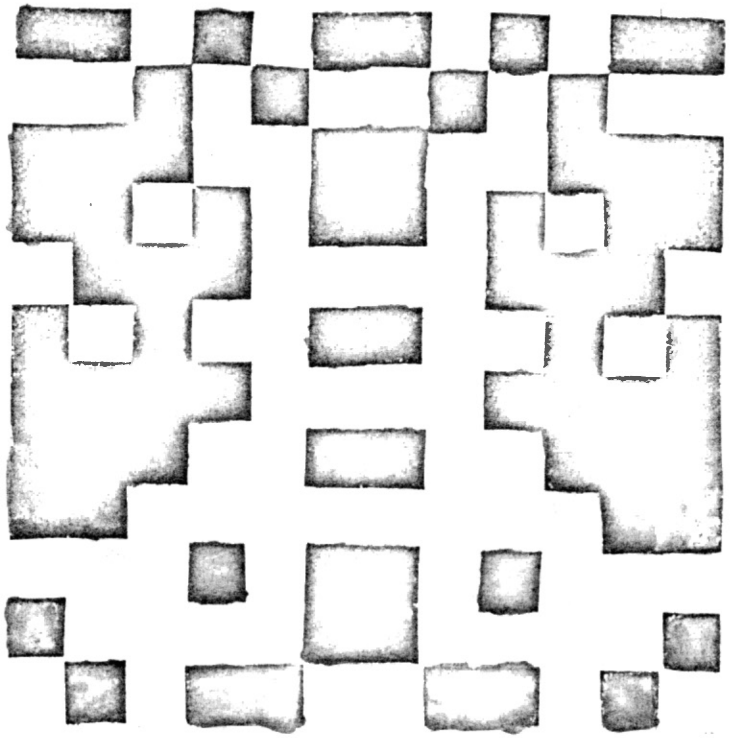
Number of Cells - 8x8; Score Value - 3



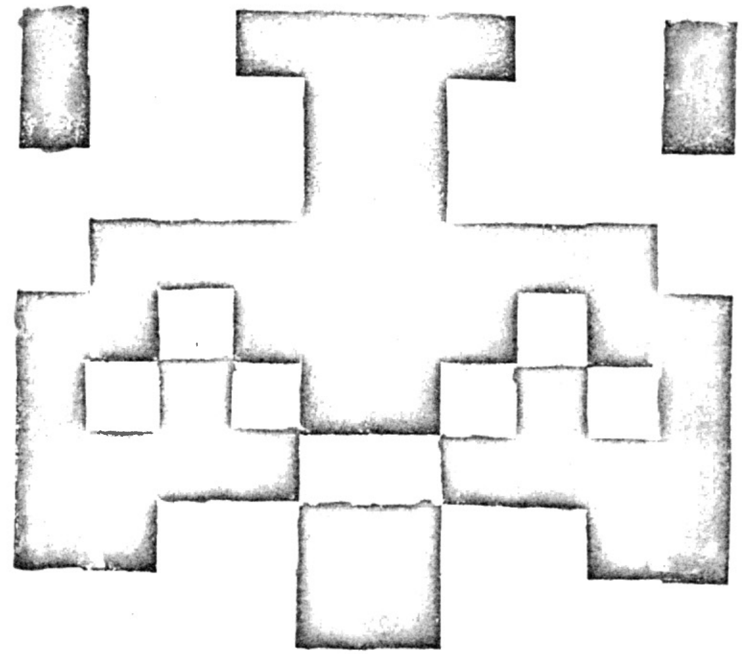
Number of Cells - 8x8; Score Value - 3



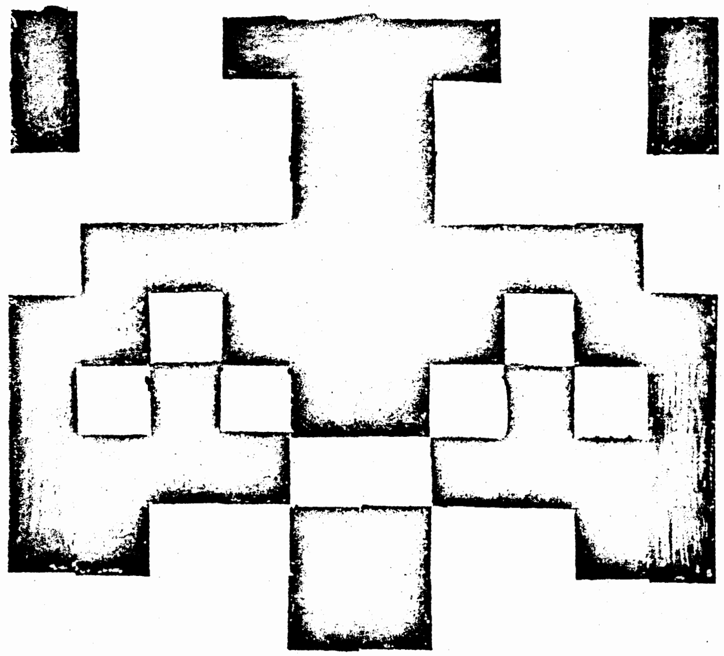
Number of Cells - 14x14; Score Value - 6



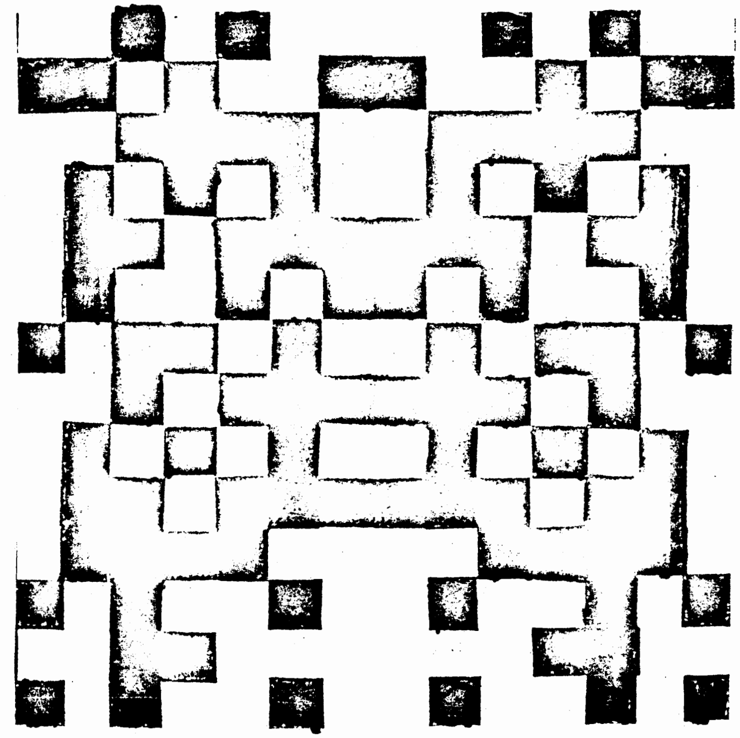
Number of Cells - 12x12; Score Value - 5



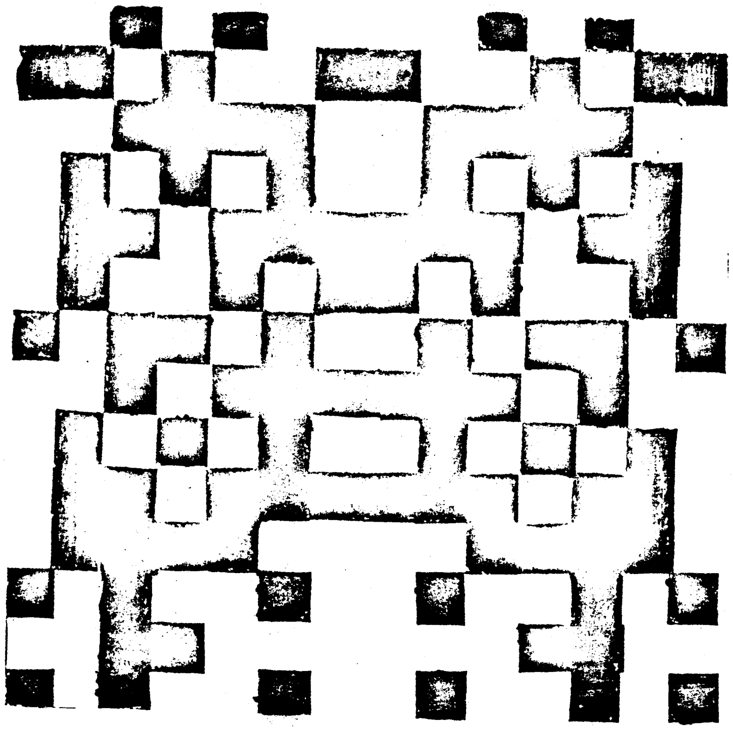
Number of Cells - 10x10; Score Value - 4



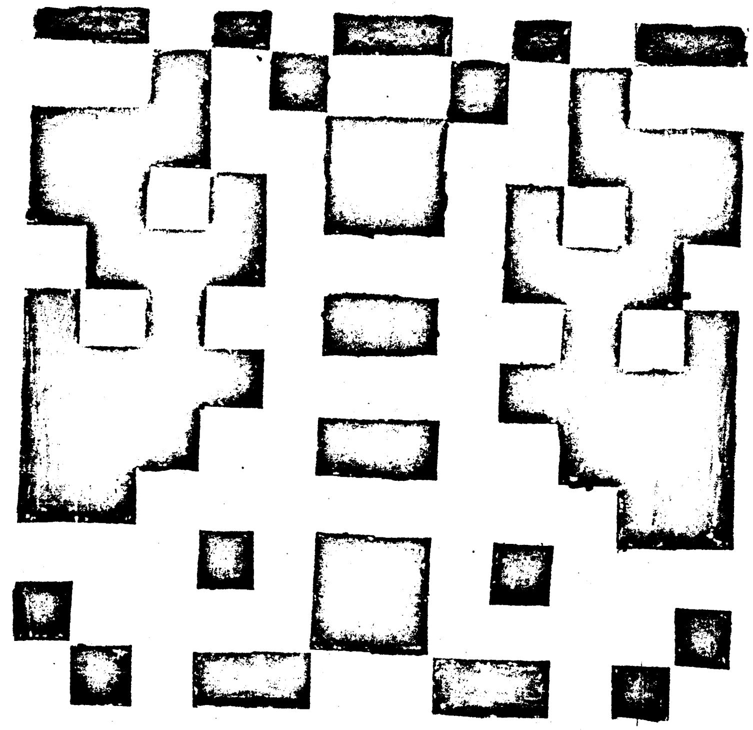
Number of Cells - 10x10; Score Value - 4



Number of Cells - 14x14; Score Value - 6



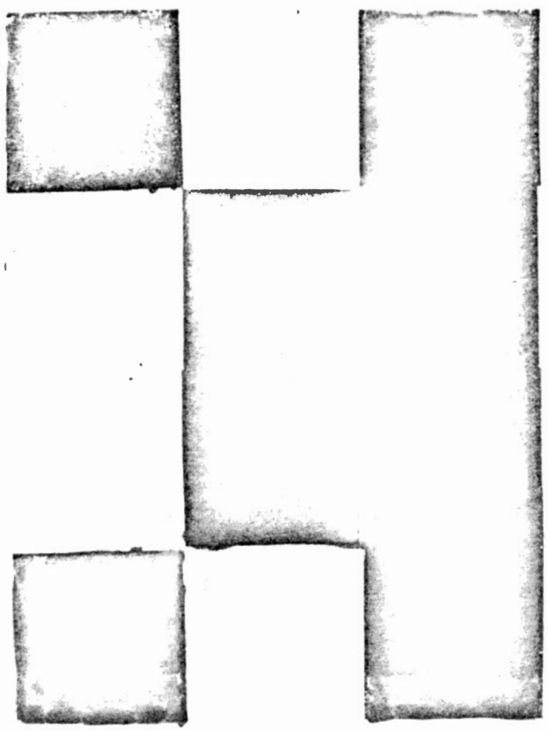
Number of Cells - 14x14; Score Value - 6



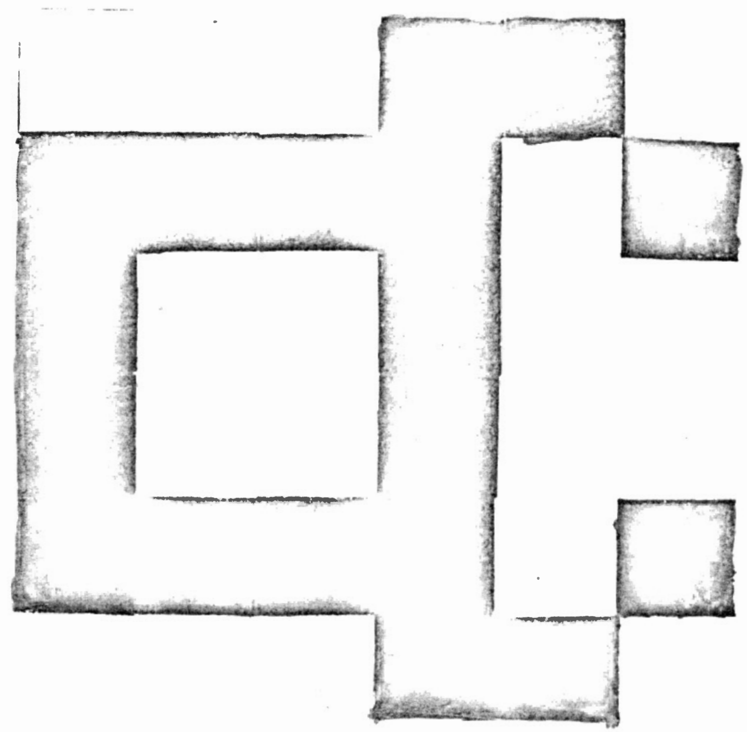
Number of Cells - 12x12; Score Value - 5

Set 2 (red)

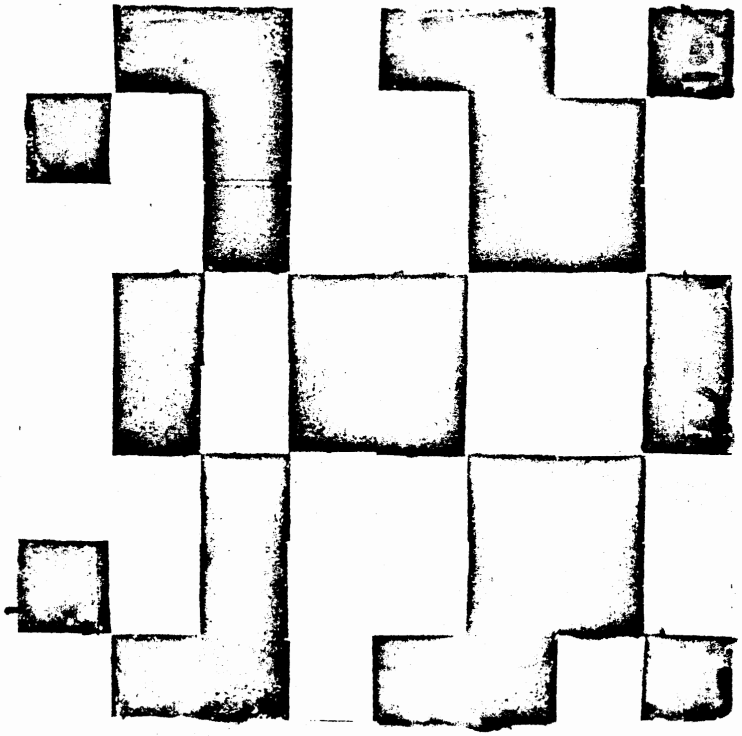
Horizontal Symmetry



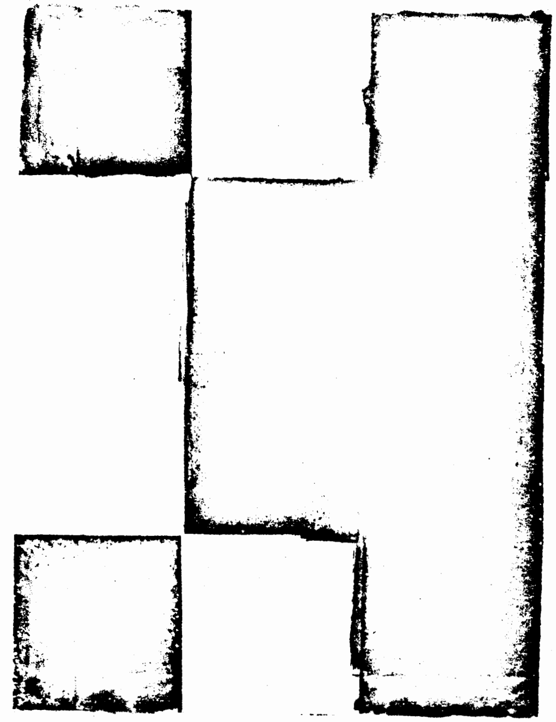
Number of Cells - 4x4; Score Value - 1



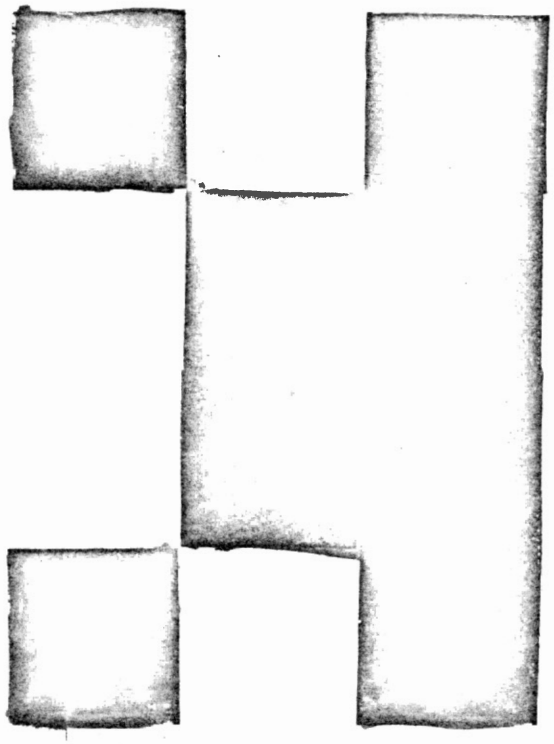
Number of Cells - 6x6; Score Value 2



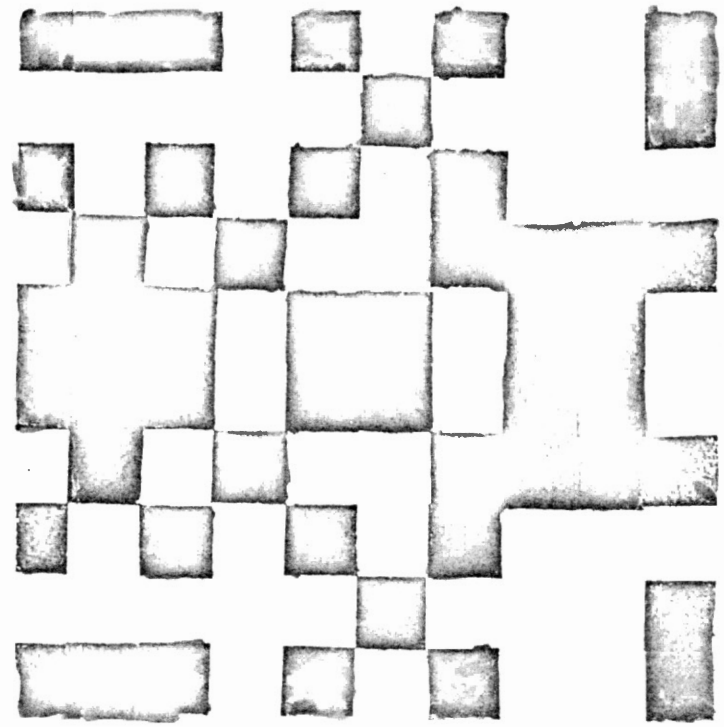
Number of Cells - 8x8; Score Value - 3



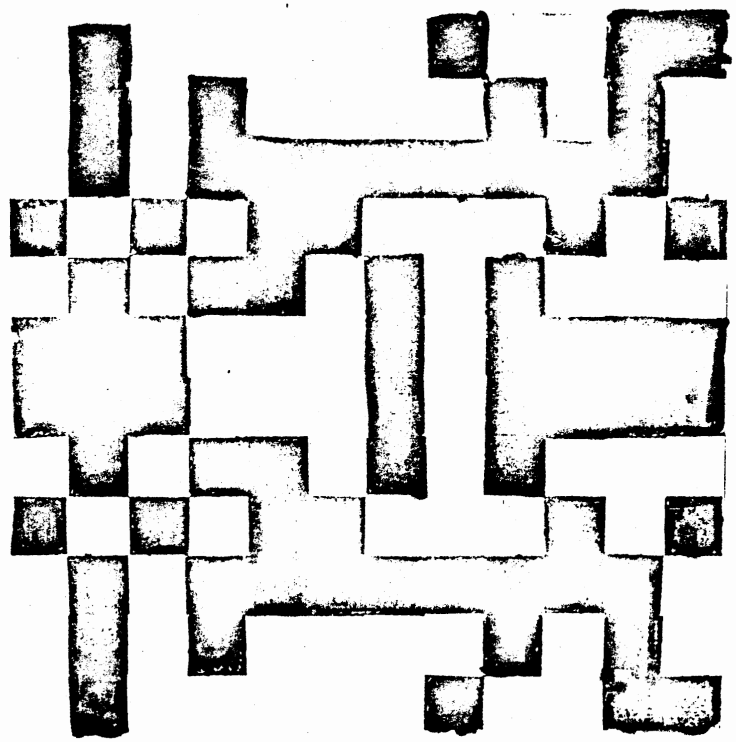
Number of Cells - 4x4; Score Value - 1



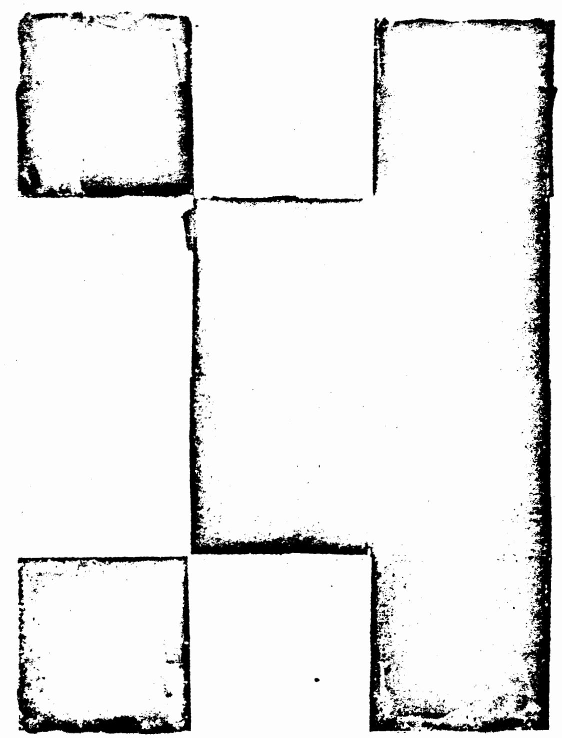
Number of Cells - 4x4; Score Value - 1



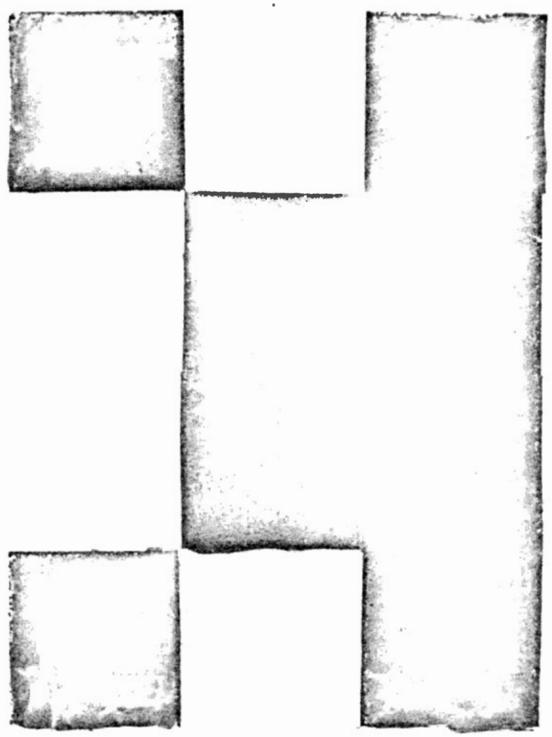
Number of Cells - 10x10; Score Value - 4



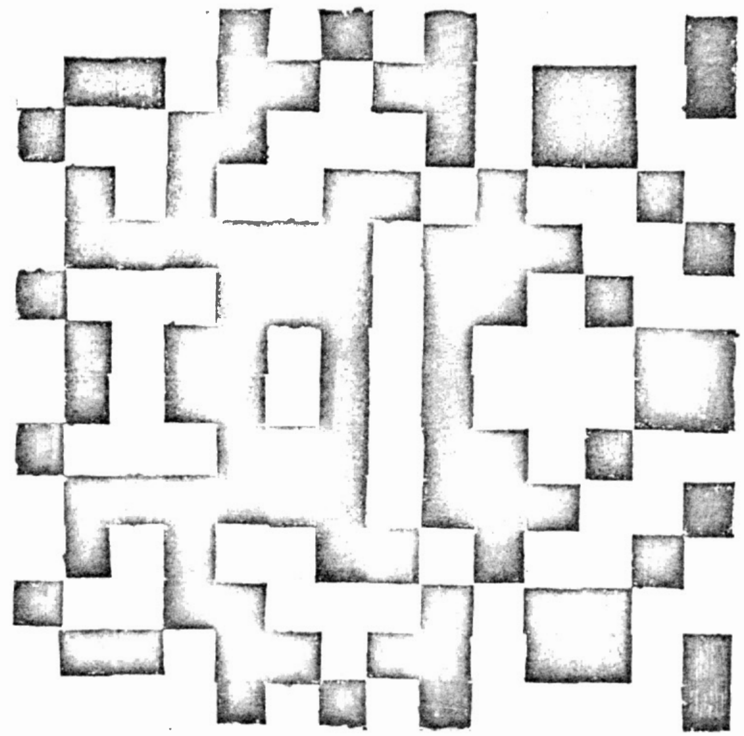
Number of Cells - 12x12; Score Value - 5



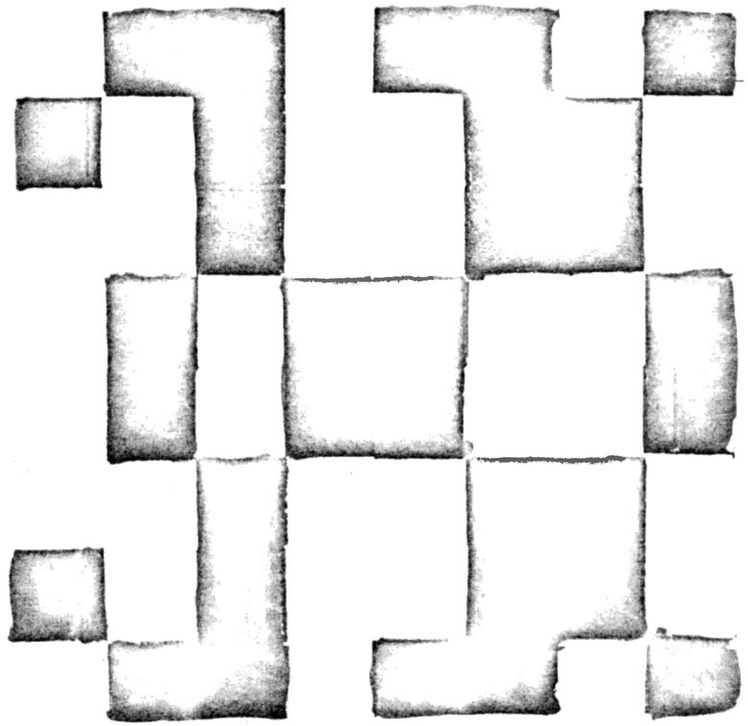
Number of Cells - 4x4; Score Value - 1



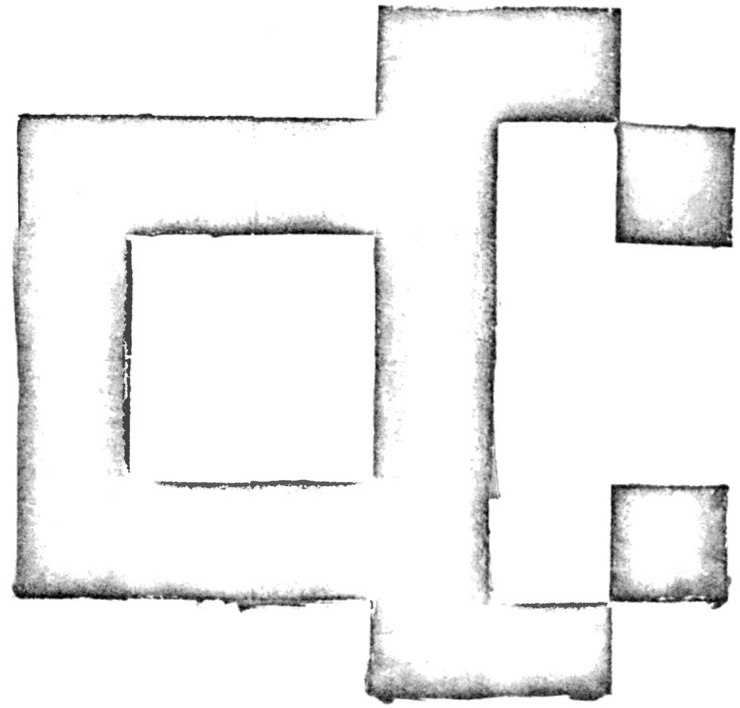
Number of Cells - 4x4; Score Value - 1



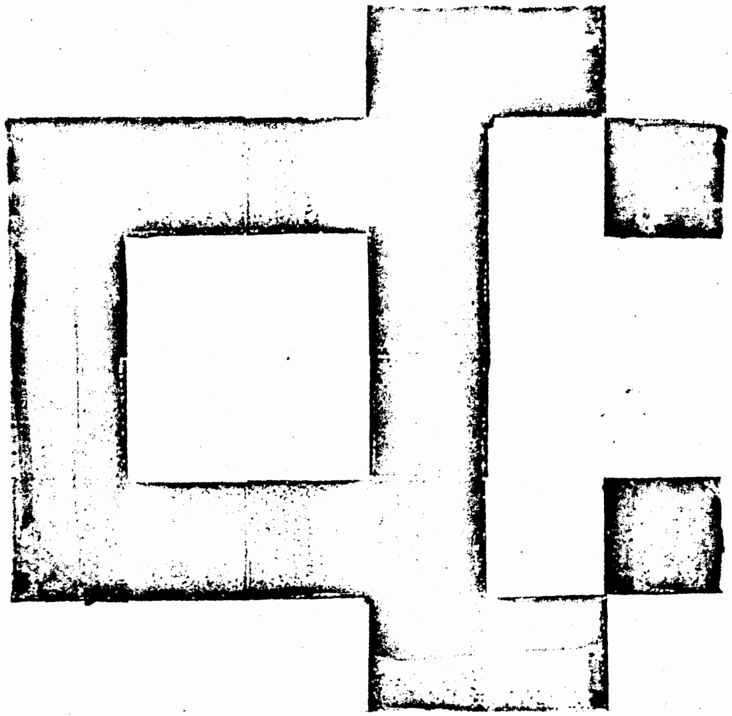
Number of Cells - 14x14; Score Value - 6



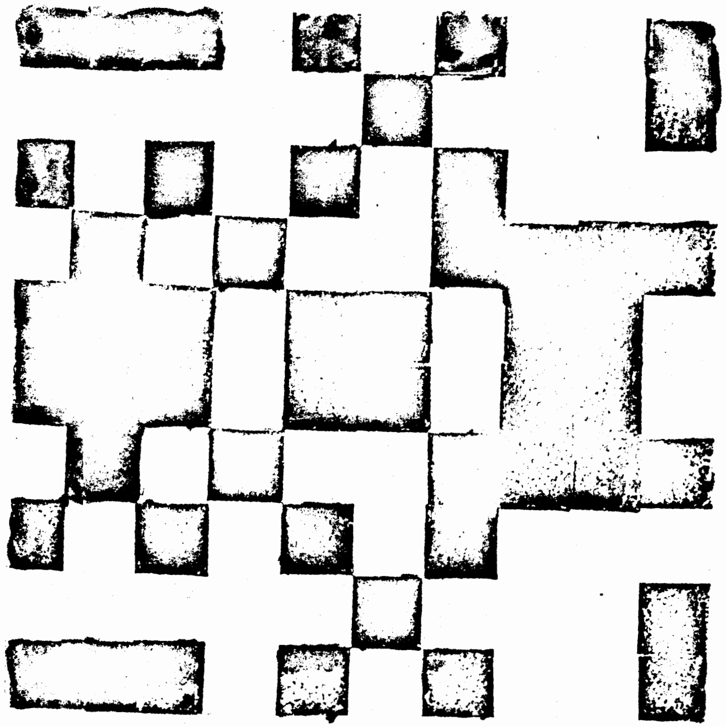
Number of Cells - 8x8; Score Value - 3



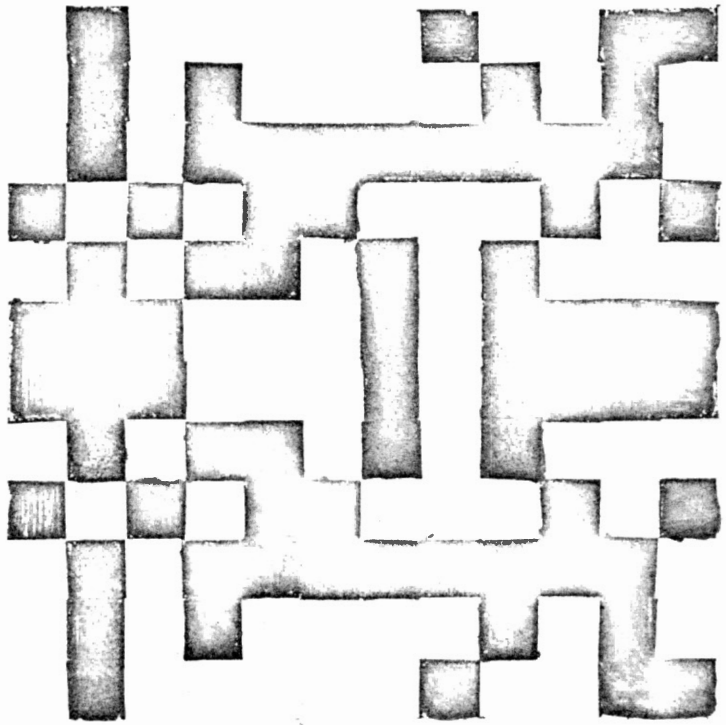
Number of Cells - 6x6; Score Value - 2



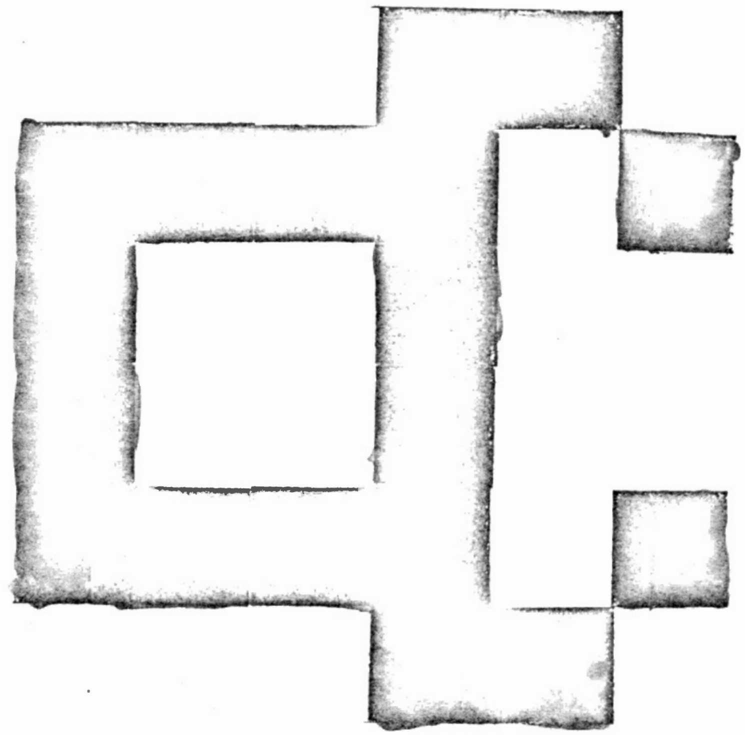
Number of Cells - 6x6; Score Value - 2



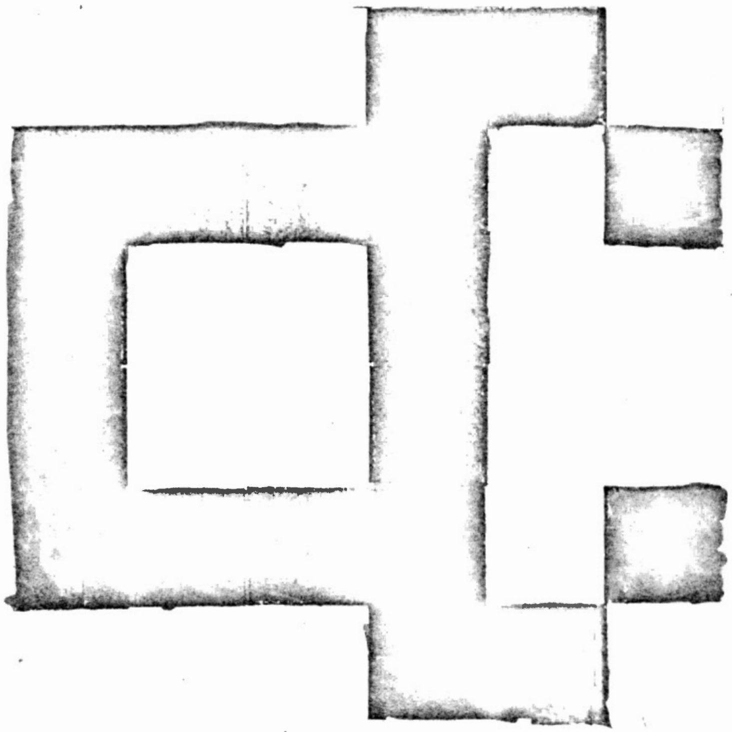
Number of Cells - 10x10; Score Value - 4



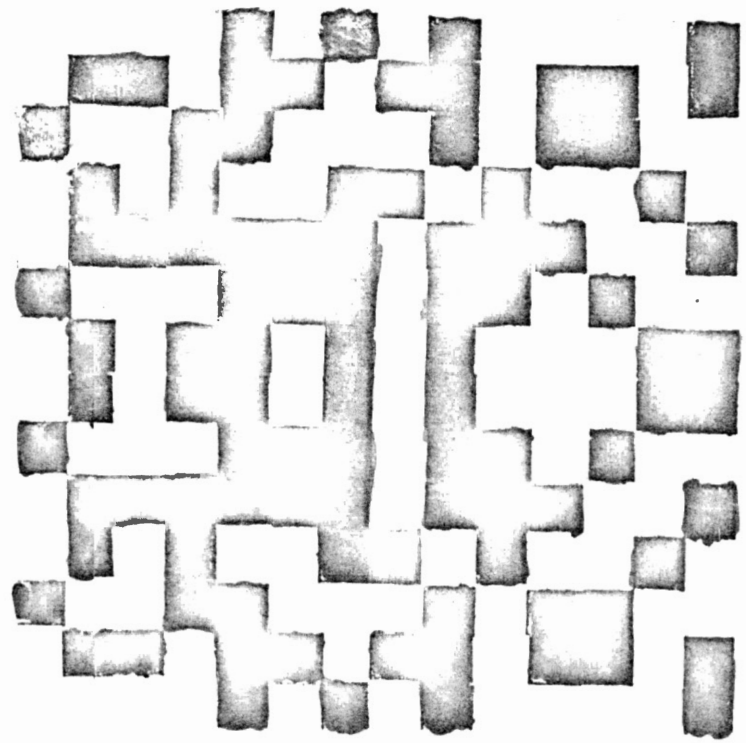
Number of Cells - 12x12; Score Value - 5



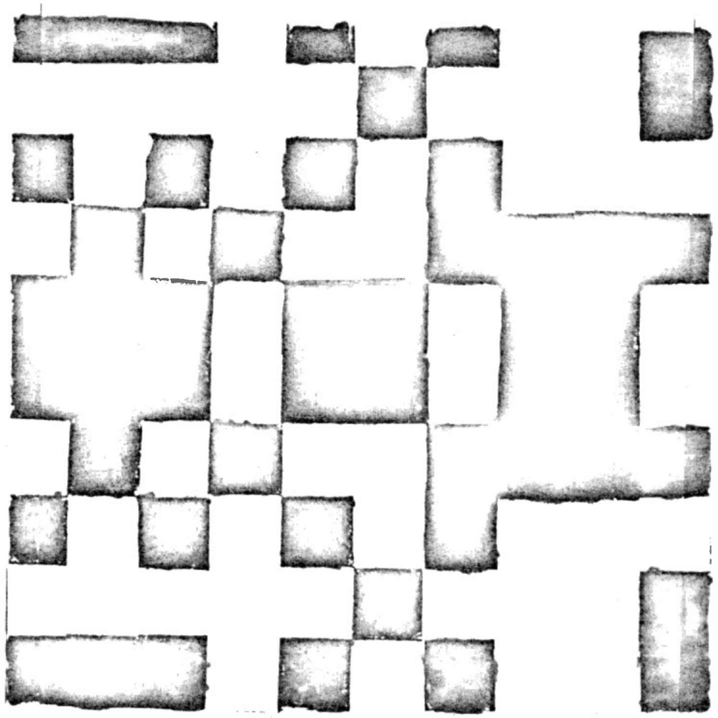
Number of Cells - 6x6; Score Value - 2



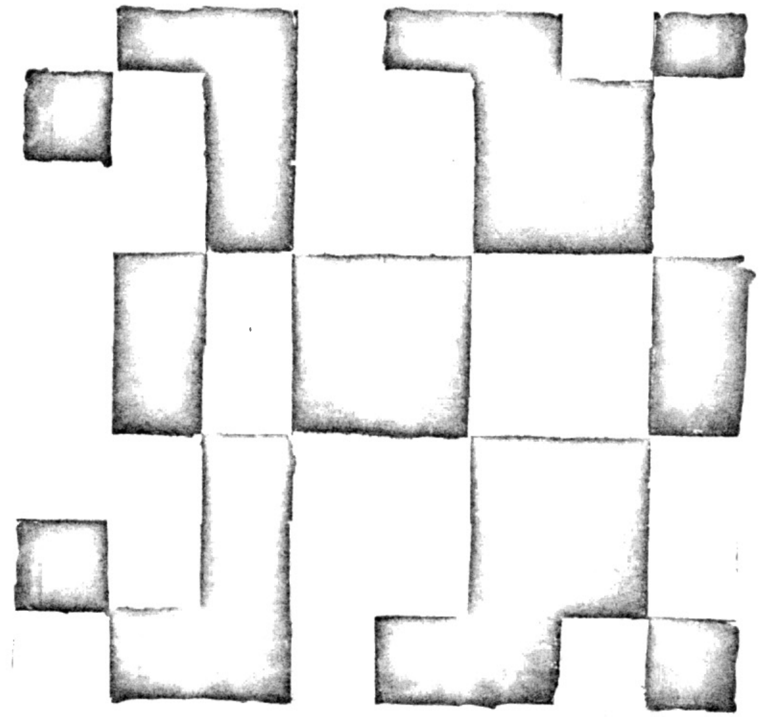
Number of Cells - 6x6; Score Value - 2



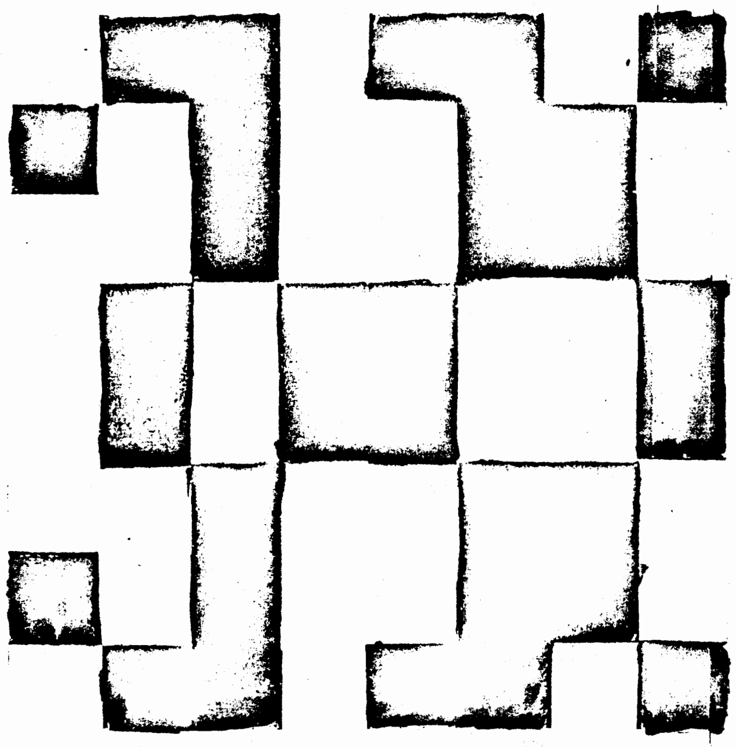
Number of Cells - 14x14; Score Value - 6



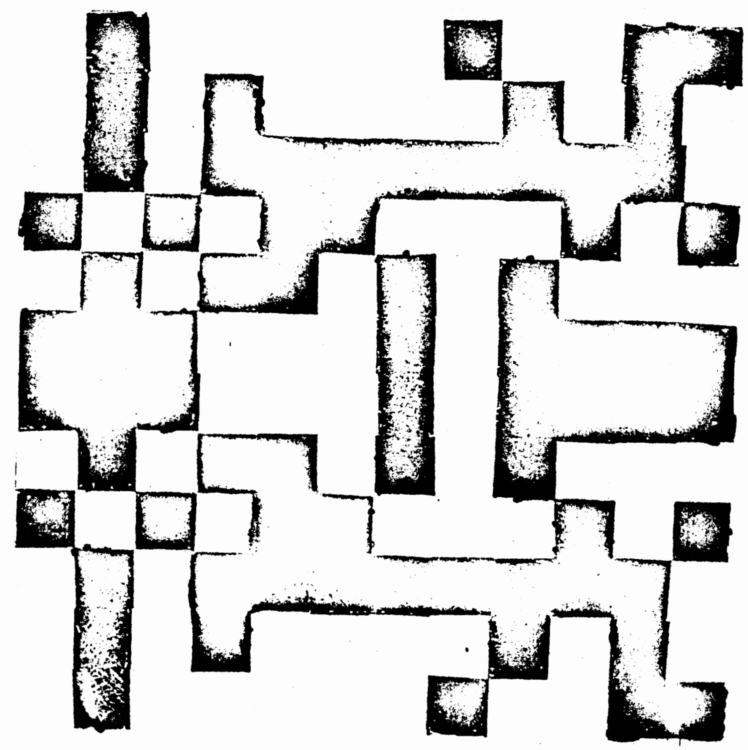
Number of Cells - 10x10; Score Value - 4



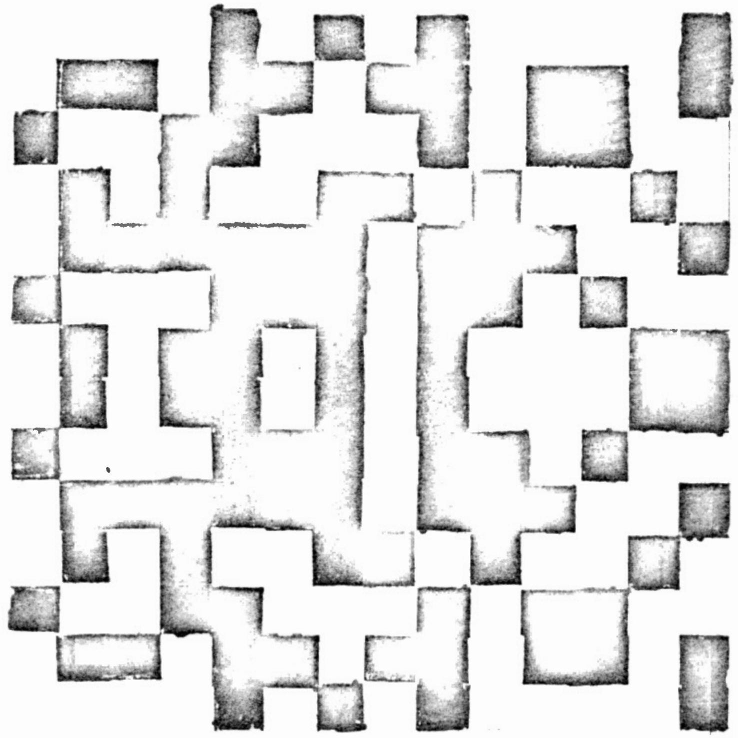
Number of Cells - 8x8; Score Value - 3



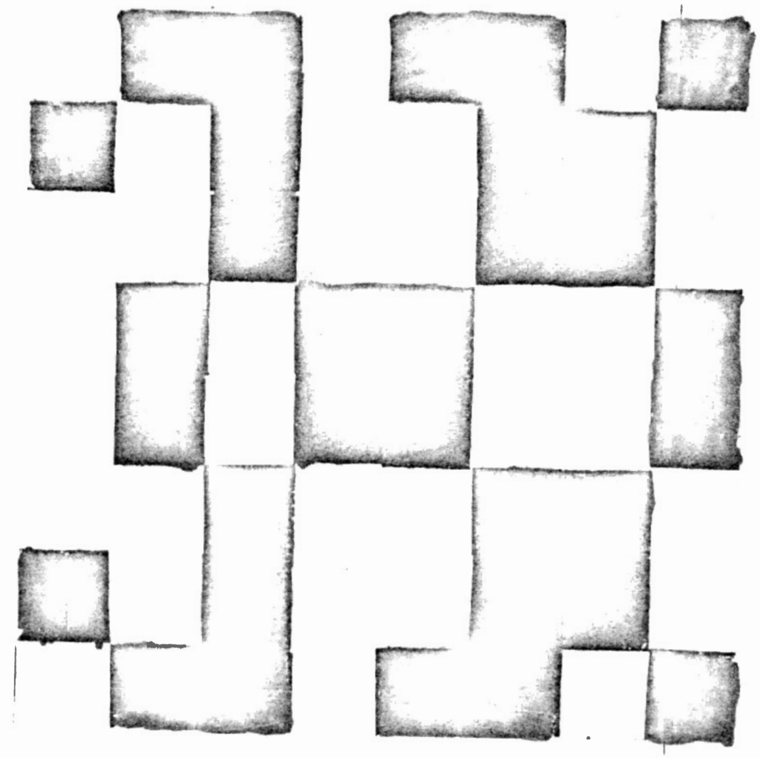
Number of Cells - 8x8; Score Value - 3



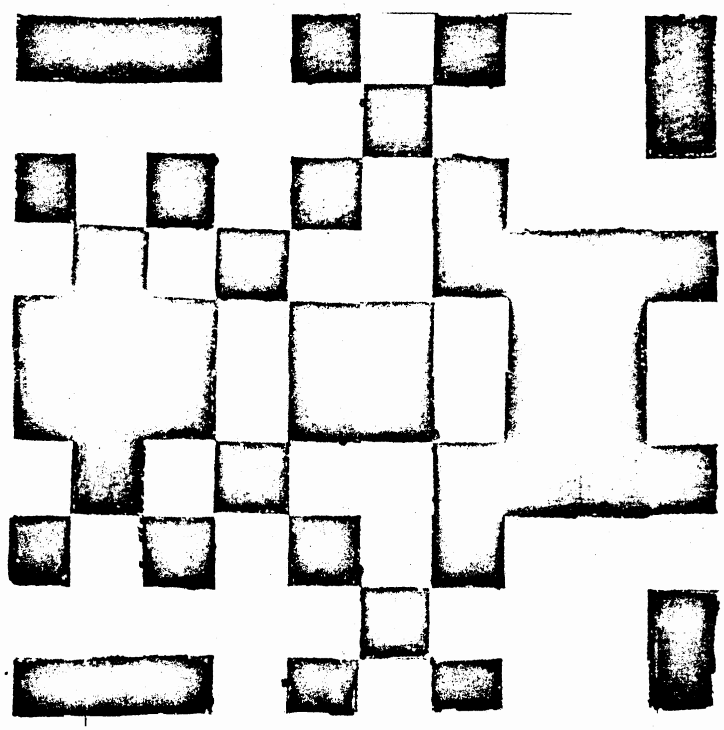
Number of Cells - 12x12; Score Value - 5



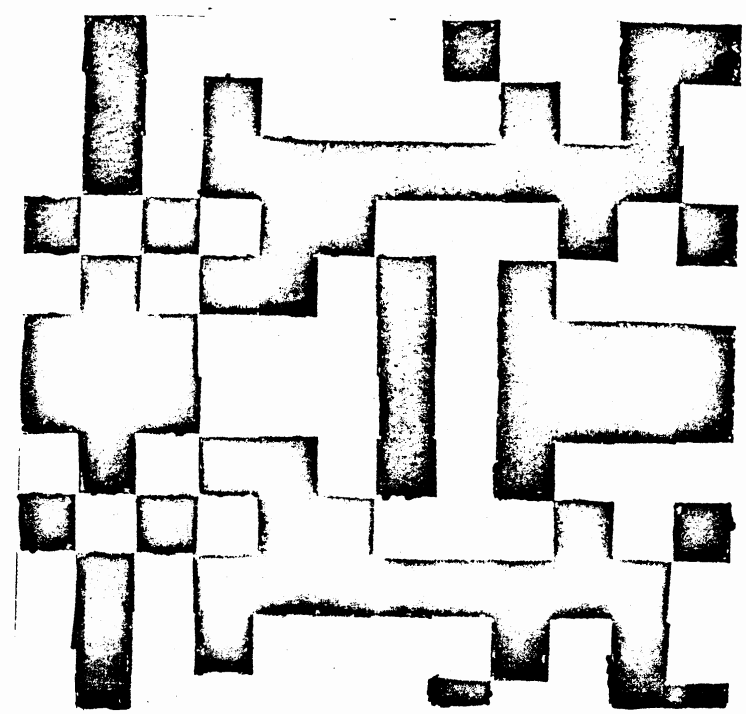
Number of Cells - 14x14; Score Value - 6



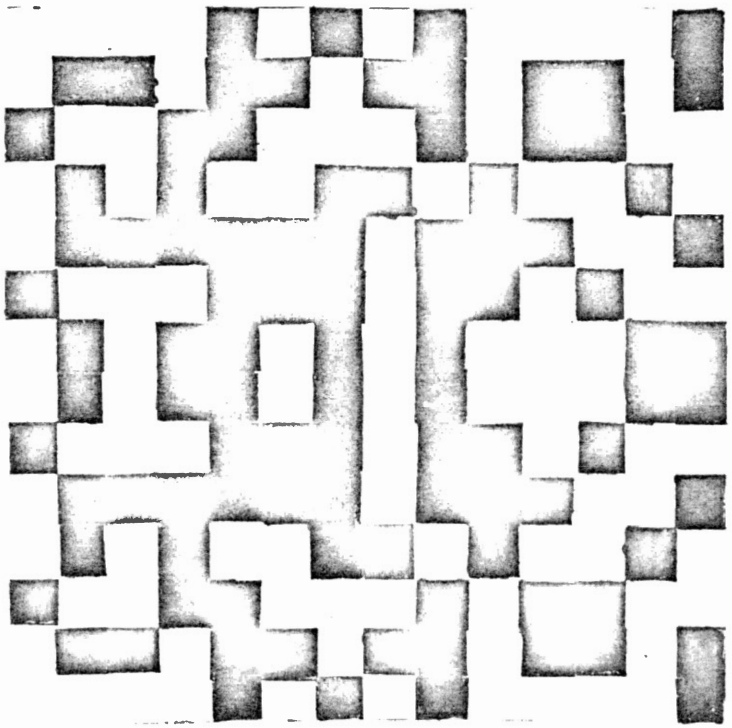
Number of Cells - 8x8; Score Value - 3



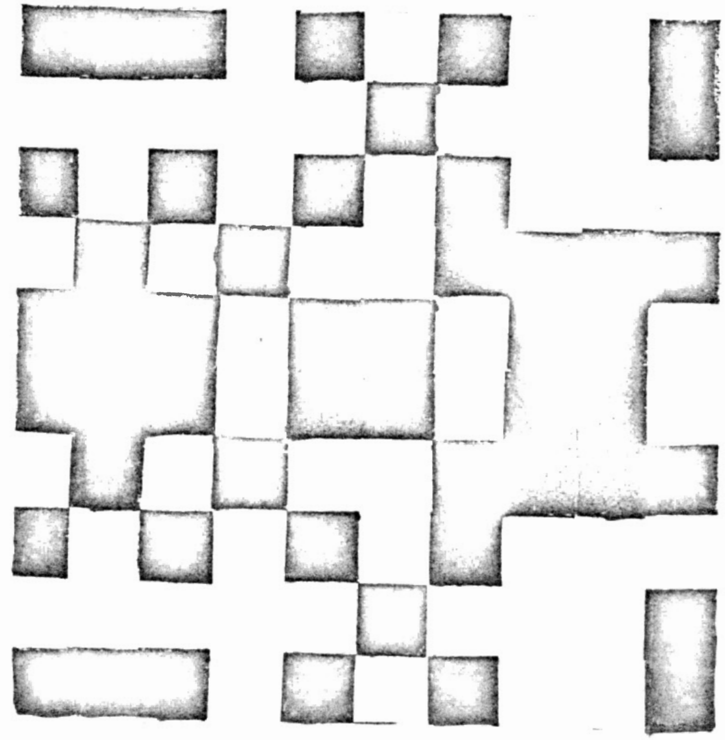
Number of Cells - 10x10; Score Value - 4



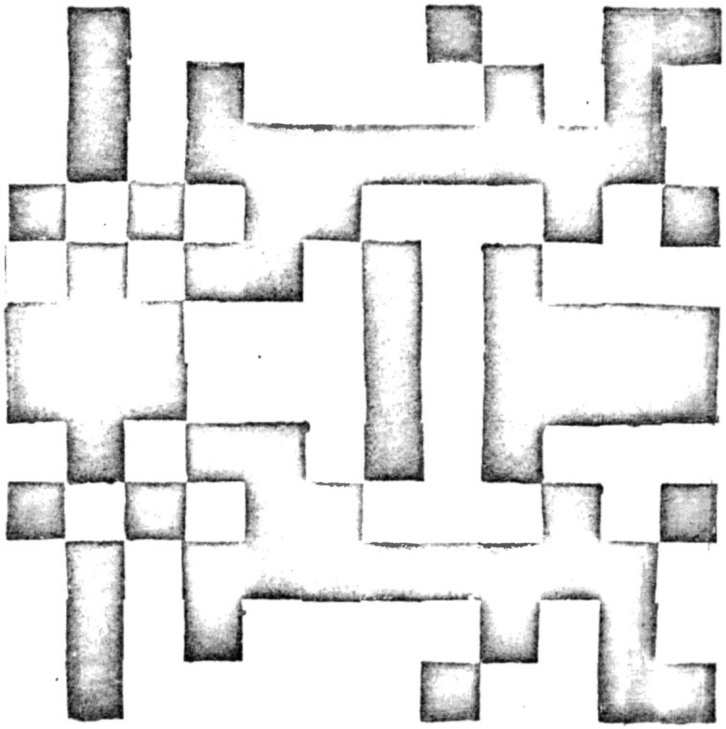
Number of Cells - 12x12; Score Value - 5



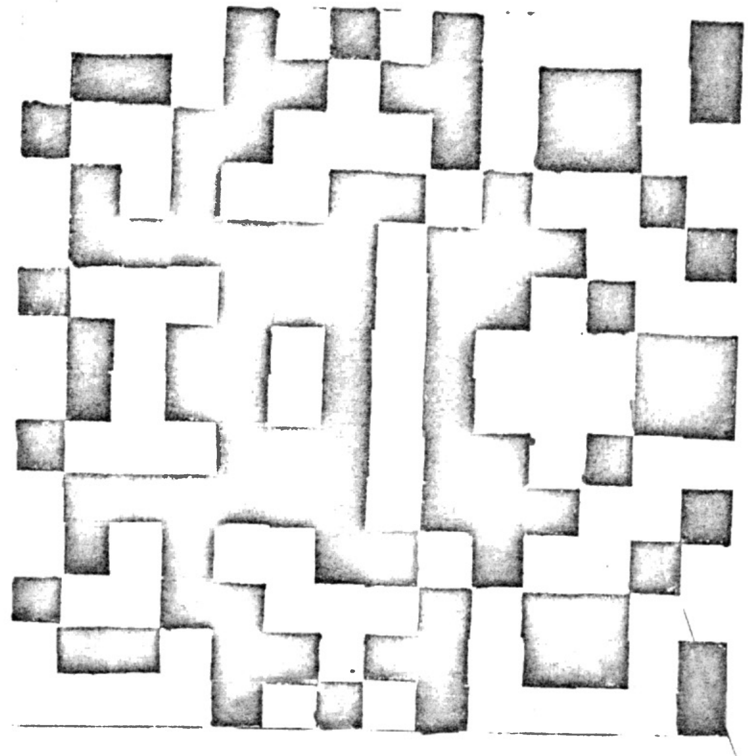
Number of Cells - 14x14; Score Value - 6



Number of Cells - 10x10; Score Value - 4



Number of Cells - 12x12; Score Value - 5



Number of Cells - 14x14; Score Value - 6

CHECKERBOARD PATTERNS RESPONSE FORM

Child's Name ______________________________

Set 1 - Vertical (blue)		Set 2 - Horizontal (red)	
1.	2 - 1	1.	1 - 2
2.	1 - 3	2.	3 - 1
3.	4 - 1	3.	1 - 4
4.	1 - 5	4.	5 - 1
5.	6 - 1	5.	1 - 6
6.	2 - 3	6.	3 - 2
7.	4 - 2	7.	2 - 4
8.	2 - 5	8.	5 - 2
9.	6 - 2	9.	2 - 6
10.	3 - 4	10.	4 - 3
11.	5 - 3	11.	3 - 5
12.	3 - 6	12.	6 - 3
13.	5 - 4	13.	4 - 5
14.	4 - 6	14.	6 - 4
15.	6 - 5	15.	5 - 6

Set 1 Score ______

Set 2 Score ______

Scoring Key

Number of Matrix Cells	Score Value
4 x 6	1
6 x 6	2
8 x 8	3
10 x 10	4
12 x 12	5
14 x 14	6

Comments:

Total Score ____________

APPENDIX E

VISUAL STIMULUS COMPLEXITY MEASURE #3 SIMPLE-COMPLEX

DESIGNS AND RESPONSE FORM

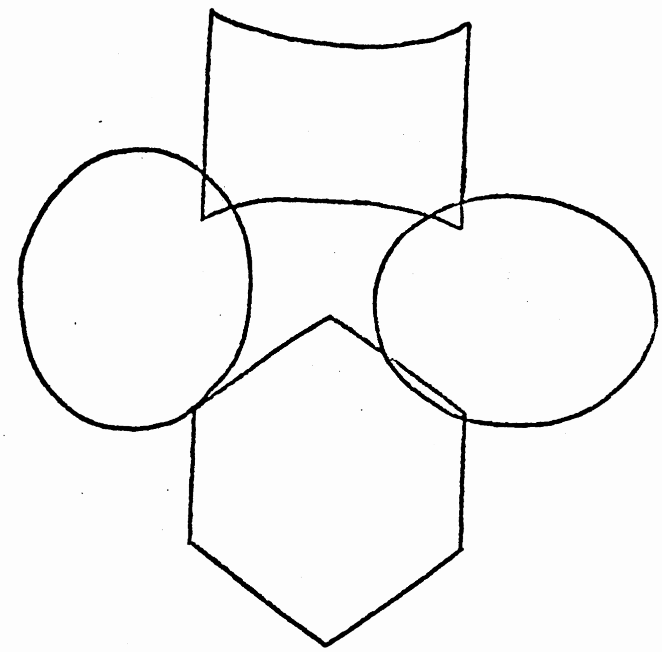
Set 1 - Red

KEY

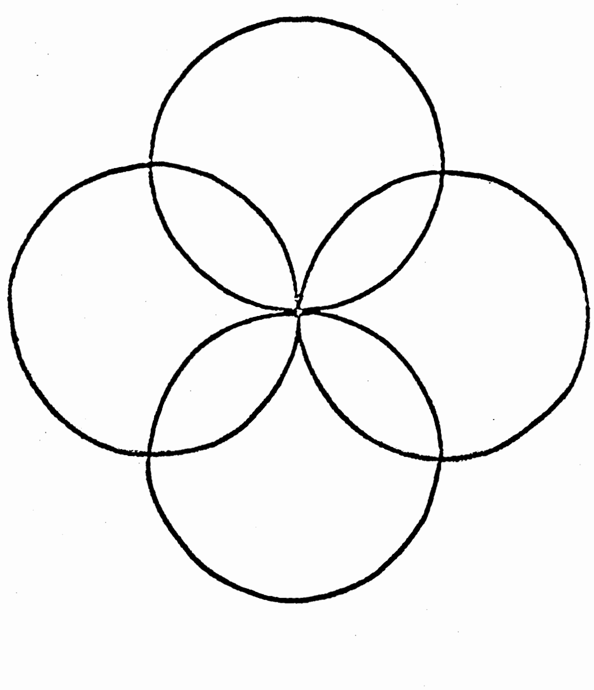
Complexity Dimension

1. Homogeneity/heterogeneity of elements
2. Regular/irregular arrangement
3. Amount of material
4. Regularity/irregularity of contour
5. Congruity/incongruity of elements

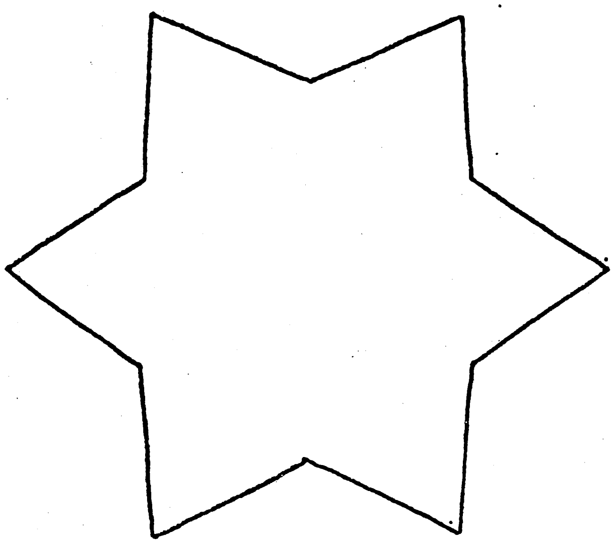
S - Simple C - Complex



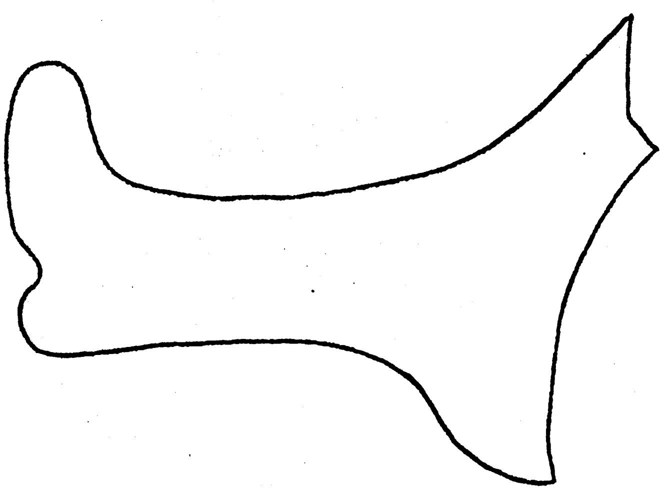
1 - C



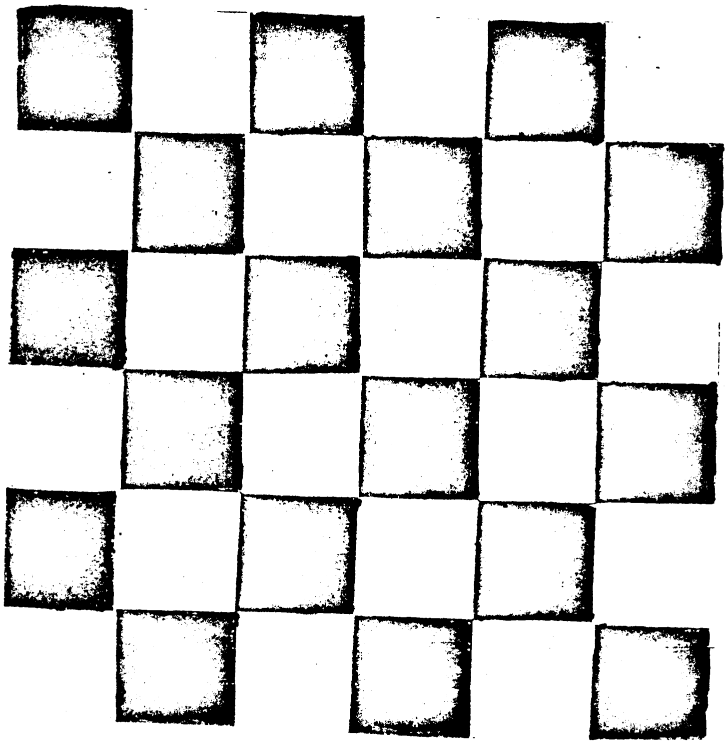
1 - S



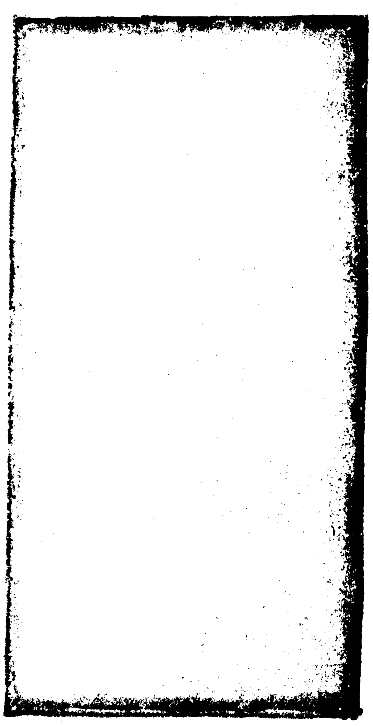
4 - S



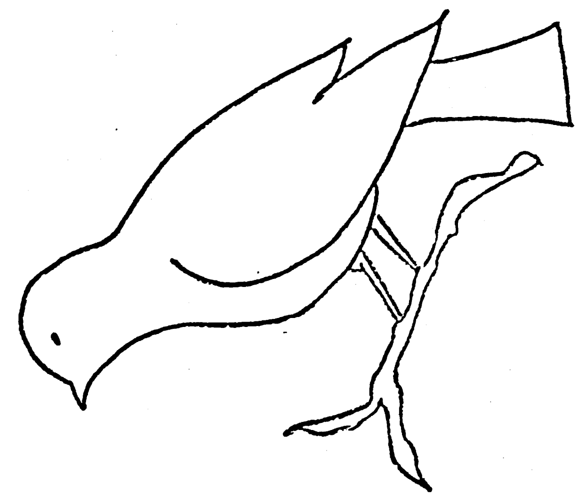
4 - C



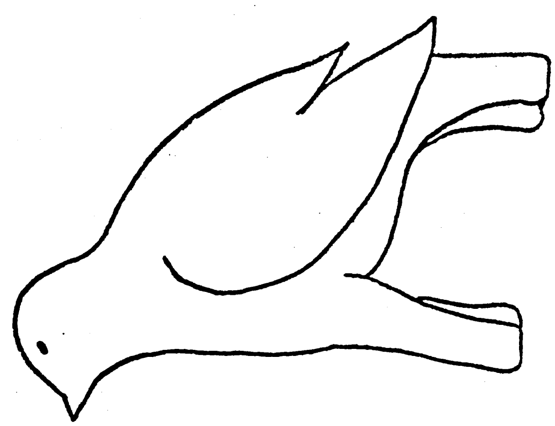
3 - C



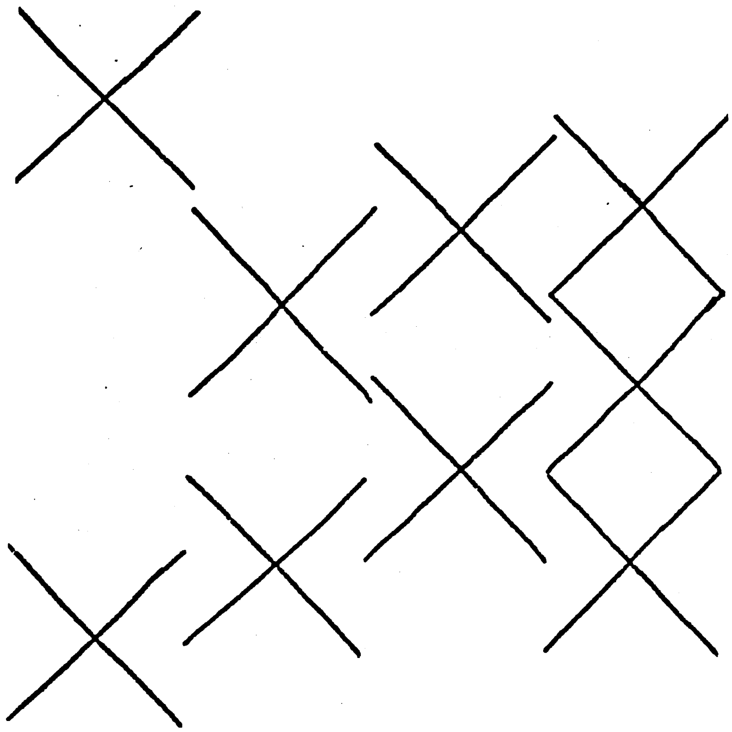
3 - S



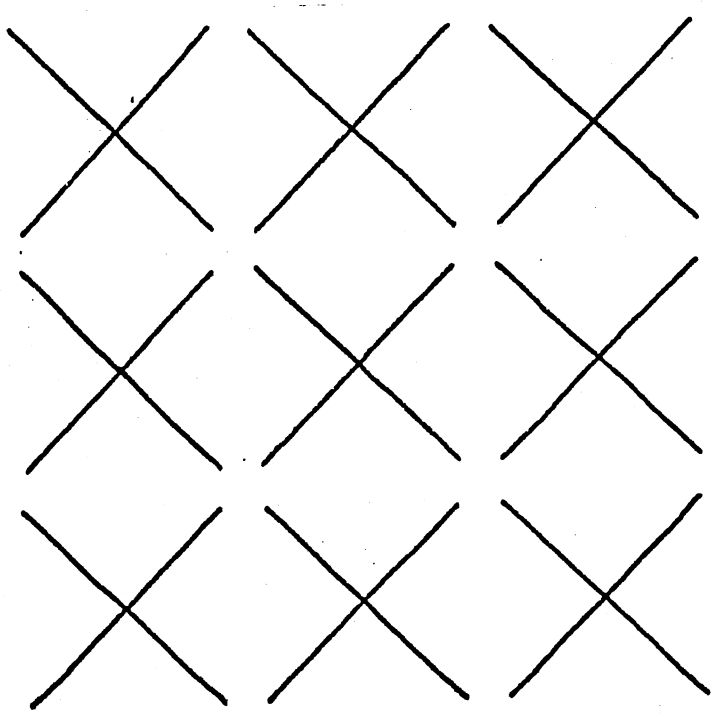
5 - S



5 - C



2 – C



2 – S

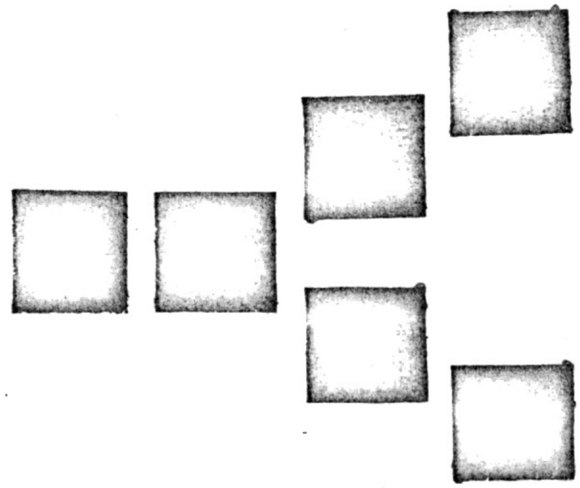
Set 2 - Yellow

KEY

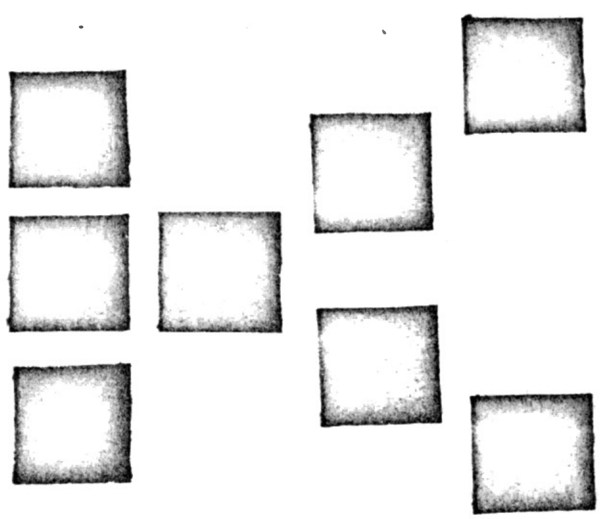
Complexity Dimension

1. Homogeneity/heterogeneity of elements
2. Regular/irregular arrangement
3. Amount of material
4. Regularity/irregularity of contour
5. Congruity/incongruity of elements

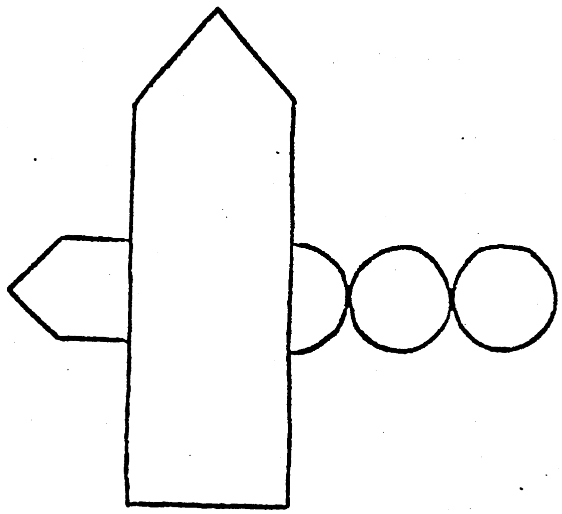
S - Simple C - Complex



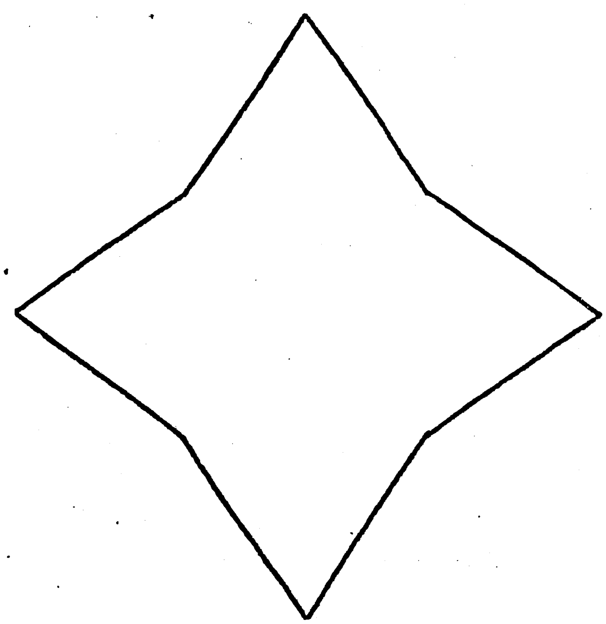
3 – S



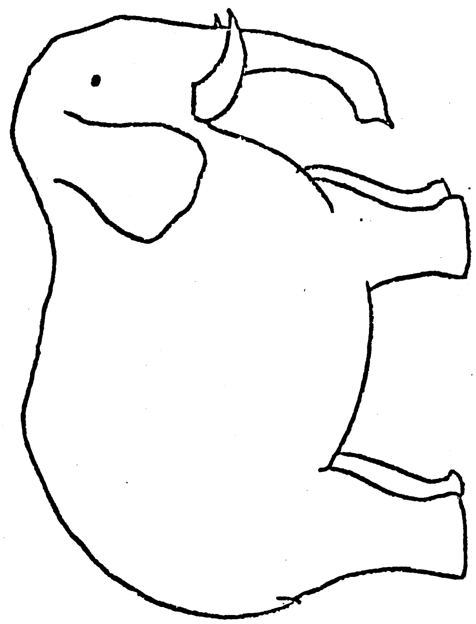
3 – C



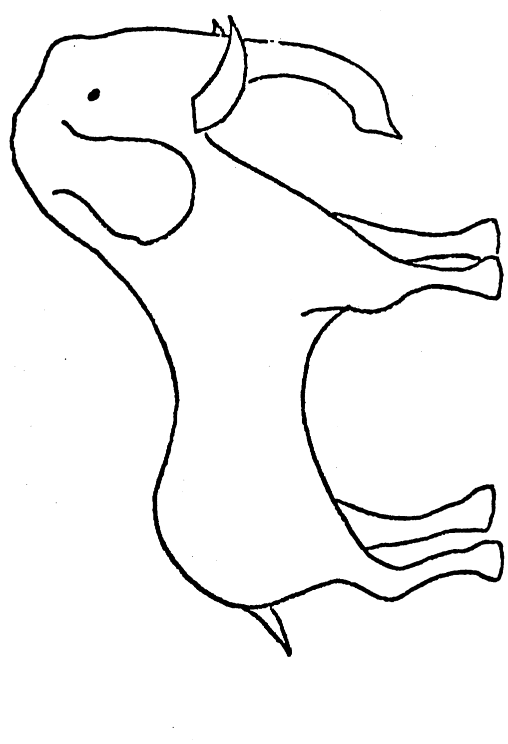
1 - C



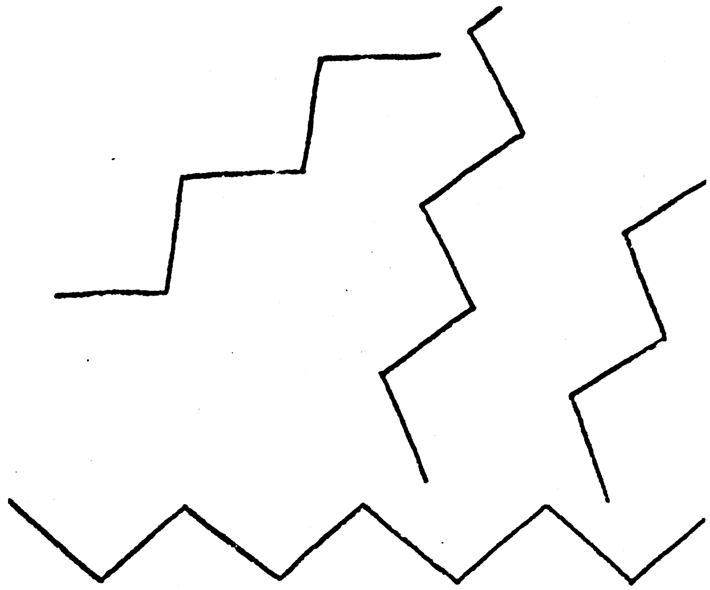
1 - S



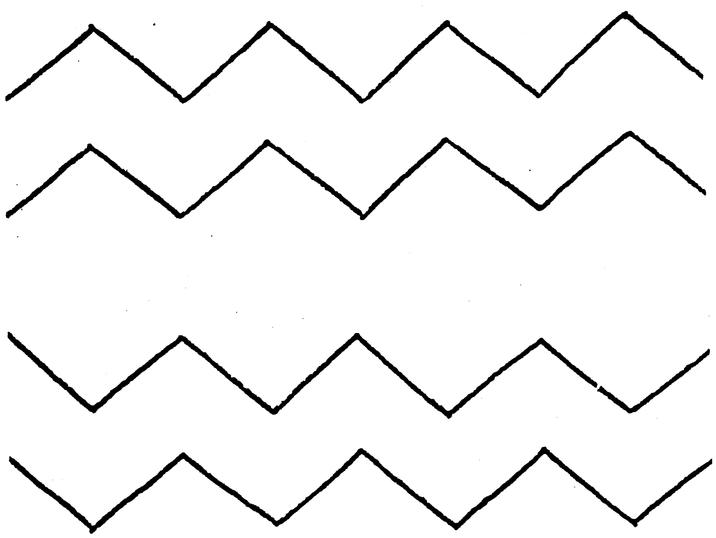
5 - S



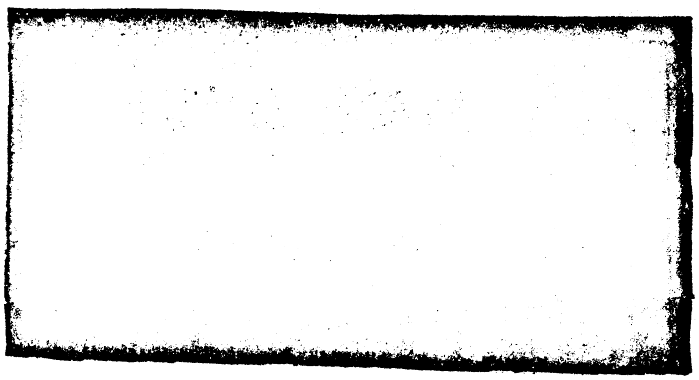
5 - C



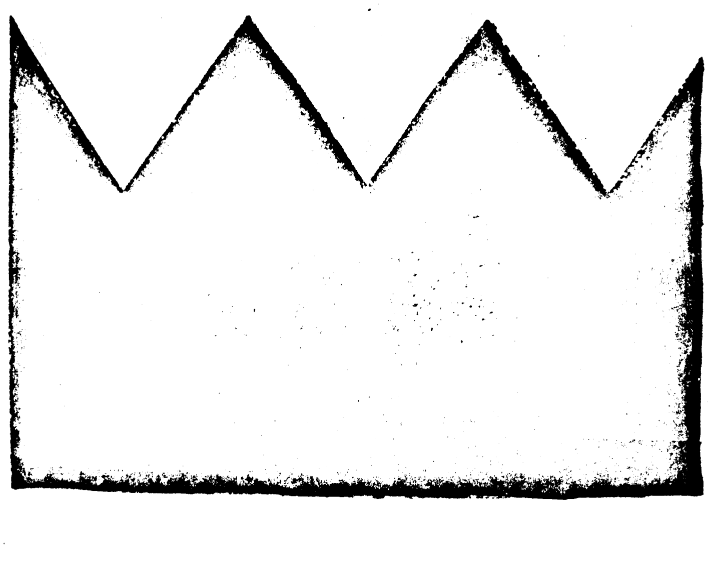
2 - C



2 - S



4 – S



4 – C

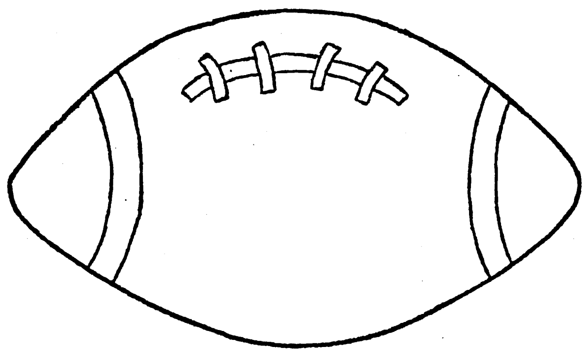
Set 3 - Green

KEY

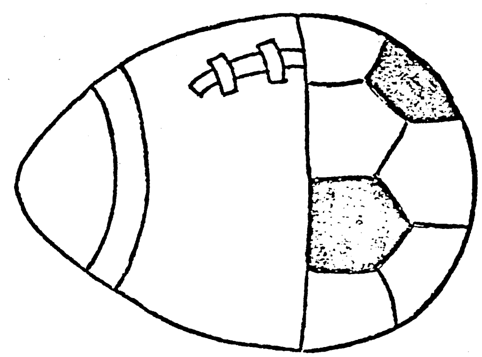
Complexity Dimension

1. Homogeneity/heterogeneity of elements
2. Regular/irregular arrangement
3. Amount of material
4. Regularity/irregularity of contour
5. Congruity/incongruity of elements

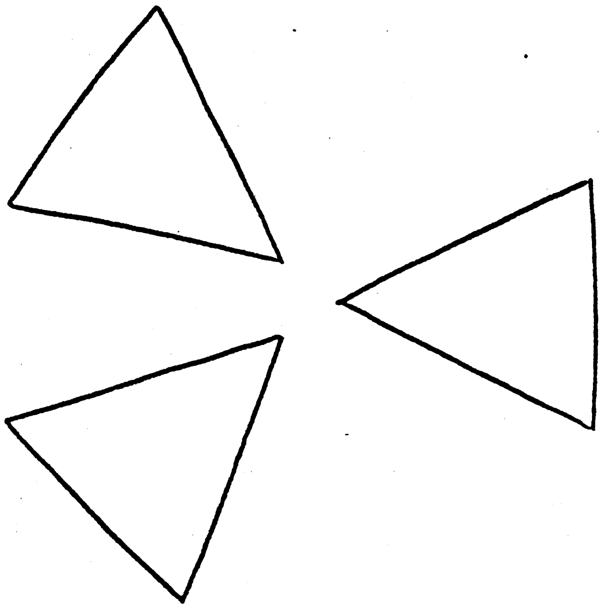
S - Simple C - Complex



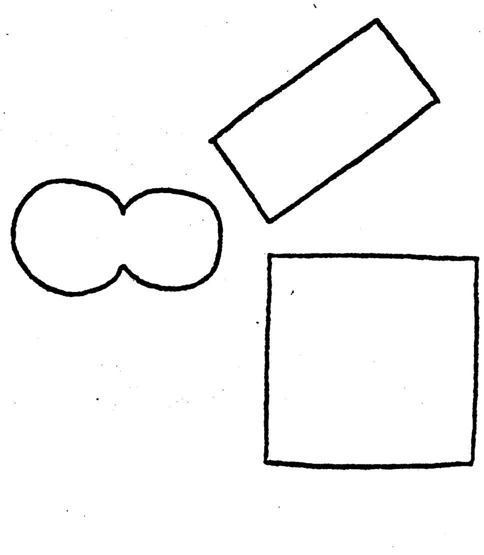
5 - S



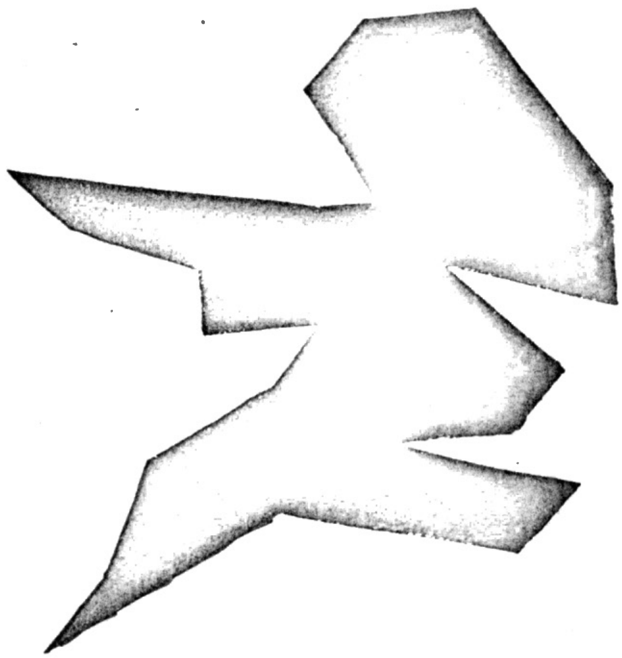
5 - C



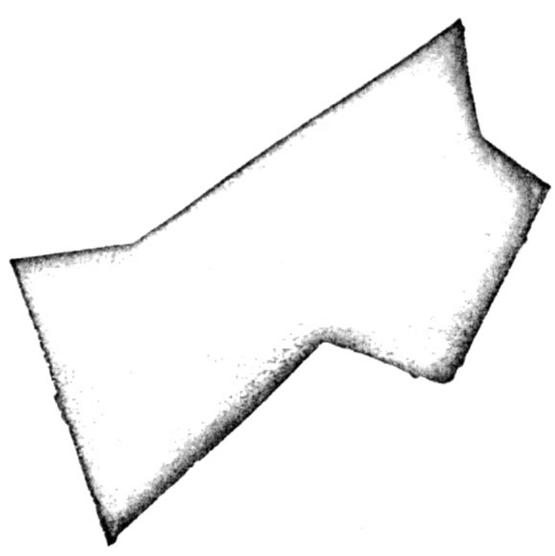
1 - S



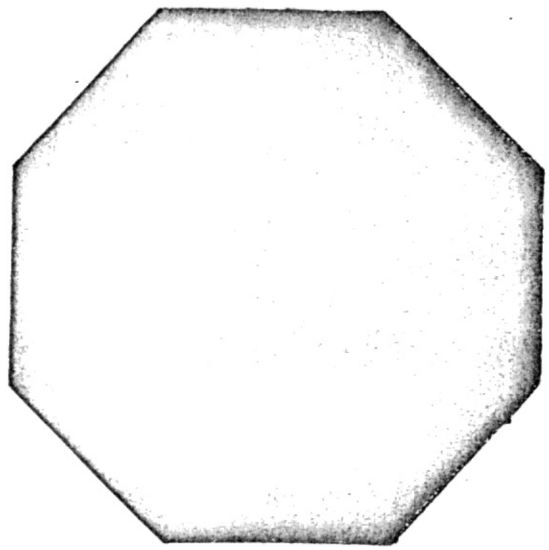
1 - C



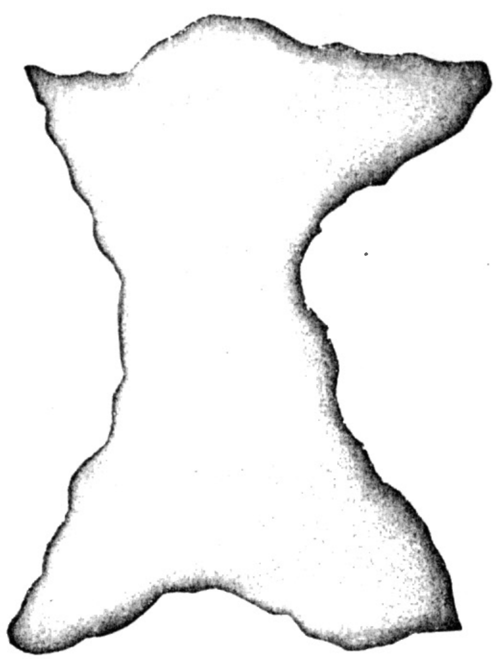
3 – C



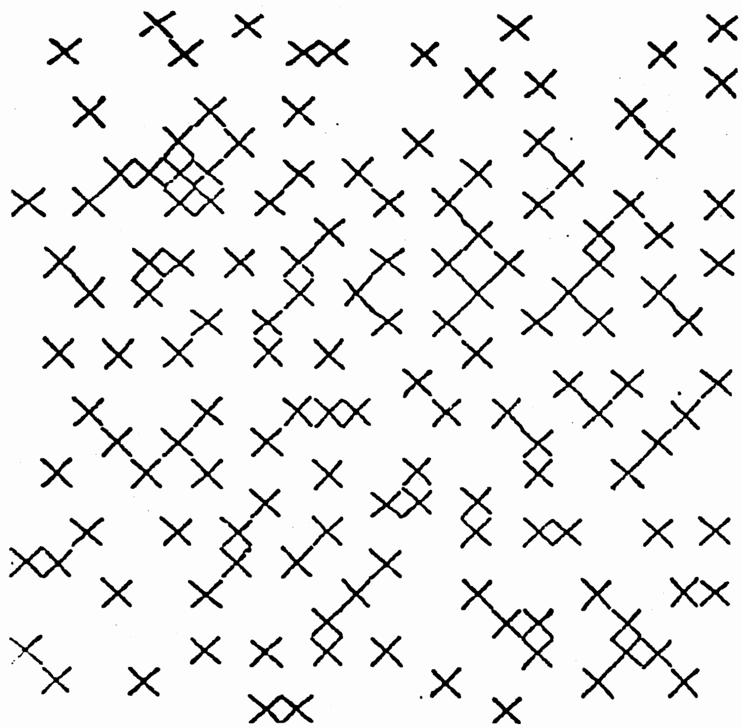
3 – S



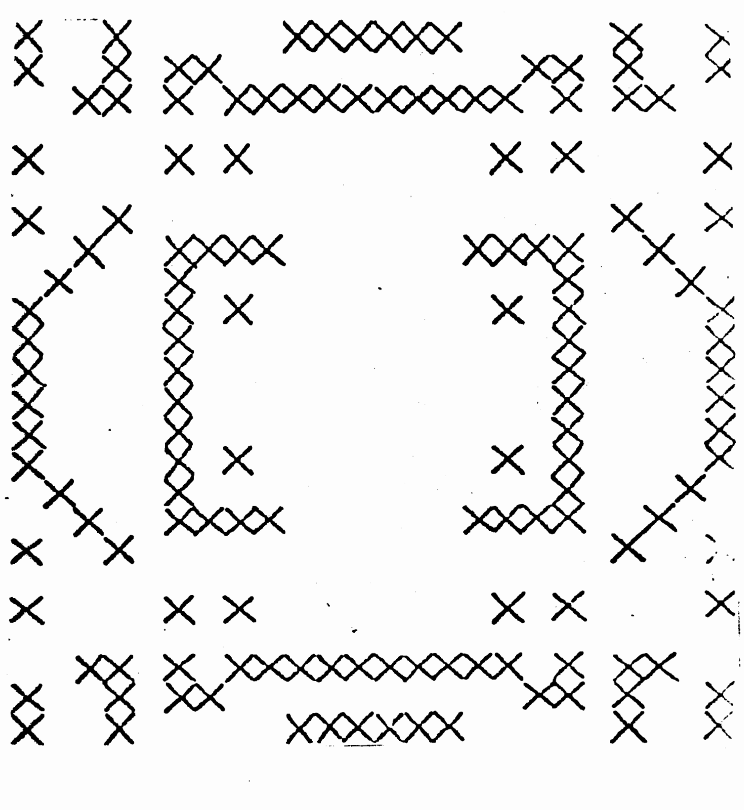
4 – S



4 – C



2 - C



2 - S

Set 4 - Black

KEY

Complexity Dimension

1. Homogeneity/heterogeneity of elements

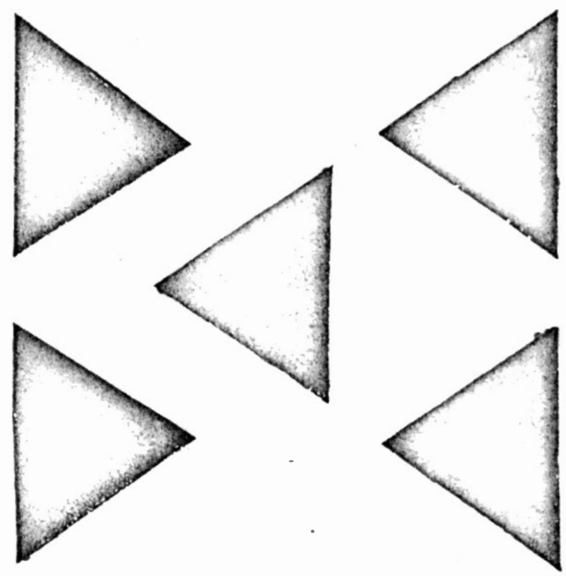
2. Regular/irregular arrangement

3. Amount of material

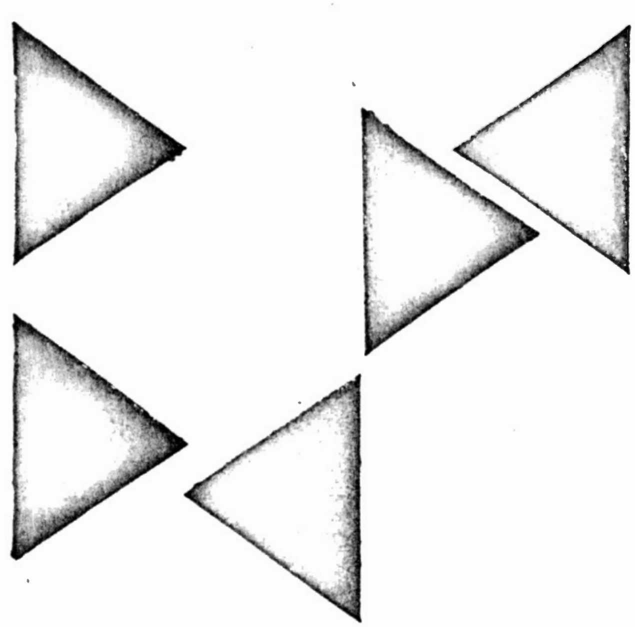
4. Regularity/irregularity of contour

5. Congruity/incongruity of elements

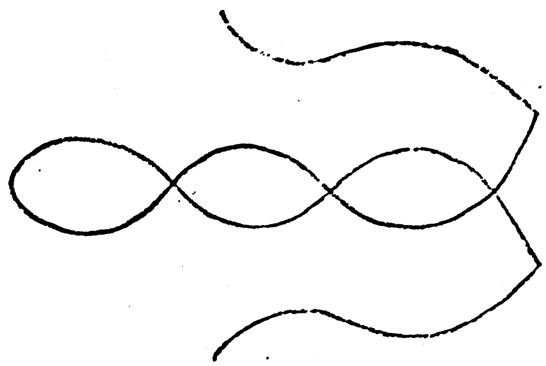
S - Simple C - Complex



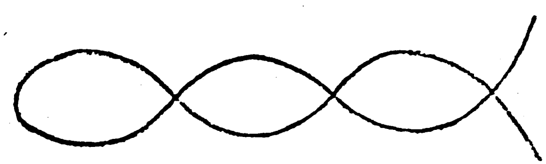
2 - S



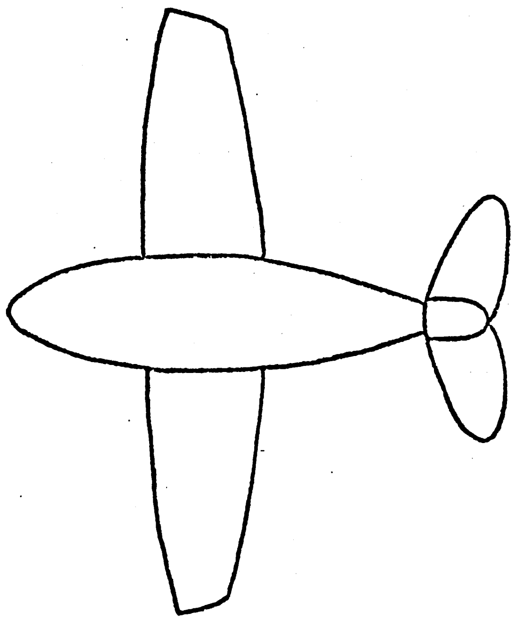
2 - C



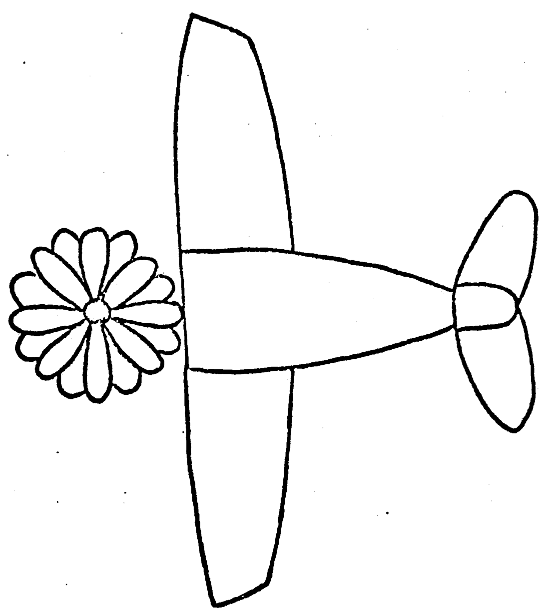
3 – C



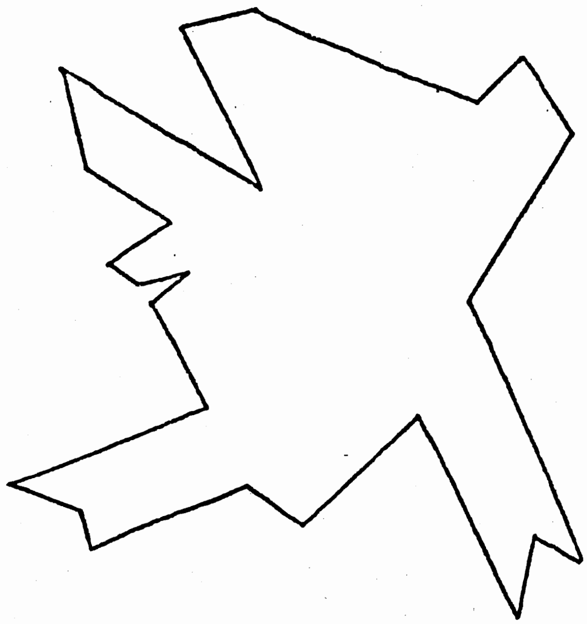
3 – S



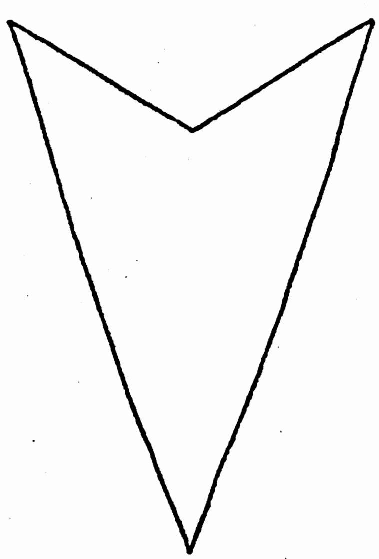
5 – S



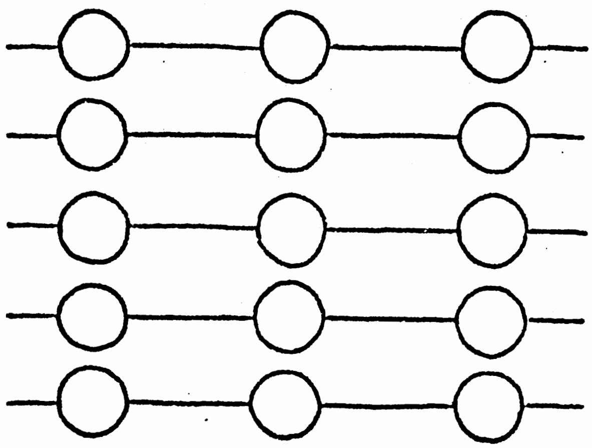
5 – C



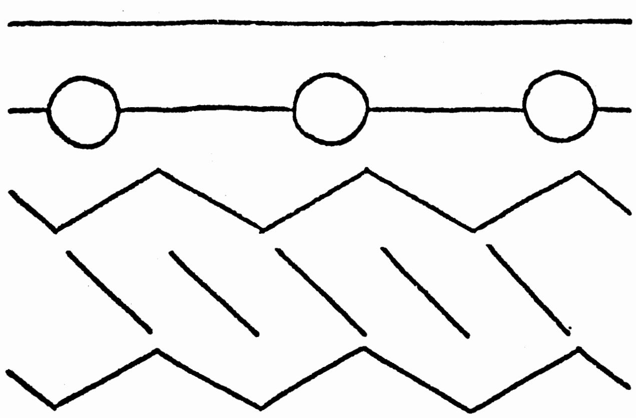
4 – C



4 – S



1 - S



1 - C

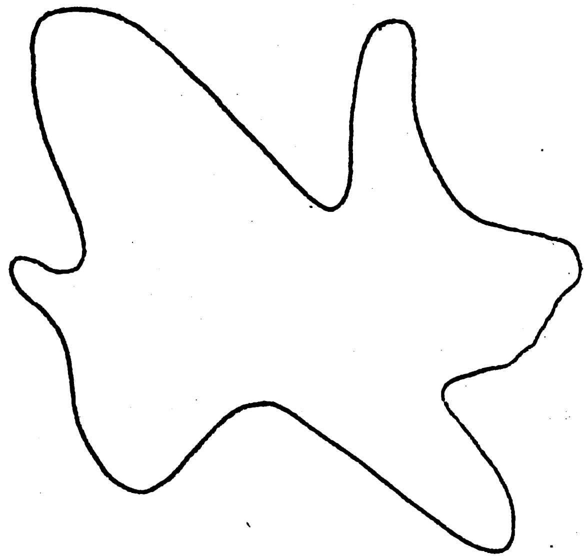
Set 5 - Orange

KEY

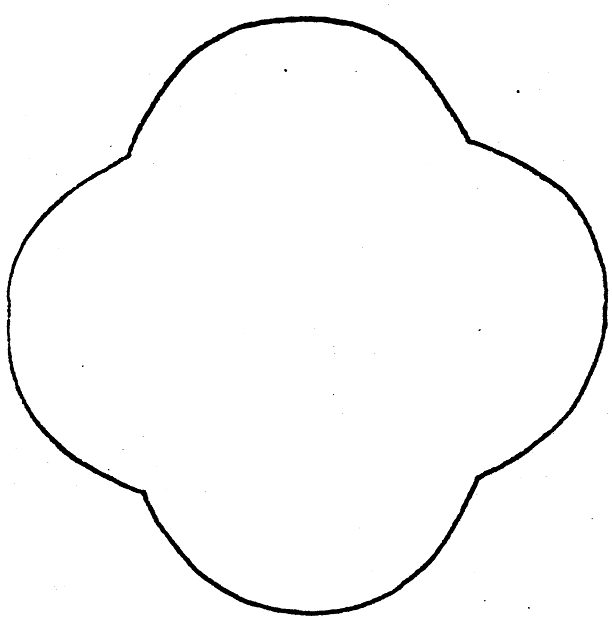
Complexity Dimension

1. Homogeneity/heterogeneity of elements
2. Regular/irregular arrangement
3. Amount of material
4. Regularity/irregularity of contour
5. Congruity/incongruity of elements

S - Simple C - Complex



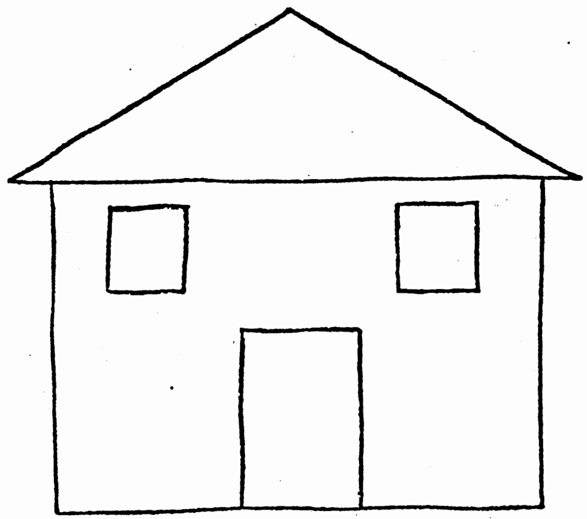
4 – C



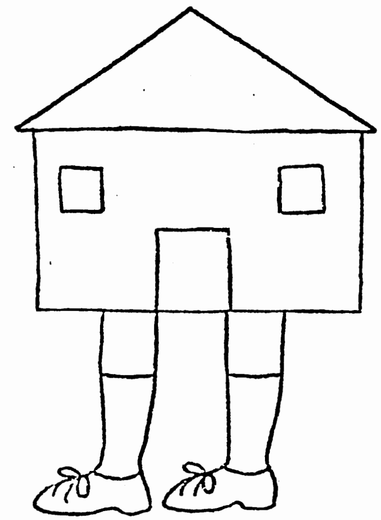
4 – S

ASN AAA

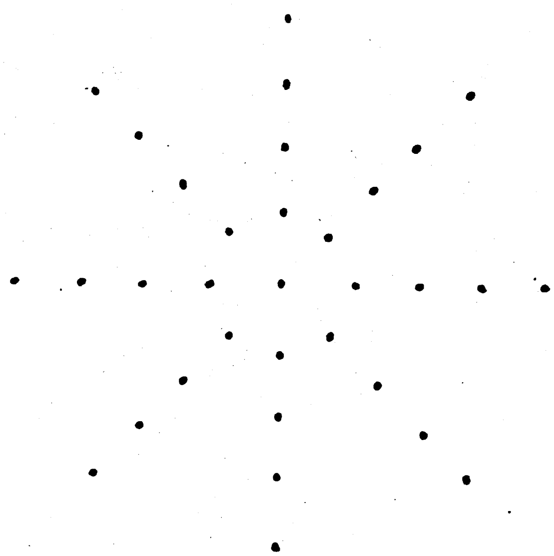
1 - C   1 - 5



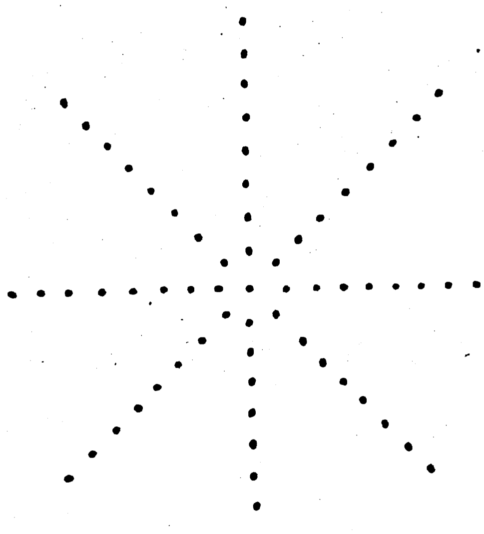
5 - S



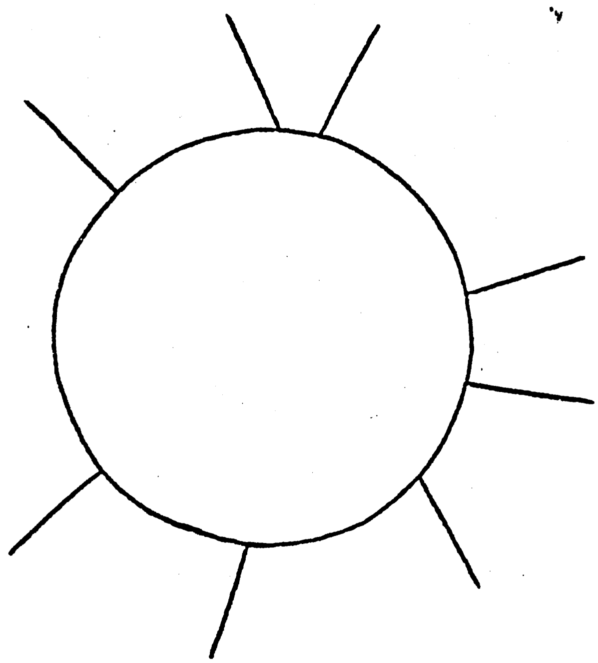
5 - C



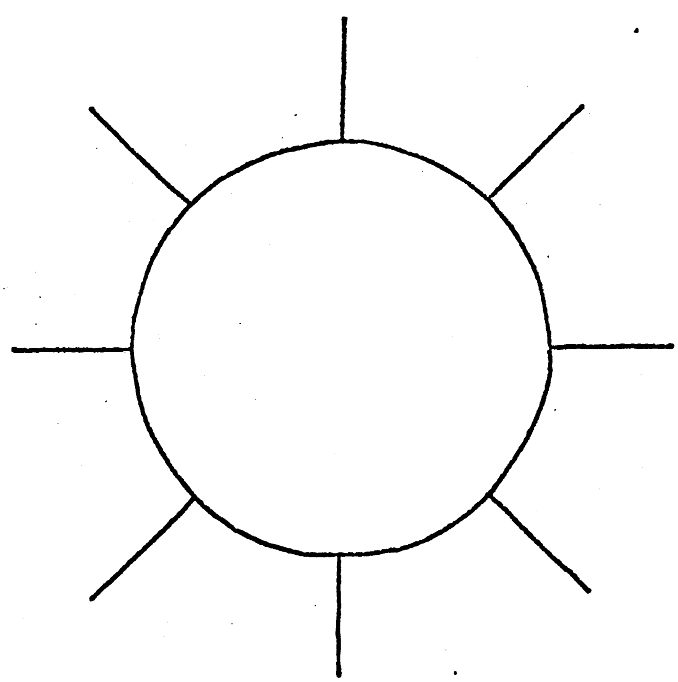
3 – S



3 – C



2 - C



2 - S

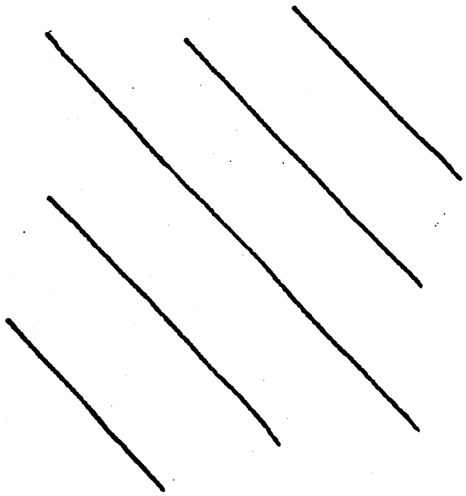
Set 6 - Blue

KEY

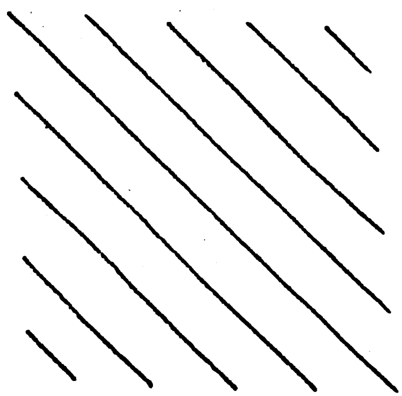
Complexity Dimension

1. Homogeneity/heterogeneity of elements
2. Regular/irregular arrangement
3. Amount of material
4. Regularity/irregularity of contour
5. Congruity/incongruity of elements

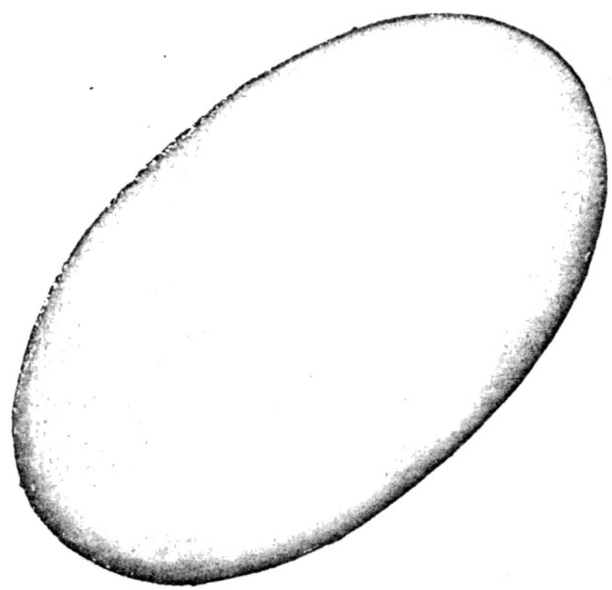
S - Simple C - Complex



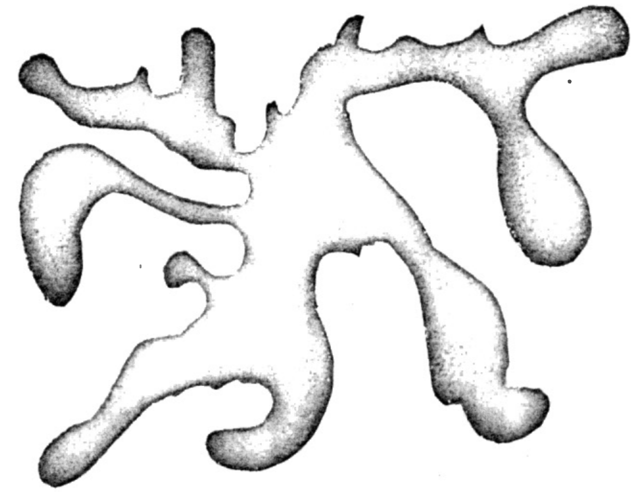
3 – S



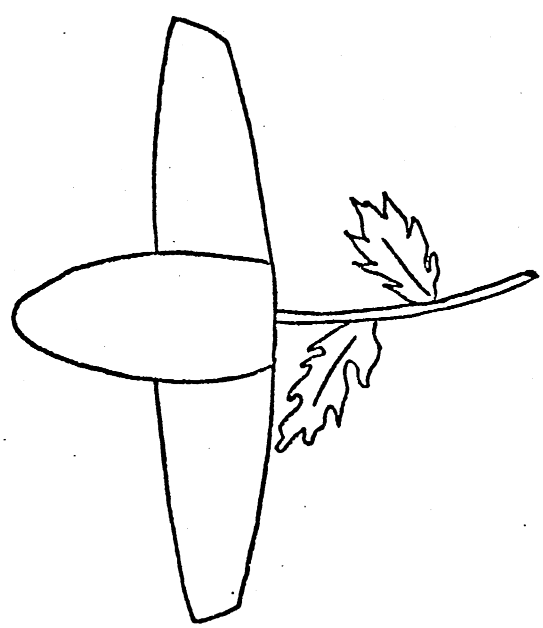
3 – C



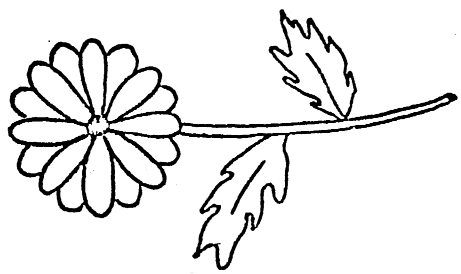
4 – S



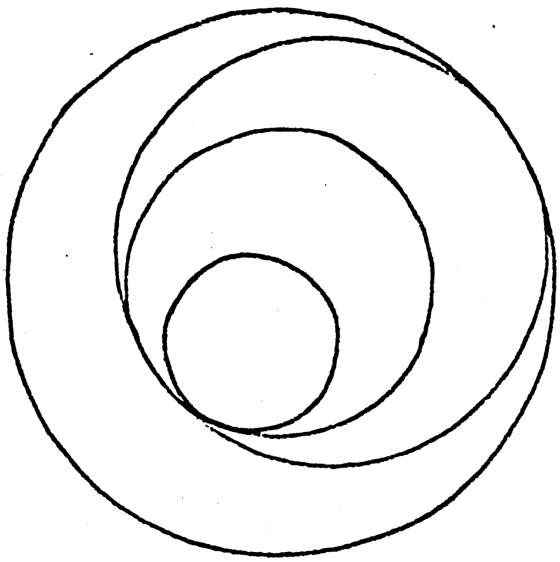
4 – C



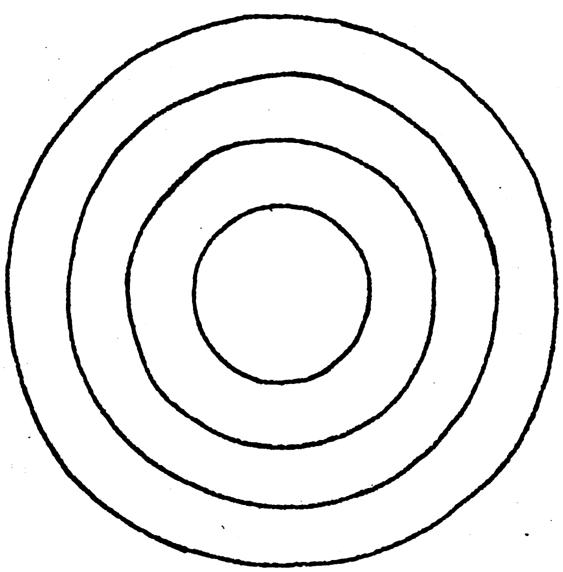
5 – C



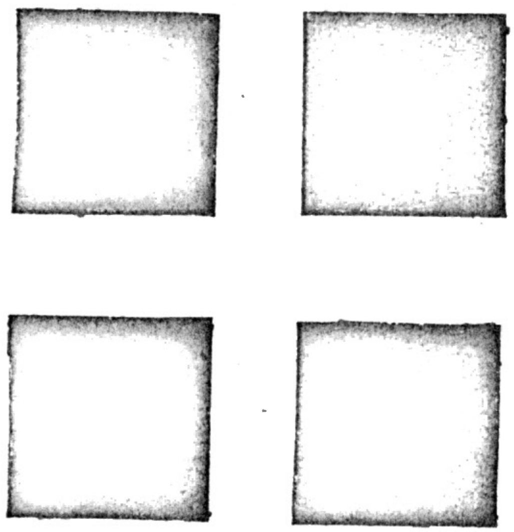
5 – S



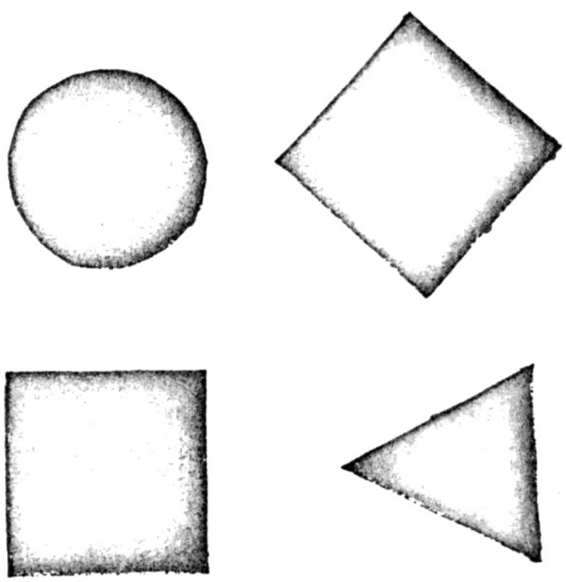
2 - C



2 - S



1 - S



1 - C

SIMPLE-COMPLEX DESIGNS RESPONSE FORM

Child's Name ______________________________

Set 1 (red) Score_____

1. 1S - 1C
2. 4C - 4S
3. 3S - 3C
4. 5C - 5S
5. 2S - 2C

Set 2 (yellow) Score_____

1. 3C - 3S
2. 1S - 1C
3. 5C - 5S
4. 2S - 2C
5. 4C - 4S

Set 3 (green) Score_____

1. 5S - 5C
2. 1C - 1S
3. 3S - 3C
4. 4C - 4S
5. 2S - 2C

Set 4 (black) Score_____

1. 2C - 2S
2. 3S - 3C
3. 5C - 5S
4. 4S - 4C
5. 1C - 1S

Set 5 (orange) Score_____

1. 4S - 4C
2. 1C - 1S
3. 5S - 5C
4. 3C - 3S
5. 2S - 2C

Set 6 (blue) Score_____

1. 3C - 3S
2. 4S - 4C
3. 5C - 5S
4. 2S - 2C
5. 1C - 1S

Total Score ____________

Scoring Key

	Complexity Dimension
1	Homogeneity/heterogeneity of elements
2	Regular/irregular arrangement
3	Amount of material
4	Regularity/irregularity of contour
5	Congruity/incongruity of elements

S - simple; C - complex

APPENDIX F

REFERENCES, SIMPLE-COMPLEX DESIGNS

Set 1

1. Berlyne, 1958b
2. Berlyne, 1958b
3. Cantor et al., 1963
4. Berlyne, 1958b
5. Berlyne, 1958b

Set 2

1. Berlyne, 1958b
2. Berlyne, 1958b
3. Berlyne, 1958b
4. Berlyne, 1958b
5. Berlyne, 1958a

Set 3

1. Author
2. Hoats et al., 1963
3. Author
4. Berlyne, 1958b
5. Berlyne, 1966a

Set 4

1. Berlyne, 1958b
2. Berlyne, 1958b
3. Berlyne, 1958b
4. Smock and Holt, 1962
5. Berlyne, 1958b

Set 5

1. Berlyne, 1958b
2. Author
3. Hoats et al., 1963
4. Author
5. Berlyne, 1958b

Set 6

1. Berlyne, 1958b
2. Cantor et al., 1963
3. Berlyne, 1958b
4. Hoats et al., 1963
5. Berlyne, 1958b

APPENDIX G

LETTER OF REQUEST FOR RESEARCH - BROKEN ARROW, OKLAHOMA,

SCHOOL BOARD

To Members of the Broken Arrow, Oklahoma, School Board:

I am a doctoral student in school psychology at Oklahoma State University and I am presently engaged in research for my doctoral dissertation. I would like to inquire about the possibility of collecting the data for my dissertation study in the Broken Arrow school system.

My study involves the individual assessment of cognitive abilities and visual complexity preferences in young children ages five to seven. The assessment instruments to be utilized in the study are the McCarthy Scales of Children's Abilities and three measures of visual complexity preference. The complexity measures consist of showing the child visual patterns of varying degrees of complexity and asking the child to indicate which of these designs he prefers. The total time involved in the assessment of each child is estimated to be approximately one hour. The testing time would be divided into two separate sessions of approximately thirty minutes each. The information obtained from the comprehensive individual assessment would, in my opinion, be exceedingly beneficial to the teachers and parents of the participating students. Results of the McCarthy Scales of Children's Abilities, in particular, provide diagnostic information regarding learning strengths and weaknesses in verbal, perceptual, quantitative, memory, and motor abilities. The results of each child's performance could be made available to your Director of Special Services and could be utilized in the evaluation of readiness skills or in placement decisions. I will also provide your school system with a summary of the results of my research.

-2-

I have previously been employed as a school psychologist and acting co-ordinator of special services in the Jenks school system, as a psychometrist in the Tulsa school system, and as an elementary teacher and associate co-ordinator of the testing program in the Bartlesville school system. I am certified in Oklahoma as an elementary teacher, psychometrist, school psychologist, and counselor.

I would be most happy to provide you with additional details concerning my study or meet personally with any personnel in your school system.

Thank you very much for your consideration of my request.

Sincerely,

Leslie Burton

APPENDIX H

PARENT LETTER REQUESTING PERMISSION FOR TESTING;

TESTING RESULT'S FORM SENT TO PARENTS

Dear Parent,

Your child has been selected for participation in a research study sponsored by Oklahoma State University. With your permission, an individual evaluation of your child's school-related abilities will be done using the McCarthy Scales of Children's Abilities. The evaluation will take approximately one hour and will be conducted by a qualified individual. The results of this evaluation should be very helpful to you, as a parent, in recognizing specific ability strengths and weaknesses and should provide useful information about your child's development. You will receive a written copy of the results of the evaluation and, if you so desire, a conference to discuss these results will be arranged. For research purposes, your child's scores will be used anonymously and will not be identifiable by name in any way.

If you would like your child to participate in this project, please sign the form at the bottom of the page and return it to school at your earliest convenience. If you have an questions regarding the project, please contact Gary Gerber, Director of Special Services, Broken Arrow Public Schools, at 258-5545. Thank you for your cooperation.

Sincerely,

Leslie Burton
Doctoral student, Oklahoma
State University
Certified School Psychologist

I hereby give my permission for my child ____________________ to participate in the research project described above and to receive an individual evaluation of developmental abilities. I understand that I will be thoroughly informed of the results of the evaluation.

____
Parent's signature

TESTING RESULTS - MCCARTHY SCALES OF CHILDREN'S ABILITIES

Name: ______________________________ Age: __________

Verbal Ability - ______________________________

Assesses the child's ability to express himself verbally and his understanding of verbal concepts.

Perceptual Performance Ability - ______________________________

Assesses the child's ability to organize material visually, to copy and classify geometric forms, to imitate motor movements, and to identify right and left.

Quantitative Ability - ______________________________

Assesses the child's ability to use numbers and to understand numerical concepts.

General Cognitive Ability - ______________________________

Assesses the child's overall level of cognitive ability.

Memory Ability - ______________________________

Assesses the child's short-term visual and auditory memory.

Motor Ability - ______________________________

Assesses the child's gross and fine motor coordination.

Special Strengths:

Comments:

In scoring, each child's performance is compared with other children of corresponding chronological age.

If you have further questions about the test results, please contact me at my home phone - 492-8534. Thank you for your cooperation and your child's participation in this project.

Sincerely,

Leslie Burton

APPENDIX I

SAMPLE RESPONSE FORMS WITH RANDOM ORDERS OF PRESENTATION

RANDOM POLYGONS RESPONSE FORM 1-3-2 1

Child's Name____________________ Birthdate____________

Sex______ Age______ School____________________ Grade______

Set 1 (blue)	(random order of presentation of items)	Set 2 (red)	(random order of presentation of items)
1. 1 - 2	5.	1. 2 - 1	12.
2. 3 - 1	9.	2. 1 - 3	3.
3. 1 - 4	3.	3. 4 - 1	4.
4. 5 - 1	10.	4. 1 - 5	5.
5. 1 - 6	11.	5. 6 - 1	15.
6. 3 - 2	13.	6. 2 - 3	9.
7. 2 - 4	14.	7. 4 - 2	1.
8. 5 - 2	12.	8. 2 - 5	10.
9. 2 - 6	4.	9. 6 - 2	6.
10. 4 - 3	2.	10. 3 - 4	2.
11. 3 - 5	7.	11. 5 - 3	13.
12. 6 - 3	15.	12. 3 - 6	14.
13. 4 - 5	8.	13. 5 - 4	7.
14. 6 - 4	6.	14. 4 - 6	8.
15. 5 - 6	1.	15. 6 - 5	11.

Set 1 Score ______ Set 2 Score ______

Scoring Key

Number of Angles	Score Value
6	1
10	2
14	3
20	4
28	5
40	6

Comments:

Total Score__________

CHECKERBOARD PATTERNS RESPONSE FORM 3

Child's Name ______________________________

Set 1 - Vertical (blue)

		(random order of presentation of items)
1.	2 - 1	9.
2.	1 - 3	4.
3.	4 - 1	12.
4.	1 - 5	2.
5.	6 - 1	11.
6.	2 - 3	6.
7.	4 - 2	14.
8.	2 - 5	5.
9.	6 - 2	7.
10.	3 - 4	15.
11.	5 - 3	8.
12.	3 - 6	13.
13.	5 - 4	10.
14.	4 - 6	3.
15.	6 - 5	1.

Set 1 Score ______

Set 2 - Horizontal (red)

		(random order of presentation of items)
1.	1 - 2	2.
2.	3 - 1	4.
3.	1 - 4	8.
4.	5 - 1	5.
5.	1 - 6	3.
6.	3 - 2	12.
7.	2 - 4	7.
8.	5 - 2	9.
9.	2 - 6	15.
10.	4 - 3	6.
11.	3 - 5	11.
12.	6 - 3	10.
13.	4 - 5	1.
14.	6 - 4	13.
15.	5 - 6	14.

Set 2 Score ______

Scoring Key

Number of Matrix Cells	Score Value
4 x 6	1
6 x 6	2
8 x 8	3
10 x 10	4
12 x 12	5
14 x 14	6

Comments:

Total Score ____________

SIMPLE-COMPLEX DESIGNS RESPONSE FORM 2

Child's Name ______________________________

Set 1 (red) Score______

1. 1S - 1C
2. 4C - 4S
3. 3S - 3C
4. 5C - 5S
5. 2S - 2C

(random order of presentation of sets of designs) 2.

Set 2 (yellow) Score______

1. 3C - 3S
2. 1S - 1C
3. 5C - 5S
4. 2S - 2C
5. 4C - 4S

(random order of presentation of sets of designs) 6.

Set 3 (green) Score______

1. 5S - 5C
2. 1C - 1S
3. 3S - 3C
4. 4C - 4S
5. 2S - 2C

(random order of presentation of sets of designs) 3.

Set 4 (black) Score______

1. 2C - 2S
2. 3S - 3C
3. 5C - 5S
4. 4S - 4C
5. 1C - 1S

(random order of presentation of sets of designs) 4.

Set 5 (orange) Score______

1. 4S - 4C
2. 1C - 1S
3. 5S - 5C
4. 3C - 3S
5. 2S - 2C

(random order of presentation of sets of designs) 5.

Set 6 (blue) Score______

1. 3C - 3S
2. 4S - 4C
3. 5C - 5S
4. 2S - 2C
5. 1C - 1S

(random order of presentation of sets of designs) 1.

Scoring Key

Total Score______________

	Complexity Dimension
1	Homogeneity/heterogeneity of elements
2	Regular/irregular arrangement
3	Amount of material
4	Regularity/irregularity of contour
5	Congruity/incongruity of elements

S - simple; C - complex

APPENDIX J

SCORE DATA FROM STIMULUS COMPLEXITY MEASURES AND COGNITIVE ABILITY SCALES FOR ALL SUBJECTS

(n=80)

5 YEAR OLD BOYS

I.D.#	Sex	Age in Months	Random Poly 1	Random Poly 2	Random Poly Total	Check. Pat. 1	Check. Pat. 2	Check. Pat. Total	Simple-Complex Designs	MSCA Verbal	MSCA Perc./ Perf.	MSCA Quant.	MSCA Gen. Cog.	MSCA Memory	MSCA Motor
01	0	69	43	53	096	48	55	103	07	47	49	32	090	44	38
02	0	66	48	54	102	57	51	101	18	49	45	48	096	50	36
03	0	69	48	58	106	43	45	089	07	54	53	45	103	44	31
04	0	62	44	45	089	47	42	089	13	35	42	31	076	30	38
05	0	66	39	36	075	59	55	114	07	45	64	44	103	55	55
06	0	71	61	64	125	63	69	132	08	69	65	47	122	58	60
07	0	63	48	52	100	51	53	104	12	35	31	34	069	34	31
08	0	66	54	51	105	59	49	108	12	56	40	40	095	51	54
09	0	70	70	69	139	58	35	093	08	53	51	43	103	42	52
10	0	62	48	60	108	47	57	104	13	46	52	44	096	39	54
11	0	66	53	42	095	46	44	090	03	67	50	52	114	51	37
12	0	64	39	37	076	39	43	082	08	52	52	56	106	54	62
13	0	66	59	56	115	37	53	110	13	43	40	39	084	37	45
14	0	64	54	57	111	56	44	100	15	55	39	46	096	54	45
15	0	65	52	61	113	55	54	109	10	50	68	49	113	50	60
16	0	66	60	60	120	64	62	126	10	57	63	57	116	56	60
17	0	62	57	45	102	40	45	095	10	53	56	46	105	44	46
18	0	63	56	53	109	58	46	104	06	40	46	40	084	35	49
19	0	63	57	54	111	52	60	112	17	42	53	44	092	38	48
20	0	66	59	53	112	58	53	111	14	55	50	54	108	65	56

5 YEAR OLD GIRLS

I.D.#	Sex	Age in Months	Random Poly 1	Random Poly 2	Random Poly Total	Check. Pat. 1	Check. Pat. 2	Check. Pat. Total	Simple-Complex Designs	MSCA Verbal	MSCA Perc./Perf.	MSCA Quant.	MSCA Gen. Cog.	MSCA Memory	MSCA Motor
21	1	65	67	61	128	42	35	077	06	46	44	43	096	45	51
22	1	61	53	56	109	52	40	092	06	52	64	57	115	59	67
23	1	67	55	53	108	50	53	103	12	45	39	39	084	39	43
24	1	62	39	45	084	39	36	075	11	56	55	40	104	51	58
25	1	69	52	53	105	70	70	140	13	71	60	50	123	59	53
26	1	66	50	59	109	49	57	106	11	73	55	64	129	66	54
27	1	65	65	45	110	57	51	108	19	64	61	61	123	59	64
28	1	66	52	54	106	51	54	095	12	53	57	53	100	59	35
29	1	69	46	53	099	52	55	107	14	51	53	50	104	55	43
30	1	91	56	55	111	55	50	105	13	54	60	48	109	47	61
31	1	71	61	57	118	46	54	100	18	49	59	38	099	44	64
32	1	69	52	57	109	50	43	093	09	53	54	46	103	54	60
33	1	69	52	54	106	49	54	103	10	42	50	30	085	35	53
34	1	67	59	60	119	58	49	107	14	41	44	43	086	45	41
35	1	69	43	44	087	50	48	098	13	42	56	54	101	58	64
36	1	62	42	42	084	55	43	098	15	50	46	50	098	47	35
37	1	63	55	56	111	60	57	117	17	54	66	50	113	49	70
38	1	69	47	59	106	35	35	070	10	52	63	46	109	52	54
39	1	64	53	49	102	54	57	111	19	64	62	46	116	51	60
40	1	68	50	47	097	55	45	100	04	55	40	39	093	48	51

6 YEAR OLD BOYS

I.D.#	Sex	Age in Months	Random Poly 1	Random Poly 2	Random Poly Total	Check. Pat. 1	Check. Pat. 2	Check. Pat. Total	Simple-Complex Designs	MSCA Verbal	MSCA Perc./Perf.	MSCA Quant.	MSCA Gen. Cog.	MSCA Memory	MSCA Motor
41	0	79	59	60	119	70	70	140	09	62	77	62	134	67	68
42	0	78	61	59	120	60	60	120	11	64	65	34	109	36	60
43	0	72	61	35	096	49	48	097	08	53	65	48	112	48	61
44	0	80	64	57	121	69	62	131	10	44	57	52	101	55	70
45	0	74	62	57	119	58	54	112	18	77	63	56	135	60	68
46	0	72	55	50	105	54	58	112	15	62	60	60	120	57	53
47	0	79	48	53	101	54	59	113	08	53	43	58	103	61	40
48	0	78	66	64	130	61	66	127	13	38	51	42	087	54	47
49	0	81	61	45	106	46	51	097	11	57	58	56	112	53	55
50	0	77	56	47	103	45	50	095	13	49	47	42	095	44	54
51	0	82	59	64	123	54	39	093	10	63	58	51	115	51	52
52	0	73	62	70	132	55	56	111	21	71	74	58	138	54	68
53	0	78	47	56	103	52	46	098	15	55	49	59	109	51	40
54	0	77	68	68	136	65	66	131	14	60	76	64	132	62	60
55	0	78	65	67	132	53	52	105	15	50	65	53	111	53	63
56	0	81	53	58	111	50	44	094	12	64	48	44	107	46	41
57	0	76	63	58	121	49	46	095	18	61	64	58	121	56	58
58	0	74	62	52	114	54	52	106	13	64	57	52	115	48	57
59	0	73	44	48	092	48	52	100	15	44	44	47	092	44	39
60	0	82	58	47	105	51	52	103	05	57	56	48	106	50	48

6 YEAR OLD GIRLS

I.D.#	Sex	Age in Months	Random Poly 1	Random Poly 2	Random Poly Total	Check. Pat. 1	Check. Pat. 2	Check. Pat. Total	Simple-Complex Designs	MSCA Verbal	MSCA Perc./Perf.	MSCA Quant.	MSCA Gen. Cog.	MSCA Memory	MSCA Motor
61	1	81	66	67	133	48	47	095	21	43	45	39	085	38	48
62	1	76	53	45	098	40	36	076	09	56	78	58	127	56	73
63	1	72	63	57	120	60	50	110	10	50	56	47	104	46	53
64	1	72	53	54	107	53	55	108	15	53	54	45	104	57	48
65	1	75	59	47	106	42	48	090	13	71	54	38	112	50	47
66	1	72	42	47	089	41	49	090	08	51	65	38	104	41	61
67	1	78	53	43	096	38	37	075	11	36	35	31	070	29	46
68	1	77	70	69	139	69	69	138	19	49	68	49	111	50	40
69	1	77	51	67	118	66	57	123	19	48	61	57	109	51	41
70	1	78	53	57	110	46	51	097	08	65	72	45	120	53	68
71	1	76	69	69	138	54	63	117	17	67	74	62	138	62	52
72	1	76	51	67	118	59	47	106	10	78	59	57	143	58	50
73	1	73	67	66	133	53	41	094	17	50	53	59	108	65	54
74	1	81	57	51	108	61	43	104	16	64	75	57	131	59	66
75	1	72	47	36	083	52	51	103	24	72	66	68	139	62	68
76	1	82	66	53	119	60	47	107	17	65	59	48	116	59	55
77	1	78	55	60	115	67	65	132	21	74	68	66	143	73	65
78	1	81	54	57	111	50	54	104	22	59	68	48	112	46	69
79	1	78	48	49	097	51	52	103	14	43	35	33	074	41	36
80	1	75	49	44	093	52	43	095	11	50	52	48	102	52	45

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VITA

Leslie Elizabeth Burton

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE RELATIONSHIP BETWEEN SELECTED MEASURES OF PREFERENCE FOR VISUAL STIMULUS COMPLEXITY AND COGNITIVE ABILITIES IN YOUNG CHILDREN

Major Field: Applied Behavioral Studies

Biographical:

Personal Data: Born in Wichita, Kansas, December 30, 1946, the daughter of B. Leslie and Dorothy Elizabeth Moll; married to Gregory Steven Burton; mother of Brian Christopher and Laurel Allison Burton.

Education: Graduated from Briarcliff High School, Atlanta, Georgia, 1963; attended the University of Georgia, 1964-66; attended the University of Oklahoma, 1966-78; attended Memphis State University, 1967; received Bachelor of Science in Education degree from the University of Oklahoma in 1967; received Master of Education degree from the University of Nebraska, 1968; attended the University of Tulsa, 1971, 1976; enrolled in the doctoral program at Oklahoma State University, 1978; completed requirements for the Doctor of Philosophy degree at Oklahoma State University, May, 1981.

Professional Experience: Graduate counselor, University of Nebraska, 1967-68; research assistant, University of Nebraska, 1967-68; elementary teacher, 1968-71; remedial summer school instructor, 1970, 1971; associate director of elementary testing program, 1970-71, Bartlesville, Oklahoma, Public Schools; psychometrist, 1971-72; federal projects evaluation team, 1971-72, Tulsa, Oklahoma, Public Schools; diagnostician; director of summer school program, Parkwood Clinic for Children with Learning Disabilities, 1972-73; self-employed as private tutor, 1972-76; psychometrist, 1976-78; school psychologist, 1978-79; acting coordinator of special services, 1976-77, Jenks, Oklahoma, Public Schools.