DOCUMENT RESUME

ED 055 502 40 FL 002 617

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TITLE Factors of Visual Perception and Their Relation to the Language Proficiency of Children. Final Report.
INSTITUTION University of Southern California, Los Angeles.
SPONS AGENCY Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
REPORT NO P-14-2069
PUB DATE May 70
GRANT OEG-4-7-062088-0386
NOTE 321p.

EDRS PRICE MF-$0.65 HC-$13.16
DESCRIPTORS *Children; Cognitive Processes; Comparative Testing; *Educational Experiments; *Educational Research; Interference (Language Learning); Language Instruction; *Language Proficiency; Learning Theories; Low Income; Minority Groups; Semantics; Standardized Tests; Statistical Analysis; Tables (Data); Visual Acuity; Visual Discrimination; Visual Learning; *Visual Perception

ABSTRACT

This report describes an experiment concerned with a possible relationship between the inability to learn basic educational skills, such as reading and writing, and the inability to organize incoming stimuli for communication purposes, in spite of adequate intellectual potential. The study had three main tasks. The first problem was to develop a battery of test items that would be subject to varying degrees of interference and that would be sensitive to a wide range of responses of children between three and six. The second task was to compare the responses of two groups of children, one with expected low language proficiency and one with expected high language proficiency, on the newly devised tests and on a battery of standard tests designed to measure language proficiency. The third step was to study the data and discover the implications for improved educational methods for children with language learning problems, especially those from minority groups. Included are details on personnel, test administration, experimental and standard tests, analysis of the data, conclusions, and implications for further studies. Tables give the statistical results; examples of the experimental test items are provided along with administrative details and references. (VM)

FINAL REPORT

Project No. 14-2069
Grant or Contract No. OEG-4-7-062088-0386

Factors of Visual Perception and Their Relation to the Language Proficiency of Children

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University of Southern California
Los Angeles, California

May 1970

The research reported herein was performed pursuant to a grant with the Bureau of Education for the Handicapped, U.S. Office of Education, Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official position of the Bureau of Education for the Handicapped.

Department of Health, Education, and Welfare

U.S. Office of Education
Bureau of Education for the Handicapped

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ACKNOWLEDGEMENTS

The Project Staff wishes to express appreciation to Esther K. Weir, Director, Brentwood Church Nursery School, and Robert Wright, Project Director, Project Head Start, for their cooperation and interest in this study. Also, to the nursery school teachers and children with whom we shared this learning experience, our heartfelt thanks. This investigation was facilitated by services obtained from the Computer Center at the University of Southern California and at San Fernando Valley State College. Also, computing assistance was obtained from the Health Sciences Computing Facility, UCLA, sponsored by NIH Special Resources Grant RR - 3.

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SUMMARY

This exploratory study had three main objectives: (1) to develop a series of perceptual measures which could quantitatively assess tolerance levels of interference to visual signal (figure-ground discrimination) and signal loss (closure) to be used with young children; (2) to compare the performance of two groups: Group I with expected low language proficiency; Group II with expected high language proficiency on the experimental measures and on a series of standard measures, frequently used to evaluate language skills; and (3) to analyze the resulting data for educational implications.

The total sample consisted of 343 subjects: 190 from low and 153 from high socio-economic backgrounds; between the ages of three and six years; and known to be free from any major physical or psychologic problems. The standard measures selected were known to be in current use in schools and clinics throughout the country to evaluate language proficiency in young children. The experimental measures consisted of 30 items, tachistoscopically exposed at one second, and presented in four units: (1) Figure-Ground Discrimination (Heterogeneous); Figure-Ground Discrimination (Homogeneous); Closure (Heterogeneous); Closure (Homogeneous). The heterogeneity or homogeneity were contained in the 30 response cards designed for this purpose. The slides (items) were exposed randomly, and the subject was required to point to the intact stimulus on the response card. For each of the Figure-Ground items (15), there were eight slide presentations, each with a standard measure of increased interference to signal; for the Closure items (15), there were seven slide presentations, each with a standard measure of increased signal loss. Testing was accomplished in two sessions for each subject, with the standard measures presented first. Throughout testing, standard procedures were used.

The data were analyzed in two stages in order to obtain two kinds of information: specific information pertaining to <u>intra</u>-relations among selected variables on individual or related measures; general information concerning subject behavior along independent dimensions derived from the <u>inter</u>-relation of all variables. Pearson's product moment coefficients, analysis of factor variance, and coefficients of invariance were used, when appropriate, to compare different sets of factor scores.

The findings showed that, as expected, the LOW group performed markedly below the level of the HIGH group on language measures, particularly <u>Symbol Facility</u>. The LOW group had a marked verbal-performance differential, with the trend toward

greater skill on performance tasks than verbal ones. Conversely, the HIGH group tended to perform equally well on both verbal and performance items. Unexpectedly, the two groups performed equally well on the experimental Figure-Ground Discrimination tasks, but a remarkable difference was present between groups on the Closure tasks, with the LOW group performing significantly below the performance level of the HIGH group on all Closure items, particularly those which require vertical scanning.

The significance of these findings for the education of children with low language proficiency, particularly young children from minority groups, lies in the need for visual closure abilities (in this case, both horizontal and vertical scanning abilities), in order to successfully master language skills basic to academic achievement in learning to read and to write. The findings also suggest that the experimental measures could be refined to serve not only in the detection of visual figure-ground discrimination and closure tolerance levels but also in the development of educational methods to improve visual discrimination and integration skills which appear to be related to the development of language proficiency in young children.

CHAPTER I

THE PROBLEM

I. INTRODUCTION

Educators have become concerned recently with what appears to be an increasing number of children who are unable to learn basic educational skills, such as reading and writing, in spite of the fact that they have normal intellectual potential when evaluated on standard psychologic tests. Many of these same children are unable to express their thoughts clearly when asked to recite; often they are unable to understand verbal instructions. The inability to organize incoming stimuli for communication purposes (i.e. interference at the perceptual level of verbal learning) has been considered a possible cause of this discrepancy between their adequate intellectual potential and their reduced language proficiency.

Examinations of children with severe language deficiencies usually include assessments of their perceptual abilities as well as the intellectual, emotional, social and motor components of their behavior. In more subtle language problems, however, a child's perceptual responses may not be assessed separately, although tests used to measure language and other aspects of behavior may depend entirely or in part upon the ability of the child to perceive accurately. This seemingly apparent relation between perception and language has generated many questions, some of which formed the basis for this study, for example:

> How much interference can a child tolerate before he fails to perceive incoming cues?
>
> Is there a relation between language proficiency and the ability to perceive partially presented or masked visual stimuli?
>
> Do responses to visual stimuli requiring closure or figure-ground discrimination differ in children from contrasting environments?

The current project was concerned, therefore, with selected factors of visual perception (visual closure and figure-ground discrimination) and the relation of these factors to language proficiency. The review of the literature which follows is presented in an effort to point up the complexity of the perceptual phenomenon and to provide a basis for considering the underlying purposes and objectives of the study under discussion.

II. BACKGROUND AND RELATED STUDIES

A. Historical Review of Perception

Despite its obvious importance to human learning, the perceptual processes are difficult to isolate and define. In early attempts to explain man's awareness of his environment, perception was not identified as a separate phenomenon; instead, a direct relation between sensation and thinking was thought to exist. Protagoras, the ancient Greek philosopher, considered sensation to be synonomous with psychic life itself (Sarton, 1927), and Descartes, in the seventeenth century, described sensation as a trigger mechanism which released the body to act in "a thousand different ways" (Freres, 1963).

Some philosophers continued to refer to sensation as the primary source of knowledge, but Locke (Pringle-Patterson, 1967) believed that the "idea," composed of sensations and reflections, was the basic unit of mental activity. Others (Hume, 1955) agreed with Locke in principle but preferred to describe the "idea" as a faint copy or image of sensation which could be stored in the memory or used for the thinking processes.

Regardless of differences in the definition of the "idea," this change in thinking implied here became part of the empirical movement which attempted to explain the phenomenon of awareness as a combination of many related simple sensory experiences. This view was emphasized further by the works of Lotze (1852), Helmholtz (Warren and Warren, 1968), and Wundt (1886) who contributed to the theory of Local Signs which, they believed, accounted for the effects of space and movement. Although the theory of Local Signs had numerous variations, basically it suggested a one-to-one relation between sensation and awareness. It is important to note, however, that the theory of Local Signs was considered to be related to the innate behavior of the organism, but the development of these signs was thought to be dependent upon experience and learning. The role of experience and learning in behavior was emphasized later, in the early twentieth century, by the work of two Russian scientists, Pavlov and Bekhterev (Yerkes and Morgulis, 1922) whose research on the conditioned reflex proved to be one of the most useful tools for the objective study of discrimination in animals, including man.

Interest in objective research took an upward surge in the United States at the beginning of the twentieth century, stimulated by Watson's (1913) theory of Behaviorism (i.e. the study of the organism based upon the stimulus-response paradigm). Awareness was couched in terms of reflex arcs, combinations of arcs, and conditioned reflexes. Considerable experimental activity, especially with animals, was generated by Watson's approach and much of what is known today about the discrimination of the senses can be attributed to the initial work of behaviorists such as Hunter (1924), Lashley (1929) and Tolman (1936).

Culmination of the empirical trend, at least to this date, can be seen in Hebb's (1949) Cell-Assembly Theory which minutely describes awareness in terms of neurologic development. Hebb proposed that complex networks of nerves, which subsume the cognitive act, are formed meticulously through the combination of simple neurologic circuits. These circuits are forged by the energy of stimulation and, then, linked through the association of time. The burden of awareness is placed most heavily upon the phenomenon of learning, and the influence of learning presupposes an active role for the central nervous system in the formation of the percept.

Along another dimension, the beginnings of another distinction was made between sensation and the "idea" during the latter half of the eighteenth century. Reid (1765) suggested the existence of "a priori universal knowledge" about the environment which he said was innate within every individual. Along this line of thought, Reid believed that knowledge, combined with external sensations, allowed men "to perceive." Later scientists attempted to describe more precisely the nature of this innate ability, predicating their description on the phrase "to know."

Muller (1826) proposed that sensation did not enter the mind directly but originated at the periphery of the nervous system, as a result of the transduction of external stimuli. Muller suggested further that the meaning of sensation was determined by the nature of the energy of the particular nerves involved, and in this way he attempted to explain Reid's "priori knowledge," in terms of specific nerve energies.

Research which followed Muller's, attempted to describe a phenomenon which was extant within the nervous system (a nativistic point of view), and the emphasis of inquiry was placed on introspection. For example, subjects were asked to make observations of controlled stimuli and to report, subjectively, their perceptual experiences. This phenomenologic approach was later used extensively by Gestalt psychologists to study perception.

Gestalt psychology, an outgrowth of the nativistic school, was an antagonist of the sensation-association theories of perception. Originated by Wertheimer (1912), Gestalt psychology attempted to explain the perception of movement, which Wertheimer claimed was not a sensation but a phenomenon. The Phi-phenomenon, as it was called, occurs when one watches a moving picture. Although each separate frame of the film projects a still picture on the screen, in a series they are perceived as mobile when observed in rapid succession. In this situation, perception appeared to depend not so much upon the individual patterns of sensation as on the overall structuring process which occurs within the brain. Two colleagues of Wertheimer, Koffka (1922) and Koehler (1929), apparently impressed by this new approach, explored some of its parameters. In fact, Koffka and Koehler were largely responsible for the growth and acceptance of the Gestalt theory in Germany, its spread throughout Europe, and to some extent, its introduction in the United States.

Generally, Gestalt psychologists de-emphasized the importance of sensations and images, branding them as artificial elements of experience, and they rejected the one-to-one relation between sensation and cognition. In essence, Gestaltists held that perception was more than the sum of its parts; that it was a global reaction in which changes in the parts caused changes in the whole and vice versa. This dynamic system has been studied over the years, accumulating a number of basic laws, the list of which has reached as high as 114. The most fundamental of these laws (Koffka, 1935), and the ones most basic to the study under discussion, are the laws of closure and figure-ground.

The law of figure-ground was based upon the observation that the field (in this case the visual field) is divided into two areas: a dominant central figure having characteristics of contour and strength; a recessive ground with fading boundaries and softened features. The law of closure was predicated on the assumption that there is a predisposition for forms to be completed perceptually even when insufficient stimuli are provided by the environment. The tendencies underlying both of these laws (figure-ground and closure) have been identified as inherent within the structure of the nervous system and as being independent of experience and learning.

Struggles to define and describe perception appear, therefore, to have progressed over the years along two opposing trends: one (e.g. the Cell-Assembly Theory of Hebb) was based upon the accumulation of discrete experiences, association and learning; the other (e.g. as represented in theories reflected in Gestalt Psychology) was tied to the innate, dynamic and global operation of the central nervous system. Between these extremes, of course, numerous whole and partial theories evolved which utilized various elements of both trends.

A current example of the meshing of these two trends is the Cybernetic Theory of Perception (Pitts, 1947) which proposed an analogy between the nervous system and electronic digital computers, in which oscillation, stored information, scanning and negative feedback were used to describe the perceptual process. Actually, feedback was an integral part of most perceptual theories, but two in particular placed special emphasis upon feedback from the skeletal musculature: the Motor Adjustment Theory (Freeman, 1948) and the Sensory Tonic Theory (Werner and Wapner, 1952). Both of these theories explained perception in terms of postural set and the maintenance of symmetry in the muscle tonus of the body. Tichner's (1909) Core Context Theory described perception as an interfusion of simple sensations (generated by transducers) and images or ideas (released from memory) whereby meaning is derived through the interrelation of these combined impulses. Helson's (1948) Adaptation Level Theory also considered the pooling of impulses which are derived from the figure (or signal), the ground (or noise) which surrounds it, and from experiences stored in the memory areas of the brain. Unlike Tichner's theory which relied on interstimulus structuring, Helson's theory was based upon judgments of meaning, made on the basis of a statistical averaging of the combined impulses.

In the Transactional Theory of Ames (1953) and the Probabilistic-Functional Theory of Brunswik (1943) perception was defined as a guess or a prognosis concerning the identity or meaning of a figure in the visual field. The former theory grew from an attempt to explain the process by which two different objects are discriminated when they project identical patterns on the retina of the eye. The roles of experience and learning were paramount in the formation of these neural hypotheses which constitute cognition (i.e. the culmination of the perceptual act). The latter theory assumed the construction of a neural image resembling the object perceived in the environment. The formation of this image was thought to be based on the accumulation of cues from the retina and, as such, could never be complete. A percept, then, is always something less than the real object.

The Directive State Theory of Brunner and Postman (1947, 1948) was more eclectic, in that it recognized the interplay of two factors in perception: structure and behavior. Structure referred to the innate qualities of the nervous system to transduce, transmit and organize environmental cues; behavior accounted for the influences of learning and experience to supplement or distort the perceptual end product, including tensions, needs, learned value systems, etc. Brunner (1951, 1953) elaborated further on this latter factor in his Expectancy Theory in which he stressed the importance of anticipation and set, in the development of perceptual experience.

Although controversies persisted in perceptual theories, at least one aspect of the phenomenon became apparent: perception, it is clear, is a process. Perception begins with sensation (the transduction of environmental energy into neural impulses), and ends with cognition (the acquisition of meaning at some level of complexity within the organism). Interfused between these extremes are a number of important variables which need to be considered if perception is to be understood. Subsumed under three general categories, these variables include: the organization of sensation, the structuring of the percept, and the transfer of meaning. Before these can be examined, however, the perceptual phenomenon must be viewed as a total process so that the contribution of its parts can be discussed in relation to the whole.

B. Visual Perception Viewed As A Process

Considering visual perception as a process brings into focus two corollary ideas: that something more is accomplished during perception than the mere reflection of an image; and that a number of steps are required to accomplish it. If it is reasonable to assume that the environment is the primary source of knowledge, visual perception can be viewed as a means of extracting useful information from the environment. The term useful is critical here, because the mosaic of energies that strike the retina far exceed the decoding capability of the neurologic system. There is a need, therefore, to limit and to select within the input channel, the cues which are most important. The visual processes have been described phenomenologically in experiments which have arrested the development of perception at different stages of completion (Davies, 1905).

The first stage can be identified as vague awareness of the stimulus, similar to the brief sensation of light which is experienced momentarily before the emergence of a nondescript form in the visual field. This stage has been demonstrated by experiments in which the duration or the intensity of the stimulus has been reduced to threshold, or in which the stimulus has been removed toward the periphery of the visual range (Zigler, Cook, Miller and Wemple, 1930).

The second stage can be called the generic awareness of stimulus form. This awareness involves a structuring of the visual field into two areas: a central figure in which particular features are accentuated in the consciousness; and a peripheral ground in which the remaining properties are suppressed (Freeman, 1929). Identification of the form is made on the basis of the salient features of the figure, which is possible only at the generic level of accuracy. This point was made through Fehrer's (1935) experiment, in which a complex line drawing was repeatedly flashed to observers who attempted to identify it after each exposure. In that study, preliminary classification errors were unstable, indicating that the judgments were made from a wide range of possibilities.

The third stage of visual perception can be classified as specific awareness, in which the figure continues to strengthen and appears to move forward from the field. The pattern of the form becomes consciously complete, but it is still devoid of its proper significance. In Fehrer's (1935) study, for example, an increase in the number of exposures resulted in a stabilization of errors. This consistency was attributed to the discrimination of the finer details in the figure, enabling the observers to narrow the range of possible categories from which they were prone to guess the identity of the perceived object.

The final stage of the visual perceptual process can be referred to as the awareness of meaning or the "I know what it is" feeling. At this point, the figure is identified with a fair degree of accuracy with respect to the real object or source of stimulation in the environment. There is, according to Bartlett (1916), a natural drive within man to complete this final step. The ease with which it is accomplished, however, varies with the nature of the stimulus and the experience of the individual. In most instances, perception is completed almost immediately upon stimulation, with an apparent lack of effort on the part of the observer or awareness of the intermediate steps involved. Simple and familiar figures have been identified, for example, at exposure rates of 10 to 30 milliseconds. Under less desirable conditions, however, the process may be prolonged, with considerable energy being expended consciously at the lower stages of perceptual awareness (Carl, 1933).

The perceptual processes seemingly involve a dual mechanism for the screening and selection of incoming stimuli. One part of this mechanism is anchored to the structure of the nervous system which organizes the field in order to reduce the number of stimuli, and structures the figure so that a maximum amount of information can be obtained from a minimum amount of cues. Another part of the mechanism is held within the core of the central nervous system, where schematas formed by experience dictate to a large extent the allocation of stimuli to the figure or to the ground. The natural tendency for the nervous system to structure incoming stimuli operates throughout the entire perceptual processing, but the influences of learning and experience increases from a minimum effect at the onset to a major effect in the final stages. This "gathering of momentum" effect suggests that perceptual awareness, at least in the initial stages, is dependent almost exclusively on the ability of the individual to organize stimuli as they are transduced and transmitted from the periphery of the nervous system.

C. Organization of Visual Stimuli

The transducer itself, by the nature of its structure, is a stimulus screening mechanism, which selects only a fraction of the available energy from the environment for conversion into neural impulses. The rods and cones of the retina, for example, are sensitive only to a small band of electro-magnetic wave lengths (between 400 and 800 millimicrons). The rods have a lower threshold than the cones and, therefore, they play a greater role in perception, as illumination decreases. The rods are spread throughout the periphery of the retina and a considerable amount of overlapping processing occurs with the first order neurons of the afferent system. As a result, direct function of the rods is limited. Conversely, the cones are situated toward the center of the retina, filling the fovea where the density peaks sharply at 147,000 cones per square millimeter. In addition, there is a one-to-one correspondence between the cones and the neural endings so that spatial resolving ability is maximum (Chapanis, 1949).

Normal visual acuity is fundamental to the resolution of the finer details of the third and fourth stages of visual perception, whereby one figure is differentiated from another and ultimately is identified. In these latter stages, however, the retina (with its rods, cones and afferent connections), in comparison with the higher centers of the brain, plays only a minor role in the reorganization of visual cues. It is at the lower levels of perception, during the detection and discrimination of brightness differences, that the transducer (retina) assumes a major role in the structuring of the field.

The sensation of brightness varies with the amount of physical energy reflected from the environment. When two objects are observed under fluctuating levels of illumination, however, their relative brightnesses remain constant. This constancy factor occurs because the perception of relative brightness depends upon the <u>albedos</u> of the objects in the field (i.e. the ratio of the light reflected from its surface to the level of the incident light in the environment). Because the ratio is relatively consonant, the relative brightness of objects under the same field of illumination are also constant. This point was made in an experiment reported by Gelb (1929), in which subjects observed a highly illuminated black sphere in a darkened room. Although the subjects were aware of the real color (or lack of it), they reported that the sphere was white (i.e. the maximum degree of brightness). When a smaller white sphere was introduced in front of the black one, the black sphere appeared to turn black and the white one was, then, perceived as white. The relative difference between the two was preserved by their respective albedos, suggesting the reflexive nature of perceptual experience. The important point here is, that despite past knowledge and expectancy, the subjects could not perceive the brightness of the spheres in any way other than the way they did. The higher levels of cortical control had not yet entered into these levels of perceptual awareness and the structuring of the field was left, primarily, to the influence of the transducer and the lower functions of neurologic organization.

Not only is perception a process of organization, then, but the stimuli which impinge upon the retina from the environment are, in themselves, not without a considerable amount of organization. This structure can and usually does facilitate the formation of the field aided by the strengthening effects of the natural boundaries which occur within the environment. It has been demonstrated experimentally that boundaries not only increase the clearness or attention value of a simple form but also the speed with which it is perceived (Meads, 1915; Woodrow, 1916). When boundaries enclose a complex form, the intra-structure of the stimulus becomes a variable which affects the perceptual organization of the figure. Attneave (1957) defined the complexity of a form in terms of its symmetry and contour, taking into account both the number and degree of turns in the boundary. The structural qualities of symmetry, simplicity, compactness and continuity also facilitate the organization of the figure in the perceptual processes (Koffka, 1935).

It is not always the case, however, that a stimulus from the environment will be structured in such a way that it will project a closed, unified simple form across the retina. Instead, there may be a mass of small discrete forms or fragmented contours which compete for prominence in the perceptual organization of the field. In these instances, the interstructure of the stimuli plays an important role in determining how the mass will be perceived; the variability can be accounted for in terms of three structural principles: proximity, similarity, and continuity (Vernon, 1952).

A common example of the principle of proximity is the conventional grouping of letters on the printed page to form easily perceivable word units. The principle of similarity can be demonstrated by the familiar color-blind test in which the correct figure can be identified by tracing identical colored dots. The principle of continuity describes the ideas quality of a figure in which the fragmented contours are continuous, uninterrupted or deployed in the same general direction. For example, if a capital "W" is printed in block form on top of a capital "M" so that the points are in contact, the resultant figure could be perceived not as two letters but as a diamond suspended between two parallel lines. These three structural principles--proximity, similarity, and continuity--are basic to the organization of visual stimuli.

D. Structuring the Visual Percept

Stimuli from the environment, passed by the retina, provide too many cues for the input channel to decode. Perceptual events which follow the transduction reduce further the number of cues by accentuating some cues and by suppressing others. This restructuring of cues is evident by the second stage of the perceptual process and the visual field is organized into a central figure and a peripheral ground. The formation of the field follows an orderly and predictable sequence of developments which has been described by Wever (1927).

The first stage in structuring the percept is the detection of a heterogeneous quality in the visual field, which forms the basis for division: the source of the heterogeneity becomes the figure; the remainder of the field provides the ground. Although there appears to be a natural tendency for the input system to separate figure from ground, when the field does not have heterogeneous poles upon which to divide, the field (homogeneous) becomes unstable. A stimulus field which presents a uniform distribution of light energy is called a ganzfeld (Cohen, 1957). An experience closely approximating a ganzfeld can be created by covering the opened eyes with the concave halves of a ping pong ball. Cohen (1958) has reported that subjects observing a ganzfeld with a saturated hue experienced a phenomenologic shift after several minutes: the hue appeared to become unsaturated and faded into a gray field, the center of which was darker than the rest. The center of the field, moreover, appeared to be closer to the observer than the surrounding field. If, by contrast, a heterogeneous stimulus, such as a small sphere of different intensity or hue were introduced into the field, the perception of the original hue of the ganzfeld was maintained.

Auto-kinetic effects also demonstrate the need for heterogeneity, if stability is to be maintained in the visual field (Cohen, 1958). If a bright spot is viewed against an unilluminated field, such as a dark room, the light will appear to move unpredictably across the homogeneous background. If heterogeneity is introduced, by progressively increasing the illumination in the room so that the background detail becomes gradually more visible, the apparent movement of the spot diminishes (Luchins, 1954).

Occurring concomitantly with the detection of heterogeneity in the first stage, is an awareness of an apparent brightness difference between this area and the remainder of the field. This difference gradually increases until a definite shape begins to solidify and the presence of contours can be defined clearly. This accommodation takes approximately ten milliseconds to complete according to Wever (1927).

In the second stage, the emerging figure appears to raise out from the field and assume some qualities of depth. The surface details of the figure become fixed and clearly discriminated, while those of the field (the ground) are filmy and vaguely defined. The stability of the figure has been demonstrated by its resistance to change both in hue and in brightness, the color limen being much larger for the figure than for the ground (Gelb and Granit, 1923; Roberts, 1932). The culmination of this structuring process is the experience of a halo effect around the figure. Wever (1929) reported that this second stage lasted for approximately seven milliseconds in his experiments, but it should be noted that he was using simple two-dimensional stimuli with clearly defined figure-ground dimensions. The execution time of these stages has been reported to vary with the complexity and familiarity of the stimulus (Leeper, 1935).

The orderly reorganization of stimulus cues into a figure-ground relation is apparently guided by a set of behavioral principles which have been described by Gestalt psychologists and which are subsumed under the Law of Pragnanz. Specifically, the Law of Pragnanz states that the formation of the figure is directed into the very best form possible for purposes of perception. A "good" form is one that is stable and clearly defined so that it can be perceived quickly and with minimum stress (Koffka, 1935).

Both extrinsic and intrinsic forces are involved in the formation of a "good" form. These forces can operate independently of experience and learning, although there is evidence to suggest that these latter factors do play at least a minor role (Thurstone, 1944; Mooney, 1954) in the final perception. As discussed previously, the extrinsic forces include the structure of the stimulus in the environment which can facilitate or hinder the formation of the figure. The intrinsic forces (i.e. the innate tendencies of the input channel to modify the formation of the figure) are discussed below.

E. Intrinsic Forces in Visual Perception

A basic intrinsic tendency contributing to the Law of Pragnanz is the principle of simplicity. It has been hypothesized that simplicity creates sufficient redundancy in the figure so that it can be decoded effectively and stored efficiently in the memory (Miller, 1956). There is evidence to suggest that not only are simple figures perceived more readily than complex ones (Razran, 1939), but, also, that the perceptual figure itself is simplified over that which is reflected on the retina from the environment (Fuchs, 1920). This becomes increasingly evident when the structure of the external stimulus is weakened, thereby allowing the internal forces to exert more influence on the formation of the figure. Tachistoscopic exposure of a figure at high shutter speeds, for example, results in a reduction of the perceptual form to a circular patch of light (a circle being the simplest possible form (Helson and Fegrer, 1932; Wilcox, 1932). Experiments permitting a greater abundance of external cues have demonstrated lesser degrees of simplification, but always in the direction of symmetry, regularity and rectilinearity (Hempstead, 1900; Perkins, 1932). Even perceived after-images adhere to the simplification principle, and as the stimulus becomes more complex, the required amount of simplification increases.

When the stimulus is scattered loosely across the visual field so that a single figural simplification is impossible, a reduction of the cues still may be obtained by a grouping process. The cues are combined perceptually to become the elements of a super form which develops along the previously mentioned lines of symmetry and regularity. This grouping process is based on the principles of proximity, similarities, and continuity which, although they have been represented as environmental influences, also reflect the intrinsic capability of the nervous system to capitalize upon them in the organization of the perceptual field.

Closely related to and partially dependent on this grouping activity of the perceptual system is another important principle under the Law of Pragnanz: the tendency toward closure. This reflects the disposition of the forces within the input channel to complete the formation of the figure when the pattern of cues from the environment is disrupted or incomplete. This phenomenon may be experienced during a casual glance at a line-drawn newspaper advertisement. Although parts of the picture are deleted frequently, the viewer may be unaware of the missing boundaries, which are reconstructed internally in the perceptual process. The tendency toward closure has been demonstrated experimentally with semi-blind patients who perceived a complete geometric form, such as a circle, despite the fact that they were physically capable of receiving only part of the stimulus (Bender and Teuber, 1946; Fuchs, 1920). Subjects with normal vision also have been found to close the discontinuous portions of incomplete pictures. In a study by Bobbit (1942), for example, a series of incomplete triangles were exposed tachistoscopically, each with successively more closure than the preceding one. Before the completed form was reached, however, the subjects perceived the triangle as continuous.

Even when the individual elements of a cluster of stimuli are undeniably separate, the tendency to close them into a unitary meaningful figure can be observed. Thurstone (1944), presented subjects with patterns of dots which followed the contours of symbols, such as the letter "A." The patterns were identified as the symbols they resembled despite the fact that the subjects reported an awareness of the individuality of the dots.

The law of closure is hypothesized on the premise that a closed figure conforms more to the Gestalt definition of a "good" form than does an open figure. This concept has received some indirect support from a study by Wulf (1922) in which subjects were requested to observe line drawings, some of which were incomplete. When they attempted to reproduce them from memory, after an elapsed period of time, Wulf found less distortion among the reproductions of the closed figures than the discontinuous ones. An inherent preference for closed figures was also suggested in a study by Bakay and Schillar (1948) where subjects were asked to change several two-dimensional disconnected forms in whatever way they wished. They spontaneously connected the open portions of the figures, which suggested an attempt to reduce perceptual stress created by the discontinuity of the forms.

F. Transfer of Meaning

As an individual moves within the environment, his intake of visual cues is not a random affair; only certain objects in the field are selected to be observed. For each situation, an inventory of observable items is developed on the basis of past experiences and present needs. This inventory constitutes an expectancy of what is to be perceived.

Expectancy is an important factor in the transfer of meaning because it enhances the selection of significant stimuli (i.e. those which will have the greatest positive reward value) and narrows the range of possible interpretations which need to be considered in the following trial and search, or decoding process. The development of expectancies is believed, by Bartlett (1932) to reflect the formation of schemata, similar to those hypothesized by Lashley (1929) to explain the routinization of complex motor movements, such as playing the piano. These schemata are, in essence, neurologic records of past experiences against which incoming cues can be compared.

Because expectancies are a function of experience, they represent by their strength the frequency of past events and, in turn, the probabilities of future ones. The projection of probabilities is a capability that appears to be most highly evolved in the human nervous system (Hake and Hyman, 1953). Expectancies are formed quickly on the basis of a few repeated events. If a series of large pictures are presented to a child, he will soon expect each succeeding picture to be _large_ (Messick and Solley, 1957). Probability estimates, of course, are subject to many kinds of conscious modification. For example, if two events, such as the heads and tails of a coin, are presented in random order, and one by chance appears several times in a row, there is an increasing tendency for an observer to expect the alternate event to occur with each passing trial, although the probability remains constant at 50 per cent.

Perhaps the most pervasive expectancies are those suggested by the term _einstellung_ (Gibson, 1941), which refers to the general attitude overlaying the perceptual act as a result of many previous perceptual and conceptual experiences. This point was supported by an experiment of Bruner and Goodman (1947), in which children attempted to adjust a circle of light to the size of a small coin. The children from lower economic backgrounds estimated the size of the coins to be larger than did the children from more affluent backgrounds, and the experimentors concluded that the differences in responses of the two groups was due to differences in their attitudes toward money.

Instructions given prior to the onset of a perceptual experience also can qualify responses. Kulpe and Bryan (1904) illustrated this principle when they presented different colored letters in various spatial arrangements tachistoscopically, and instructed the subjects to look for a particular feature, such as a color. Under these conditions, the subjects were unable to recall other characteristics of the stimuli such as letter identity or spatial arrangement.

Another point which should be mentioned is that perception is clearer and response time is more rapid when attention is focused directly upon an object. It has been found that when the width of the field of attention is increased, the clearness of the percept diminishes; conversely, as the width is decreased, discrimination improves. Solley and Murphy (1960) were concerned with the qualitative aspects of attention as well as quantitative factors including: _subliminal attention_ in which information is registered and stored without awareness; _nonreflective attention_ in which there is an awareness of planes, edges, textures, colors, etc.; _reflective consciousness_ in which there is a unification of the stimulus into a cohesive whole; and _semantic attention_ in which a host of meanings are attached to the stimulus in terms of the past experiences of the individual.

Semantic attention, of particular importance to language, is attained, according to a number of authorities, after incoming stimuli are compared with stored patterns generated from previous experiences (Allport, 1955; Bruner, 1951; Postman, 1951). When patterns do not match the expectancies, searching is continued with new possibilities or hypotheses being tested. Interim percepts may be unstable or incorrect. This was demonstrated by Postman, et al. (1951), who used pictures of playing cards exposed tachistoscopically, in which the diamonds and hearts were black and the spades and clubs were red. Some observers were unable to achieve a stable percept on their first exposure, while others reported seeing suits in their expected colors or as blends of black and red.

The ease with which meaning is transferred during the perceptual process is dependent not only on the experience and expectancies of the individual but, also, on the nature of the task--whether it involves the discrimination of real objects, the recognition of representations of real objects, the appreciation of abstract shapes and patterns, or the decoding of symbolic material.

For real objects, under normal conditions, the transfer of meaning is immediate and the primary stages of awareness are completely dominated by the semantic significance of the stimulus. Moore (1919) reported that meaning occurs first along the dimensions of utility and consistency, but Vernon (1952) suggested that naming at the imaginal level may even precede these basic categorizations.

Representations of real objects, when they are clear and familiar, also are perceived instantly on the semantic level. When identification is difficult, however, meaning may be achieved temporarily and only at a rudimentary level of awareness, revealing shapes, edges, textures, colors and shades, etc. (Street, 1931).

Abstract shapes and patterns that are simple and conform to the Gestalt principles of "good" form, such as a circle, square or triangle, are readily discriminable by both animal and man (Gellerman, 1933;

Gesell, 1949; Droh, 1927; Lashley, 1938). Complex form recognition is possible for man without the aid of language but identification is facilitated by language.

G. Development of Visual Perception

Despite neurologic immaturity, infants are endowed with remarkable inventories of sensitivities which stimulate growth of the perceptual processes. Piaget (1932) hypothesized, on the basis of his observations of infants, that perceptual behavior is developed through the modification of simple reflexes which are functional at the time of birth or evolve soon after, as maturation occurs. The orienting reflex, for example, which has received much attention in Russian psychology, is a basic neurologic circuit which automatically directs attention to incoming stimuli. Such simple reflexes, according to Piaget, are elaborated through experiences and eventually are suppressed by the overriding influences of the developing schemata, or changes in the circuit. In time, the automatic responses of the orienting reflexes are subordinated to the voluntary searching for perceptual cues.

Some innate responses of the visual system are relatively sophisticated and there is evidence to suggest that infants are sensitive to the same brightness values as are adults (Peiper, 1937). This, in turn, may relate to another apparently complex reaction involving heterogeneity. It has already been noted that the visual system of the adult requires heterogeneity, such as a brightness differential, for stabilization of the field. It is logical to expect that neonates may also have the same need. This need was observed by Fantz (1961, 1963) who studied the visual fixations of infants as young as one week and found that complex patterns, presented in random pairs, elicited greater visual attention than did homogeneous stimuli. He concluded that infants not only have the capacity to perceive patterns but that they also prefer them to diffuse kinds of stimuli. In addition, he noted that children over two years attended to a sphere in preference to a flattened disc. This finding also was attributed to the presence of patterns formed by the brightness gradients, or shadows, on the sphere. This early affinity for patterns possibly provides an explanation for the frequent observation that young infants attend to human faces (Fantz, 1966). Hubel (1960) also reported greater cortical activity in response to specific visual patterns than for diffuse stimuli, which led to the conclusion that patterns contain more information about the environment than do homogeneous, unstructured stimuli. Add to this a finding reported by Fantz (1966), that although the size, shape and color of objects may vary with perspective, the pattern will remain relatively the same, and it would appear that a kernel of consistency is available in a pattern from which recognition and meaning can evolve.

Infants do not respond to all of the numerous patterns which exist in their surroundings, however. To the contrary, there are limited factors which effectively reduce the field. For example, visual acuity in the infant is considerably less effective than that of the adult. Gorman, et al. (1957), using an opticokinetic response estimated the acuity of neonates one and one-half hours to five days old to be 20/670 by Snellen chart standards. Fantz (1958), using fixation technique, reported significantly better visual performance, but at best, neonates could resolve patterns no finer than 1/8 of an inch at a distance of nine inches.

In addition to acuity restrictions, perception appears to be limited to infants by an inflexible state of accommodation that fixes the range of focus to a spherical plane with a radius of eight or nine inches (Haynes, 1962). Only those objects which are close can be perceived readily but apparently accommodation flexibility is achieved quickly (Haynes, 1962).

Closely following the control of accommodation is the development of depth perception. This ability is evident in the motor behavior of infants at three months and continues to show improvement into the second year (Cruickshank, 1941; Gesell, 1949; Piaget, 1955). This point was demonstrated most dramatically, by the visual cliff study of Gibson (1960) in which infants of six months were placed on a transparent platform under which half the floor was lowered. It was found that infants would not crawl on the portion of the platform under which the floor level was depressed. Concomitant with the development of depth perception is a growing mastery of size constancy, which although it is absent before three months, is significantly advanced in the six-month-old infant

(Cruickshank, 1941). For great distances, however, the full appreciation of size constancy continues to improve throughout childhood and early adulthood.

As the child matures, the ability to discriminate simple patterns continues to improve. Under high motivation a child of 15 months can distinguish between a cross and a black square (Munn and Steining, 1931), and a child of two years can detect small differences in a geometric form, such as a triangle with its top removed (Gellerman, 1933). Under normal motivation and with complex forms, however, there is a tendency for the child to disregard parts and details of a form and to syncretize the pattern into a meaningful whole. In an experiment by Segers (1926), for example, the heads of picture-animals were switched. Yet, children under five failed to notice the discrepancies and identified the animals on the basis of their body form. The ability of young children to complete closures on large groups of stimuli appears to be poor (Freeman, 1929), particularly when the field is complex. The child under six may attend merely syncretistically to individual conglomerates of stimuli, without making any attempt to relate them to each other.

Inclusive, or grouping power, which is important to closure, is partly a function of color perception. Although discrimination of the primary colors has been observed in infants as early as 15 days after birth (Chase, 1937), matching of colors is not developed significantly until the age of two years, at which time 45 per cent accuracy is expected. Accuracy of matching increases to 97 per cent at six years (Cook, 1931). For the two-year old, however, matching behavior is rudimentary in that it must be relearned before each new experience: a child may learn to match a blue toy with a blue box, but he may be unable to apply the process in order to match a pink toy with a pink box, without further training (Roberts, 1932).

As the child gains experience, perceptual grouping becomes increasingly influenced by other intrinsic factors. For example, the child of one and one-half years is predominantly interested in colors. The attention of the two-and-one-half-year old, however, is drawn more to pictures of real objects. The interim age is occupied by a transitional compromise in which meaningless colored forms are preferred to either real pictures or patches of color (Hetzer, Beaumont and Wiehemeyer, 1929). By the age of three years, if the stimuli are meaningless colored forms (e.g. geometric figures), the child may match them on the basis of color; if they carry symbolic significance for the child, the stimuli will be matched according to form (Descoeudres, 1914).

Although the ability to discriminate forms develops rapidly, this ability is limited in some respects by the late formalization of directional coordinates in the perceptual field. Children of two years, for example, are not able to distinguish between a plus sign and its tilted counterpart, the "X" (Hanfmann, 1933). This lack of absolute judgment may reflect poor body image or insufficient proprioceptive feedback. Perhaps as a consequence, many young children fail to notice the transposition of forms (discrimination vital to reading). Of particular importance, for example, are the commonly recognized mirror images ("d" and "b") and upside down reversals ("q" and "d" or "q" and "b"). These letters persist in giving preschool and first-grade pupils discrimination problems despite the fact that children in this age range have developed at least rudimentary concepts of vertical and horizontal line (Davidson, 1935; Hanfmann, 1933). Training has been found to hasten the development of directional orientation, however, mirror images appear to be more difficult to resolve than vertical reversals (Rudel, 1959). This may be due to the dependence of vertical orientation on proprioceptive feedback while horizontal orientation is a function of left-right discrimination. The latter comes with cerebral dominance, usually by the fourth or fifth years.

As acuity is refined and accommodation becomes more flexible; as depth perception evolves and coordinates in the field are crystallized; as color and form concepts develop and discrimination of patterns becomes more selective and precise; the percepts of the child are able to assume greater symbolic meaning and utility. It is apparent that meanings are sensory in nature initially, consisting primarily of patterns formed by contours of shades and colors. Obviously, there is little possibility for perceptual inference at the neonate level and meaning is related to immediate sensations: a child of three months may grasp an object that comes within his gaze, and ultimately place it in his mouth. According to Piaget (1952), however, with each succeeding experience, meaning becomes more elaborated and contributions from the participating senses are combined into a developing schemata which in future events serves as a core for recognition and identification. This point can be seen in a child of six months, when he deliberately reaches for objects in his environment. Meaning at this nonverbal level is extremely concrete and as Piaget (1955) points out, a familiar object, such as a bottle, may not be recognized by a young child when it is presented upside down. By the eighth and ninth months, however, meaning becomes more general and crystallized. Not only will the infant recognize the bottle from every angle, but he will be able to retain a memory of it when it is removed from view. With experience, the growing schematas become increasingly interassociated so that perceptual events can be related and perceptual expectancies can be formed.

It is when verbal utterances are added to visual images that language is interjected into the perceptual processes. Initially a child's associations are concrete, usually with one name representing one object. At one year a child may associate the word "cup" with a small pink cup but not, for example, with a large white one. By the second year, however, his vocabulary is expected to have developed to a degree where he can identify four out of six items (Granit, 1921; Liublinskaya, 1957; Terman and Merrill, 1937; Wekh, 1940). This increase in the use of linguistic labels is accompanied by an important innovation: the child begins to abstract certain features of the percept and classify these, with increasing accuracy, into verbal categories.

Like a powerful catalyst, language facilitates the perceptual processes by measurably increasing the precision of attention used to organize the field. Liublinskaya (1957) noted, for example, that children could not recognize objects (e.g. a butterfly with stripes) until they mastered linguistic representations. The labeling of visual images apparently increases the flexibility of attention by selectively strengthening the identify of individual elements which make up the general pattern of the inclusive figure. Also, children are able to attend to the whole figure or to the specific parts by recalling appropriate associated symbols. The labeling of simple figures, therefore, increases their resistance to masking, and linguistic development facilitates the differentiation and reorganization of percepts along lines of relevance and expectancies. This point was made by Ames (1953) in a study in which two-year-old children globally perceived the Rorschach inkblot forms but three-year olds, in whom language was presumably more advanced, organized their percepts in terms of specifically selected features.

Language also permits greater inclusiveness in the perceptual transfer of information by providing a conceptual synthesis of visual cues. Vernon (1952) and Amen (1941) found that young children simply enumerate the names of objects in a complex picture, but as they become older, children perceive the pictures in terms of their activities, their underlying causes and effects, and ultimately, their emotional and social significance (Stern, 1924). It can be seen, therefore, that language carries the perceptual processes from the realm of immediate response to sensations or conditioned responses, to the conceptual level of use.

Language is meaningful, however, only after the basic structure of perception is mastered. In visual perception, if there is no orderly or consistent screening of visual cues; if there is no ability to draw the elements of the figure into a cohesive whole; or if perception is accomplished with such inefficiency and effort that an inordinate amount of time is required, there is little opportunity for symbolic association to occur and the modality fails to develop into an effective channel for communication.

H. Visual Figure-Ground Discrimination Research

Figure-ground discrimination refers to the ability to differentiate figures from their backgrounds when differences between figure and ground are minimal. Research investigating the relation between figure and ground generally has followed one of three experimental approaches involving: the perception of ambiguous figures, the recognition of hidden figures, or the identification of masked forms.

On tests of ambiguous figures, the stimuli are structured so that the figure and ground can be psychologically reversed to create a radically different percept. The Necker Cube and the Schroeder Staircase are two common examples (Woodworth, 1938). There has been evidence to suggest that the reversal phenomenon is linked to maturation so that children below the age of six do not experience the shift (Snyder and Freud, 1967; Spivack and Levine, 1957).

For normal adults and older children, however, when under voluntary control, performance on the ambiguous figures tests is similar to that on both the masked and the hidden figures tests (Haronian and Sugarman, 1966, 1967; Jackson, 1955, 1956; Newbigging, 1954).

In hidden figures tests, the object to be perceived is placed partially or completely within the contours of a larger figure. The surrounding structure must be selectively suppressed into the perceptual ground before the relevant figure can be identified. Stimuli such as these have been used extensively in the exploration of perceptual style, and to determine its correlation with attributes of intelligence, personality and academic achievement (Witkin, 1965).

Witkin (1965) defined two opposing styles of figure-ground perception: field dependence and field independence. These polar terms refer to a range of perceptual abilities used to overcome the influence of context, or ground, in the organization of the field. According to Witkin, the capacity to differentiate complex stimulus fields and to attend only to the selected field (which now becomes the figure) is the relevant task of figure-ground discrimination. He developed three tests to determine perceptual style; two of these: the body adjustment test and the rod and frame test involved proprioceptive feedback as well as the visual modality. The third, and of particular interest to the present study, was an embedded figures test which relied exclusively on visual cues.

Witkin's embedded figures test, which was an adaptation of Gottschdalt's hidden figures test, was found to have a high correlation with a similar test designed by Thurstone (Elliott, 1961; Gardner, Jackson and Messick, 1960) to evaluate flexibility of closure, and also with tests of general intelligence, concept attainment and personality.

There has been some controversy concerning tests of hidden or embedded figures as to whether or not resulting scores reflect only figure-ground perception or if they represent a combination of several other basic abilities. Several factorial studies have reported, however, that figure-ground discrimination emerges as a strong independent factor (Ayres, 1965; Silverstein, 1965). This finding led some investigators (e.g. Ayres) to conclude that there must be a neurologic mechanism specifically responsible for figure-ground perception. Indications are, however, that such a mechanism would be modality specific since intermodality performances have been found to have weak correlations (Cruickshank, 1957; Siegenthaler and Goldstein, 1967).

Also, a number of factorial studies have reported that hidden figures tests measure more than one elementary skill (Corah and Powell, 1963; Sprague, 1963). Oakley (1961), for example, found that the variance on the embedded figures test loaded highly on three separate factors: gestalt flexibility, spatial perception and reasoning ability. This finding suggested that unwanted complexity could be circumvented by using more precise figure-ground tasks, such as the use of masked figure items.

In a masked figure item, the structure of the perceptual target can be weakened by the influence of a ground which acts as visual noise. For example, an extraneous pattern or grid of lines can be placed between and around visual stimuli to decrease the differential between the figure and the ground. Thus, the concept of signal to noise ratios, familiar to those concerned with auditory perception, can be applied usefully to the study of visual perception (Shannon, 1948 and 1949).

Numerous research studies have been conducted using varying degrees of noise with visual patterns formed by matrices of small lights or printed forms. In general, it would be expected that as the visual noise or interference is increased beyond certain limits, discrimination would become less accurate. In addition, variables other than accuracy may be affected. Webster (1963, 1964, 1966), for example, found that a rise in the level of noise from 10 per cent to 50 per cent was accompanied by an increase in the response time needed, although discrimination accuracy was not affected (Arnoult, 1956; Attneave, 1954 and 1955; Hake, Rodwan and Weintraub, 1965; Miller, 1953 and 1956; Rappaport, 1957; Van de Geer, 1963; Webster, 1963 and 1964).

Information obtained from studies of figure-ground discrimination has suggested a correlation between brain pathology and problems in figure-ground discrimination (Goldstein, 1938; Horrower, 1939; Teuber and Weinstein, 1956). Of particular interest to the field of education is the research involving neurologically impaired children reported by Werner and Strauss (1941). For their study they developed a figure-ground discrimination picture test for children, consisting of a series of nine cards with black and white line drawings of familiar objects, masked by a background grid of homogeneous lines. Using these items, the investigators found that brain injured children had a much higher percentage of background responses than either non-brain injured retarded children or normal children. Dolphin and Cruickshank (1951) studied figure-ground relations among children with cerebral palsy and reported findings similar to those of Werner and Strauss. In addition, Myklebust and Brutten (1953), exploring the visual perception of the deaf, concluded that children with a peripheral hearing loss can be differentiated from those with central perceptual disorders on tests of figure-ground discrimination. In essence, these and other studies (e.g. Wood, 1955) point to a strong relation between problems in figure-ground discrimination and central nervous system dysfunction.

I. Visual Closure Research

Visual closure refers to the ability of the individual to respond to the "whole" when only partial, and therefore, incomplete clues are presented. Experiments on visual closure have been based on the controlled reduction of visual cues. Two rather popular methods have been used to achieve this reduction: the defocusing method, in which the stimulus is presented at a position in the visual field peripheral to the focal center of the observer; and the fragmented picture method, in which the stimulus is exposed with varying degrees of cues artifically removed. Recognition performance on such tasks has been described by Thurstone (1944) as a measure of perception.

There has been some question, however, as to whether or not the concept of closure represents an individual ability or represents merely another aspect of figure-ground discrimination. Gump and Witkin both studied this relation using the defocusing method. Gump (1955), working with adult subjects, found a significant correlation between closure and figure-ground discrimination. Witkin (1965), however, in a study of children, was unable to replicate Gump's findings. In another study, Campbell (1967), using the fragmented picture method also failed to find a relation between closure and figure-ground discrimination, and he concluded that they were separate skills. Many years before, Street (1931) compared children's scores on his Gestalt Completion Test with various kinds of analytic tasks and reported a significant correlation only with the Healy Picture Completion Test. He concluded that closure tasks measured a specific perceptual response, and that closure and figure-ground discrimination required separate abilities.

Part of the confusion regarding closure and figure-ground discrimination stems, probably, from the variation in stimuli used to study these phenomena. In one study of closure (Goldstein and Mackenberg, 1966), for example, the subjects viewed a limited portion of a photograph of a familiar face. These kinds of stimuli were used instead of schematic-type drawings because, it was reasoned, these items permitted a minimal amount of extraneous interstimulus differences by which the observer could guess the correct response. The example given to support this point was that these items prevented the identification of a picture of a horse (e.g. as opposed to that of a house) on the basis of gross conceptual clues, such as the awareness of a leg. By the same token, this type of closure task, seemingly requires a high level of cortical activity and a considerable emphasis on memory, since there is no question that the total figure could not be perceived as presented (Giorgi and Colaizzi, 1966 and 1967).

A less cognitive task of closure in which a three-dimensional schematic representation of a figure from which portions of the figure were deleted selectively has been used, also (Street, 1931). With these items, the remaining voids and patches of the picture must be filled in and combined mentally before recognition is possible. This type of task differs from the photographic picture method referred to previously, in that the entire dimension of the figure is presented to the observer (i.e. deletions are made uniformly throughout the photograph so that the viewer can meaningfully perceive the whole only after closure has been made). In some cases, this occurs so automatically that the subject may not even notice the reduction or omission of visual cues. But tasks such as these still require considerable cortical participation, and a child who has not had previous experience with identifying photographs may not be able to respond to a distorted representation of one on a visual closure test.

A more primitive type of closure task is one in which the subject observes a single-line drawing of a figure from which portions of the contour have been removed uniformly. These differ from the three dimensional photographed or drawn items in that conceptualization is not necessary for the identification of the single-line drawing. Instead, matching is possible through a comparison of one perceived item with another. Performance on this task is more a measure of innate ability, than of learned or conceptualized behavior.

It seems clear from this brief review of selected studies and others not discussed here, that both closure and figure-ground discrimination have been explored from many standpoints and for many years. The major concern of the majority of these studies, however, appears to be focused on what the subject perceives or whether or not subjects can respond accurately to selected items presented in a specific manner. In visual studies, at least, very little information has been reported regarding how much interference subjects can tolerate before they are unable to respond accurately to the stimuli presented. In terms of closure research, Long and Reid (1952a, b) have reported that for normal subjects, deletions as high as 10 per cent of the pattern can be tolerated before closure performance is affected. Under more severe stimulus restrictions, however, recognition appears to vary as a direct function of the remaining visual cues. Similar information regarding figure-ground discrimination does not seem to be available.

Because children learn language in environments with various degrees of interference--the classroom, the playground, the home--the importance of learning something about these tolerance levels in young children appears evident. Certainly the relation between language proficiency and tolerance levels of perceptual interference should have implications for the education of children with language learning problems.

III. PURPOSE AND OBJECTIVES

Generally, the purpose of this project was to explore the relation between language proficiency and selected factors of visual perception in young children. More specifically, the objectives of the study were:

(1) to develop an experimental battery of visual closure and figure-ground discrimination items which would have a series of degrees of interference levels (from complete closure to almost totally omitted visual cues and from complete figure to almost complete absence of figure), and which would be sensitive to a wide range of responses in young children (three to six years of age);

(2) to compare the responses of two groups of children (Group I with expected low language proficiency performance; Group II with expected high language proficiency performance) on the experimental battery and on a battery of standard tests used to evaluate language proficiency; and

(3) to study the data resulting from these measures for implications which might aid in the adaptation of old or the development of new educational methods for children with language learning problems.

CHAPTER II

METHOD

I. INTRODUCTION

The major problem posed by the undertaking of this study was the need to develop an instrument which would be adequately sensitive to a wide range of responses of young children on figure-ground discrimination and closure tasks. Initial work on the construction of the Experimental Battery was carried out during the first year of the study, the details of which are reported in Appendix C. Briefly, the following recommendations resulted from that pilot study.

A. The Experimental Battery should be adapted to provide additional items of average and greater-than-average difficulty. The method recommended for adaptation was to increase the complexity of the slides to provide seven or eight degrees of closure and figure-ground discrimination, instead of the original three degrees, in order to provide a wider range of limit for all items. It was decided that the aspect of Perceptual Speed, which was included in the pilot study, should be set aside for subsequent study.

B. The adapted Experimental Battery and selected Standard Battery should be run on a much larger sample (approximately 200 subjects) of young children (three to six years of age) in order to obtain additional information about the lower developmental levels of the experimental items. This age range was selected because the perceptual processes have, proportionately, the greatest degree of development during this age span.

The discussion which follows describes the procedures used in the second phase of the study, with specific reference to: the selection of the experimental sample; the selection of measures which made up the Standard Battery; the adaptation and use of the Experimental Battery; and the methods used to relate these measures to Clinical Judgments as they frequently are carried out in evaluations of language proficiency.

II. THE EXPERIMENTAL SAMPLE

A. Criteria for Selection

To meet the particular needs of this study, the experimental sample was selected according to several basic criteria. All subjects were between the ages of three years and six years at the time of testing; considered to be free of any major physical or psychologic problems; known to be able to respond in a formal test situation; and expected to participate in both phases of the examination (the Standard Battery and the Experimental Battery), administered in two separate test sessions.

B. Description of the Experimental Sample

Adhering strictly to these selection criteria, the Total Sample was selected from two markedly different socio-economic areas and included subjects from deprived lower class areas and subjects from wealthy upper class areas. (Details concerning the selection of subgroups are described later in this discussion.) The selection of subjects from these two socio-economic extremes was predicated on the belief that responses obtained from these two groups would reflect a greater range of responses extant in the general preschool population as opposed to that of a particular middle class group. Subjects from the low socio-economic background were referred to as the Expected Low Language Proficiency Subgroup on the assumption that they had below average exposures to language building experiences; the high socio-economic group was called the Expected High Language Proficiency Subgroup on the assumption that they had above average exposures to language building experiences. It was believed that these two subgroups could be compared along a number of dimensions, particularly an exploration of their responses to visual figure-ground discrimination and closure items, in order to explore differences which may exist between language "advantaged" and language "disadvantaged" children.

The experimental population included only subjects who were considered to be developmentally normal to the extent that they had no severe sensory or motor disabilities which would require special educational consideration. It seemed obvious that handicaps such as visual impairment, hearing loss, cerebral palsy, mental retardation, emotional disturbance, etc. naturally would eclipse responses on any perceptual battery, resulting in severe biasing of the results of the study.

The subjects included only children at the preschool age level because this age span was believed to represent a critical period of learning, during which the child is acquiring, through perceptual experiences, a basis for developing the concepts which later will form the basis for his academic achievement.

A final consideration, which was primarily logistic in nature, involved the accessibility of a relatively large sample for testing. Because this study had as one of its main objectives the application of findings to educational methods, it was considered preferable to test subjects in a school environment in order to obtain a sizeable sample as economically as possible and to test the efficacy of administering the Experimental Battery under classroom conditions.

Consequently, the experimental sample consisted of two groups of preschool children between the ages of three and six years, who were in attendance at various preschools throughout the City of Los Angeles. One group, composed of 190 subjects, was derived from nursery schools located in areas equated with a low socio-economic level; the other group, made up of 153 subjects, were from nursery schools in areas representative of the upper socio-economic level. This dichotomy was based primarily on residential locations. The first group came from the Central Los Angeles area, in which the real estate values for single dwellings is $25,000 and below, while the other group was located in the West Los Angeles area with a value of single homes ranging from $25,000 to $100,000. More pertinent to this study, West Los Angeles is known to house a predominance of families where one or both parents are engaged in highly verbal professions (i.e. the parents are professors, artists, actors, etc.), while in the Central Los Angeles area the predominance of families are day laborers or are unemployed. The age range of the Central Los Angeles group was 3.2 to 5.9 years, with a mean of 4.1 years. This group was 95 per cent Negro, four per cent Mexican, one-half per cent Caucasian, and one-half per cent Indian. The West Los Angeles group had an age range of 3.0 to 5.8 years with a mean of 3.9 years. This group was composed mainly of Caucasian subjects (98 per cent) with the addition of a small number of children from Negro (one per cent) and other various racial backgrounds (one per cent). Again, it is important to note that if, during the first test session, any child was found to have uncorrected visual or auditory impairments, motor involvement, or signs of abnormal social and emotional behavior, they were not included in the test sample. Many more children were examined at the first test session (N = 514) than were retained for the second test session. With some normal attrition, the final experimental sample totaled 343.

III. THE STANDARD BATTERY

A. Criteria for Selection

As discussed in another context (Wood, 1969), there are many tests available today which can provide comprehensive information about language proficiency and perceptual development in young children. Many of these tests, however, require special training of the examiners who intend to use them (Allerhand, 1960). Because this study was exploratory in nature and because it was designed to yield information which could be used by educators and speech and language specialists in the schools, it was necessary for the measurements selected for the Standard Battery to meet certain criteria. In essence, the measures selected were known to be inexpensive, easy to administer, and objectively scorable. No special training was required for administration or interpretation. Of paramount importance, the measures selected were considered representative of those typically used by professional personnel in the schools (e.g. speech and language specialists, special educators, teachers) for . e gross evaluation of the verbal abilities of young children, particularly spoken language.

On the basis of these criteria, the following tests and measurements were selected for use in this study: the Peabody Picture Vocabulary Test, the Columbia Mental Maturity Scale, the Geometric Designs Drawing Test, a Motor Development Inventory, a Speech Articulation Test, a Dominance Test, and a Test Attitude Rating Scale.

B. Description of the Standard Battery

1. Peabody Picture Vocabulary Test: The Peabody Picture Vocabulary Test (PPVT) was designed originally as a measure of intelligence, but its use in this study was not intended for that purpose. Because the two groups of subjects studied

originated from considerably different socio-economic backgrounds in which the language values were markedly dissimilar, for purposes of this study, vocabulary assessment could not be meaningfully translated into intelligence ratings. The PPVT was administered, therefore, in order to obtain some information concerning the subject's auditory input, vocabulary growth, and conceptual strength. The PPVT was selected because it utilizes an auditory stimulus, it has a measure of standardization, it requires no special training for administration or interpretation, and it is in common use in clinics and schools throughout the country. In addition, the PPVT is relatively brief, requiring usually less than 15 minutes to complete for most subjects. The time factor was considered to be an important feature relevant to the evaluation of young children, because frequently their attention span is short and they fatigue easily.

The PPVT was administered according to the normal operating procedures described in the test manual (Dunn, 1965). In brief, the child listened to a stimulus word spoken by the examiner and then responded by pointing to one of four pictures presented on a page of the test booklet. These pictures are uncolored single-line drawings, only one of which depicts the meaning of the auditory stimulus.

The stimuli in this test were particularly suited to the needs of the present study because they are relatively free from figure-ground confusions and closure disturbances. Both the test stimuli and the corresponding sets of pictures progress gradually from simple, concrete items to complex, abstract ones. In the early stages of the test, the subject's task is primarily involved with auditory decoding while in the latter portion of the test, verbal abstraction and conceptualization appear to be needed to perform accurately. As stipulated in the test manual, when the subject missed six out of eight items, the test was discontinued. Care was taken to be sure that the subject did not experience a feeling of failure. This was accomplished by having the examiner's reaction to the child's response always positive, regardless of the accuracy of the child's answers.

2. The Columbia Mental Maturity Scale: In many respects, the Columbia Mental Maturity Scale (CMMS) is similar to the PPVT. The CMMS is a test with some standardization and it employs simple pictures as a response medium. The subjects are required to point to one of three or more figures contained on a response card, and the testing is continued only until a certain percentage of the responses are found to be incorrect. Consequently, in many instances with very young children, the test can be completed in less than 15 minutes.

Unlike the PPVT, however, the CMMS is a nonverbal test. The child makes his selection on the basis of visual likenesses and differences among the figures on the response card. The test begins with a series of simple discriminations between color and shape and progresses toward the identification of differences based on more abstract qualities. Consequently, this test not only provided a measure of the subject's ability to decode visual stimuli under optimum figure-ground and closure conditions, but it also served as a measure of nonverbal conceptual ability.

The CMMS was administered according to the standard operating procedures outlined in the test manual (Burgmeister, 1954). Briefly, the examiner turned each response card face up, one at a time, from a stack of cards in front of the child, and asked the subject to point to the figure that was "different" or which "did not belong." The simple mode of response expected here (i.e. pointing) minimized any extraneous effects of verbal expressive problems or immature motor involvement.

In brief, the CMMS was selected because it permitted the examiner an opportunity to interact with the subjects on a nonverbal level and because it provided a measure of nonverbal performance which was relatively free from the need for verbal proficiency.

3. Geometric Designs Drawing Test: The Geometric Designs Drawing Test (GDDT) was included in the Standard Battery as a measure of gross and fine motor development, eye-hand coordination, hand preference, spatial orientation, and visual

recall. The GDDT was selected because it is a simple, brief, and generally enjoyable task for children, yet it can yield a considerable amount of information pertinent to the development of educational methods.

The GDDT, as used here, consisted of five drawing tasks of increasing difficulty: a circle, a cross, a square, a triangle, and a diamond. Before each task, the examiner provided the subject with an example of the figure to be drawn and instructed the child by saying:

> See this picture? Look at it very carefully because I am going to ask you to draw one just like it.

After the example had been observed for five seconds (timed), the sample drawing was removed and replaced with a blank sheet of paper. The child, then, was asked to draw the figure he had just seen. If the subject was unable to perform the task required, the examiner showed him the example again. On this occasion the examiner traced the contour of the figure with his finger, so that the child could observe the necessary pattern of movements. The tracing sequence was always consistent, being counterclockwise for the circle, beginning at the top; left to right and top to bottom for the cross; and counterclockwise for the square, triangle and diamond, beginning in the upper left-hand corner or top respectively. If the child was still unable to respond after watching the tracing movements, he was encouraged verbally by the examiner. If verbal encouragement failed, testing on the GDDT was discontinued.

Those figures which were successfully completed by the child were evaluated according to two sets of criteria, which served to increase the sensitivity of the test to a wide range of subtle differences. First, the child's performance was scored according to the standard operating procedures outlined in published instructions for evaluating the test (Gesell, 1940). For example, full credit was allowed for the circle if the arcs were joined with good closure, and if the figure was round or only slightly oval with an axis less than one and a half times the length of the short axis. Partial credit was given if the circle was oval with a long axis, one and a half times the length of the short axis, or if the figure was concave or contained angles. No score was permitted for half circles, spirals, or polygons. The criteria set forth by Gesell were observed in the scoring of the remaining four tasks.

A second aspect of scoring involved an additional score allotted according to the amount of encouragement required from the examiner before the response was executed. For this scoring, two points were added to the score if the subject completed the figure on the first trial, after having only passively observed the example. One point additional credit was added if the figure was reproduced by the subject after the examiner had traced the example. If the subject needed to trace the form himself, with the aid of the examiner, or if the subject required more than normal verbal encouragement from the examiner, no additional credit was given. In this way, the child's performance was evaluated not only from the point of view of achievement, but also in terms of the spontaneity with which his performance was initiated.

The GDDT was considered extremely pertinent to the needs of this study because it embodies a series of tasks which are matched in difficulty to the level of motor and perceptual development of preschool children. In addition, the reproduction of these figures requires various psychomotor skills which are believed to be basically related to the development of visual perception and language (Winters, 1959; Wohlwill, 1962; Stuart, 1967). The GDDT apparently draws upon abilities of visual recall, because each figure is reproduced from memory; it clearly is involved with eye-hand coordination because the movements of the hand must be adjusted in terms of the visual input; and it seemingly taps the child's level of development for left-right awareness and spatial orientation for the discrimination of figure differences as occurs, for example, between the square and the diamond.

4. Motor Development Inventory: In addition to the performance scores obtained on the GDDT, additional information describing motor development was obtained from observation of the child's movement within the test environment. Gross

motor coordination was rated through an appraisal of the child's manner of walking as he approached the test table. Ratings of balance, gait, stance, and other aspects of locomotor function were noted on the test form provided for that purpose (see Appendix D).

In addition, the general sitting posture of the subject was rated as he sat at the test table. Normal posture was considered to be an upright position with the head held approximately six to eight inches from the paper. An abnormal position was recorded if the subject sat with his body twisted or extremely bent with his head tilted in a skewed position or brought within two to three inches from the paper. Such variations in sitting posture, it was reasoned, may be indicative of visual impairment, but more often, it was thought, unusual body postures reflect uncooperative attitudes toward the test situation. Regardless of the reason, however, if a child maintains abnormal sitting posture, particularly in an educational setting, his perception of body image, size constancy, spatial orientation, etc. could become faulty.

During the paper-pencil tasks, another aspect of motor development was observed and recorded. Of particular interest to this study was the observation of hand preference during paper-pencil tasks (Palmer, 1963; Silverman, Adeval, McGough, 1966). The examiner recorded: (1) the consistent use of either the right or left hand; (2) the alternate use of both hands; or (3) the simultaneous use of both hands to hold the pencil.

Observation of pencil grasp also afforded the examiner an opportunity to evaluate certain aspects of fine motor coordination. Pencil grasp was considered normal if the subject's thumb opposed the index and middle fingers. An overhand grip in which the pencil was held in a closed fist, or any manner other than the accepted method, was recorded as immature or not acceptable.

In addition to these fine and gross motor behavior ratings, the examiner also recorded whether or not certain psychomotor behavior patterns (Myklebust and Boshes, 1960) were present, including: Tremors, Tics, Extraneous Tapping Movements, Overflow Movements and Perseveration.

For purposes of this study, Tremors were described as sustained involuntary bursts of oscillatory movements of muscle groups involved in a particular motor activity; Tics were defined as short spasmodic movements of any part of the body, such as the head, mouth, or eyes; Extraneous Tapping was considered to be a volitional repetitive motion of an extremity such as the fingers or feet; Overflow Movements were defined as nonrepetitive motions or tensions in parts of the body not directly participating in the particular motor tasks; and Perseveration was defined as an inability to relinquish a particular motor set in order to initiate a new one.

In order to assure as much examiner-to-examiner reliability as possible, considerable discussion of these definitions was undertaken by the examiners involved in this study. In addition, the field supervisor provided continuity to the testing whereby the examiner could check with the supervisor to determine whether or not a certain behavior was present, if questions concerning the observations arose. Details of these procedures are described later in the discussion.

In brief, the Motor Development Inventory evolved from clinical cues of young children. The method used in this study was not considered to be unlike the methods currently used in clinics and school programs throughout the country.

5. Speech Articulation Test: The movements of speech are intricate and rapid and require a high degree of motor control. In addition, speech articulation is unique in that the movements required are symmetrically executed along the midline of the body. Accurate performance, therefore, suggests a dependence upon a complex system of neural coordination. Articulation testing can be a rich source of information concerning the development and integrity of the child's motor system. Generally, articulation tests used in speech clinics and school screening programs involve the presentation of visual stimuli which are intended to evoke verbal responses (Templin, 1957). For the present study, however, an "aural-vocal stimulus-response" was used. This method was

used because it was anticipated that the two groups of subjects selected would differ considerably in terms of their experiences with books and pictures. Perhaps even more important, because the present study was concerned with the visual modality, a nonvisual stimulus was selected to elicit articulation responses.

In brief, the Speech Articulation Test (SAT) used an auditory stimulus which was repeated by the subject, for two reasons: no intermodality conversion of the stimulus was necessary for subject response, therefore, a minimal amount of cognitive activity was required, and the SAT could be administered rapidly, which helped reduce the effects of fatigue which might influence subject performance on the other tests which made up the Standard Battery.

The SAT consisted of a series of one-syllable words in which the test consonant was located in the initial or final position and a series of two-syllable words in which the test stimulus was located in the medial position. The brevity of the stimuli minimized the effects of memory or sequential discrimination weaknesses. Simple and familiar words were used as stimuli, in preference to nonsense syllables, in order to decrease the possibility of decoding errors. Only consonants were designated as test stimuli within each stimulus word, because consonants are less subject to dialectal influences (a condition which might be expected in the Low Language Proficiency Subgroup) than vowels, and because the exclusion of the vowels as a test item greatly decreased the length of the articulation test.

The SAT was administered in the form of a game in order to maintain the interest and attention of the young subjects. The examiner suggested to the child that they were going to play a game called "Follow the Leader" in which the examiner would say a word and the child would repeat it. The specific instructions were as follows:

> We are going to play a game called Follow the Leader. I will say a word and you will see if you can follow me by saying the same word. Ready?

When it was clear that the subject understood the task, the examiner said each successive word (see Appendix D for word list), pausing only long enough to record the response. If the child did not respond to the stimulus, the word was repeated a maximum of three times and then bypassed. The test, generally, required approximately twenty minutes to administer.

Three types of errors were noted for each position of the test consonant: the initial, medial and final positions. These included errors of distortion, substitution and omission. There were 23 words in which the test stimuli were placed in the initial position; 22 in the medial position; and 21 in the final position. In addition, there were 13 words which contained representative consonant blends in the initial position. The number of errors noted for each type of misarticulation were tallied to obtain the subject's ranking on the test. Specific forms were designed for this test, a sample of which can be found in Appendix D.

6. Dominance Test: Although the SAT provided data relating to the complex coordination of bilateral movements, unilateral movements which seemingly relate to the degree to which dominance is established also were noted. This observation was accomplished through the use of three simple gamelike activities.

The first involved the use of a kaleidoscope, through which the subject was encouraged to sight, on three occasions during the course of standard test procedures. Particular care was taken to be sure that before each viewing the scope was presented to the subject at midline and without a sidedness bias. Each time the scope was placed on the test table directly in front of the subject, at a distance equidistant from his shoulders and hands. The eye through which the child viewed the kaleidoscope was recorded for each occasion.

The second and third activities involved measures of hand preference and foot preference by having the subjects throw and kick a ball three times in succession. As before, care was taken to be sure that neither side was favored in the presentation of the ball to the subject. Side preference was inferred from the degree of consistency, both during and between the three activities.

These simple gamelike procedures are similar to those used frequently in clinics and schools throughout the country to evaluate sidedness (laterality) and usually, they are interpreted as providing evidence concerning the degree to which dominance has been established. Realistically, it is possible that these tasks served a more basic purpose, which was a change of pace from the other less active tasks necessary to evaluative procedures and, in some cases, these activities might have provided incentive for the subjects to anticipate the remaining evaluative procedures with added interest.

7. Test Attitude Rating Scale: The subject's attitude toward the test situation was considered to be an important aspect of the evaluation of their test performance. It was reasoned that not only could test attitude reflect the general level of subject interest, but, in addition, the energy investment which the subject might assign to the accurate execution of test tasks. In essence, test attitude itself might serve as a measure of subject adjustment and control.

For this study, therefore, several sets of behaviors were selected which were thought to reflect subject attitude toward the test situation.

The first set involved observation of attitude toward the examiner as the subject moved from the classroom to the examination room. As can be seen in the recording form provided for this purpose (Appendix D), the examiners were asked to rate how the child left the classroom: Did he refuse to leave the classroom? Did he require urging by the teacher? Did he accompany the examiner willingly? During test procedures, the examiner also rated each subject's participation in the test procedures: Did the subject refuse to participate? Was he reluctant to participate? Did he participate only when encouraged to do so? Was he generally free of reluctance although he did not volunteer to participate? Did he volunteer to participate? These questions were translated into the following rating scale: the child refused to participate;

he was reluctant to participate; he participated when encouraged; he was unconcerned but did not volunteer to participate; he volunteered to participate.

A second set of conditions concerned the subject's reactions to the test procedures as they were in process: viz. the child conformed to the test requirements; the child was eager to participate.

A third set of observations described the child's behavior as he attempted to solve the problems presented by the various tasks. With reference to other studies (Teuber, 1950; Wood, 1960), it was assumed that some children might display evidence of certain types of behavior: e.g. Distractibility, Hyperactivity, Perseveration, Short Attention Span, Fluctuating Attention, etc. In this study, Distractibility was defined as the attention of the child being drawn from the test stimulus by simultaneously occurring extraneous stimuli (e.g. the fingers of the examiner, an eraser on a pencil, a noise outside the test room, etc.). Hyperactivity was defined as aimless shifts of attention which resulted in the subject moving around the examination room, which necessitated examiner control of the subject's gross motor behavior. Both of these behavior patterns have been classified as responses resulting from the inability of the child to effectively suppress internal drives (Solinsky, 1956), however, Hyperactivity is considered to be nongoal oriented (Doyle, 1962). Short Attention Span, by the same token, has been defined as the inability of the subject to focus on a test stimulus long enough to effectively utilize it. This behavior differs slightly from Fluctuations of Attention, which has been defined as the focus of concentration wandering in search of new stimuli before old stimuli have been satisfactorily processed. In this last division of behavior patterns, the first behavior is nonvolitional; the second, volitional. Finally, the antithesis of Short Attention Span, Perseverative Behavior was defined as the inability to cease a particular course of verbal or motor behavior at the appropriate time.

These and other behavior patterns have been discussed in detail (Birch, 1964). The recording of observation of these behaviors was included in this study because clinic reports and school records frequently include them.

IV. THE EXPERIMENTAL BATTERY

A. Development of the Experimental Battery

1. Item Selection: Items for the Experimental Battery were selected from a list of words which were compiled to reflect the reading vocabulary of children in the primary grades (Gates, 1935). It was reasoned that if children in the primary grades could read these words, children of preschool age should be able to identify (by matching) a pictorial representation of selected objects. All words selected represented objects, persons or things. No proper names, or parts of speech other than nouns were included (Ammons, 1954). All words selected were known to be:

   a. within the identification range of preschool age children (3-6 years).

   b. pictorially representable in simple line drawings without requiring additional cues for identification (e.g. color, depth, size, texture).

   c. mutually exclusive with identification overlap restricted to general classes (e.g. clothing items, food items, people, animals).

2. Preparation of Experimental Slides: Both sets of slides were generated from a single set of intermediate negatives which consisted of 30 line drawings of the test items, and nine intermediate interference negatives.

   The 30 line drawings were photographed with 4"x5" ortho lith film and processed in regular litho developer. Exposure was at manufacturer's recommendation, processed by inspection to a solid step three on the eleven-step Stouffer Density Scale.

   The nine interference intermediates were created by using Benday Screen tints (sheets of thin paper with a wax adhesive and backing sheet containing an overall even pattern of black dots of a given size) which are available from any printer's supply house, and which come in various densities (relative size of black dots listed by per cent of area blackened) and screen sizes (dots per linear inch). To make the intermediates, pieces of the screen tint were adhered to acetate sheets and burnished with a smooth object to remove air bubbles. They were then projected in an ordinary enlarger to make a fifteen-line screen (15 dots to the inch) and projected onto lith film. Processing was by inspection, using the twenty-one step Stouffer negative scale to guarantee uniformity of all nine intermediates.

a. The Figure-Ground Slides: The figure-ground series was created by exposing the 4"x5" line negative of the test subjects by transmitted light and re-exposing the same frame for a 1:1 close-up with one of the nine intermediates. This was done using a Nikon F with Auto Macro Nikor f 3.5 lens (this lens with its auto bellows correction can save considerable time since both exposures must be equal and a bellows correction factor must be considered). The film was Kodalith type 3 ortho (35 mm.), exposed to manufacturer's recommendation and processed by inspection in fine line developer. It was considered advantageous to photograph a 21-step Stouffer negative scale for control purposes on the first and last frame of each roll because this procedure aids in uniform development of all slides.

b. The Closure Slides: The closure series was photographed by using the 4"x5" line subject negative and one or more of the interference negatives sandwiched together under a piece of plate glass. For the first few slides it was found that one interference negative did not provide enough blocking effect; therefore, two were used when necessary. To obtain the proper effect, it was necessary to place the screens at 45-degree angles to each other.

3. Equipment and Supplies Used: All equipment and supplies used in the preparation of the slides were supplied by the Department of Medical Illustration, School of Medicine, University of Southern California.

   a. Equipment:

      4"x5" view camera
      35mm. camera (Nikon recommended, see text)
      11 Step Stouffer Density Scale (for reflected copy, other brands available)

a. Equipment (continued):

21 Step Stouffer Density Scale (for transmitted copy, other brands available)
Light table or transmitted light source

b. Supplies:

Benday Screen Tints, 80 per cent through 20 per cent (by 10 per cent gradations); recommend using largest dot pattern available (usually 65 line screen)
Film, 4x5 Litho (Kodalith type 3 ortho, or many others)
Film, 35mm. Litho (Kodalith type 3 ortho, special order for Kodak)
Developer, Litho (Fine line type recommended, for all films such as Kodalith fine line)

c. Screen Intermediates Used for Each Slide:

Slide Degree	Figure Ground	Closure
1	80%	80% + 50%
2	70%	80% + 20%
3	60%	80%
4	50%	70%
5	40%	60%
6	30%	50%
7	20%	none
8	none	X

4. Preparation of Response Cards: Each response card contained five figures: the stimulus item plus four other response figures. Line weights of all drawings were identical. The figures were assigned randomly (Hodgman, 1959) to a translucent film strip which was mounted on heavy white poster board and sprayed with a fixative. The final response cards (6"x19") were photographed to eliminate tearing when stacked for use.

5. Description of the Final Experimental Battery: For the final Experimental Battery the slides were reduced from the 110 which made up the initial battery (see Appendix C) to 30 items. The Figure-Ground items (Total 15) were treated with from one to eight degrees of interference, giving a total of 120 slides. The Visual Closure items (Total

15) were treated with from one to seven degrees of interference, rendering a total of 105 slides. The entire Experimental Battery consisted of 225 Figure-Ground and Closure slides. Because slide projection of each item ceased after the subject had successfully identified the item in two successive tries, the number of slides projected corresponded with the ability of subject to accurately identify the stimulus (i.e. if the subject was able to identify the test stimuli at the maximum degrees of interference, it was not necessary to project the remaining slides for that item at lesser degrees of interference).

The response cards also were reduced in number from the original 150 (see Appendix C) to 30. This reduction was considered necessary because it was found in the first year study that the constant shifting of response cards for each stimulus presented seemed to be distracting to the subjects. In addition, the sorting and stacking of the larger number of cards added measurably to the time required to administer the battery. In an effort to reduce distraction and administration time, a different response card was used for each of the 30 major stimulus items presented, rather than a new card for each degree of variation for each item.

Twenty response cards were selected from the original 150 response cards on the basis of one criterion: by noting where the correct response item fell on the response card. This criterion for selection was used in order to avoid duplicating consecutive positions and in an effort to reduce any tendency on the part of the subject to point routinely to an area on the card in a fixed selection pattern. In addition, ten new response cards were designed: five for the Closure battery and five for the Figure-Ground battery. This was done by using items from the original response cards and placing them on new cards so that all five items on each card were either horizontal or vertical (i.e. homogeneous) in directionality. The final battery consisted of 225 (possible) slides and 30 response cards. A pictorial presentation of the slides and the response cards which made up the final Experimental Battery can be seen in Appendix B.

B. Administration of Experimental Battery

1. Equipment: Because each stimulus was presented by means of a projected image, the major piece of equipment for the *Experimental Battery* was a Kodak Carousel slide projector with a Stoelting tachistoscopic attachment. These were mounted as a unit on an adjustable photographic-type tripod. Although the tachistoscope was capable of exposure speeds up to 1/100 of a second, preliminary study (see Appendix C) indicated that speed differences ranging between one-tenth and one second were not a factor in the perceptual performance of preschool children. The factor of perceptual speed was, therefore, set aside and the exposure speed was held constant at one second.

   The experimental slides were projected on a four-by-four foot nonglare portable screen. A tape measure was used to insure that, for each testing site, the screen was always set at a distance of 12 feet from the lens of the projector. A Photo Cell light meter was used to assess the illumination level of the examination room. Typical classroom light was used because it was found that a darkened room contributed to after image. Brightness fluctuations which could occur over a period of time and between testing sites or during testing were accommodated in relation to light meter readings taken before and after each test session. Nursery school regulation tables and chairs were used for all test occasions.

2. Instructions for Administering Experimental Battery: Conditions considered necessary for good test administration prevailed. Time was taken at the beginning of each test session to establish rapport with the subject, and every effort was made to maintain the subject's interest and motivation to respond to the best of his ability.

   Two examiners participated in the administration of the *Experimental Battery**: one recorded

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*Only one examiner would be required for ordinary test conditions, but in order to maintain rigorous control and assure accuracy of data, two examiners participated in the test procedures during this study.

the subjects' responses (the recorder); the other presented the slides, gave the instructions, related to the subject (the examiner).

The examiner sat to the right of the subject; the response cards were placed in front of the subject face down. The examiner, after allowing time for the subject to adjust to the test situation said:

> You are going to see some pictures on the screen in front of you. I am going to show you a card with that picture and some other pictures on it. I want you to point to the picture you just saw on the screen.

The examiner then directed the subject's attention to the screen, and gave the command "WATCH" or "LOOK" before each individual slide.

Four demonstration slides and two demonstration response cards were available for use. If the subject made an error in the first demonstration, the examiner indicated the correct answer on the response card and showed slide two again. If necessary, the examiner used demonstration slides three and four and demonstration response card two to be sure the subject understood the task. No credit was given for demonstration items. If the subject was unable to perform the task after being shown the four demonstration items, he was dropped from the sample.

No time limit was set for the subject's response. However, if he made no response after five to ten seconds, the examiner would ask:

> What do you think you saw?

This was done in an attempt to elicit a response or a definite indication of no response.

The examiner made sure that the subject looked at all the drawings on the response card. If it appeared that the subject was continuing to point to one particular position on the response card, regardless of the stimuli, the examiner urged him to:

> Look at all the pictures and then show me the one you just saw on the screen.

If the subject required reassurance during the course of the testing, the examiner gave him encouragement, but the examiner did not indicate whether or not the subject's responses were correct.

B. Scoring the Experimental Battery

The slides were presented in four units: (1) Figure-Ground Heterogeneous; (2) Closure Heterogeneous; (3) Figure-Ground Homogeneous; (4) Closure Homogeneous. These slide units were presented in random order throughout testing in order to reduce the possibility of fatigue or practice effect.

For the Figure-Ground series, each item had eight slides, each with a different degree of interference (eight degrees to one degree); the slides with eight degrees of interference being the most difficult. The Closure series had seven slides for each item (seven degrees to one degree); the slides with seven degrees of interference being the most difficult. The order of presentation for each slide series was from the most difficult to the least difficult.

Only correct responses were scored. The examiner checked the degree of Figure-Ground or Closure at which the subject responded correctly. Two consecutive correct responses were necessary for passing the item. After recording responses on the form designed for that purpose (see Appendix D), the examiner added the row totals column to obtain a grand total for each slide series.

V. CLINICAL JUDGMENTS

A. Rationale for Procedures

The Clinical Judgment aspect of this study attempted to duplicate certain procedures which are carried out routinely in speech and hearing clinics and educational evaluation centers throughout the country. Particularly in those clinics and centers which have large intake schedules (hospital clinics, community agencies, university centers, State screening programs), it frequently becomes the responsibility of some one person (e.g. the Clinical Supervisor) to decide which cases should be referred for further study and what kinds of additional evaluation services appear to be indicated on the basis of initial findings. In language evaluations, it is often necessary to assign some temporary classification to the case history, in order to process the subject's folder.

Whether or not this ongoing procedure is clinically sound will not be debated here. The fact that "clinical hunch" is one of the factors which makes clinical evaluation both a science and an art, and the fact that these procedures are in process in clinics throughout the country, seemed to be sufficient rationale for including this aspect of judgment in the current study.

B. Description of the Clinical Judges

Each of the three Clinical Judges who participated in this aspect of the study held the Certificate of Clinical Competence (CCC) in Speech Pathology from the American Speech and Hearing Association; two also held the CCC in Audiology. All of the judges had had more than ten years each of professional experience as clinical supervisors. It was not unusual for any of these judges to be required to make clinical decisions on the basis of case history reports or on the results of tests administered by other examiners. They were all considered to be competent in the evaluation of the language proficiency of young children. Their professional preparation had been received from three different universities.

C. Procedures

The manner in which the Clinical Judgments were to be made was not discussed. Instead, the judges were given score sheets which contained the number of the subject, followed by the letter "O" and numbers one through five. The letter "O" was checked if the judge believed, after reviewing the case history, that an organic problem was present. Also, for each subject, each judge assigned a language proficiency rating: one represented poor language proficiency; two indicated below average language proficiency; three equaled average language proficiency; four represented above average language proficiency; and five was reserved for superior language proficiency. In brief, each judge recorded two Clinical Judgments: an Organicity Rating and a rating on Language Proficiency for each of the 343 subjects on the basis of a review of each case history which contained scores from the Standard Battery and scores from the Experimental Battery.

In order to assure a random order of review, a record analyst pulled the folders from the case file and placed them, at random, in stacks of five. The Record Analyst gave each Judge a stack of five folders; this stack was replaced by another, and then another, until the Record Analyst had recorded that each Judge had reviewed each folder and had recorded two judgments for each subject. The case folders were not discussed before or during the judgment procedures, although the judges met in the same room for the same time period, during which the judgments were recorded. These procedures required seven eight-hour days for completion.

After all 343 histories had been reviewed and assessed, each Judge recorded the method she used to arrive at her individual judgments. These records were given to the data processing staff to be coded for incorporation into the data cards.

VI. GENERAL PROCEDURES

A. Selection of Test Sites

In order to reduce the possibility of sample bias, the test sites used in this study were selected randomly. First, permission to test in the nursery school programs located in the two geographic areas selected (Central Los Angeles and West Los Angeles) was obtained from the appropriate officials. Then, a list of all the nursery school programs in these two areas was obtained, and a number was assigned to each program. The numbers were placed in a bowl, drawn and recorded in sequence. The Project Manager met with the official in charge of each of the first 24 sites drawn and explained the test procedures. These 24 sites contained approximately 1,000 children who met the age criterion for this study.

B. Sequence of Testing

The Standard Battery and the Experimental Battery were administered separately, and an effort was made not to allow more than two weeks to elapse between test sessions. The nursery school teachers referred the subjects for testing according to the study criteria, and the Standard Battery was administered first to be sure that all accepted subjects were relatively free from major educational problems.

C. Control of Examiner-to-Examiner Reliability

The tests used in this study were selected because they are known to be in current use in schools and clinics throughout the country, and the six examiners who participated in this study had had considerable experience with these test procedures. Nevertheless, examiner-to-examiner reliability was maintained by a supervisor who specializes in the examination of young children, particularly children from minority groups. This was accomplished by a series of training sessions scheduled prior to testing, and by maintaining quality control in the field while testing was in process.

D. Organization of Data for Analysis

The two-stage method selected for organizing and analyzing the data which resulted from this study had two major advantages: First, not all of the variables included in this study could be measured with an equal degree of precision and validity; some had a high degree of objectivity (e.g. the Experimental Battery), others had a high degree of subjectivity (e.g. the observations of behavior). The two-stage method of analysis avoided the inequities of the variables by transforming the scores on the incongruous variables to a common set of measures (i.e. Z scores) before final analysis was undertaken. Second, the two-stage method provided an opportunity to examine, in detail, the relations between individual clusters of variables grouped on the basis of logic and tradition. Consequently, it was possible to obtain two kinds of information: (1) specific information pertaining to intra-relations among selected variables on individual or related tests (the first stage of the analysis); and (2) general information concerning the behavior of the subjects along the independent dimensions derived from the interrelations of all the variables (the second stage of analysis).

In brief, the paramount value of the first stage of analysis was the definition of a number of basic patterns which represented independent measures of behavior within a cluster. These patterns served not only as tools for comparison in the second stage of analysis, but they also provided potential focal points for subsequent study.

CHAPTER III

ANALYSIS AND RESULTS

I. INTRODUCTION

A. Organization of the Data

For the purposes of analysis, the data were organized into three sections. Section I consisted of five sets of data from the Standard Battery (i.e. scores and test ratings pertaining to: Maturation, Articulation, Visual Motor Behavior, Motor Behavior, and Test Behavior; Section II was formed from scores obtained on the Experimental Battery (i.e. fifteen measures each of figure-ground discrimination and closure, considered collectively as thirty separate measures); Section III was based upon two Clinical Judgments (i.e. ratings of language proficiency and organicity). Data from these eight categories were analyzed in two stages:

1. First Stage of Analysis: As shown in Figure 1, different N's were involved in the initial factor analysis of each of the eight data categories. This procedure was followed in order to determine the basic number of dimensions underlying the subjects' performance in each of the areas on the largest possible body of data. The dimensions were obtained through a principal component analysis of the test intercorrelations in which the factors (components) attaining an eigenvalue of 1.00 (or greater) were rotated according to the varimax techniques described by Kaiser (1958); factor scores for each subject were computed by means of the complete estimation formula as given by Harmon (1960).

2. Second Stage of Analysis: In order to have unrelated factor scores within each of the eight data categories when determining the interrelations among these sets, the above procedure was repeated in the second stage of analysis for the subjects for whom no data were missing (see Figure 2).

The use of factor scores provided a common basis from which the perceptual and language abilities of the Total Sample and the two subgroups (Group I with Expected Low Language Proficiency and Group II with Expected High Language

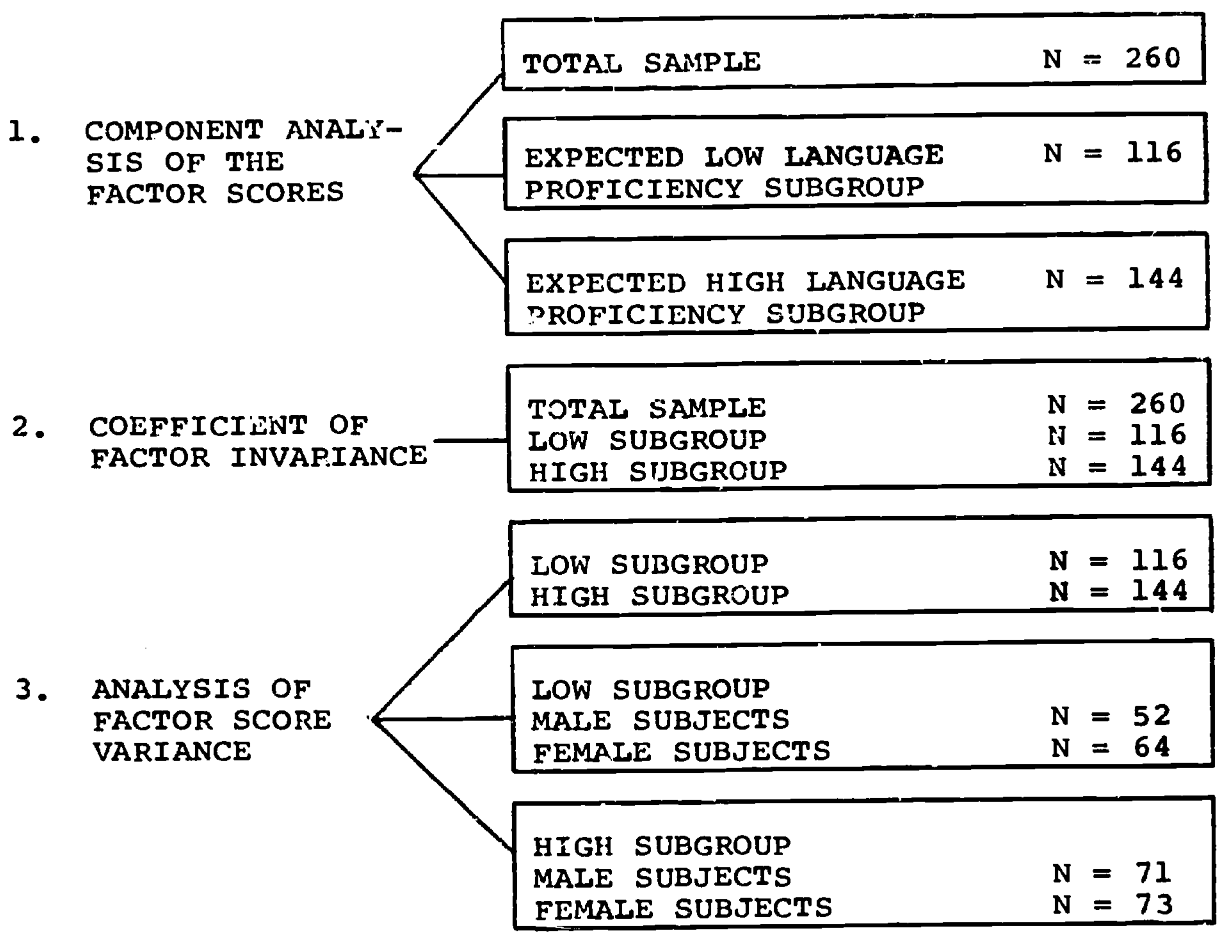
FIGURE 1. Schema of Analysis for Total Sample.

Stage I. Programs used in the analysis of each category allowed for a varying number of subjects. The correlation between each pair of variables was computed for all instances in which values were present for both. Hence, the number of subjects on which the correlation was based varied from one attribute to another as is indicated below.

1. STANDARD BATTERY	MATURATION (PPVT, CMMS, CA, DS)	N (RANGE) 260 - 343
	ARTICULATION (12 VARIABLES)	N = 294
	VISUAL MOTOR BEHAVIOR (GDDT)	N = 342
	MOTOR BEHAVIOR (14 VARIABLES)	N (RANGE) 333 - 341
	TEST BEHAVIOR (11 VARIABLES)	N (RANGE) 337 - 342
2. EXPERIMENTAL BATTERY	EXPERIMENTAL BATTERY (30 VARIABLES)	N (RANGE) 292 - 295
3. CLINICAL JUDGMENTS	LANGUAGE PROFICIENCY (3 VARIABLES)	N = 295
	SIGNS OF ORGANICITY (3 VARIABLES)	N = 260

FIGURE 2. Schema of Analysis for Total Sample.

Stage II. Complete data were available on only 260 of the 343 subjects. Since the available factor analytic program computes orthogonal factor scores only when no data are missing, the subsequent analyses are based only on the 260 subjects for whom data are complete.



Proficiency) were compared. Pearson's product moment correlation coefficients, analysis of factor variance (Pinneau, et al., 1966), and coefficients of invariance (Pinneau and Newhouse, 1964) were used when appropriate, to compare different sets of factor scores.

B. Areas of Research Interest

Three broad areas of research interest formed the background for investigation:

First, the relation between subject performance on the Standard Battery and subject performance on the Experimental Battery was explored. This information was gathered in an attempt to clarify the usefulness of the Experimental Battery as a predictor of reduced language proficiency.

Second, an attempt was made to identify those tests from the Standard Battery which were most highly related to language proficiency. It was believed that this information concerning language and language related behavior as reflected by the subjects' responses on standard tests, would be valuable to clinicians and teachers who usually have access to these commonly used tests.

Third, the data derived from the Experimental Battery and the Standard Battery were compared with the Clinical Judgments. In these comparisons, the idea of "clinical hunch" was, in a sense, put to objective evaluation.

II. FIRST STAGE ANALYSIS

A. Analysis of the Standard Battery

1. The Peabody Picture Vocabulary Test and the Columbia Mental Maturity Scale: Two tests from the Standard Battery provided maturational data concerning the cognitive development of the subjects: the Peabody Picture Vocabulary Test (PPVT) and the Columbia Mental Maturity Scale (CMMS). The scores from these tests were considered in conjunction with: chronological age (CA). For the total research population (343 subjects), the mean CA was 52.3 months, with a range from 36 months to 64 months, and a standard deviation of 6.1 months

(see Table 1).* The average mental age (MA), as reflected by the PPVT, was slightly below the CA (49.4 months); for the CMMS it was somewhat higher (57.0 months). The standard deviations for these tests were 18.3 and 12.0 months respectively.

a. <u>CMMS and PPVT Intercorrelation</u>: A correlation of .78 was found between the PPVT and the CMMS, which suggested that these tests, which emphasized different aspects of language (i.e. verbal (PPVT) and nonverbal CMMS) were, nevertheless, in high accord when used to assess the cognitive development of the Total Sample. The much smaller correlations of these tests with CA (.35 and .32), may have been due partly to restricted age range of the sample.

b. <u>CMMS and PPVT Component Analysis</u>: When the intercorrelations of what might be called the maturity variables were analyzed by principal component method, only one of the components exceeded an eigenvalue of 1.00. As can be seen in Table 2, the loadings on this component were .61 for CA, .91 for the PPVT and .90 for the CMMS. This set of loadings suggested that a single maturational force was present which included both age and mental attributes of growth. This component accounted for approximately two-thirds of the total variance. It can be noted, also, that the loading for CA was even higher (.79) on a second component (see Table 3) which, although it failed to attain an eigenvalue of one, accounted for an additional 27 per cent of the variance. Moreover, when these two components were rotated by Kaiser's procedure (1958), to maximize the variance of the loadings on each pattern, the emergence of a cognitive factor independent of age became clearly evident. The high loadings for the PPVT and the CMMS on the first component remained relatively constant through the rotation at .92 and .93, respectively (see Table 4), while the emphasis for CA shifted to the second factor with a loading of .98 (see

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* All tables have been allocated to a special appendix (see Appendix A) in order to reduce interruption to the continuity of this report.

Table 5). These rotated component patterns, which shared 58 per cent and 34 per cent of the attribute variance, clearly differentiated b ween cognitive maturity and chronological age.

c. <u>CMMS and PPVT Differential Raw Score Analyses:</u> The interrelations of the differential scores between the CMMS and the PPVT with the other maturational variables were also of interest. When the PPVT scores were subtracted from the CMMS scores, the differential averaged 6.5 months (see Table 6). The size of this differential varied inversely with scores on the PPVT, giving a negative correlation of -.75. This negative correlation indicated that as the subjects scored higher on the PPVT, the differential between the two tests became smaller. The importance of the differential score was seen in the discrepancy of six and a half months between the means of the CMMS and the PPVT. It appeared that performance on the CMMS was easier than the PPVT, regardless of the fact that their published norms suggest equal test difficulty. The question asked here was: Did the differential between these tests have any significance in terms of reflecting verbal and nonverbal ability differences, or was this difference merely an artifact of unrelated norms?

d. <u>CMMS and PPVT Differential Z Score Analysis:</u> In an attempt to answer the preceding question, the differential scores were reduced to Z scores so that the difference in the means could be ameliorated. These Z scores were then related to other maturational variables. When the intercorrelations of these variables were analyzed by the component method, the eigenvalues of two dimensions were found to exceed the 1.00 (or greater) criterion. These two dimensions accounted for 51 per cent and 33 per cent of the variance. Because a third eigenvalue appeared to hold nearly all the remaining variance (15 per cent), it was also included in the varimax rotation, despite the fact that its eigenvalue (.75) was below criterion level.

(1) <u>Component I (Verbal-Performance Differential:</u> Table 7 shows that the first of these components was monopolized by the

variance of the two differential variables: the Z score (.98) and the raw score (.94). The fact that this composite variable accounted for so much variance clearly indicated that the differential represented more than an artifact of the test norms and was, indeed, a real difference.

(2) Component II (Symbol Facility): The second component (see Table 8) contained high loadings on the CMMS (.97) and the PPVT (.86), which indicated that subjects who performed well on the CMMS also tended to do well on the PPVT, and vice versa. This second factor, therefore, was referred to as Symbol Facility.

(3) Component III (Chronological Age): The third component (see Table 9) was clearly an age dimension as can be seen in the singularly high loading of .98, and this factor was named Chronological Age.

2. The Speech Articulation Test: The Speech Articulation Test was composed of 12 categories, each of which represented a particular subtest of misarticulations. These subtests consisted of consonant substitutions, omissions, or distortions which occurred in blends or in single phonemes at three different locations in the test stimuli: the initial, the medial, and the final positions. The scores for each subtest was based on the number of misarticulations which occurred as the subjects repeated each test stimulus in each of the 12 subtests.

As shown in Table 10, the largest number of errors on the articulation test consisted of substitutions of single consonants in the final and the initial positions. These substitutions had mean scores, respectively, of 2.8 and 2.0 errors per subject. Following in decreasing order of severity, were substitutions in the medial position (2.0 errors), omissions in the final position (1.3 errors), substitutions of consonant blends (1.2 errors), distortions of single consonants in the medial position (0.9 errors) and in the final position (0.6 errors), distortions in the initial position (0.5 errors), distortions of consonant blends (0.4 errors), omissions of single consonants in the medial position (0.3 errors) and in the initial position (0.05 errors).

a. Articulation Scores Component Analyses: The question asked was: Did this array of misarticulations represent 12 separate types of articulation problems or was there a random sampling of errors which reflected a lesser number of general deficiencies? Component analysis of the intercorrelations among the 12 subtests revealed three basic components which attained eigenvalues of 1.00 or greater. These components accounted for more than 58 per cent of the total variance.

(1) Component I (Articulation Distortions): After varimax rotation, Component I alone was seen to account for 22 per cent of the variance and was loaded most heavily with distortion errors regardless of their location in the stimulus (see Table 11); all four measures of articulation errors received loadings greater than .50. Although omission errors in the final position also appeared in this cluster, their presence was thought to be a function of sample idiosyncracy, since none of the other omission variables appeared here. An alternative explanation might be that this type of misarticulation represented a case of premature clipping or distortion of final consonants, a finding which would not be unexpected in the sample studied. In general, however, this factor appeared as a fairly clear measure of Articulation Distortions.

(2) Component II (Articulation Substitutions): The second component to emerge on the articulation test accounted for 21 per cent of the total variance. This factor was heavily loaded with substitution articulation errors in all of the possible positions and in the blends (see Table 12). The obtained loadings on these articulation errors were all above .70 which is in sharp contrast to the remaining categories which failed to load greater than .27. Factor II, therefore, was referred to as the Articulation Substitutions factor.

(3) Component III (Articulation Omissions): The third component included 15 per cent of the total variance and was most heavily

loaded with articulation errors of omission in the initial and medial positions, and in the consonant blends. Table 13 shows that these categories were loaded above .60, whereas all the other misarticulations received less than .32. This third set of loadings appeared, then, to be a factor of Articulation Omissions.

Analysis of the data from the Articulation Test indicated that those children who substituted one consonant for another, generally were not the ones who distorted sounds or omitted them altogether; and that those children who omitted the test consonants were not inclined to make errors of substitution or omission. This delineation of the articulation scores into three factors suggested that these articulation errors probably have different causes, a point which should carry implications for speech and language evaluation and therapy.

3. The Geometric Designs Drawing Test: Each of the five drawing tasks on the Geometric Designs Drawing Test (GDDT) was treated as a separate measure so that each subject received five separate scores. The maximum score, which represented the best reproduction of each stimulus, was three points. As shown in Table 14, the highest scores were attained on the reproduction of the circle which had a mean of 2.46 points. This item was closely followed by the mean score for the cross which was 2.09 points. As expected, these two tests were the least difficult for preschool subjects to perform. Reproduction of the square was of intermediate difficulty (as is shown by a mean of 1.10), whereas the triangle and the diamond represented almost impossible tasks (reflected by their low means for the sample of 0.62 and 0.21 respectively). The standard deviations for these subtests of the GDDT were relatively varied, being 0.99 for the circle task, 1.29 for the cross, 1.32 for the square, 1.08 for the triangle and 0.66 for the diamond. These findings conformed with the general principle that standard deviations for easy and difficult tasks tend to be restricted, while those for items of intermediate difficulty tend to reflect greater variance.

a. GDDT Component Analysis: When the GDDT scores were clustered by component analysis, two eigenvalues were obtained which met the criterion of acceptance of 1.00 or more:

(1) Component I (Spatial Awareness): The first of these components, which accounted for 37 per cent of the variance (see Table 15), was conspicuously loaded on the more difficult GDDT items involving reproductions of the diamond (.81), the triangle (.81) and the square (.70). The remaining test loadings were minimal, reaching values of only .23 and .06 for the cross and the circle respectively.

(2) Component II (Visual Motor Coordination): This pattern was reversed on Component II, however, where the circle and the cross were represented most heavily, receiving loadings of .85 and .82 respectively (see Table 16). None of the remaining tests on this factor exceeded loadings of .43. Nevertheless, this second factor accounted for 32 per cent of the total variance.

The finding of two different component variables on the GDDT subtests suggested that the three tasks represented on Component I emphasized different, as well as more complex, psychomotor skills than Component II. For example, peculiar to the task on Component I was the need to perceive and reproduce oblique lines and contour angles. These perceptual-motor skills appeared to be largely dependent upon the development of spatial orientation which, at least in this study, might have been related to the establishment of dominance. For these reasons, Factor I was referred to as Spatial Awareness.

By the same token, the relatively easier tasks loading on Component II appeared to be more dependent upon the development of eye-hand coordination. For example, in the reproduction of the arc of the circle or the straight lines of the cross, feedback from the visual modality is essential, if the proper motor patterning is to be maintained. The second cluster of tests (Factor II) was called Visual-Motor Coordination.

4. Motor Behavior: There were fourteen measures of motor behavior which were scored individually on the Standard Battery. Eight of these measures, as shown in Table 17, resulted from examiner ratings of the subjects' motor performance as various motor tasks were completed, particularly

the GDDT. These ratings were based upon observations of: hand preference (visual-motor), sitting posture, pencil control and signs of perseveration, tremors, overflow movements, tics and extraneous tapping. In assigning values to these measures, the lower the score, the more normal the behavior.

a. Hand Preference (Visual-Motor): The maximum score possible on this measure was four, which indicated a complete lack of hand preference in pencil use (i.e. the subject used both hands to hold the pencil for drawing). Conversely, a score of one was assigned to the exclusive use of the right hand and two represented exclusive use of the left hand.* An intermediate score of three was used when the subject used either hand, alternately, during the drawing tasks. If the obtained scores were arranged along a continuum of increasing laterality, the mean for the sample was 1.26 (see Table 17). This finding suggested that most of the subjects tended to use their right hand, insofar as pencil-paper tasks were concerned.

b. Perseveration (Visual-Motor): Visual-Motor Perseveration was rated on a six-point scale which reflected its occurrence collectively on each of the five GDDT tasks. A score of zero indicated a total absence of perseverative behavior. A score from one to five was accrued if perseveration was noted on any GDDT reproduction. Table 17 shows that the reported incidence of perseverative behavior in the sample was extremely low, as can be seen by the obtained mean of 0.21.

c. Sitting Posture: Sitting posture, as assessed through observation, was considered to be a measure of gross neuromuscular development, and was evaluated according to a rating scale in which abnormal posture was scored as two, and normal posture was scored as one. Only a small fraction of the subjects was judged

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*The right hand was ranked higher than the left arbitrarily because, from an educational point of view, so many tools and classroom situations are constructed to favor this side.

to have abnormal posture; the mean of 1.01 for the group was very close to the base level representing normal development.

d. Pencil Control: A two-point system also was used to rate pencil control; a score of one represented normal grasp for the subjects' age level; a score of two signified an immature grasp. Table 17 shows a mean score of 1.23 suggesting a normal trend within the research sample.

e. Tremors, Overflow, Tics and Extraneous Tapping: As can be seen in Table 17, signs of tremors (1.02) were scattered sparsely throughout the sample. The scoring system assigned a value of one to the absence of the sign and a score of two to its presence. Overflow movements (1.04), tics (1.01) and extraneous tapping (1.02) were also fairly rare, as represented by the obtained means.

f. Dominance (Foot, Hand and Eye Preference): In addition to those observations which were made as subjects performed at the test table, six additional ratings of motor development were recorded as the subjects moved within the examination room. Three of these ratings were based upon tasks which involved foot, hand and eye preference: kicking a ball, throwing a ball and viewing through a kaleidoscope. For each activity, there were three trials. The lower the score (minimum one), the more consistent the use of the right (R) or left (L) hand, foot or eye on each trial. The examiner recorded each task in sequence (e.g. RRR or LLL). If, however, the subject had only two consecutive trials on the same side (e.g. RLL, RRL, LLR or LRR), a score of two was recorded. Three points were recorded for the alternating use of either side with successive trials (e.g. RLR or LRL).

As shown in Table 17, the mean for eye preference (i.e. as measured on three trials) was the least strongly established in this preschool sample, as shown by the mean 2.20. Gross motor dominance, however, was rather well established, as can be seen in the means of 1.53 for hand preference and 1.42

for foot preference. The fact that eye preference was the least well established in this sample, is of particular interest to the study under discussion.

g. Gross Motor Development (Stance, Balance and Gait): The remaining three aspects of gross motor development (stance, balance, and gait) were rated as the subjects moved about the examination room. A score of one was assigned to normal function; a score of two was recorded if the child's behavior suggested possible problems. As Table 17 indicates, for the sample tested, the level of locomotor development and coordination was considered to be essentially normal.

h. Motor Behavior Component Analysis: When the motor behavior scores were clustered by component analysis, six composite variables reached the acceptance criterion of 1.00 or more.

(1) Component I (Motor Dominance): As shown in Table 14, the largest of these composite variables, Component I, accounted for 16 per cent of the variance and was loaded most highly on Hand Preference (.80), as evaluated through the nonsymbolic related activity of ball throwing; Visual-Motor Hand Preference (.78), as tested by the symbolic associated motor activity of drawing; and Foot Preference (.75). This general dominance factor, which exhibited a global trend toward lateralization, was called Motor Dominance.

(2) Component II (Gross Motor Development): Locomotor variables dominated the Component I pattern on the second composite variable which accounted for 14 per cent of the variance. Table 19 shows that this factor included high loadings on ratings of Gait (.85), Stance (.77) and Balance (.73). Factor II, which represented gross measures of body control, was called Gross Motor Development.

(3) Component III (Signs of Involuntary Motor Behavior Disorders): Component III

incorporated a cluster of variables (see Table 20), which included loadings on Visual-Motor Perseveration (.72), Tremors (.67) and Overflow Movements (.60), accounted for 10 per cent of the variance. The loadings on this composite variable were referred to, collectively, as Signs of Involuntary Motor Behavior.

(4) Components IV, V and VI (Extraneous Tapping, Presence of Tics, and Sitting Posture: The remaining three components, collectively, accounted for only 23 per cent of the total variance. Eight per cent of this was attributable to Factor IV, on which the leading variable was Extraneous Tapping Behavior with a loading of .75 (see Table 21).

In the second stage of the analysis, however, when the N was reduced in order to obtain uncorrelated factor scores, a different fourth factor was obtained. On this pattern, Pencil Control accounted for approximately 71 per cent of the variance. Consequently, for the latter part of this study, this factor was referred to as Fine Motor Control.

The Presence of Tics variable received the highest loading of .78 on Component V, which accounted for another eight per cent of the total variance (see Table 22). The final pattern, Component VI, also featured only one major loading on the variable Sitting Posture (see Table 23). Because of the relative lack of clustering on these components, they were named according to the leading variable in the pattern. Hence, Factor V was called Presence of Tics and Factor VI, Good Posture.

5. Test Behavior: Information concerning test behavior was divided into three sections: Participation Ratings; Psycho-Motor Behavior; and Test Attitude. This division was made in an effort to increase the sensitivity of the test behavior analysis.

a. Participation Ratings:

(1) Reluctant to Participate: This rating related to the clinically observed reluctance of some children to accompany an examiner to the test room. Recorded on an absence or presence basis (zero or one), the obtained mean of .09 (see Table 24) indicated that only a very small proportion of the sample resisted accompanying the examiner to the test room.

(2) Participates Only When Encouraged: Another rating was related to the need for more than expected encouragement before the child would cooperate, during test procedures. It was found that although some children were willing to leave the classroom without hesitance, they were not willing to participate in test procedures, once they had reached the examination room. This need for encouragement was given a score of one; zero represented no need for repeated encouragement. As shown by the mean .06 (see Table 24), only a few of the subjects required special encouragement during testing.

(3) Unconcerned but Does Not Volunteer to Participate: Observable reactions to the test experience also were rated. Those subjects who appeared to be unconcerned (although they did not actively volunteer to participate in test procedures) received a score of one. Those subjects who gave even subtle signs of concern (i.e. either they cried or verbally complained about having to participate or they gave other less direct signs of concern such as: thumb sucking or trembling) received a score of zero. As Table 24 shows, the mean of .74 suggested that the majority of the subjects were unconcerned during testing.

(4) Volunteers to Participate: As test procedures progressed, the majority of the subjects apparently were eager to participate, as indicated by the obtained mean of .92 on this variable (see Table

24). Those who volunteered to participate received a score of one; those who did not volunteer, received a score of zero.

b. Psycho-Motor Behavior: The examiners' observations of the subjects' reactions to the stresses generated by the individual tests were of considerable importance to this study. The following classic behaviors were listed on the recording form: Distractibility, Hyperactivity, Perseveration, Short Attention Span and Fluctuating Attention. These variables were rated on a four-point value scale, beginning with zero (which indicated an absence of the behavior) and extended to a maximum score of three. A score of one could be accrued on each of the following tests: CMMS, PPVT, or GDDT. Thus, a score of three represented the presence of the given behavior (rated separately) on all of these tests.

Table 24 shows that with the exception of Fluctuating Attention (with a mean of 1.0), the incidence of the others (Distractibility, Hyperactivity, Perseveration, or Short Attention Span) was minimal.

c. Test Attitude:

(1) Eager to Participate and Conforms to Test Requirements: The final two measures of attitude toward the test situation were focused upon the subjects' adjustment to the three major tests of the Standard Battery: the PPVT, the CMMS and the GDDT. Both the subjects' ability to conform to test requirements and their eagerness to participate in test activities were rated on a three-point scale, in which zero represented a lack of Eagerness to Participate or Conforms to Test Requirements, and one point was accrued for the presence of these behaviors on each of the three tests. Thus, a total score of three was possible. The respective means of 2.3 and 2.9, as shown in Table 24, indicated that only a very small segment of the sample was not eager to participate in test procedures or was unable to conform to the test requirements.

d. Test Behavior Component Analysis:

(1) Intercorrelations among Eleven Variables: Component analysis of the intercorrelations among the eleven test attitude variables confirmed the reliability of the examiners' judgments concerning the subjects' attitudes as they approached the test situation. Of the four eigenvalues that exceeded 1.00, the largest accounted for 28 per cent of the total variance.

(a) Component I (Willing to Participate): The first component (see Table 25) clearly reflected an attitude continuum on which one pole was defined by the attribute Volunteers to Participate (.85), and the other, by the variable Reluctance to Participate (-.84). Also included on this dimension were those subjects who appeared to be unconcerned about leaving the classroom, although they did not volunteer to participate. This category received a relatively high loading of .71 on the third variable. Factor I, which appeared to reflect the emotional orientation of the subject, was referred to as Willing to Participate.

(b) Component II (Attention): The second largest component, which accounted for 21 per cent of the variance, was concerned with the subjects' reactions to the stresses created by the tests (see Table 26). The similar high loadings on variables called: Distractible (.83), Short Attention Span (.76), Attention Fluctuates (.71) and Hyperactive (.69) suggested that the fine clinical differentiation used to distinguish between these behaviors and other similar behaviors was not achieved by the examiners in this study. Factor II, therefore, was considered to be a global component which was referred to merely as Attention.

(c) Component III (Follows Instructions): Component III (see Table 27), which accounted for an additional 13 per cent of the variance, contained the highest loadings on the variables Conforms to Test Requirements (.79), and on Perseverative Behavior (-.66). Factor III was, therefore, named Follows Instructions.

(d) Component IV (Participates Only When Encouraged): The fourth component, which accounted for 10 per cent of the variance was strongly loaded on the single variable Participates Only When Encouraged (.92). As can be seen in Table 28, this variable apparently constituted a special type of behavior that was unrelated to routine confidence, attention or conformity during testing. Factor IV was referred to as Participates Only When Encouraged.

B. Analysis of the Experimental Battery

The Experimental Battery was divided into four categories: figure-ground (10 items), visual closure (10 items), figure-ground homogeneous (5 items), and visual closure homogeneous (5 items). The stimuli for the first two categories were used with a heterogeneous set of response cards. Each item in all of these categories was scored individually. A maximum of eight represented a correct response on the figure-ground at the most difficult level; a score of seven was assigned to the most difficult closure task.

The means for these 30 items, as shown in Table 29, represented the degree of perceptual accuracy obtained for each stimulus, and collectively reflected the accuracy levels for the perceptual tasks represented by each of the four categories.

For example, the range of the means for the items on the figure-ground items extended from 4.8 (chicken) to 6.5 (hat), with an average level of response for all the heterogeneous Figure-Ground of 5.77; the range for the means on the closure variables was from 3.8 (bunny) to 5.3 (horse), with an average of 4.56. Under the homogeneous condition, the average Figure-Ground response level was 5.61; for Closure it was

3.27. Thus, the level for the Total Sample on the heterogeneous figure-ground tasks were approximated at the fifth degree of difficulty, and the closure tasks level was slightly above the fourth degree of difficulty. For the homogeneous slides of figure-ground, the level of difficulty was at the fifth degree; for the closure slides, the level was at the third degree. This finding confirmed the expectation that the Experimental Battery, as designed, contained tasks neither too easy nor too difficult for the age range of subjects which made up the research sample.

The question which logically followed, here, was: Did the figure-ground and closure items represent different perceptual dimensions or were they merely different items which measured the same perceptual process? In order to answer this question, it was necessary to determine the basic number of independent factors which formed the core of the Experimental Battery, and to establish the expected level of perceptual accuracy on these factors.

1. Component Analysis of the Thirty Perceptual Items: Component analysis of the 30 perceptual items disclosed six eigenvalues which exceeded the criterion of 1.00 or more. These six eigenvalues accounted for 54 per cent of the total variance.

   a. Heterogeneous Items:

      (1) Component I (Figure-Ground): The first composite variable, as shown in Table 30, accounted for 13 per cent of the variance and was conspicuously loaded in succession by all of the ten heterogeneous figure-ground items. These had loadings extending from .41 to .71, while the remaining variables were less than .27. Factor I, therefore, clearly represented an exclusive figure-ground process and was, consequently, referred to as Figure-Ground.

      (2) Components II and III (Visual Closure): The next two largest components, each of which accounted for eleven per cent of the total variance, were most heavily loaded on the heterogeneous Visual Closure items. The first of these two composite variables (Factor II), contained three Visual Closure

items (soldier, man, and boat) in the highest factor pattern positions, having loadings of .70, .67, and .63 respectively (see Table 31). This factor, therefore, was called Visual Closure II.

Component III contained the remaining seven closure items in succession in the leading factor pattern positions (see Table 32) and this factor was referred to as Visual Closure I.

As a result of this aspect of the analysis, a dichotomy of responses was clearly evident with a strong figure-ground factor counterbalanced by two almost equally exclusive closure factors. This dichotomy would support the contention that figure-ground discrimination and visual closure are separate perceptual processes.

b. Homogeneous Items:

(1) Component IV (Figure-Ground): A separation of the homogeneous figure-ground and closure scores (similar to that observed among the heterogeneous perceptual items) also was evident, although to a lesser degree, among the homogeneous variables. Four of the five possible figure-ground homogeneous items emerged to have the highest loadings on the fourth component, which accounted for four per cent of the total variance (see Table 33). Four items (saw, ice cream, bowl, and fish) had loadings of .61 or more; the remaining items received loadings of .50 or less. As was found among the heterogeneous variables, therefore, a factor pattern was defined which clearly represented a figure-ground perceptual process. Factor IV was referred to as Figure-Ground Homogeneous.

(2) Components V and VI (Visual Closure): The remaining two components were most heavily loaded, as before, with visual closure variables. A single outstanding visual closure homogeneous stimulus (boy) received the highest loading of .78 (see Table 34);

while the remaining variables achieved loadings no greater than .48. Factor V was called Visual Closure Homogeneous II.

Similarly, a single visual closure homogeneous stimulus (cow) accounted for the major portion of the variance on Component VI with a loading of .71, while the remaining variables failed to load higher than .39 (see Table 35). Consequently, Factor VI was named Visual Closure Homogeneous I.

B. Analysis of Clinical Judgments

Clinical Judgments of the language proficiency level and possible organic involvement were recorded separately for each of the case reports. Language Proficiency was judged on a five-point scale, with extremely poor language proficiency designated by a score of one; superior language proficiency, a score of five. The midpoint score of three was a judgment of average language proficiency; the scores two and four represented relative points above and below the average. The clinical judgments pertaining to possible organic involvement received either a score of one, which represented a judgment that an organic problem was present (see Table 36); zero indicated a judgment that organic involvement was not present.

1. Language Proficiency: Table 37 shows that the overall level of language proficiency for the total research sample was judged to be slightly below normal by all three clinical judges. The mean scores of 2.8, 2.6 and 2.6 suggested that there was general agreement among the Clinical Judgments, a point further confirmed by the intercorrelations of ratings (.67, .69 and .81). These intercorrelations, when factor analyzed by the component method, revealed only one eigenvalue which exceeded the 1.00 criterion. As Table 38 shows, this single component accounted for 82 per cent of the total variance and included high loadings for each of the Clinical Judgments (.92, .92 and .87).

2. Signs of Organicity: In a similar manner, the correlations for the three organicity ratings were compared to determine their level of agreement and reliability. From the obtained correlations of .36, .38 and .43, only one eigenvalue was found to equal or exceed 1.00, and this

component accounted for 58 per cent of the variance. As seen in Table 39, this single component contained equally high loadings for each of the three clinical judgments (.78, .76 and .75). The emergence of a single composite variable indicated a considerable degree of consistency in the ratings of the three judges on both clinical judgments (Language Proficiency and Organicity Ratings).

III. SECOND STAGE ANALYSIS

A. Analysis of Factor Scores for the Total Sample

In order to identify those behaviors and abilities which constituted discriminating clinical cues in the ratings of language proficiency, factor scores derived from the Clinical Judgments were related to the factor scores obtained for each subject on all of the components of the Standard Battery and the Experimental Battery. Twenty-six composite factors were involved (see Table 40) which included six from the Experimental Battery, eighteen from the Standard Battery (three from the articulation test, six from the motor behavior variables, two from the GDDT, three maturational factors, four test behavior measures), and the two ratings from Clinical Judgments.

Table 75 presents a matrix of the intercorrelations between Clinical Judgments and the other 24 components from the Standard and Experimental Batteries. When the intercorrelations for all these variables were analyzed by the component method, 11 eigenvalues were found to exceed the 1.00 criterion. These underscored 11 independent dimensions which reflected the use of particular clinical cues in reaching the Clinical Judgments. They also portrayed typical behavior patterns, descriptive of perceptual and motor development.

1. The General Clinical Judgment Factor Pattern: It was interesting to note (before varimax rotation) that the first pattern, which included the greatest percentage of the variance among the principal components (15 per cent), appeared to portray a general hierarchy of cues underlying the Clinical Judgments (see Table 40). This trend was, therefore, called the General Clinical Judgments Factor Pattern. Foremost on this pattern was the composite variable of Language Proficiency Judgments, which had the highest loading of .86. Leading the remaining list of clinical cues, which shared the

same variance with Language Proficiency, was Symbol Facility. This composite variable (which included both verbal and nonverbal abstracting abilities) had a loading of .76. This relation indicated that children who were judged to have low language proficiency gave evidence of being deficient in both verbal and nonverbal symbolization skills. Aligned negatively with the Language Proficiency Judgments was the composite variable called Signs of Organicity Judgments. The loading of -.62 for this variable suggested that the probability of a low language proficiency rating became greater, if clinical cues of organic involvement were judged to be present in the case report.

Of the remaining composite variables which were moderately loaded on this General Clinical Judgment Factor Pattern, Visual Closure II was the leading clinical cue. The loading of .54 for this composite variable suggested that subjects who scored low on this Clinical Judgment factor were prone to have difficulty with both Visual Closure II and Symbol Facility. This relation was confirmed further by the fact that Visual Closure Homogeneous II also received a notable position on this factor pattern with a loading of .36. There appeared to be a strong tendency, therefore, for children who had difficulty with visual closure to be judged as having low language proficiency.

Of almost equal importance on this factor was the subject's performance on Spatial Awareness (.54), which was represented by the final three tasks on the GDDT and was directly related to the Clinical Judgments of Language Proficiency. Subjects who were judged to have low language proficiency, also appeared to be unable to perform adequately on the reproduction of the GDDT figures.

Another prominent diagnostic correlate was the composite variable Follows Instructions which, as it may be recalled, contained some element of perseverative behavior. This factor had a loading of .49 which indicated that those children who were judged to have low language proficiency, often were the ones who were unable to follow the proper test procedures to completion.

Visual Motor Coordination, as measured by the first two tests on the GDDT, appeared as a noteworthy composite variable on this factor pattern with a loading of .42. This finding suggested that children with poorly developed eye-hand coordination were considered, on the average, more likely to have low language proficiency.

A clinical correlate of particular interest in this factor pattern was the Verbal-Performance Score Differential, found to be among the leading composite variables in the Clinical Judgment Factor Pattern. The loading of -.42 indicated that children rated as having low language proficiency had greater discrepancies between the CMMS and PPVT scores, than those who were judged to have average or above average language proficiency.

Perhaps, of special relevance to speech and language specialists, was the occurrence of two errors of articulation on this General Clinical Judgment Factor Pattern: Distortions (-.42) and Substitutions (-.39). The loadings of these variables indicated that those children who were judged to have low language proficiency were prone to have these particular types of articulation errors.

The final clinical correlates which could be considered fringe cues to the General Clinical Judgment Factor Pattern were the Figure-Ground Discrimination variables for both the heterogeneous (.33) and homogeneous (.27) stimuli; the degree of Willingness to Participate (.30); and Signs of Involuntary Motor Behavior (-.28).

2. <u>The Primary Language Evaluation Pattern (Component I)</u>: The components were rotated by varimax procedure to gain the greatest distribution of the variance among the ten clinical judgment factors. This rotation resulted in groupings which constituted the most independent clinical patterns. The first varimax factor pattern, which contained the largest percentage of the total variance (11.7 per cent), appeared as a variation of the General Clinical Judgment Factor Pattern.

Because the pattern of this new composite variable was slightly altered by the analysis, a comparison of the old and new clinical patterns was considered to be helpful in underlining the importance of some of the clinical correlates. Table 41 shows that the highest loadings of the rotated factor were on the composite variables of Symbol Facility (.81), Language Proficiency (.78), Follows Instructions (.70), and Visual Closure II (.66). These behavior patterns appeared (at least in this study) to represent highly discriminating clinical cues for the detection of low language proficiency. Maintaining a prominent position still in the varimax factor pattern were the composite variables: Signs of Organicity Judgments (-.42), Signs of Involuntary Motor Behavior (-.39), Articulation Distortions (-.36), and Spatial Awareness (.27). The presence of these variables, through rotation, suggested that they represented a fairly persistent pattern of behaviors which are considered to be characteristic of the child with low language proficiency. The loss of shared variance of the variables for Visual Closure Homogeneous II, Visual Motor Coordination, Figure-Ground Discrimination, Articulation Substitutions, and the Verbal-Performance Differential suggested that these characteristics represented perhaps a peripheral order of evaluation signs. (This assumption received some support from the emergence of a less inclusive Secondary Language Proficiency Pattern, which is discussed later.)

Varimax Factor I, which showed the abilities and behaviors of those subjects who were judged to have low language proficiency, was called the Primary Language Evaluation Pattern.

3. The Chronological Age Pattern (Component II): The second most important group of variables, Component II, which accounted for 7.5 per cent of the total variance, appeared as an age factor (see Table 42). The loading of .76 for Chronological Age represented a trend of increasing age so that the moderately high positive loading for Visual Motor Coordination (.66) and the positive loading for Fine Motor Control (.55) reflected a maturational link for these perceptual-motor dimensions. Associated, also, with this age factor were the perceptual performances of the subjects on the Visual Closure I tasks involving both

heterogeneous (.42) and homogeneous (.38) stimuli. The emergence of this age factor suggested that, for preschool-aged children, ability on the specific tasks represented by these composite variables was largely a function of maturation. It would seem important, therefore, that care be taken to avoid assigning some of these behavior trends to what might be classified as abnormal or pathologic behavior or to conclude, erroneously, that a relation exists between these behaviors and low language proficiency. By the same token, with additional evidence, as suggested by the following varimax factors, these variables may assume important evaluation significance in the detection of children with subtle language problems.

4. The Secondary Language Evaluation Pattern (Component III): Component III, which accounted for 6.2 per cent of the total variance, revealed a second language evaluation pattern of diagnostic correlates (see Table 43). Of singular importance on this component were the Verbal-Performance Differential scores between the PPVT and the CMMS (.77). Of particular interest to this study, was the pattern of a six and a half month discrepancy in which the CMMS score was higher than the PPVT score. This pattern was found among those children who were judged to have poor language performance but with what appeared to be good language potential.

   There also was evidence on this pattern of a slight tendency for the subjects who were not Willing to Participate in the test procedures (-.47) to do poorly on Visual Closure Homogeneous I test items (-.34), in contrast to the positive loading on the heterogeneous Visual Closure I variable (.31). Perhaps, the additional difficulty of the homogeneous condition was sufficient to tax to the limits the abilities of those subjects whose behavior was represented by this particular factor pattern, and the subjects became unwilling to participate in test procedures which were frustrating because of expected failure. Figure-Ground discrimination appeared in this pattern with a loading of -.29 and accounted for approximately eight per cent of the factor variance, suggesting that some of the "fringe" cues were recovered on this pattern in the varimax rotation. Because of the nature of the factors involved, Varimax Factor III was considered to be a Secondary Language Evaluation Pattern.

5. Gross Motor Development (Component IV): Component IV was the fourth largest component and accounted for 5.8 per cent of the total variance. This factor contained a pattern of signs which are often related to children suspected of having neurologic impairment. Foremost among these variables (see Table 44) on this component was Gross Motor Development which attained a loading of .77, closely followed by Figure-Ground Discrimination with a loading of .56. These loadings, in relation to the Signs of Organicity Judgments (-.46), suggested that some subjects who might be considered candidates for neurologic referral, were among the children who tended to show poor figure-ground discrimination and abnormal gross motor behavior. In addition, as might be expected, if gross motor control was poor, other skills relating to motor control could be affected, also. This notion was supported, to some extent, by the loading of .36 on Visual-Motor Coordination. With reference to this factor, it was interesting to note that there were no high loadings on any of the closure variables, with the exception of Visual Closure Homogeneous II which showed a small positive relation with the Organicity Ratings. Because this sample was known to be relatively free from central nervous system involvement, such a relation was expected. The fact that even a small relation was found, however, suggests that a more comprehensive examination of the composition of Visual Closure Homogeneous II would be warranted.

6. The Test Adaptation Pattern (Component V): The remaining six varimax components appeared to hold few remarkable relations within the patterns, but represented primarily simple measures of perceptual, psychomotor or social development. For example, on Varimax Component V, which accounted for 5.7 per cent of the total variance, Participates Only When Encouraged appeared as a strong and almost singular measure of behavior (see Table 45). The loading of .71 for this variable indicated that children who scored high on this factor were initially wary about the testing situation but were able to adjust to the tasks. There was also a tendency for these children to be the younger subjects in the group as reflected by the moderate loading of .33 for Chronological Age. Of interest on this component is the shared variance by the attributes of Spatial Awareness and Visual Closure Homogeneous II, with loadings respectively of -.52 and -.48. This suggested that many children who scored high on this factor

experienced difficulty with these types of tasks. Because the first composite variable accounted for approximately 50 per cent of the factor variance, Component V was referred to as the Test Adaptation Factor.

7. The Test Attitude Pattern (Component VI): Component VI contributed to 4.8 per cent of the total variance. This pattern was dominated by the composite variable labeled Good Posture which had a loading of .74 (see Table 46). The somewhat close relation between this variable and the next highest, called Willing to Participate, suggested that a psychologic influence might have been exerted, in which the attitude of those subjects who were reluctant to participate in the testing experience was reflected by their body position as they sat at the test table. In addition, the loading of -.43 for Articulation Distortions reflected a trend in which children who scored low on this factor tended to have both poor posture and distorted speech errors.

   In this respect, it would seem to be important to note the relative absence, among the higher loadings on this component, of the variables most closely related to language, such as: Symbol Facility and Follows Instructions. This finding suggests that certain nonlinguistic related influences, perhaps behavior problems, were present in those subjects who scored high on this factor.

   If the foregoing assumption is valid, then it would be increasingly interesting to note the lack of shared variances of any of the perceptual factors with this varimax factor. This lack of shared variance suggested that performance on the Experimental Battery was not related to an unfavorable test attitude on the part of the subjects. This finding would tend to support the usefulness of the test strategy employed in the Experimental Battery, whereby meaningful pictures were used as visual stimuli to capture and hold the attention of the subjects, including even those subjects who were reluctant to participate. Also, the method used (tachistoscopic exposure of slides and the matching of stimuli to response cards) apparently reduced the need for the subject to "relate" directly to the examiner, which frequently is the case in other test techniques.

8. The Articulation Substitution Pattern (Component VII): On the next two components, measures of

articulation obtained the highest factor loadings. Component VII, for example, which accounted for 4.8 per cent of the total variance, was clearly defined as an Articulation Substitutions Factor by the loading of .66 on the first variable (see Table 47). Also worthy of note on this component were the two perceptual related variables of Visual Closure I and Spatial Awareness, with respective loadings of -.49 and -.39. These values suggested that subjects who scored high on this factor were prone to have a greater-than-average incidence of substitution errors and low scores on tasks related to Visual Closure I and Spatial Awareness.

9. <u>The Articulation Omissions Pattern (Component VIII)</u>: On Component VIII, the Articulation Omissions composite variable held the highest loading of .80 (see Table 48) and shared a considerable amount of the variance with the Figure-Ground Homogeneous responses (-.43). This finding suggested that disabilities in both areas were prone to occur simultaneously for subjects scoring high on this factor. Factor VIII, therefore, which accounted for 4.7 per cent of the total variance, was referred to by the leading variable, Articulation Omissions.

10. <u>The Attention to Task Pattern (Component IX)</u>: The attention variable accounted for approximately 63 per cent of the variance on Component IX (see Table 49). Three other variables may have constituted fringe cues with relatively minor loadings; Articulation Distortions, .34; Visual Closure I, -.27; and Fine Motor Control, .26. This component, therefore, which accounted for 4.6 per cent of the total variance, was referred to as Attention to Task.

11. <u>The Presence of Tics (Component X)</u>: On Component X, which accounted for only 4.5 per cent of the total variance, Figure-Ground Homogeneous, with a moderate loading of -.47 is associated on the pattern with The Presence of Tics (see Table 50). However, because the latter variable accounted for approximately 72 per cent of the factor variance, this component was designated as the Presence of Tics Factor.

12. <u>The Motor Dominance Pattern (Component XI)</u>: The singularly high loading of .82 for the Motor Dominance variable ranked this attribute as the

most obvious source of variance on this component (see Table 51). The development of dominance, as reflected on this component, shared variance to a limited extent with Figure-Ground Homogeneous and Visual Closure I, which had respective loadings of .33 and .29. This suggested a trend whereby children who appeared to show less-than-average signs of dominance also performed below average on these perceptual tasks. Factor XI, then, which accounted for 4.3 per cent of the total variance, was called Motor Dominance.

IV. ANALYSIS OF COMPONENT STABILITY

There is some indication, from the relative sparseness of the clusters on a number of the orthogonal components, that a lack of cohesiveness existed among many of the 26 composite variables. To explore this possibility further, the stability of the eleven orthogonal components for the Total Sample was evaluated through a coefficient of invariance (as described by Pinneau and Newhouse, 1964). The question here was: Would the variables characterizing each orthogonal component for the Total Sample be identifiable among the corresponding components for each individual subgroup? If so, then these patterns of cues would, indeed, appear to represent general behavior patterns which could be said to be representative of the Total Sample. Conversely, if it were found that the patterns observed in the Total Sample were primarily a product of one subgroup in particular, then consideration of the component differences would become increasingly important in providing, perhaps, qualitative clues to the origin of quantitative group differences on these measures.

In order to obtain a coefficient of component invariance, the scores on the 26 composite variables, identified in the first stage of the analysis for the Total Sample, were divided into the LOW and HIGH Subgroups and analyzed again individually by the component method. Under the criteria specified earlier, that only eigenvalues of 1.00 or more would be accepted, eleven components were defined in the subgroup analysis for the LOW Subgroup while the HIGH Subgroup yielded only ten. Since the former coincided with the number of components obtained for the Total Sample, a coefficient of invariance was first determined between each pair of components in the Total Sample and the LOW Subgroup. The coefficients of invariance from this comparison, of course, were characteristically expected to be high because the Total Sample merely represented a combination of the subgroups. Those components from the LOW Subgroup, which were found to correspond with one or more of the eleven orthogonal components in the Total Sample by high coefficient of invariance, were then compared with each component from the HIGH Subgroup. Again, those with the highest coefficients of invariance were considered to represent the closest corresponding components between the two subgroups. The identities of the HIGH Subgroup components were then confirmed by relating them back again to the Total Sample through a third coefficient of invariance.

In the comparison of the component variables, only those accounting for at least five per cent of the component variance were considered to be significant contributors to the pattern. Those occurring on all three of the corresponding components (i.e. the Total Sample, the LOW Subgroup and the HIGH Subgroup) constituted the most stable variables of the cluster and were generalized to represent a behavior pattern that was common to both subgroups.

A. The Primary Language Evaluation

Of considerable interest to the course of this study was the pattern of variables constituting the Primary Language Evaluation Component for the Total Sample. The primary question was: Did this pattern represent a consistent syndrome of behaviors or observations that could be used to identify language disorders? The answer obtained from the components identified through the coefficient of invariance was clearly negative. As seen in Table 76, Component I (The Primary Language Evaluation Pattern for the Total Sample; see Table 41) corresponded most highly with Component II for the LOW Subgroup (see Table 54) with a coefficient of .80.

Component II, which will be referred to as the Primary Language Evaluation Pattern for the LOW Subgroup, corresponded most closely with Component II for the HIGH Subgroup (see Table 66), with a coefficient of .47 (see Table 77). The latter was henceforth called the Primary Language Evaluation Component for the HIGH Subgroup.

The correctness of this identification was confirmed when the HIGH Subgroup components were compared with those from the Total Sample. As shown in Table 78, the coefficient of invariance between Component I for the Total Sample and Component II for the HIGH Subgroup was .44. This was one of four components in the HIGH Subgroup which appeared to have a relatively high coefficient of invariance with the Primary Language Evaluation Pattern. The distribution of the variance on the other components in this instance may have been due partially to the fact that only ten components had been rotated for the HIGH Subgroup while eleven were rotated for the Total Sample.

An inspection of these three Primary Language Evaluation Components revealed that only three variables were common to all among the higher loadings: Language Proficiency Judgments, Symbol Facility, and Signs of Organicity Judgments. Two of these, moreover, involved evaluations of behavior, not actual performance scores. This, in essence, reduced the only consistent language related measure on the Primary Language Evaluation Component to one, Symbol Facility, which could be considered as a general measure for the Total Sample. The pattern of the remaining composite variables on this component, however, appeared to differ, depending upon the subgroup from which the component was derived. Chronological Age, for example, appeared as a particularly important variable for the LOW Subgroup, while Signs of Gross Motor Development and Involuntary Motor Control were underscored by the component of the HIGH Subgroup.

Further investigation may be suggested here, with an increased number of language related and psychomotor variables, to determine more precisely how the language components of children from various backgrounds differ, particularly at the preschool-age level. Such information would be beneficial in helping educators recognize and plan for basic language differences among minority group children.

B. Chronological Age

As seen in Table 76, Component II for the Total Sample, called Chronological Age (see Table 42), was one of the less stable patterns. This component, when compared to those derived from the subgroup analysis, did not correspond clearly to any single component in the LOW Subgroup, but, instead, related moderately to five: Components I, II, V, VI and IX (see Tables 53, 54, 57, 58 and 61).

Component II, for the LOW Subgroup (see Table 54), held the highest coefficient of .47 with the Age pattern for the Total Sample, but previously was identified as the Primary Language Evaluation Component.

Thus, a maturational link was apparent for this language related component in the LOW Subgroup. This suggested, perhaps, that language and the ability of the child to attend for this subgroup were primarily a matter of age. With the exception of age, however, no other variables were common to both of these corresponding components, and since the Chronological Age variable did not exceed five per cent of the variance on any of the other corresponding components in the LOW Subgroup, these components were not considered further.

As mentioned above, Component II for the LOW Subgroup was found to correspond with Component II of the HIGH Subgroup (see Table 66). The Chronological Age variable, however, was not a significant contributor on this latter pattern. Apparently the coefficient for these patterns was determined largely by the aggregate of lesser variables in the components. This underscores, perhaps, the importance of considering the pattern of the variables, as well as the extent of the loadings.

It should be noted, in addition, that another pattern reflecting maturational development did exist for the HIGH Subgroup. This was Component I (see Table 65) which was clearly identifiable as the Chronological Age Component for the HIGH Subgroup. The coefficient of .45 between this pattern and Component II for the Total Sample (see Table 78), although moderate, was the highest among those corresponding to the Chronological Age Component. The fact that this component did not correspond to the age component for the LOW Subgroup may have been indicative of different growth trends between the subgroups. On the assumption that maturation can be facilitated by training or vice versa, this difference would carry important implications for educational planning and research.

C. <u>The Secondary Language Evaluation Pattern</u>

The variable reflecting the difference between the CMMS and the PPVT appeared as a singularly high measure on Component III for the Total Sample (see Table 43). The domination of this variable was evident, also, in the corresponding subgroup components. Component IV, for example, from the LOW Subgroup (see Table 56) corresponded to the Secondary Language Pattern with a coefficient of .73 (see Table 76); and this, in turn, was most similar to Component V for the HIGH Subgroup (see Table 69) with a coefficient of .56 (see Table 77). As shown in Table 78, Component V corresponded back again to the Secondary Language Evaluation pattern in the Total Sample with a coefficient of .68.

The Verbal-Performance Differential variable, which accounted for the highest portion of the variance on the Secondary Language component was also the only measure to appear in common on all three patterns. It may be interesting to note, in this respect, that Low Language Proficiency judgments tended to be associated with a large differential for the LOW Subgroup but not for the HIGH Subgroup. This point suggested that the HIGH Subgroup scored generally higher on the Symbol Facility variable and that the differential scores tended to be reduced as the scores on the PPVT increased. This finding raises two interesting questions for further consideration: Of what predictive value is the differential in terms of language proficiency; and is the significance of the size of the differential constant from one subgroup to another?

D. Gross Motor Development

Component I for the LOW Subgroup (see Table 53) clearly corresponded to Component IV, Gross Motor Development for the Total Sample (see Table 44). The coefficient of invariance for these components was .70 (see Table 76). Inspection of these components revealed that they constituted close replications of each other, with the perceptual and psychomotor variables of Gross Motor Development, Figure-Ground, and Visual Motor Coordination associated most closely with Signs of Organicity Judgments. Component II from the HIGH Subgroup (see Table 66), however, which corresponded most closely with the Gross Motor Development pattern from the LOW Subgroup, was cited previously as the Primary Language Evaluation Component for the HIGH Subgroup; the coefficient of invariance between these components was .44 (see Table 77). Nevertheless, the correspondence of Component II from the HIGH Subgroup with the Gross Motor Development Pattern in the Total Sample was confirmed by the coefficient of -.51 (see Table 78). In addition, it should be noted that of the variables found to be associated with the Gross Motor Development Component for the Total Sample and the LOW Subgroup, only the variable of the same name predominated for the HIGH Subgroup.

E. Test Adaptation

Component V, called Test Adaptation, for the Total Sample (see Table 45) corresponded most highly with Component III for the LOW Subgroup (see Table 55) with a coefficient of .80 (see Table 76). Hence, the latter was referred to as the Test Adaptation Component for the LOW Subgroup. This, in turn, was most similar to Component VI in the HIGH Subgroup (see Table 70) as shown by the coefficient of .60 (see Table 77). Component VI was found to be related to Component V, the Test Adaptation Pattern for the Total Sample, by the singularly high coefficient of .73 (see Table 78). This variable pattern, therefore, was designated as the Test Adaptation Component for the HIGH Subgroup.

On all three Test Adaptation Components, three variables were consistently evident: Participates Only When Encouraged, Spatial Awareness, and Visual Closure Homogeneous II. The third variable, although it represented only a possible fringe cue, consistently accounted for at least five per cent of the variance on each of these components. Thus, the Test Adaptation Pattern, as identified by these three variables, appeared to be a relatively stable syndrome of behavioral cues for the Total Sample.

F. Test Attitude

Component VI, called Test Attitude, for the Total Sample (see Table 46) corresponded clearly to Component VII for the LOW Subgroup (see Table 59) with a coefficient of .66 (see Table 76). The latter, therefore, was called the Test Attitude Component for the LOW Subgroup. This component, however, was distributed among three patterns (see Table 77) in the HIGH Subgroup with moderate coefficients of -.42, -.37 and -.39.

Component II, previously cited as the Primary Language Evaluation Component for the HIGH Subgroup (see Table 66), did not contain the variables of Good Posture or Willing to Participate, which characterized the Attitude patterns of the Total Sample and the LOW Subgroup. Neither did the Component III (see Table 67) include these variables among those loading high on the pattern. Component IV, however, did include these variables and consequently was called the Test Attitude Component for the HIGH Subgroup (see Table 68). The correctness of this identification was confirmed by the coefficient of -.61 (see

Table 78) between Component IV in the HIGH Subgroup and VI for the Total Sample. Hence, the two variables which formed the core of the Attitude component (Posture and Willing to Participate) apparently represented a stable pattern of behaviors common to both subgroups.

G. Articulation Substitutions

Component VII for the Total Sample (see Table 47) featured the first of two articulation measures to head the ranks of variables on separate orthogonal patterns. The first, Articulation Substitutions, accounted for approximately 44 per cent of the factor variance on this component and was associated to a moderate degree with the perceptually oriented variables of Visual Closure I and Spatial Awareness. Component VII, however, called by the name of the leading variable (Articulation Substitutions) did not correspond clearly with any single pattern in the LOW Subgroup, but held, instead, a moderate similarity to Components VII (see Table 59) and X (see Table 62). The coefficients for these components were respectively -.39 and -.43 (see Table 76).

Component X, from the LOW Subgroup, contained only the Visual Closure I variable from those identifying this pattern in the Total Sample. This variable accounted for approximately 77 per cent of the factor variance. However, since the Articulation Substitutions variable failed to load significantly on this pattern, it could not be considered to be an articulation related measure.

Component VII, for the LOW Subgroup (see Table 59), did, however, contain the Articulation Substitutions variable in the second highest loading position. Spatial Awareness was also present on this component as a fringe cue, accounting for approximately five per cent of the factor variance. Despite the fact that this component had been cited previously as the Test Attitude pattern, it also appeared to represent a measure of speech development for the LOW Subgroup.

Component VII for the LOW Subgroup, as mentioned above, corresponded in turn with three HIGH Subgroup components: II, III and IV (see Table 77). The first two components were designated as Language Evaluation Patterns for the HIGH Subgroup (see Tables 66 and 67), while the last was called Test Attitude (see Table 68).

Of these three, only the Test Attitude Component for the HIGH Subgroup contained the Articulation Substitutions variable with a remarkable loading, and this accounted for only approximately nine per cent of the factor variance. Nevertheless, for both subgroups, a weak but constant association was apparent between Attitude, as reflected by Good Posture and Willingness to Participate, and Articulation Substitution errors.

This same association was not evident in the Substitution Pattern for the Total Sample, however, and a further comparison between Component IV of the HIGH Subgroup and Component VII in the Total Sample revealed that they did not hold a sufficiently high correlation of invariance to warrant the same identification. As seen in Table 78, the coefficient between these components was only -.14.

Conversely, two different patterns in the HIGH Subgroup did reflect a considerable degree of correspondence with the Articulation Component for the total Sample. These were Components I and III, which held coefficients respectively of -.60 and .43 (see Table 78). Only the former contained the Articulation Substitutions variable among the leading attributes with a loading of -.52 (see Table 65). This pattern was discussed previously as the Chronological Age Component for the HIGH Subgroup and it reflected a cluster of variables that appeared to be closely associated with maturation. Subjects who scored high on this component were generally older and were more proficient on Visual Closure I and Spatial Awareness tasks. In addition, these subjects also tended to have a lower incidence of articulation substitution errors.

It is apparent, then, that the Substitutions Pattern for the Total Sample represented a composite of different patterns of behavior between the subgroups. For the LOW Subgroup, the Substitutions variable was more closely associated with the subjects' attitude as reflected by the attributes of Posture and Willingness to Participate; for the HIGH Subgroup, attributes of growth appeared to be a primary consideration. The question arises as to whether or not this lack of correspondence indicates a qualitative difference between the subgroups in terms of the cause of Articulation Substitution errors (e.g. a physiological etiology versus a psychological one). The latter cause, for example, could represent a consequence of subject reaction to the stresses of his environment. These possibilities carry important implications for speech and language learning problems, particularly as they exist among minority groups. Further research may clarify these differences.

H. Articulation Omissions

As seen in Table 48, Component VIII contained the second articulation measure to rank as the highest variable on an orthogonal component for the Total Sample. This component corresponded with three patterns in the LOW Subgroup: VIII (see Table 60), IX (see Table 61) and XI (see Table 63). The coefficients of invariance for these components were -.33, .36 and .48 (see Table 76). Each of these components contained one variable from those characterizing the Omissions component for the Total Sample. Component VIII, for example, contained the Articulation Omissions variable in the second highest ranking position, accounting for approximately 25 per cent of the factor variance. The Presence of Tics variable, however, dominated this pattern, which was referred to, consequently, as the Presence of Tics Component. Component IX featured the Figure-Ground Homogeneous variable, while Component XI contained Visual Closure Homogeneous I. Both of these latter variables occupied the highest ranking position on the components.

Component VIII, the Presence of Tics Pattern, for the LOW Subgroup, corresponded with Component X in the HIGH Subgroup (see Table 77). This was also identified as the Presence of Tics pattern for the HIGH Subgroup (see Table 74) but did not contain the Articulation Omissions variable as did the LOW Subgroup. Components IX and XI, for the LOW Subgroup, however, both corresponded to Component VII in the HIGH Subgroup (see Table 71) with coefficients respectively of -.41 and -.34 (see Table 77). This pattern for the HIGH Subgroup contained the Figure-Ground Homogeneous, Articulation Omissions and Visual Closure Homogeneous variables, which formed the core of the Omissions Pattern in the Total Sample. The identification was further confirmed by the singularly high coefficient of .71 (see Table 78) between Component VII for the HIGH Subgroup and the Articulation Omissions Component for the Total Sample.

It would seem from this subgroup comparison that the Articulation Omissions, Figure-Ground Homogeneous and Visual Closure Homogeneous variables represented fairly independent behaviors in the LOW Subgroup. In the HIGH Subgroup these responses combined, perhaps as the prelude to the emergence of a more sophisticated behavior. The question here is whether differentiation may be taking place in the LOW Subgroup and integration in the HIGH Subgroup, or is it possible that in the less well developed subgroup, basic responses appear as independent components, but as these behaviors become more advanced, they coalesce to form the basis for more complicated skills. This is an area which suggests future study, probably by component analysis, which could serve as a useful tool to functionally map the formation of skills basic to advanced language development.

I. Attention to Task

Component IX for the Total Sample (see Table 49) featured primarily one major variable (Attention), which accounted for approximately 64 per cent of the factor variance. Articulation Distortions and Visual Closure I appeared, also, on this pattern as fringe cues. This component was identified clearly in the LOW Subgroup as Component X (see Table 62) by a coefficient of .55 (see Table 76). The Attention variable reached the second highest loading on this component, accounting for approximately 18 per cent of the variance, but Visual Closure I attained the highest ranking position with a loading of .89.

The Attention to Task Component for the LOW Subgroup corresponded with two components in the HIGH Subgroup--I and IX (see Table 77), neither of which featured the Attention variable to any considerable extent. The former, which had a coefficient of .36 has previously been cited as the Chronological Age Component (see Table 65), while the latter, having a coefficient of -.38, was called Articulation Distortions after the leading variable (see Table 73). This component, despite the minor loading of the attention variable, corresponded most highly with the Attention Component for the Total Sample. As seen in Table 78, the coefficient of invariance between Component IX for the Total Sample and Component IX for the HIGH Subgroup was .47. This suggested that the Attention variable emerging as a measure of behavior in the Total Sample may have been formed primarily through the influence of the LOW Subgroup.

Of further interest is the fact that the Attention variable shared between five and eighteen per cent of the factor variance on seven of the eleven

LOW Subgroup components (see Tables 54, 55, 56, 58, 59, 60 and 62). The pervasiveness of the Attention variable may suggest that this attribute is particularly critical to the children from this subgroup in terms of their readiness for learning.

J. Presence of Tics

Component X presented another fairly non-complex pattern for the Total Sample (see Table 50), in which the Presence of Tics variable attained the singularly high loading of .85. This component corresponded clearly with Component VIII for the LOW Subgroup (see Table 60) which in turn related to Component X for the HIGH Subgroup (see Table 74). The coefficient of invariance for these patterns were respectively .60 and .46 (see Tables 76 and 77). Component X for the HIGH Subgroup, in turn, corresponded with Presence of Tics Component in the Total Sample with a coefficient of .74 (see Table 78). On each of these components for the subgroups, the Presence of Tics variable dominated the pattern. Hence, this variable appears to represent a specific component of behavior for the Total Sample.

K. Motor Dominance

Component XI for the Total Sample (see Table 51) contained a variable which has received much attention in respect to the maturation of the central nervous system, the establishment of dominance, and language development. This variable, Motor Dominance, was foremost on the final orthogonal component for the Total Sample, accounting for 67 per cent of the factor variance. Component XI for the LOW Subgroup (see Table 63) corresponded most highly to the Dominance pattern in the Total Sample with a coefficient of .50 (see Table 76). The Motor Dominance variable was still prominent on this pattern, accounting for approximately 27 per cent of the factor variance.

In the HIGH Subgroup, the component which corresponded most with this Dominance pattern was Component VII (see Table 71) with a coefficient of -.34 (see Table 77). This component, however, did not have the Motor Dominance variable among the highest loading variables; nor did it correspond with the Dominance Pattern for the Total Sample as shown by the low coefficient of invariance (-.01) in Table 78. An inspection of the other components for the HIGH Subgroup reveals that Component VIII did feature the Motor Dominance variable with the highest loading of .75 (see Table 72). This component, in addition, did relate to the Dominance Pattern with a relatively high coefficient of .51 (see Table 78).

This discrepancy underscores the point, perhaps, that although a particular behavior such as dominance is present in both groups of children; the significance of this behavior should not be considered in isolation from the other leading variables in the pattern. This concept of varying context may help to account for the fact that many children or groups of children, although they have been evaluated to be equivalent in a particular behavior, may, nevertheless, perform at different proficiency levels on skills associated with this behavior. This is, perhaps, another reason why a single measure is generally inadequate as an indication of a child's development and potential.

V. ANALYSIS OF INTERGROUP DIFFERENCES

In order to evaluate the language and psychomotor development of the individual subgroups along the dimensions described in the first and second stages of the analysis, the raw scores of the subjects were weighted on each variable according to the beta weights derived in the component analysis. The resulting factor scores were then compared between the subgroups to detect developmental differences in the basic abilities defined by the component patterns.

A. First Order Components

Tables 52 and 64 show the means of the factor scores for the respective subgroups on the 26 composite variables, derived from the raw data.* Comparison of these tables, will show that there was considerable difference between the means of the LOW Subgroup (42.42) and HIGH Subgroup (56.11) with respect to the Clinical Judgments of Language Proficiency.

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*For this type of analysis, the means arbitrarily were set at 50 so that a value above or below this norm reflected the general level of performance for the subgroup on the variable.

Outstanding differences between the subgroups were also evident among the composite variables of Visual Closure II and Symbol Facility. In both instances, the respective means of 42.86 and 42.87 for the LOW Subgroup were well below the arbitrarily set mean 50 for the Total Sample. The HIGH Subgroup, conversely, scored considerably above average on these variables as reflected by the respective means of 55.79 and 55.84. Although these differences appeared to be marked, the significance of the differences could not be computed here because the measures were not independent.

B. Orthogonal Components

1. LOW and HIGH Subgroup Comparison: The final relation to be explored among the factor scores was the effectiveness of the eleven independent components to measure and detect minimal but significant differences in the language and perceptual development of this sample. The question asked here was: Would the factor scores of subjects from subgroups which were expected to have language differences, actually show marked differences?

   In order to investigate this question, the factor scores of the LOW and HIGH Language Proficiency Subgroups were compared through analysis of factor variance as described by Pinneau, et al. (1966). An F value of 6.96 is significant at the .01 level for one and 115 degrees of freedom. Because the eleven orthogonal components were derived from the same subgroups, however, it was not possible to test the significance of the difference between the subgroups of more than one of these components since an appropriate test for multiple comparisons has not yet been developed for the analysis of factor variance. However, using that value as a referent, the F value of 204.83, for Primary Language Evaluation, was clearly significant and two of the other F's: Chronological Age (27.46) and Secondary Language Evaluation (26.43) also exceeded the requirement for .01 level of significance (see Table 79).

   On the Primary and Secondary Language Evaluation patterns, the means of the factor scores for the LOW Subgroup were respectively 42.61 and 53.37. A higher factor score on the Secondary Language Evaluation Component, it will be recalled, reflected a large Verbal-Performance differential score. These scores deviated considerably from the norm and also from the means of the HIGH Subgroup on these components which were 55.96 and 47.22 respectively. These differences reflected a higher incidence of low language proficiency ratings for the LOW Subgroup.

The Chronological Age Pattern, dominated by the variable of age, reflected this maturity difference between the LOW and HIGH Subgroups. The LOW Subgroup constituted an older group of subjects. The Gross Motor Development Pattern gave little indication of subgroup differences for the variable of age, reflected this maturity difference between the LOW and HIGH Subgroups. The LOW Subgroup constituted an older group of subjects. The Gross Motor Development Pattern gave little indication of subgroup differences for the variables loading high on this component. Differences were also minimal for the remaining seven measures.

2. Male and Female Comparison: When factor scores for the eleven independent components were compared by an analysis of factor variance between the male and female subjects within each subgroup, no remarkable differences were indicated by the data for the LOW Subgroup (see Table 80).

In the HIGH Subgroup, however, a trend was evident for the females to receive a higher language factor score than the males. As seen in Table 81 on the Primary Language Evaluation Component, the males scored an average of 54.72, while the female subjects averaged 57.16. On the Articulation Omissions Component, the males had a mean factor score of 51.14; the females, a factor score mean of 47.30. Motor Dominance reflected a slight trend, whereby the boys appeared to have better established dominance than the girls. While the significance of these differences could not be tested at present, they tend to suggest relations which should receive attention in subsequent research.

CHAPTER IV

DISCUSSION

I. INTRODUCTION

The purpose of the preceding chapter was to provide the reader with the results of a rather comprehensive analysis of the data derived from this exploratory study. In the discussion which follows, the objective is to analyze those facets of the study which appear to have educational implications, particularly in terms of the language proficiency of children. The discussion has been divided into two parts: the first focuses on the individual tests and measures defined in the first stage analysis; the second centers around orthogonal patterns formed by these measures in the second stage analysis and on the differences between the scores of the two subgroups on these patterns of behavior.

II. FIRST STAGE ANALYSIS

In the first stage of the analysis, the variables from the tests and observations were grouped into eight data sets on the basis of their face validity: the Standard Battery (i.e. Maturation, Articulation, Visual Motor Behavior, Motor Behavior, and Test Behavior); The Experimental Pattery (i.e. Figure-Ground Discrimination and Closure); and the Clinical Judgments (i.e. Language Proficiency and Organicity Ratings). Raw data within each set were intercorrelated and factor analyzed by the principal component method, resulting in a reduction of the number of variables in each set because the portions of each variable that measured the same attribute were combined mathematically. Each of the remaining composite variables, therefore, measured an independent dimension of behavior within the set. These dimensions were of particular interest because they tended to represent relatively pure measures of behaviors and abilities by which the strengths and weaknesses of the sample could be evaluated.

A. Maturation

In the cluster of tests and observations, primarily concerned with Maturation, four variables were involved: Scores from the Peabody Picture Vocabulary Test (PPVT); scores from the Columbia Mental Maturity Scale (CMMS); the Differential Score between these two tests (DS); and Chronological Age (CA). From the component analysis of these variables, three independent measures were defined: Symbol Facility, Verbal-Performance Differential and Chronological Age (see Tables 7 to 9).

1. Symbol Facility: The independent measure called Symbol Facility was derived from scores obtained by the subjects on the CMMS and the PPVT.

   Scores for the Total Sample averaged six and a half months higher on the CMMS than the PPVT. It is possible that this observed trend might be related to differences in the initial items of the two tests. On the CMMS, for example, the beginning items tend to involve less complex judgments than the beginning items on the PPVT. On the CMMS, the primary task is the selection of one picture out of several (on a similar or different basis). This selection seems to place primary emphasis on perceptual organization within a single modality (visual) and it appears to require a minimum of conceptual activity. Conversely, on the PPVT the primary task is more of a cross modality matching of auditory and visual cues in order for the subject to perform accurately. Appropriate responses on the PPVT, therefore, seem to involve recognition, identification, and association of both auditory and visual information. Because of these apparent differences in the initial items on these tests, the youngest subjects in the sample (three-year olds) possibly were able to score more easily on the initial items of the CMMS than on the initial items of the PPVT. Thus, with the mean CA being less than four and one-half years for the Total Sample, it was not remarkable to find that subjects performed better on the CMMS than on the PPVT.

   As the items on the CMMS and the PPVT progress, however, there appears to be a change of emphasis on both tests from what could be considered concrete tasks to more abstract ones. This change from concrete to abstract appears to increase the need for the subject to categorize the symbols and manipulate the cues internally, before the task can be completed successfully. The Total Sample was found to perform similarly on tasks from both of these tests, as reflected by the relatively high correlation (.78) between these two tests. For the subjects in this sample, therefore, performance on the CMMS might be considered predictive of performance on the PPVT, especially if the tests are viewed as a measure of verbal receptive ability. If this assumption is true, then at least for the subjects in this sample, an above average score on the CMMS might be indicative of normal language potential, in spite of below average performance on the PPVT. Further, the emergence of a separate maturation factor on which these two tests accounted almost exclusively for all of the variance, suggested that subjects who scored high on the factor Symbol Facility performed equally well on both the CMMS and the PPVT.

2. Verbal-Performance Differential: In contrast to the six and a half month differential which was found to exist between the CMMS and the PPVT, larger differentials between scores on these tests appeared to constitute a pattern which was entirely different in nature. This was reflected by the emergence of a second maturation factor in which the differential scores between the PPVT and the CMMS became a major factor variable called Verbal-Performance Differential. This differential was found to be in the direction of a higher score on the CMMS and it represented a separate dimension of behavior which was independent of the norms of the two tests. In addition, this larger differential correlated negatively with the PPVT (-.75) which suggested that a marked differential between scores would be less likely to occur among children who have a well developed receptive vocabulary and, conversely, it would be more prevalent among children with low language proficiency.

   In the later stages of the analysis, this differential was ranked among the leading correlates contributing to the Clinical Judgments of Low Language Proficiency (see Tables 40 and 43). It is not suggested here that language proficiency can be evaluated efficiently on the basis of two such brief and restricted measures as the PPVT and the CMMS. To the contrary, these findings tend to point up that, although tests similar to the PPVT and the CMMS may serve an important role in screening language proficiency where the objective is to indicate general areas of cognitive strengths and weaknesses, these tests do not proport to measure nor do they provide for comprehensive, quantitative measures of language proficiency.

3. Chronological Age: The third independent measure to be defined on the maturation cluster was

Chronological Age (CA), which contained some unexpected implications because the skills required on the CMMS and the PPVT traditionally are considered to be closely related to age. A similar relation usually is taken for granted in the elementary grades where progression from grade to grade tends to be geared to the age of the child. Yet, in the sample studied here, there was a relatively low correlation between CA and performance on the PPVT (.35) or the CMMS (.32). This lack of correspondence was further evidenced by the appearance of chronological age as a third independent factor. Obviously, age alone should not be relied upon as an isolated predictor of conceptual development or learning ability. This point seems to have particular relevance to the problems created for the underachieving child who finds himself in a curriculum which, all too often, stresses CA as the primary basis for grade placement.

B. Articulation

In the sample studied, the most frequent type of articulation error was the substitution of one sound (phoneme) for another (see Table 10). A similar trend reportedly continues through the primary grade levels (Snow, 1963). Of particular interest from the analysis of the twelve articulation categories, however, was the emergence of three clearly defined patterns in which the type of articulation error appeared as the major determinant of the factor variance (see Tables 11 to 13).

1. Three Measures of Misarticulations: In this study, articulation distortions, omissions and substitutions were found to represent three independent measures of speech proficiency, each of which could be related separately to other areas of development. Of interest was the lack of articulation differentiation on the basis of the position of the error in the test word (i.e. initial, medial, or final position), a point which has both theoretical and practical implications. Theoretically, this finding could be related to the reports of other studies (e.g. Powell and McReynolds, 1969) which have indicated that position generalization is not a function of the position trained. In addition, the data from the present study tended to elaborate findings reported from other studies (e.g. Kozhevnikov and Chistovich, 1965; Ohman,

1967; Daniloff and Moll, 1968) in which evidence was presented to indicate that articulation errors may involve units greater in size than an isolated syllable. From a practical standpoint, findings from the present study suggested that remedial speech training, based upon the correction of isolated sounds, often is too fractionated to be generalized effectively. In essence, it becomes necessary to consider each misarticulated phoneme as part of many larger independent structural units, each of which require remediation in addition to that which typically is directed only toward isolated phonemes.

2. <u>Articulation and Motor Behavior</u>: Because articulation is basically a motor response, its relation to the general motor behavior of the child is of particular interest. Parents may believe, for example, that their child's misarticulations are due to poor motor development; sometimes they describe their child as having a "lazy tongue." The lack of correlation among any of the three articulation measures and gross motor development found in the present study (distortions, -.01; substitutions, .08; and omissions, -.01) did not support this belief (see Table 75). Other studies, carried out over several decades, have reported similar findings (Carrell, 1936; Mase, 1946; Fairbanks and Bebout, 1950; Fairbanks and Spriestersbach, 1950). Even children with severe articulation disorders have been observed to have no signs of gross motor abnormalities as far as the speech musculature is concerned (Shriner, et al., 1969).

   It should be pointed out, however, that the findings in the present study (although they agree with the studies mentioned and others which have reported a lack of relation between motor dysfunction and misarticulation) must be viewed with certain reservations, because the measures of motor behavior used in this study may have been too gross to permit effective comparison. Since the subjects in this study were screened to exclude severe motor involvement, the variances may have been due to motor deficits too subtle to invilve the speech musculature to any measurable extent.

   Perhaps more discriminating tests of motor behavior would have indicated different results. A study by Jenkins and Lohr (1964), for example, reported a significant difference between the motor performance of normal and severely speech defective children using The Oseretsky Test of Motor Proficiency (Doll, 1946). It is of particular interest here that what may be the trace of a trend was apparent in the subgroup component analysis involving the variable Fine Motor Control and two of the articulation measures: Distortions and Omissions (see Tables 58 and 60). This association suggests that children who scored high on the first factor and low on the second tended to have these types of articulation errors and were observed to be less proficient in the fine motor tasks. What significance this may have in view of the fact that the relation is evident only for the Low Language Subgroup can only be speculated. However, it does suggest a need for further research in this area. It may be that by using more comprehensive measures of motor behavior, a relation between motor dysfunction and specific types of speech problems might be disclosed.

3. Articulation and Perception: One of the questions posed by the present study concerned the relation between articulation and perception: Does a child with an articulation disorder generally have poor perceptual development? A negative answer to this question was indicated by the relative lack of correlation (ranging in absolute value from .04 to .23; see Table 75) among these measures.

There was, however, an orthogonal component in which an articulation measure did share common variance with a perceptual composite variable. This was the occurrence of the articulation omissions and figure-ground homogeneous variables on the eighth component for the Total Sample (see Table 48). Although the conclusions which could be drawn from this association are limited, they do suggest possibilities for further study. For example, subjects who scored high on Factor VIII (see Table 48) consistently experienced difficulty along both of these dimensions (Articulation Omissions and Figure-Ground Homogeneous). This same association is apparent, also, on Component VII for the High Language Proficiency Subgroup (see Table 71).

It would be interesting to determine (for children in whom such combined disabilities were found) if these problems originated from the same general deficiency. Particularly with the figure-ground items, where figure and ground are meshed to such an extent that cues necessary to differentiate figure from ground are almost totally omitted, it would seem logical to accept a relation between difficulty with figure-ground homogeneous discrimination and articulation errors of omission. The thinking here might be generated from the clinical observation that when speech patterns become embedded in a milieu of articulatory events, the correct pattern becomes obscured. The legitimacy of this thinking was obfuscated to some extent when the Total Sample was analyzed by subgroup differences, and the "articulation omission-figure-ground homogeneous" relation was clearly evident only in the High Language Proficiency Subgroup.

A provocative aspect of this finding was a consideration of what was basic to this relation. Did it suggest differences in the education and training of the subjects from the HIGH Subgroup (e.g. was the education and training for the HIGH Subgroup less concerned with attention to detail and more with abstract tasks and generalization, or was it due to the fact that the subjects in the HIGH Subgroup were younger, on the average, and therfore articulatory omissions and figure-ground homogeneous differentiation might not be mastered yet). In any event, this relation suggests a productive area for further study.

4. Articulation and Clinical Judgments: Another major relation which received attention in this study was how much influence the articulation measures had on the Clinical Judgments. The question here was: Did the judges tend to consider articulation errors commensurate with low language proficiency and were misarticulations associated with their judgments of organicity? This relation was suggested to some extent by the moderate loadings of the Articulation Distortions variable on several language related components for the Total Sample. For example, the loading for this variable on the General Clinical Judgment Pattern was -.42 (see Table 40); for the Primary Language Evaluation Component, -.36; and for the Secondary Language Evaluation Pattern, .26 (see Tables 41 and 43). In the subgroup analysis, this variable appeared as an almost independent measure of behavior (see Tables 58 and 73). Yet, it is interesting to note that for the Low Language Proficiency Subgroup, Signs of Organicity shares a considerably greater proportion of the variance on the Distortions Component than it does on the

corresponding component in the HIGH Subgroup. At face value, this relation between distortion errors and organicity would seem logical and it has been mirrored by reports in the literature which have described the speech patterns of various neurologically impaired subjects. In fact, the distortion of consonants has been noted to be one of the most prevalent characteristics of subjects with neurologic impairment (Halpern, et al., 1967; Darley, et al., 1969). In the present study, however, a relation between distortions and organicity was not present in the HIGH Subgroup, and because the two subgroups were very similar in terms of their standings on the organicity oriented Gross Motor Component for the Total Sample (see Table 79), it would seem likely that the distortion errors for the LOW Subgroup may have had a dialectic rather than organic origin. Further, the tendency to relate distortions with organicity would appear to have confounded the Clinical Judgments. Support for this latter viewpoint can be gained from reports which describe Negro-American English as a lawful linguistic system separate from General American, with its own rules of phonology, morphology and syntax (Stewart, 1965; Loflin, 1967). If speech differences are based upon these rules, then it follows that although these errors may sound incorrect to teachers and speech and language pathologists, they are representative of non-standard speech, not substandard speech.

5. Articulation and Language Development: The relation between articulation disorders and low language proficiency is of particular interest to speech and language specialists and teachers who are faced with the task of classifying the problem of a child who has difficulty expressing himself orally. In brief, the question asked is: Do articulation problems indicate that an underlying language problem is present? The relation is credible and has received considerable attention in the literature (e.g. Monroe, 1932; Jackson, 1944; Jones, 1951; Wilson, 1960; Wilcox, 1959; Durante, 1960; Weaver, et al., 1960; Sommers, et al., 1961; Irwin, 1962; Irwin, 1963). These studies have examined the relation of articulation or the effects of articulation therapy on cognitive skills such as word recognition, picture recognition, and reading. The results from these studies vary in degree, if not in kind, with some studies reporting a relation between disorders of

articulation and disorders of language and other studies reporting relatively little improvement in cognitive skills, even when the articulation errors were decreased.

In this study, the lack of correlation (ranging in absolute value from .10 to .27; see Table 75), between the articulation measures and Symbol Facility would tend to indicate that articulation problems <u>did</u> exist in the sample studied separate from language disorders which involved symbol decoding and organization. This point cannot be generalized to say that children with language disorders do not have articulation errors or that these errors, along with other patterns of behavior, are not an important component of language evaluation. What <u>is</u> suggested, however, is that perhaps the pendulum has swung too far whereby children with articulation errors are classified erroneously as having disorders of language which, naturally, reduces the effectiveness of the language disorder classification. This point also warns against generalizations which can confound the selection of appropriate therapeutic and educational methods for children who have articulation errors due to poor speech models, immaturity, or cultural differences as opposed to those children who have articulation errors due to central problems involving symbol decoding and perceptual organization.

C. Visual-Motor Behavior

Because pencil and paper tasks are employed frequently in schools and clinics in an attempt to make some prediction about perceptual proficiency, a comparison of the subjects' performances on drawing tasks was made with their responses on the <u>Experimental Battery</u>. Before this comparison could be made, the basic skills underlying the drawing task had to be defined.

From the five levels of difficulty on the Geometric Designs Drawing Test (GDDT), two separate trends, or measures, were isolated. These trends were consistent with previous observations of children's performances on this test. As expected, the majority of the subjects had attained sufficient visual-motor coordination (Factor II) to reproduce the circle, the cross and sometimes the square, with ease. Also, as expected because of the age range of the sample, many subjects were not able to reproduce the triangle or the diamond.

In view of the fact that the sample performed generally as expected, it is interesting to note that the GDDT scores were not found to be predictive of figure--round or closure performance. The Spatial Awareness Factor, nevertheless, did appear to be a discriminating measure, which appeared among the correlates of cues used by the consultants to judge levels of language proficiency. As can be seen in Table 75, the correlation between Spatial Awareness and Language Proficiency judgments was .41. In addition, the pervasiveness of the visual-motor coordination and/or spatial awareness may be noted, particularly in the latter stages of the analysis as evidenced by their frequent appearance among the higher ranking variables on fifteen of the components. For example, on each of these patterns (see Tables 40, 42, 44, 45, 46, 47, 53, 55, 56, 57, 59, 65, 66, 67, 70), visual-motor coordination and/or spatial awareness accounted for at least four per cent and as high as 53 per cent of the factor variance. As might be expected, these basic skills appear as a part of a wide range of behaviors--a finding which would tend to corroborate the general importance of activities such as: tracing, coloring and drawing for children of this age group.

D. Motor Behavior

The role of motor development in the perceptual process and the acquisition of language has received considerable attention and discussion (e.g. Piaget, 1952; Getman and Kephart, 1953). It is natural, therefore, for examiners to evaluate a child's motor behavior when perceptual or language development is being assessed. In terms of this study, the question asked was: Can information obtained by almost casual observations of motor behavior by the examiner (a rather routine aspect of evaluation procedures) be of value in predicting subtle perceptual or language deficiencies?

Of the fourteen motor behavior variables included in the evaluation procedures, nine variables were rated on a two-point scale, while three others had a range of only three points. The grossness of these measures was reflected, perhaps, by the consequent lack of variance on these variables and made the usefulness of these data questionable. Nevertheless, since it is not unusual for these motor behaviors to be judged in ways similar to those used in this study, the behaviors were included in the present analysis.

From the fourteen variables included in this cluster, six independent measures were defined. These were called: Motor Dominance, Gross Motor Development, Signs of Involuntary Motor Behavior, Fine Motor Control, Presence of Tics, and Good Posture (see Tables 18 to 23). These measures were then related to subject performance on the Experimental Battery and to the Clinical Judgments.

1. Motor Dominance: Only a very small proportion of the subjects were judged to have signs of poorly established motor dominance, and this measure was not found to be related to the measures of visual perception, nor to any of the Clinical Judgment variables (the correlations ranged in absolute value from .04 to .13; see Table 75). Nevertheless, some interesting observations concerning this measure can be made on the basis of its occurrence initially in the first stage of the analysis, and, also, later in the factor patterns formed in the second stage of analysis.

   First, from Component I (Motor Dominance; see Table 18) it appeared that motor dominance was a relatively independent and consistent measure of psychomotor behavior. Even in the second stage of the analysis, Motor Dominance appeared as a separate and consistent measure of behavior (see Tables 51, 63 and 72). In addition, it is interesting to note that in each case the next highest loading involves a measure of perception from the Experimental Battery. Whether or not this represents a meaningful association between the establishment of dominance and proficiency on the Experimental Battery cannot be determined from these data. Nevertheless, the trend suggested here warrants further investigation. It also underscores the usefulness of a dominance test as a part of the general assessment of child development and behavior.

   Second, as shown in Table 18, general motor dominance did not, as might have been expected, appear to be governed by visual dominance (eye preference). This independence of the visual modality may be related to the fact that man is a binocular animal and tends to use both eyes equally, although minor acuity differences between the eyes could cause the individual to favor one eye for sighting. Regardless of the reason, the absence of this relation lessens the significance frequently attached to tests of eye dominance in the evaluation of language proficiency, although recording observations of eye-hand coordination continues to be important, particularly in terms of education.

2. Gross Motor Development: Component II (see Table 19) revealed another relatively clear measure of behavior called Gross Motor Development. While this measure did not appear to be related to perceptual performance, it indirectly influenced the Clinical Judgments of language proficiency. As seen in later stages of analysis, for example, this measure apparently received considerable weight in the Clinical Judgments of Organicity (see Tables 44, 53, and 66); which in turn, as shown on the Language Evaluation patterns (see Tables 40 and 41), played a major role in the Clinical Judgments of Low Language Proficiency.

3. Signs of Involuntary Motor Behavior: In contrast to Gross Motor Development, the pattern called Involuntary Motor Behavior (see Table 20), apparently was not associated with the judgments of language proficiency, organicity or the measures of visual perception (see Table 75). With the reservation that there was a low incidence of observed motor involvement among the subjects of this study, and recognizing the grossness of the measures used for evaluation, it must be reported that, at least for the sample studied, the involuntary motor behaviors (soft signs and tremors) held little relevance to the visual-perceptual or language related measures.

4. Fine Motor Control: Fine Motor Control, as assessed by the child's ability to manipulate a pencil, shared a considerable portion of the variance along with visual-motor coordination on the Chronological Age Component (see Table 42). This suggests, as would be expected, that Fine Motor Control was generally better developed in the older children. This variable contributed little, however, to the language evaluation or perceptual components. It would appear that for the present sample, the assessment of fine motor control would be of value in determining the child's motor readiness to write, but held little relevance to the development of language and perception.

5. Presence of Tics: The Presence of Tics was a psychomotor variable which, in the first stage

of the analysis, appeared virtually to constitute a separate component of behavior (see Table 22). In the second stage of the analysis, this trend was still clearly evident as seen in Tables 50, 60 and 74. Nevertheless, it was apparent that this factor was found to bear little consistent relation to any of the other test dimensions.

6. Good Posture: Similarly, the variable of Good Posture contributed exclusively to over 75 per cent of the factor variance on the last component (see Table 23). It was apparent, by its separation from the other motor behaviors (such as balance, gait and stance, and pencil control), that a subject who was well coordinated as he moved about the room, did not necessarily exhibit adequate gross or fine motor control, while seated at the test table. There is no way to determine if this lack of association among motor behaviors was due to motivational influences or to actual motor involvement; because all subjects with suspected motor disabilities were excluded from this sample, the former possibility appears to be more likely. In addition, on the component referred to as Test Attitude (see Table 46), Good Posture was associated with the variable (Willing to Participate), which may have reflected the subject's attitude toward the examiner or the pending test experience. This finding suggested that if the subjects scored low on this variable (i.e. they were reluctant to participate in testing) their negative attitude toward the test situation frequently was reflected in their sitting posture.

E. Test Behavior

Eleven variables were observed in the analysis of test behavior to describe the emotional set of the subject. Originally, there were thirteen variables, but those observations relating to aggressiveness and destructiveness were discarded because such instances did not occur. From the analysis of these variables, four independent measures were defined: Willing to Participate, Attention, Follows Instructions, and Participates Only When Encouraged (see Tables 25 to 28). These measures constituted independent dimensions of behavior as recorded by the examiners.

1. Willing to Participate and Attention: The first and second measures derived from these variables (see Tables 25 and 26) appeared to be valid measures of test behavior. They both contained

patterns with a number of variables which can be associated logically. Nevertheless, these measures (Willing to Participate and Attention) were not found to be related to any of the other test variables (see Table 75).

2. Follows Instructions: The third measure (Follows Instructions; see Table 27) appeared to have relatively less internal structure and logic than many of those previously cited. It had only two variables in the leading cluster which were not generally related--Conformity and Perseveration. Nevertheless, this component was found to be correlated to the extent of .39 with Symbol Facility and .42 with Language Proficiency (see Table 75). These relations, of course, could be accounted for in a number of ways. The subjects who were not cooperative could have had a negative set toward the examiner, or they might have been unable to understand, remember, or execute the sequences as expected. Regardless of the reason, it is interesting to speculate about the apparent association of Perseveration and Conformity on this component, in that perseverative behavior (which can be associated with rigid perceptual and motor sets) may render the constantly changing activities of the test experience uncommonly difficult or unpleasant, for the child. This association tends to suggest that examiners may confuse "over-conformity" with perseveration and vice versa, particularly in samples similar to the one studied here. This point raised some interesting questions, one of the most obvious being: Are young children, particularly those from minority groups, so diligently disciplined that their behavior is frequently considered abnormally rigid by examiners who are unfamiliar with the stringent behavior requirements of these children?

3. Participates Only When Encouraged: The final measure did not have a true pattern since only one variable, Participates Only When Encouraged, achieved a noteworthy loading (see Table 28). Since, in addition, this variable held little relevance to any of the other measures, no interpretation seems warranted.

In summary, with the exception of the cluster of variables on the third component (Follows Instructions) the casual and gross examiner observations of behavior in the test situation, as carried out in this study, appeared to contribute little toward a useful understanding of the subject's perceptual development or language abilities.

F. Perceptual Performance

The Experimental Battery contained 30 items, each of which was treated as a separate variable. There was a possibility, therefore, of obtaining 30 separate measures of perception, each corresponding to an individual item. After the component analysis, however, only six independent dimensions were defined: Figure-Ground, Visual Closure II, Visual Closure I, Figure-Ground Homogeneous, Visual Closure Homogeneous II and Visual Closure Homogeneous I (see Tables 30 to 35). From these, the separation of the figure-ground discrimination and closure responses was remarkably clear. This finding, consistent with findings from other studies (e.g. Ayres, 1965; Silverstein, 1965; Campbell, 1967) indicated that figure-ground discrimination and closure are related to separate perceptual processes, which lends credence to the usefulness of the Experimental Battery as a means of evaluating these perceptual dimensions individually.

1. Figure-Ground Discrimination: The Figure-Ground component was the most inclusive measure, accounting for the greatest amount of the variance. This inclusiveness helps to explain the severity of perceptual disabilities when the figure-ground process is disrupted. The emergence of a second "homogeneous" figure-ground measure suggested that this process apparently involves various levels or steps to complete, and that figure-ground discrimination under one set of conditions may not be equivalent to figure-ground discrimination under another set of conditions. Thus, the level at which the figure can be discriminated from the ground depends upon the degree to which the ground functions as interference. This would tend to support the practice of testing the input of stimuli under various conditions of interference, as well as in the absence of competing stimuli, in order to learn the true capacity of the individual to cope with interference effectively.

2. Visual Closure I and II: The bifurcation of the visual closure components invites additional consideration. The question here is: How do these visual closure factors differ? While a definitive answer cannot be obtained on the basis of

the present data, some direction for further research may be suggested through an appraisal of the test stimuli.

a. Spatial Patterning and Directionality: Preliminary inspection of the dual heterogeneous closure components revealed that they differed with respect to the spatial patterning of the stimulus figures. Visual Closure I (see Table 32), for example, contained items which were pictures of an airplane, a dog, a horse and an engine, all of which were horizontal in their general configuration. Those items on Visual Closure II (see Table 31) included pictures of a soldier, a man and a boat with a sail, all of which had an overall vertical orientation. (Actually, in terms of directionality, the boat had both vertical and horizontal projections, and it was interesting to note that it appeared among the higher ranking variables of both the Visual Closure I and II Components.) Even among the homogeneous composite variables, this same separation of the closure components existed on the basis of directionality. Visual Closure II (Homogeneous) (see Table 34) featured a single major variable represented by a picture of a standing boy, which had a vertical orientation; while Visual Closure I (Homogeneous) (see Table 35) was composed of the responses to a cow, a figure drawn in a prone position, which gave it a horizontal dimension.

b. Dominance: It could be hypothesized that the apparent spatial and directionality influences on closure items were related in some way, to the development of dominance, but this assumption was not supported in this study, as indicated by the low correlations between the motor dominance and visual closure variables (see Table 75). There were, however, as mentioned previously, a series of interesting associations between dominance and several of the experimental perceptual measures (see Tables 51, 63 and 72). Although no conclusions could be drawn from these associations at present, they seemed to warrant more definitive exploration to determine whether or not a lack of established dominance could be a factor in reduced visual closure efficiency.

c. Role of Cognition: The separate closure factors also may have reflected, in part, different levels of perceptual difficulty, with the vertical orientation of the stimulus representing the more difficult closure task. In such instances, intervening influences (e.g. variations in cognitive skills) could have had an effect on the responses. This may have been indicated in the present data by the correlation of .53 between the Symbol Facility Component and Visual Closure II (i.e. vertically oriented stimuli).

d. Intervention of other Learned Variables: In addition to the possible influence of directionality, spatial patterning, dominance and cognitive skills, there were other possible bases upon which the closure components could be separated: e.g. the Visual Closure II variables included, almost exclusively, pictures of humans, whereas the variables on Visual Closure I involved animals or inanimate objects. Semantic variables, and others such as: abstraction, familiarity and emotional interest, may have interacted to cause the separation of the closure factors.

3. Relation of the Experimental Battery to the Standard Battery and Clinical Judgments: Regardless of their origins, the six measures of perception, including both the figure-ground discrimination and the visual-closure factors were related to practically none of the variables included in the Standard Battery. This finding indicated that at least for this sample, the measures which were included on the Standard Battery (and which are used frequently to screen language proficiency) did not provide information which could be related to perceptual proficiency. Yet, it was interesting to note that results for the Experimental Battery were related to the decisions of the clinical judges, as evidenced in the Primary Language Evaluation Pattern and the Gross Motor Development Component (see Tables 41 and 44 respectively).

G. Clinical Judgments

1. Judgments of Language Proficiency: From the data available to the clinical judges for rating the Language Proficiency of the subjects, only a few measures consistently varied with the judgments of language proficiency. As would be expected, the most important was the language related

variable of Symbol Facility which had a correlation coefficient of .77 (see Table 75). This variable, as discussed below, was also associated with the Organicity Ratings. The Visual Closure II measure also correlated to some extent with the Clinical Judgments of Language Proficiency (.55), but unlike Symbol Facility, it was not a correlate of those cues identified with the Organicity Ratings. Only three other composite variables appeared to vary systematically with the language judgments: the Verbal-Performance Differential (-.46), Spatial Awareness (.41) and Follows Instructions (.42). None of these measures was related to the Organicity Ratings. A fourth fringe variable, Articulation Distortions, would seem to be worth noting because of its correlation of approximately .31 with both the Language Proficiency and Organicity Ratings.

2. Judgments of Organicity: Organicity Ratings for the Total Sample by the clinical judges were rare. Three measures, in general, formed the core of these Clinical Judgments: Symbol Facility, Gross Motor Development and Articulation Errors of Distortion. The Organicity Ratings, in turn, were related to the Language Proficiency as seen by the correlation of -.48 (see Table 75). Consequently, Signs of Organicity, if present in the Clinical Judgments, increased the probabilities of a Low Language Proficiency Rating, but not to the extent expected. Again, it is necessary to keep in mind the selection criteria for the sample studied excluded known organic involvement.

In summary, a child who was considered to have low language proficiency by the judges was apt to show poor facility with symbols; have a PPVT-CMMS differential greater than six and a half months; exhibit spatial problems in drawing and appear unable to Follow Instructions to completion. On the Experimental Battery, the child with low language proficiency tended to have problems with visual closure tasks. Although these composite variables were descriptive of behavior generally associated with suspected language learning problems, they did not provide information concerning the basic dimensions whereby one child differs from another in terms of perceptual performance. In an attempt to determine the nature of this differentiation, the second stage of the analysis was undertaken, and the two subgroups were compared.

IV. SECOND STAGE ANALYSIS

From the first stage of the analysis, the original 82 variables, which had been grouped into clusters, were reduced to 26 in number. Although these remaining (composite) variables were independent within each set, they still contained correlations between sets. In the second stage of the analysis, the remaining overlapping variances were extracted so that 11 final measures, which were independent of each other, were identified. These measures were then used to describe and to compare the perceptual and psychomotor development of the Total Sample, and similarities and differences between the two subgroups.

A. Intra-Analysis of the Orthogonal Components

Three of the final orthogonal components will be discussed in detail because they appear to reflect some of the major findings of the study. These are the Primary Language Evaluation, Chronological Age, and the Gross Motor Development components. The remaining eight patterns will be noted as relatively simple measures of development with only minimal relations pertinent to the course of this study.

1. Primary Language Evaluation Measure: The Primary Language Evaluation Pattern (see Table 41) was the most substantial independent measure of those defined in the second stage of the analysis. It accounted for the greatest amount of the variance after the varimax rotation (11.7 per cent) and contained one of the largest aggregates of high-ranking composite variables. Within the structure of this measure, several important variable associations were observed which could be related to the educational management of children with language learning problems.

   a. Symbol Facility and Follows Instructions: The association of the composite variables, Symbol Facility and Follows Instructions, on Component I (the Primary Language Evaluation Pattern for the Total Sample, see Table 41) raises an interesting point: that children who scored low on this factor (i.e. had a low level of Symbol Facility), also exhibited a tendency not to comply with the test requirements. The small degree of shared variance by any of the test attitude variables on this component suggested that this lack of compliance may not have been associated with an unwillingness to Follow Instructions; rather, it appeared to be related more to an inability to perform adequately. From this factor pattern, it would appear that language proficiency, as reflected by the Symbol Facility scores, was related directly to the ability of the child to understand instructions and comprehend what was expected of him, particularly in terms of task performance. This simple, but nevertheless frequently neglected, clue suggested the need for a better understanding of how the perceptual processes function for the child with low language proficiency, not only what he seemingly perceives. This point is particularly pertinent to those children who appear to be confused in the regular classroom and who seem unable to cope with school activities which require the comprehension and use of symbols. It would appear, then, that it may be the lack of exploration of how the child goes about this performance on tasks which becomes the major contributor to the exclusion of some children from those school activities designed especially to help them and from which they are expected to derive their formal language experiences.

Also, because the child with low language proficiency is unable to organize symbolic sequences effectively, he may be incapable of keeping pace with those school activities which are structured to enrich language, primarily because he does not understand the nature of the tasks involved. From an educational standpoint, this problem becomes a very real one which must be recognized, and the activities selected must be adjusted to insure that children with low language proficiency do understand what is expected of them, so that they might participate in classroom procedures more effectively.

b. Visual Closure II and Symbol Facility: The Visual Closure II composite variable (Vertical Orientation) received considerable weight on the Primary Language Evaluation Patterns for the Total Sample with a loading of .66 (see Table 41). This variable, which appeared as one of the most discriminating measures between the HIGH and LOW Subgroups (see Tables 52 and 64), formed almost separate dimensions among the components of each subgroup. A comparison of these components (see Tables 61 and

73), however, fails to give any meaningful clues as to the basis of this difference between the subgroups. For both, the components that carry the highest loadings for Visual Closure II appear to be relatively dominated by perceptual attributes. However, since Visual Closure II had appeared to be related to the language measure of Symbol Facility (see Table 75), its apparent lack of development in the LOW Subgroup warranted considerable attention. This finding suggested that language proficiency facilitates the vertical visual closure process, but in instances where language is significantly underdeveloped (as characteristic of the Low Language Proficiency Subgroup) the Visual Closure II process may not function adequately. This was in marked contrast to the Visual Closure I (Horizontal Orientation) variable which, like Visual Closure II, formed almost separate perceptual components in the subgroup analysis (see Tables 62 and 65).

c. Component Stability: In one respect, the Primary Language Evaluation Component represented a general measure of language development. This was due to the presence of the language related composite variable Symbol Facility on all of the corresponding Primary Language Evaluation Components. On the other hand, it is important to note that Symbol Facility was the only variable to appear in common on all Primary Language Components (see Tables 41, 54 and 66). This suggests that basic qualitative differences existed between the subgroups on language related skills. For example, language development as reflected by the Primary Language Component for the LOW Subgroup (see Table 54) appears to stress maturation and the ability to Follow Instructions. More evident in the HIGH Subgroup (see Table 66) were signs of motor development and control and spatial awareness.

This is not to suggest that these variables form the basis or are even essential to the development of language for these subgroups. What is important is that these subgroups differed in these language related patterns. The implications for education are clear. The needs, in terms of language training, of children from different subcultures are going to vary according to their backgrounds. Consequently, many children may enter primary grade curriculums, which are not suited to meet their particular problems. As suggested here, these needs relate to prelinguistic skills such as perceptual development, motor development, self-control and social behavior.

Further research including a more comprehensive list of language related variables would be warranted to determine more precisely what these group differences are for language development. It would be important to know, in addition, whether a stable pattern reflecting specific group characteristics could be obtained for particular minority subgroups; and how these patterns would be affected by training and maturation. Such information would help educators recognize and plan according to the particular assets and problems of minority group children.

2. Chronological Age Measures: The emergence of a chronological age pattern as the second largest component generates three major points of interest involving maturational readiness, perceptual growth and training, and the effects of age on the remaining measures of psychomotor behavior.

   a. Maturational Readiness: A major contribution of the Chronological Age pattern was the isolation of specific test variables that appear to be unusually responsive to physical growth for this preschool-aged sample. Visual Motor Coordination, Fine Motor Control, Visual Closure I and Figure-Ground shared a considerable portion of the variance on this component. Some important implications for preschool training may be drawn from this variable pattern. It may be that this age range represents an optimum period of readiness for learning these specific motor and perceptual skills so that children may be particularly responsive to training at this time. Children, on the other hand, who have not yet experienced this growth or who have received no training during this period, may be at a disadvantage later when more sophisticated tasks that incorporate these basic skills are required.

   b. Perceptual Maturation: The inclusion of the Visual Closure I and the Figure-Ground variables among the higher loadings on the Chronological Age Component (see Table 42) supports the view that these more than the other attributes included in the Experimental Battery, are tied to the maturational process, being relatively independent of linguistic development. This growth factor was clearly visible, also, in the subgroup analysis of the HIGH Subgroup (see Table 65). For the LOW Subgroup, however, the relation is not so evident. Here, the Visual Closure I variable forms an almost separate factor in association with the variable of Attention (see Table 62).

It appears from this inverse relation of Attention with the factor that children who tried consciously to solve the closure tasks actually performed more poorly than those who appeared to give them little thought. It may be in such instances that these children were attempting to verbalize the task and thereby overlooked more simple but effective matching cues. This may be another indication that at a prelinguistic level, experiences and practice, free of symbol association are an important part of the learning process. Perceptual-motor training of this kind has already received considerable application such as in the Montessori method. How this training could be expanded to include Visual Closure I and Figure-Ground perceptual tasks remains an interesting question for further consideration and research.

Of particular concern in respect to perceptual maturation was the instability of the Chronological Age Pattern. When the subgroups were considered individually, different patterns of maturational development were obtained. For the LOW Subgroup (see Table 54) Symbol Facility, Attention and ability to Follow Instructions appeared to be closely associated with the age of the child. For the HIGH Subgroup (see Table 65), perceptual attributes such as Visual Closure I, Spatial Awareness and Articulation Substitutions seemed to be most interwound with the measure of age. This difference may suggest that the patterns of maturational development are not the same for children of different subgroups. If so, then patterns of readiness for skills basic to language and reading development may differ--a possibility that would carry important implications for educational planning in the primary grades.

c. The "Partialling" Effects of the Chronological Age Component: The final contribution of this component was the "partialling" effect it contributed to the other ten independent measures. By absorbing the variance due to aging on a single component, the relations observable on the other components are relatively free from the variances due to age differences within the sample.

3. Gross Motor Development: The association of the Gross Motor Development and Signs of Organicity Judgment variables on the Gross Motor Development Component for both the Total Sample and the LOW Subgroup (see Tables 44 and 53) was not unexpected. Inadequate gross motor coordination has been found to be a correlate of even subtle neural pathology (Rapin, 1959). Also anticipated, was the association of Figure-Ground Discrimination with variables related to organicity judgments. These observations are consistent with findings reported by Horrower (1939); Cruickshank (1957); Myklebust and Boshes (1960); Wood (1969) and others reporting studies which involved subjects with medically diagnosed central nervous system dysfunction.

The absence of figure-ground variance on the Gross Motor Development component in the HIGH Subgroup (see Table 66), however, was unexpected and difficult to explain. It may be that low language proficiency caused by neural pathology may be more noticeable among subjects expected to have high language proficiency than among those subjects expected to have low language proficiency because of environmental deprivation, or other reasons. A tendency to record diagnostic findings in terms of what the examiner might expect to find might be responsible for the apparent substitution of Low Language Proficiency Ratings for Figure-Ground Discrimination problems among the higher loadings for the Expected High Language Proficiency Subgroup.

4. Simple Measures of Psychomotor Development: The eight remaining orthogonal components for the second stage of the analysis held few, if any, remarkable relations within the composition of the variable pattern. However, they did represent an array of psychomotor measures by which the development of the subgroups could be compared.

a. Verbal-Performance Differential: Component III (see Table 43) reflected the discrepancy between the CMMS and the PPVT. This variable accounted for approximately 59 per cent of the variance on this component for the Total Sample and, also, for both subgroups (see Tables 56 and 69).

b. Test Adaptation: Component V appeared as a test adaptation pattern (see Table 45). There was some indication that children who needed to be coaxed to perform during the test situation performed below average on tasks requiring spatial awareness. This trend was evident in both the LOW and HIGH Subgroups (see Tables 55 and 70); in addition, in the former, the relation appeared to be linked to immaturity since there was a trend for the younger subjects to exhibit these behaviors. It may be that the insecurity exhibited by these children may be part of a general perceptual lack of readiness, indicating a need for training at basic perceptual levels.

c. Test Attitude: Component VI (see Table 46) constituted a test attitude pattern involving the variables Willing to Participate, and Posture. Paradoxically, those children who were unwilling to participate tended to sit rigidly in their chairs, thereby obtaining good posture ratings. Those who, on the other hand, joined willingly in the test experience were more inclined to be relaxed and often assumed unusual positions. This may be an indication that erectness, which was so prized in the little red school house, is not necessarily a sign that the child is maximumly receptive toward the learning situation. This inverse association with the factor was clearly evident, also, in the analysis of the HIGH Subgroup (see Table 68) and to a lesser extent in the LOW Subgroup (see Table 59), indicating that the response transcended cultural differences.

d. Articulation Substitutions: Component VII (see Table 47) represented a fairly clear measure of speech development involving specifically errors of substitution. It is interesting to note, in view of the developmental nature of this type of error, that other age related variables from the Standard Battery (viz. Spatial Awareness and Visual Closure I) were associated most closely on this component with the articulation variable. Hence, children who scored high on this factor had immature speech patterns and tended to score poorly on the Visual Closure I and Spatial Awareness measures. It is interesting to consider here whether children who have both speech and reading problems could experience the latter not only because of poor phonemic perception as is often suspected, but also, because of a concomitant difficulty with basic visual closure or poor spatial awareness skills.

e. Articulation Omissions: Component VIII (see Table 48) was viewed as another speech oriented pattern featuring primarily the articulation omissions. As noted previously, this variable shared a considerable portion of the variance with the Figure-Ground Homogeneous measure. It was speculated that a basic disability, namely poor figure-ground discrimination, may be common to both problems. This association was evident in the HIGH Subgroup (see Table 71). However, for the LOW Subgroup, these variables constituted almost independent components of behavior (see Tables 60 and 61). Further research would be helpful here to determine whether a trend is taking place. Is the coalescence of these variables on a single component a sign of a more sophisticated behavior in which the discrimination of figure and ground is being generalized to other perceptual motor skills? To answer this question, further use of component analysis as a tool to plot the building of complex behaviors from simple independent skills would be indicated.

f. Attention to Task: Component IX (see Table 49) represented a measure that is of continual concern to educators--Attention to Task. This variable accounted for approximately 64 per cent of the variance on this pattern and, therefore, represents a fairly clear measure of attention. The finding that this variable was associated with many more behaviors in the LOW Subgroup is of particular interest here. It has been observed clinically that children from deprived areas often seem to be hyperactive when they first attend kindergarten. This may account for the wide influence of the attention variable on the components for the LOW Subgroup. If so, then educational measures prior to kindergarten is suggested to help build attention skills so that these children will not be disadvantaged by attention problems in the primary grades.

g. Presence of Tics: Component X (see Table 50) appeared as a pattern primarily concerned with the observation of tics. This behavior was found to have little relation to the other skills and behaviors included in the Experimental Battery and the Standard Battery. Nevertheless, it was clearly evident as an independent measure in both subgroups (see Tables 60 and 74). The question might be entertained here as to whether the incidence of tics was greater in one subgroup than the other. The intergroup comparison of the factor scores on these measures, as discussed below, indicated that the incidence was generally the same in both subgroups.

h. Motor Dominance: Component XI (see Table 51) for the Total Sample featured almost exclusively the composite variable of Motor Dominance. Since this variable is often related with neural maturation, and consequently to language development and reading readiness, it is of considerable interest to educators. As noted earlier, this variable, in every instance that it loaded high on the factor (see Tables 63 and 72), was associated most closely with perceptual variables from the Experimental Battery. Since this relation was not consistent for the variables within the Experimental Battery, the significance of this relation cannot be judged at this time. It does, however, warrant further investigation. The question here might be: Is there a general underlying neural maturational factor basic to all the figure-ground and closure tasks? It may be that a more inclusive measure of dominance, involving, for example, cross modality matching, would show a more definitive relation.

B. Inter-Subgroup Analysis of the Orthogonal Components

Through the use of the eleven orthogonal components as measures of perceptual and psychomotor behavior, the developmental status of the subgroups could be compared. This comparison was accomplished by converting the raw scores of the subjects into factor scores on each dimension. These were then analyzed to determine intergroup differences. The subgroups, it may be recalled, were divided on the basis of high and low socio-economic levels with relatively high and low expected language proficiency levels.

1. <u>Discrimination of Language Proficiency</u>: The analysis of factor score variance indicated that marked differences existed between the HIGH and LOW Language Proficiency Subgroups on several independent measures, including the Primary and Secondary Language Evaluation Patterns and the Chronological Age Pattern (see Table 79). These differences supported the hypothesis that the two subgroups represented different samples in terms of language proficiency and perceptual development.

   Because the subjects in the two subgroups represented vastly different socio-economic levels, as well as different racial and cultural characteristics, these differences were not unexpected. For several decades these socio-economic inequities have been pointed out (e.g. Smith, 1926; McCarthy, 1930; Davis, 1937; Irwin, 1948; Irwin, 1948; Templin, 1957; Deutsch, 1959; Malone, 1966; Bereiter and Englemann, 1966; Gerber and Hertel, 1969). In these and numerous other studies, significant signs of low language proficiency have been related to low socio-economic levels.

2. <u>Discrimination of Organicity</u>: The lack of a remarkable difference between the subgroups on the organicity associated Gross Motor Development Component, or on any of the other components containing variables possibly related to signs of neural pathology was of interest. This finding may be related to the fact that with the more comprehensive welfare programs, better medical and nutritional care, attention to early childhood development and learning which is available currently for low socio-economic families, that the previously assumed "high risk" aspect of this group has been reduced, at least to some extent. In any event, any assumption that low socio-economic level can be equated with "high risk" in terms of observable signs of organicity was not supported by the data from this study.

3. <u>The Relation between Visual Closure and Figure-Ground</u>: From a consideration of the factor scores on the first four major components, there emerges what is perhaps the most educationally significant finding in this study: that the subjects from both subgroups performed equally well on the figure-ground discrimination items of the <u>Experimental Battery</u>, but that they differed measurably on the Visual Closure II items.

The equivalence of the subgroups on figure-ground discrimination was reflected by the means of the factor scores on the Gross Motor Development Component (see Table 79). This component (see Table 44) contained the Figure-Ground variable in the second highest loading position. As shown in Table 79, the means for the LOW and HIGH Subgroups on this component were respectively 50.61 and 49.50. Thus, the mean difference is very small. In contrast, on the Primary Language Evaluation Component (see Table 41), which contained the Visual Closure II measure among the highest loading variables, the means of the LOW and HIGH Subgroups (respectively 42.61 and 55.96) differed significantly, at the .01 level (see Table 79). This difference was foreshadowed, it may be recalled, by the discrepancy of the means on the Visual Closure II variable in Tables 52 and 64. Here the difference between the LOW Subgroup mean (42.86) and the HIGH Subgroup (55.79) is very large.

The fact that the subjects from the LOW Subgroup were able to identify the figure-ground discrimination items with the same level of accuracy as those from the HIGH Subgroup suggested that test interference (e.g. a general developmental lag; the presence of an emotional barrier between the examiner and examinee) could be discounted. The small differences between the subgroups on seven of the eleven independent measures supported this contention further. Also, because there were no indications of general retardation, or social incompatibility in either subgroup and because there were no apparent cues to suggest that organicity was more prevalent in one subgroup than another, the large difference which appeared on Visual Closure II was even more remarkable.

It could be reasoned, therefore, that in terms of perceiving figure-ground discriminations, where all of the information required for identification is present in the stimuli, the subjects from the Low Language Proficiency Subgroup were able to perform on the same level of accuracy as the High Language Proficiency Subgroup. On closure tasks, however, where information is absent from the stimulus figures and where the missing information must be supplied by the individual before structure could be achieved, the subjects from the LOW Subgroup were found to perform at a significantly lower level than subjects from the HIGH Subgroup. It would appear, therefore, that if it is logical to assume that it is language proficiency which facilitates the effectiveness of those perceptual processes requiring closure, then these findings have provocative implications for the education of children with low language proficiency.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS FOR SUBSEQUENT STUDY

I. INTRODUCTION

This exploratory study had as its purpose three main objectives: (1) to develop an experimental battery of visual closure and figure-ground discrimination items which would have a series of degrees of interference levels and which would be sensitive to a wide range of responses of children between the ages of three and six years; (2) to compare the responses of two groups of children (Group I with expected low language proficiency; Group II with expected high language proficiency) on both the experimental measures and on a battery of standard tests currently used to evaluate language proficiency; and (3) to study the data resulting from these measures for implications which might aid in the adaptation of old, or the development of new educational methods for children with language learning problems, particularly those children from minority groups.

The subjects who made up the total sample were between three and six years of age at the time of testing; considered to be free of any major physical or psychologic problems; and known to be able to respond in formal test situations. The reason for including only subjects considered to be developmentally normal (at least to the extent that they gave no evidence at the time of screening evaluation of severe sensory or motor disabilities which would require special educational consideration) was that it seemed obvious that handicaps such as visual impairment, hearing loss, cerebral palsy, mental retardation, emotional disturbance, etc. naturally would contaminate responses on any perceptual battery, which would result in severe biasing of the findings. The preschool-age level was selected because this age span was believed to represent a critical period of learning, during which the child is acquiring, through perceptual experiences, a basis for developing the concepts which later form the bases for his academic achievement.

The Total Sample consisted of 343 subjects; 190 subjects from nursery schools located in areas equated with low socio-economic levels, and 153 subjects from nursery schools representative of high socio-economic levels. The low socio-economic group was 95 per cent Negro, four per cent Mexican, one-half per cent Caucasian, and one-half per cent Indian. The high socio-economic group was

98 per cent Caucasian, one per cent Negro, and one per cent other various racial backgrounds. Based on both empirical and experimental evidence, it was expected that the subjects from the low socio-economic environment would perform less proficiently on measures of language skills than their counterparts from high socio-economic environments. The basic question in this study was: Would subjects from a low socio-economic community also perform less proficiently than subjects from a high socio-economic community on figure-ground discrimination and visual closure tasks?

The preceding chapter (Discussion) presents, in considerable detail, the findings from this study and some of the educational implications which these findings suggest. This was done to provide the reader an opportunity to draw conclusions which might differ from those presented below.

A. Conclusions Pertaining to Language Proficiency

In terms of educational implications, there were, in essence, three major conclusions which could be drawn from this study concerning language proficiency.

1. When the two subgroups were compared on the Primary Language Evaluation Pattern, the LOW Subgroup was found to perform at a markedly lower level of proficiency than the HIGH Subgroup. Of the three leading variables on the Primary Language Evaluation Component, the LOW Subgroup showed its greatest deficit in Symbol Facility. This finding suggested not only an inability or lack of readiness on the part of these subjects (as a group) to handle symbols and symbolic concepts, but the subjects from the LOW Subgroup also were unable to follow instructions as well as subjects from the HIGH Subgroup.

2. The LOW Subgroup was found to have a much larger Verbal-Performance Differential in their test scores, while the HIGH Subgroup tended to perform equally well on both verbal and performance tasks. Further, the LOW Subgroup performed measurably better on performance tasks than those requiring verbal comprehension or production.

3. The LOW Subgroup gave evidence of measurably more articulation errors than the HIGH Subgroup. Of particular interest was the marked difference between the two groups in the number of articulation distortions present in the speech patterns. Because the relation between articulation and symbol

facility was found to be negligible, and because the motor development of the two groups was quite similar, the distortion errors which were evident were considered to be related primarily to dialectic differences. Although these speech distortions cannot be considered articulation errors in a clinical sense, on a practical level it would appear that if children from minority groups are expected to communicate in a middle class society which is accustomed to General American Speech patterns, distorted speech patterns may constitute unnecessary communication deficits.

B. Conclusions Pertaining to Figure-Ground Discrimination and Closure

The three preceding conclusions were expected findings and, perhaps, are representative of an integral part of the sample selection criteria. What was not expected, however, and what clearly is the focal point of this study, resulted from a comparison of the two groups on the experimental Figure-Ground Discrimination and Closure tasks.

1. When the two subgroups were compared, they showed essentially no difference in their abilities to perform on the Figure-Ground Discrimination tasks as designed for the Experimental Battery; both groups were able to tolerate almost identical degrees of interference to signal. On the Closure tasks, however, the two groups differed markedly, with the LOW Subgroup performing measurably below the performance level of the HIGH Subgroup on their ability to tolerate degrees of signal loss. This finding suggests that when all the information necessary to make a judgment was available, as was the case in the Figure-Ground Discrimination tasks, both groups were able to perform similarly regardless of past experience, training, or other educational advantages. When all information necessary to make a judgment was not available, as was the case of Closure tasks, the LOW Subgroup performed markedly below the performance level of the HIGH Subgroup.

2. Of singular importance, was the finding that subjects from the LOW Subgroup performed significantly poorer on Closure tasks with a vertical orientation than on Closure tasks with a horizontal orientation. Perhaps it is because horizontal scanning develops earlier than vertical scanning

that this difference occurred, or this finding might reflect some environmental influence such as the need for horizontal scanning for survival in a ghetto, or possibly there is some ethnic difference operating which is responsible for this finding. In any event, the difference was found and some possible implications for education are considered later in this discussion.

In brief, when the two subgroups were compared, the LOW Subgroup, as expected, performed measurably below the level of the HIGH Subgroup in terms of speech and language skills. However, although the two subgroups performed equally well on the figure-ground discrimination tasks, the LOW Subgroup performed measurably below the performance level of the HIGH Subgroup on the Closure tasks, particularly in terms of vertical orientation. The implications of these conclusions for the education of children with low language proficiency and suggestions for subsequent study are considered in the discussion which follows:

C. Implications for Subsequent Study

Numerous prospects for subsequent study can be generated from this project, many of which were presented in the preceding chapter. The discussion which follows, therefore, will be concerned only with those implications which appear to have major educational overtones.

1. Refinement of the Experimental Battery: As a laboratory test, the Experimental Battery revealed six different dimensions of perception and each dimension was defined by a component which could serve subsequently as an independent measure for a specific perceptual skill and independent measures such as these could provide educators with a means of evaluating the perceptual readiness of children on both a quantitative and a qualitative basis. Thus, quantitatively, the Experimental Battery can yield a "threshold" of performance, by which the educator would be able to: (1) identify those children who perform below expectation levels, and (2) determine the extent to which each child's perceptual performance serves as an advantage or disadvantage to his language acquisition. Qualitatively, the Experimental Battery could be used to show patterns of strengths and weaknesses by which the

educator could plan a more functional course of remedial training to meet the needs of each individual child.

If these goals are to be realized in actual practice, however, it will be necessary to determine how the effectiveness of the six measures of perception (presently in a rudimentary form) can be increased. Two of the measures (Figure-Ground and Visual Closure I) were derived from remarkably clear patterns having a substantial number of variables in their leading clusters; two more (Visual Closure II and Figure-Ground Homogeneous) were defined by a few variables; the final two (Visual Closure Homogeneous I and II) were formed primarily on the basis of one perceptual task. Currently, the structure and reliability of these six measures vary considerably, but it would seem both logical and possible to augment these measures with a number of additional items designed to measure the same dimension, in order to insure reliability of the component. This procedure might entail a process of critical selection of additional stimulus pictures. New pictures could be added to the Battery until the number of high loading variables in the weaker components became more comparable to that of the more substantial ones. Concomitantly, those pictures which were found to be unrelated to the six major components but carried, instead, individual idiosyncracies could be discarded, making possible the suggested additions without substantially increasing the length of the Experimental Battery.

2. Establishment of Perceptual Norms: It was found, in the present study, that the sample could tolerate a signal interference level (figure-ground discrimination) of approximately 66 per cent, or a signal loss (closure) of about 58 per cent and still obtain the necessary information from the visual field for satisfactory response. If the Experimental Battery were modified, these performance levels would need to be redetermined. Further, implications relating to differences in cultural and racial backgrounds and, as the present study suggests, for different age levels within each of these subgroups should be considered, in order to provide information necessary to determine the perceptual assets and liabilities of different subgroups. Evaluation with various subgroups, therefore, remains a primary task. Perhaps the concept of a "perceptual

visio-gram," which could reflect a pattern of strengths and weaknesses relative to group and age norms, could be established for the six perceptual measures which would be useful for educational assessment and planning procedures.

3. Investigation of Perceptual Stress: When the homogeneous condition was introduced into the figure-ground and closure tasks on the Experimental Battery, separate homogeneous perceptual components for the figure-ground discrimination and closure integration performances were revealed. The fact that these two qualitatively different dimensions of perception emerged, raises the question as to whether the perceptual task was changed by the introduction of stress (in this case the homogeneous condition) and which, in some obtuse manner, brought new perceptual support systems into action. An investigation of the support systems which may be involved in these processes and the means by which they facilitate visual closure and figure-ground discrimination would increase our understanding of the extent to which perceptual responses depend on ancillary variables. The results of such a study might show that other sources of stress, commonly experienced in the environment, should be included in an evaluation of a child's perceptual functioning, for example:

   a. Variation of Structure in Visual Interference: The Experimental Battery employed a uniformly structured grid for the stimulus ground. Although the interference (visual noise) from the environment may be prestructured (e.g. the lines of print in a book), interference can be relatively random (e.g. the traces of chalk on a blackboard). The question here is: Does the introduction of structure into the visual ground facilitate perceptual organization or does it compete with the intended signal by combining with the structure of the figure? This question could be explored by the addition of an optional subtest to the Experimental Battery, in which the structure of the ground is systematically varied. An investigation of this issue could ascertain whether or not different items would be needed in the Experimental Battery if unstructured visual interference (noise) were used as background rather than the structured kind used in the current study. Findings from such an investigation would have implications for the organization of classroom presentation of materials, specifically for the format design of reading materials.

b. Variation of Meaning in Visual Interference: Masking grids employed as visual interference in the Experimental Battery were classified as nonmeaningful and structured. The use of meaningful stimuli as "visual noise" instead of the nonmeaningful grids might increase the stress factor in the perceptual process, possibly by distracting the attention of the child, and thereby reducing the available energy necessary for efficiently organizing the figure. Because much of the "visual noise" in the environment is, in a strict sense, meaningful, this facet of perception could result in some educationally applicable findings. Further, if an appropriate series of measures resulted from such a study, these findings could be included as an optional subtest in the present Experimental Battery. The findings would relate particularly to the reading processes and the exploration would be relevant to a series of important questions, e.g. whether or not certain types of illustrations in children's books facilitate or hinder the reading processes.

4. Investigation of Perception and Time: In the pilot study which was carried out as part of the current project (see Appendix C) the exposure time of the visual stimuli was varied (one-tenth, one-fifth, and one second) and the time variable was found to have no effect on subject performance. For this reason, perceptual speed was considered to be a negligible factor and in subsequent presentations was held constant. Subject responses indicated, however, that other temporal dimensions should be studied, e.g. some subjects were not able to match the figure and response pictures until a condition of complete closure or total absence of the ground was reached, and sometimes not even then. The question here might be: Were these subjects able to retain the structure of the image long enough to perform the matching task? Interaction of time, retention of image and performance could be simply and effectively explored by systematically varying the response time of presentation of stimuli. The analysis of responses could point up differences in performance due to interruption at various levels of

performance completion: e.g. at the coding, storage, retaining, or retrieval levels. Such findings would have particular relevance to classroom activities such as: spelling, reading, writing, copying, or following visually presented instructions.

5. <u>Investigation of Cognitive Interaction</u>: The <u>Experimental Battery</u> was designed for this study to minimize the contribution of cognition to performance, however, a single perceptual component (Visual Closure II) from the <u>Experimental Battery</u> was found to be highly related to Symbol Facility. This finding suggests a question relating to how important this dimension is in typical life conditions, e.g. in the regular classroom. This issue could be investigated in the laboratory setting, by varying the level of abstraction of the stimulus and response figures in the perceptual matching task. One possible way to approach this question would be to design the figures to progress from concrete stimuli to progressively higher levels of abstraction, e.g. simple colored forms; colorless complex nonsense figures; two and three dimensional pictures and ultimately verbal symbols. On the basis of the findings in the present study, it would be predicted that language would become increasingly important in performance on visual closure as the stimuli becomes more abstract. The importance of testing this hypothesis is implicit in the relation between visual closure and reading ability, and as found in the current study, whether or not visual closure is a crucial factor underlying the reading problems of children from minority groups with special language differences.

6. <u>Investigation of the Verbal-Performance Differential</u>: One of the major differences reported between the subgroups on the <u>Standard Battery</u> was the size of the scores between the Columbia Mental Maturity Scale (CMMS) and the Peabody Picture Vocabulary Test (PPVT). The LOW Subgroup produced a higher incidence of large verbal-performance discrepancies than the HIGH Subgroup. This was due partially to the fact that the verbal-performance differential was inversely related to vocabulary development, as measured by the PPVT, and these scores were generally lower for the LOW Subgroup. Qualitatively, it was noted that the patterns of the orthogonal Verbal-Performance Differential Components for the two subgroups differed considerably. For the HIGH Subgroup, a trend was

evident for the verbal-performance differential score to be associated with perceptual performance; for the LOW Subgroup, the differential was linked with the evaluations of a language disability. Two questions seem pertinent to the verbal-performance differential: Are the diagnostic implications of the differential the same for subgroups of children from different language backgrounds? Does the significance of the size of the differential change with the degree of language facility of the child? It may be, for example, that the smaller differential in the HIGH Subgroup is indicative of a trend of immaturity which is also reflected by the perceptual problems as measured by the components of Figure-Ground and Visual Closure Homogeneous I. For the LOW Subgroup, the large differential may result from the overriding effects of limited learning experiences and language deprivation. This suggests a need to reexamine these variables and to explore more conclusively the role of language and perception in relation to the verbal-performance differential.

7. Investigation of Three Measures of Articulation: The delineation of three components of articulation in the Standard Battery provides a set of unique measures by which the correlates of speech development can be explored. The hypothesis that articulation errors represented by these three measures may have different etiologies has implications for further study involving the three measures of articulation:

   a. Substitutions: From the present study, articulation errors of substitution appeared to be associated with correlated of general maturation and development, and particularly with the perceptual measure of Visual Closure I; the question is whether or not there is an underlying relation between these abilities. If present, this relation could be a factor associated with the clinical observation that children with speech problems often have concomitant difficulty with reading. Exploration in this regard may help to clarify some of the interrelations between various educational problems associated with immaturity.

   b. Omissions: A trend also was evident for some children who had a more than average number of consonant omission errors to have difficulty, also, with figure-ground homogeneous perceptual tasks. This association should be explored to determine whether or not a common basis for these two areas of weakness can be found. Could it be that both areas represent problems of figure-ground discrimination, which becomes evident under conditions of stress?

c. Distortions: Distortion errors are often related to correlates of poor motor control and poor figure-ground discrimination. Similar trends were evident in the data from the present study. The diagnostic significance of distortion errors, however, must separate these causal factors from dialectal inconsistencies. The need for in-depth studies of dialectic differences to articulation measures, especially those of distortion, presents a challenging area for study. It would be possible, for example, to use the three articulation measures described in the current study to explore dialectal differences at the phonemic, morphologic and syntactic levels of language. The results from such studies might be related, also, to a subsequent study of reading disabilities.

8. Investigation of the Perceptual Dimensions: Indication from the Experimental Battery that the perceptual tasks are a composite of at least six separate skills invites consideration. Of particular interest is the dichotomy of these skills between the Figure-Ground Discrimination and Closure responses. A question concerning the basis for such a dichotomy has particular relevance to education, for example: Is the difference between these two processes due to the fact that figure-ground tasks provide all of the visual cues necessary to identify the figure, so that the observer is required only to screen out a certain degree of signals; while the closure processes have cues missing, which must be abstracted by the observer? If this is the case, what are the components of the perceptual closure processes, and what is needed in order to select, process and abstract missing cues?

With regard to the components of screening, an investigation of the interaction between the ground and the figure may provide some basis for predicting learning problems, such as reading disabilities. The possibility should be explored, for example, that the direction of the ground relative to the contour of the figure may affect figure-ground differentiation. This problem is concerned with the means by which children extract a figure, such as a letter or a word, from the background and what factors are involved in facilitating this decoding process.

With regard to the ability of abstracting from stimuli with missing cues, a study of part-whole perception might provide further understanding of how children achieve closure. Studies concerned with this aspect of perception might seek answers to questions, such as: Do young children match figures on the basis of a single outstanding angle or line, or do they retain the general dimensions of the entire figure? Other questions might relate to the developmental aspects of these processes and for school-aged children, the role those aspects assume in the development of reading skills.

Although the figure-ground and closure dichotomy was expected, another dichotomy which became apparent in the analysis was not anticipated, and one which was based upon the independent dimensions of maturation and learning. Strongly evident on the maturational side were the components of Figure-Ground and Visual Closure I (horizontal orientation), while equally apparent on the learning side was Visual Closure II (vertical orientation). This dichotomy presents several interesting possibilities for further study.

a. Perception and Maturation: Both Figure-Ground Discrimination and Visual Closure I (horizontal) dimensions were associated more than the other perceptual tasks with growth and physical maturation.

   Figure-Ground Discrimination was the second highest variable to load on the Gross Motor Development Component for the Total Sample; also related to this component were the judgments of organicity. These relations suggest the need to determine whether or not children with problems with both gross motor development and figure-ground discrimination have case histories which contain evidence to support neural pathology. If this were found to be the case, the figure-ground measure might be helpful in separating subtle organic problems resulting in language learning problems different from poor language proficiency due to immaturity or slow motor development.

Similarly, Visual Closure I (horizontal) was associated with Chronological Age, which reflected growth trends for the Total Sample along the lines of fine motor control, visual motor coordination, spatial awareness and Visual Closure I. In view of the nonlinguistic nature of the Visual Closure I composite variable, it would be interesting to know if spatial awareness and motor performance play a significant role in the development of this horizontal closure. The innate and reflexive nature of the horizontal closure process was indicated further on the Attention to Task Component, and a trend was evident in which some children who appeared to attend consistently to the task, also tended to perform less proficiently than those who appeared to attend only fleetingly to the task. This finding may contain an important cue to a basic aspect of reading readiness, particularly as it pertains to the Look-See method of learning to read. Could it be, for instance, that a low score on the Visual Closure I measure indicates that a child may not be able to shift attention from one stimulus to another in sequence, which is required in reading? Further, does attention to the figure in isolation instead of sequentially (in the case of reading word by word) actually slow down the reading process, as suggested by problems in horizontal closure?

b. Perception and Learning: Visual Closure II (vertical orientation) reflected one of the largest differences between the LOW and HIGH Language Proficiency Subgroups and the question here is: How does the skill represented by this measure relate to the development of reading? Could it be that the vertical closure component is basic to the recognition of letters frequently confused or substituted in reading, such as: p, q, b, d. Do children from minority groups, as was the case with the subjects in the LOW Subgroup of the present study, tend to have particular difficulty with vertical closure because of ethnic differences in visual scanning; more experience with the horizontal scanning, or for other reasons related to minority group differences? Finally, is it possible that the vertical closure process can be improved by preschool language training programs? An interesting adjunct to this final question is the possibility of using the Experimental Battery, or some adaptation of it, not as an assessment tool, but as a teaching aid to improve the overall perceptual processes of preschool and elementary grade children, particularly vertical closure.

9. Investigation of Selected Developmental Patterns: Of particular importance were the differences between the two subgroups on the two Language Evaluation and the Chronological Age Components. These differences suggest qualitative as well as quantitative differences in the readiness of the subjects from the two groups in mastering academic basics such as learning to read and to write. Such differences need to be given careful consideration in differential educational planning; and the extent to which these differences occur in the general population should be investigated. If different language and perceptual patterns were to be found to exist consistently in minority groups, additional study should be initiated to determine if these differences influence the opportunities for these children to benefit from successful learning experiences in current elementary grade curricula.

10. Investigation of New Methods of Analysis: From this apparent need for more comprehensive evaluation and comparison of minority group patterns, there arises a need for new approaches and new methods of data analysis. Measures of invariance of components and methods of contrasting the scores of groups on components are relatively new multivariate procedures. These developments, perhaps, have given component analysis a new flexibility and purpose. In the present study, for example, patterns of variables were examined and both quantitative and qualitative differences were revealed. The use of component analysis to detect these differences offers considerable promise for future research. For example, rather than observing a single variable out of context in the laboratory, patterns of behaviors with interactions intact can be examined and compared under field conditions. Hence, more complex questions can now be explored, for example:

a. What patterns of language behavior and language development characterize particular ethnic, socio-economic or geographically related minority groups?

b. How stable are these patterns for identifying minority groups over dimensions of time and in various conditions for learning?

c. How useful are these patterns in predicting the achievement and/or adjustment of children from minority groups to general school curricula?

d. How useful are these patterns in plotting the formation of complex skills from basic to developmental behaviors?

Although the foregoing discussion of implications for subsequent study by no means exhausts the possibilities for further investigation, it is intended to present a basic core of ideas from which research in many related areas may be generated. In any event, the preceding discussion is intended to point up a conclusion reached by the staff of this project: that visual input, although studied for many years by professional workers from many disciplines, still represents a vast area of unsolved questions pertinent to the relations between language proficiency and the perceptual processes.

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APPENDIX A

TABLES

STAGE I ANALYSIS

STAGE II ANALYSIS

STAGE I

STANDARD BATTERY

Maturation: TABLES 1-9

(PPVT, CMMS, CA)

N (RANGE) 260 - 343

TABLE 1. Means and standard deviations of maturity variables for total sample.

Variable	N	Mean (in months)	Standard Deviation
CA	343	52.28	6.111
MA (CMMS)	342	57.01	12.044
MA (PPVT)	340	49.38	18.291

TABLE 2. Ordered loadings of maturity variables on Component I of principal components for total sample.

Variable	Ordered Loadings
MA (PPVT)	0.908
MA (CMMS)	0.900
CA	0.611

TABLE 3. Ordered loadings of maturity variables on Component II of principal components for total sample.

Variable	Ordered Loadings
CA	0.792
MA (CMMS)	-0.284
MA (PPVT)	-0.251

TABLE 4. Ordered loadings of maturity variables on varimax rotation of Component I for total sample.

Variable	Ordered Loadings
MA (CMMS)	0.931
MA (PPVT)	0.923
CA	0.184

TABLE 5. Ordered loadings of maturity variables on varimax rotation of Component II for total sample.

Variable	Ordered Loadings
CA	0.983
MA (PPVT)	0.190
MA (CMMS)	0.157

TABLE 6. Means and standard deviations of differential between CMMS and PPVT scores for total sample on whom all data were available (cf. stage 2 analysis) (N = 260).

Variable	Mean (in months)	Standard Deviation
CA	52.52	6.316
MA (CMMS)	59.03	12.542
MA (PPVT)	52.54	18.965
CMMS and PPVT Differential Raw Scores	6.49	12.296

TABLE 7. Ordered loadings of maturity variables plus differential scores on varimax rotation of Component I (Verbal-Performance Differential) for total sample.

Variable	Ordered Loadings
PPVT and CMMS Differential *Z* Scores	0.983
PPVT and CMMS Differential Raw Scores	0.937
MA (PPVT)	-0.483
MA (CMMS)	0.170
CA	-0.068

TABLE 8. Ordered loadings for maturity variables plus differential scores on varimax rotation of Component II (Symbol Facility) for total sample.

Variable	Ordered Loadings
MA (CMMS)	0.969
MA (PPVT)	0.856
PPVT and CMMS Differential Raw Scores	-0.326
CA	0.199
PPVT and CMMS Differential Z Scores	0.170

TABLE 9. Ordered loadings of maturity variables plus differential scores on varimax rotation of Component III (Chronological Age) for total sample.

Variable	Ordered Loadings
CA	0.978
MA (PPVT)	0.184
MA (CMMS)	0.176
PPVT and CMMS Differential Raw Scores	-0.106
PPVT and CMMS Differential Z Scores	-0.011

STAGE I

STANDARD BATTERY

Articulation: TABLES 10-13

(12 VARIABLES)

N (RANGE) 294

TABLE 10. Means and standard deviations of articulation variables for total sample (N = 294).

Variable*	Mean (Number of Errors)	Standard Deviation
Substitutions (IP)	2.03	2.082
Distortions (IP)	0.49	0.961
Omissions (IP)	0.05	0.243
Substitutions (MP)	1.95	1.978
Distortions (MP)	0.93	1.260
Omissions (MP)	0.33	0.967
Substitutions (FP)	2.79	2.372
Distortions (FP)	0.65	1.019
Omissions (FP)	1.34	2.166
Substitutions (BL)	1.15	2.194
Distortions (BL)	0.42	1.241
Omissions (BL)	0.[illegible]8	1.547

*(IP) = initial position; (MP) = medial position; (FP) = final position; (BL) = Blends.

TABLE 11. Ordered loadings of articulation variables on varimax rotation of Component I (Articulation Distortions) for total sample.

Variable*	Ordered Loadings
Distortions (MP)	0.852
Distortions (IP)	0.701
Distortions (FP)	0.694
Omissions (FP)	0.558
Distortions (BL)	0.557
Substitutions (IP)	0.339
Omissions (MP)	0.236
Substitutions (FP)	0.236
Substitutions (MP)	0.230
Omissions (BL)	0.224
Substitutions (BL)	0.131
Omissions (IP)	-0.066

*(IP) = initial position; (MP) = medial position; (FP) = final position; (BL) = blends.

TABLE 12. Ordered loadings of articulation variables on varimax rotation of Component II (Articulation Substitutions) for total sample.

Variable*	Ordered Loadings
Substitutions (MP)	0.806
Substitutions (IP)	0.752
Substitutions (BL)	0.741
Substitutions (FP)	0.739
Distortions (IP)	0.262
Omissions (MP)	0.220
Distortions (MP)	0.178
Distortions (FP)	0.176
Omissions (BL)	0.174
Omissions (FP)	0.162
Distortions (BL)	0.151
Omissions (IP)	-0.067

*(IP) = initial position; (MP) = medial position; (FP) = final position; (BL) = blends.

TABLE 13. Ordered loadings of articulation variables on varimax rotation of Component III (Articulation Omissions) for total sample.

Variable*	Ordered Loadings
Omissions (IP)	0.787
Omissions (BL)	0.712
Omissions (MP)	0.603
Substitutions (IP)	0.313
Omissions (FP)	0.306
Substitutions (MP)	0.257
Distortions (FP)	0.170
Distortions (IP)	0.108
Distortions (MP)	0.102
Substitutions (BL)	-0.054
Substitutions (FP)	0.048
Distortions (BL)	-0.034

*(IP) = initial position; (MP) = medial position; (FP) = final position; (BL) = blends.

STAGE I

STANDARD BATTERY

Visual Motor Behavior: TABLES 14-16

(GDDT)

N (RANGE) 342

TABLE 14. Means and standard deviations on geometric design reproductions for total sample (N = 342).

Variable	Mean (Scores)	Standard Deviation
Circle	2.46	0.993
Cross	2.09	1.292
Square	1.10	1.323
Triangle	0.62	1.085
Diamond	0.21	0.655

TABLE 15. Ordered loadings of geometric design reproductions on varimax rotation of Component I (Spatial Awareness) for total sample.

Variable	Ordered Loadings
Diamond	0.805
Triangle	0.805
Square	0.700
Cross	0.230
Circle	0.063

TABLE 16. Ordered loadings of geometric design reproductions on varimax rotation of Component II (Visual-Motor Coordination) for total sample.

Variable	Ordered Loadings
Circle	0.851
Cross	0.820
Square	0.421
Triangle	0.240
Diamond	-0.041

STAGE I

STANDARD BATTERY

Motor Behavior: TABLES 17-23

(14 VARIABLES)

N (RANGE) 333 - 341

TABLE 17. Means and standard deviations of motor behavior ratings for total sample.

Variable	N	Mean (Ratings)	Standard Deviation
Rated 1 (normal) to 2 (abnormal)			
Sitting Posture	337	1.01	0.108
Pencil Control	341	1.23	0.427
Tremors	341	1.02	0.132
Overflow	334	1.04	0.200
Tics	334	1.01	0.094
Extraneous Tapping	334	1.02	0.133
Gait	341	1.04	0.198
Stance	340	1.02	0.142
Balance	339	1.05	0.218
Rated 1 (consistent) to 3 (inconsistent			
Foot Preference	340	1.42	0.969
Hand Preference	335	1.53	1.086
Eye Preference	333	2.20	1.424
Rated 1(R) 2(L) 3(A) 4(B)*			
Visual-motor hand preference	339	1.26	0.569
Rated 0 (none) to 5 (frequent)			
Visual-motor perseveration	341	0.21	0.572

*R = right; L = left; A = alternate; B = both.

TABLE 18. Ordered loadings of motor behavior variables on varimax rotation of Component I (Motor Dominance) for total sample.

Variable	Ordered Loadings
Hand Preference	0.800
Visual-Motor Hand Preference	0.779
Foot Preference	0.752
Pencil Control	0.363
Tics	0.187
Eye Preference	0.163
Tremors	-0.123
Visual-motor Perseveration	0.062
Stance	0.056
Gait	-0.042
Sitting Posture	0.038
Extraneous Tapping	-0.023
Balance	0.014
Overflow	-0.044

TABLE 19. Ordered loadings of motor behavior variables on varimax rotation of Component II (Gross Motor Development) for total sample.

Variable	Ordered Loadings
Gait	0.846
Stance	0.772
Balance	0.730
Pencil Control	0.248
Visual-motor Perseveration	0.112
Tics	0.098
Eye Preference	0.064
Overflow	-0.048
Extraneous Tapping	0.027
Hand Preference	-0.024
Foot Preference	0.022
Sitting Posture	0.020
Visual-motor Hand Preference	0.006
Tremors	0.034

TABLE 20. Ordered loadings of motor behavior variables on varimax rotation of Component III (Signs of Involuntary Motor Behavior) for total sample.

Variable	Ordered Loadings
Visual-motor Perseveration	0.718
Tremors	0.668
Overflow	0.599
Pencil Control	0.200
Eye Preference	0.188
Extraneous Tapping	-0.110
Sitting Posture	-0.084
Balance	0.074
Tics	0.064
Gait	0.060
Foot Preference	-0.056
Visual-motor Hand Preference	-0.035
Stance	-0.032
Hand Preference	-0.024

TABLE 21. Ordered loadings of motor behavior variables on varimax rotation of Component IV (Extraneous Tapping) for total sample.

Variable	Ordered Loadings
Extraneous Tapping	0.755
Eye Preference	0.524
Balance	0.331
Pencil Control	-0.268
Foot Preference	0.214
Visual-motor Hand Preference	-0.136
Tics	-0.123
Stance	-0.122
Hand Preference	0.113
Overflow	0.094
Sitting Posture	-0.062
Visual-motor Perseveration	0.019
Gait	-0.012
Tremors	-C.078

TABLE 22. Ordered loadings of motor behavior variables on varimax rotation of Component V (Presence of Tics) for total sample.

Variable	Ordered Loadings
Tics	0.784
Pencil Control	-0.489
Stance	0.300
Foot Preference	0.227
Visual-motor Hand Preference	-0.220
Hand Preference	0.131
Extraneous Tapping	-0.129
Balance	-0.121
Gait	-0.091
Eye Preference	0.089
Visual-motor Perseveration	-0.074
Tremors	0.056
Sitting Posture	-0.052
Overflow	-0.001

TABLE 23. Ordered loadings of motor behavior variables on varimax rotation of Component VI (Good Posture) for total sample.

Variable	Ordered Loadings
Sitting Posture	0.881
Overflow	0.459
Visual-motor Perseveration	-0.160
Pencil Control	-0.139
Extraneous Tapping	-0.130
Tics	-0.105
Eye Preference	0.090
Foot Preference	0.081
Visual-motor Hand Preference	-0.046
Gait	0.036
Hand Preference	0.026
Balance	-0.026
Stance	-0.019
Tremors	-0.016

STAGE I

STANDARD BATTERY

Test Behavior: TABLES: 24-28

(11 VARIABLES)

N (RANGE) 337 - 342

TABLE 24. Means and standard deviations of ratings or test behaviors recorded by examiners during testing for total sample.

Variable	N	Mean	Standard Deviation
Rated 0 to 1*			
Reluctant to participate	342	0.09	0.291
Participates only when encouraged	342	0.06	0.235
Unconcerned but does not volunteer to participate	342	0.74	0.439
Volunteers to participate	342	0.92	0.274
Rated 0 to 3*			
Distractible	342	0.45	0.950
Hyperactive	341	0.14	0.583
Perseverative	341	0.58	0.965
Short attention span	342	0.58	1.113
Attention fluctuates	342	[illegible].01	1.296
Conforms to test requirements	337	2.87	0.554
Eager to participate	338	2.31	1.234

*Zero represents absence of variable.

TABLE 25. Ordered loadings of test attitude behavior variables on varimax rotation of Component I (Willing to Participate) for total sample.

Variable	Ordered Loadings
Volunteers to participate	0.848
Reluctant to participate	-0.838
Unconcerned but does not volunteer to participate	0.705
Eager to participate	0.590
Perseverative	0.210
Short attention span	0.156
Attention fluctuates	-0.148
Hyperactive	-0.084
Participates only when encouraged	-0.037
Distractible	0.029
Conforms to test requirements	-0.016

TABLE 26. Ordered loadings of test attitude behavior variables on varimax rotation of Component II (Attention) for total sample.

Variable	Ordered Loadings
Distractible	0.828
Short attention span	0.755
Attention fluctuates	0.712
Hyperactive	0.694
Perseverative	0.239
Reluctant to participate	0.055
Volunteers to participate	-0.055
Conforms to test requirements	-0.052
Eager to participate	-0.037
Unconcerned but does not volunteer to participate	0.019
Participates Only When Encouraged	-0.002

TABLE 27. Ordered loadings of test attitude behavior variables on varimax rotation of Component III (Follows Instructions) for total sample.

Variable	Ordered Loadings
Conforms to test requirements	0.787
Perseverative	-0.664
Eager to participate	0.420
Short attention span	-0.304
Attention fluctuates	-0.246
Unconcerned but does not volunteer to participate	-0.159
Hyperactive	0.146
Reluctant to participate	-0.136
Volunteers to participate	0.125
Distractible	-0.082
Participates Only When Encouraged	-0.064

TABLE 28. Ordered loadings of test attitude behavior variables on varimax rotation of Component IV (Participates Only When Encouraged) for total sample.

Variable	Ordered Loadings
Participates only when encouraged	0.920
Attention fluctuates	-0.252
Conforms to test requirements	-0.226
Perseverative	-0.211
Unconcerned but does not volunteer to participate	-0.172
Hyperactive	0.164
Short attention span	-0.107
Reluctant to participate	-0.105
Distractible	0.053
Volunteers to participate	0.045
Eager to participate	0.019

STAGE I

Experimental Battery: TABLES 29-35

(30 VARIABLES)

N (RANGE) 292 - 295

TABLE 29. Means and standard deviations of the experimental battery variables for total sample.

Variable*	N	Mean (Scores)	Standard Deviation
Heterogeneous			
FG Chicken	295	4.82	1.907
FG Football	295	5.84	1.943
FG Wagon	295	5.59	1.596
FG Basket	295	5.49	1.920
FG Bottle	295	6.14	1.841
FG Book	295	6.02	1.943
FG Boat	295	5.37	2.337
FG Duck	295	5.79	1.771
FG Cup	295	6.14	1.959
FG Hat	295	6.51	1.835
VC Bunny	293	3.78	1.533
VC Dog	293	4.26	1.544
VC Airplane	293	4.68	1.829
VC Table	293	4.50	1.954
VC Horse	293	5.26	1.780
VC Baby	293	5.18	1.895
VC Engine	293	4.95	2.060
VC Soldier	293	3.75	2.002
VC Man	293	5.08	1.848
VC Boat	293	4.17	2.164
Homogeneous			
FG Ice Cream	292	6.70	1.578
FG Bowl	292	6.34	2.127
FG Fish	292	5.71	1.768
FG Saw	292	5.96	2.170
FG Mitten	292	3.35	2.359
VC Truck	292	4.26	1.836
VC Bed	292	3.74	2.144
VC Cat	292	3.73	2.024
VC Boy	292	2.78	1.774
VC Cow	292	1.85	2.016

*Maximum score on Figure-Ground items is eight; maximum score on Visual Closure is seven. FG = Figure Ground; VC = Visual Closure.

TABLE 30. Ordered loadings of experimental battery variables on varimax rotation of Component I (Figure-Ground) for total sample.

Variable*	Ordered Loadings
FG Bottle	0.712
FG Wagon	0.684
FG Book	0.669
FG Cup	0.612
FG Chicken	0.582
FG Duck	0.577
FG Boat	0.556
FG Basket	0.477
FG Hat	0.464
FG Football	0.409
VC Horse	0.264
FG (HO) Fish	0.242
FG (HO) Bowl	0.208
VC Table	0.192
VC Engine	0.174
FG (HO) Ice Cream	0.173
VC (HO) Boy	0.172
VC Airplane	0.169
VC Boat	0.166
VC Man	0.155
FG (HO) Mitten	0.147
VC Baby	0.137
VC Bunny	0.136
VC Soldier	0.111
VC (HO) Cat	0.101
VC (HO) Bed	0.097
VC Dog	0.097
VC (HO) Cow	0.086
VC (HO) Truck	0.063
FG (HO) Saw	-0.002

*FG = Figure-Ground; VC = Visual Closure; (HO) = Homogeneous

TABLE 31. Ordered loadings of experimental battery variables on varimax rotation of Component II (Visual Closure II) for total sample.

Variable*	Ordered Loadings
VC Soldier	0.702
VC Man	0.668
VC Boat	0.631
FG Football	0.514
VC CAT	0.510
FG Basket	0.442
VC(HO) Bed	0.394
VC(HO) Saw	0.366
VC Table	0.327
FG Boat	0.319
VC Bunny	0.316
VC Engine	0.300
VC Baby	0.272
FG Bottle	0.266
FG Hat	0.262
FG(HO) Mitten	0.249
VC(HO) Truck	0.246
VC Horse	0.218
FG Chicken	0.197
VC Airplane	0.196
FG(HO) Fish	0.190
FG Duck	0.184
VC Cow	0.135
FG(HO) Bowl	0.125
VC(HO) Boy	0.093
FG Cup	-0.090
FG(HO) Ice Cream	-0.074
VC Dog	0.045
FG Book	-0.014
FG Wagon	0.008

*FG = Figure Ground; VC = Visual Closure; (HO) = Homogeneous

TABLE 32. Ordered loadings of experimental battery variables on varimax rotation of Component III (Visual Closure I) for total sample.

Variable*	Ordered Loadings
VC Airplane	0.711
VC Dog	0.672
VC Horse	0.591
VC Engine	0.585
VC Bunny	0.473
VC Baby	0.468
VC Table	0.405
VC Boat	0.372
FG Cup	0.369
FG Book	0.337
FG Duck	0.321
FG(HO) Bowl	0.289
FG Boat	0.284
FG(HO) Ice Cream	0.260
FG Hat	0.250
VC(HO) Truck	0.212
FG Bottle	0.192
FG(HO) Fish	0.191
VC Man	0.171
FG(HO) Mitten	0.157
FG Basket	0.107
FG Chicken	-0.080
VC(HO) Bed	0.065
VC(HO) Cow	0.063
VC Soldier	0.057
VC(HO) Boy	0.051
FG(HO) Saw	0.040
VC(HO) Cat	0.030
FG Wagon	0.017
FG Football	0.005

*FG = Figure-Ground; VC = Visual Closure; (HO) = Homogeneous

TABLE 33. Ordered loadings of experimental battery variables on varimax rotation of Component IV (Figure-Ground Homogeneous) for total sample.

Variable*	Ordered Loadings
FG(HO) Saw	0.685
FG(HO) Ice Cream	0.655
FG(HO) Bowl	0.639
FG(HO) Fish	0.608
VC(HO) Bed	0.503
FG Hat	0.434
VC(HO) Truck	0.367
VC Baby	0.310
VC(HO) Cat	0.283
FG Cup	0.262
VC Man	0.255
VC Horse	0.245
VC Bunny	0.231
FG Duck	0.204
FG(HO) Mitten	0.186
VC(HO) Boy	0.182
VC Dog	0.178
VC Airplane	0.177
VC Boat	0.158
FG Boat	0.147
VC(HO) Cow	0.142
VC Engine	0.130
FG Book	0.107
FG Wagon	0.086
FG Football	0.084
VC Soldier	0.082
FG Bottle	0.072
FG Basket	0.070
FG Chicken	0.042
VC Table	0.010

*FG = Figure-Ground; VC = Visual Closure; (HO) = Homogeneous

TABLE 34. Ordered loadings of experimental battery variables on varimax rotation of Component V (Visual Closure Homogeneous II) for total sample.

Variable*	Ordered Loadings
VC(HO) Boy	0.781
FG(HO) Mitten	0.473
VC(HO) Bed	-0.324
VC Baby	0.291
FG Football	0.286
FG(HO) Bowl	0.280
VC Table	0.275
FG Basket	0.250
VC(HO) Cat	0.181
VC Horse	0.178
FG(HO) Fish	0.157
FG Bottle	0.135
VC Engine	0.134
VC(HO) Truck	0.130
FG Boat	0.129
VC Man	0.128
FG(HO) Ice Cream	0.110
VC Dog	-0.107
FG Wagon	0.092
FG Hat	0.086
FG Duck	0.083
VC Boat	0.074
VC Bunny	0.067
FG(HO) Saw	0.061
FG Book	0.058
FG Chicken	0.049
VC(HO) Cow	0.047
VC Airplane	0.047
FG Cup	-0.032
VC Soldier	-0.026

*FG = Figure-Ground; VC = Visual Closure; (HO) = Homogeneous

TABLE 35. Ordered loadings of experimental battery variables on varimax rotation of Component VI (Visual Closure Homogeneous I) for total sample.

Variable*	Ordered Loadings
VC(HO) Cow	0.715
VC Bunny	0.382
VC Table	0.341
FG Wagon	0.252
VC Dog	0.224
VC Soldier	0.217
FG Football	0.215
FG(HO) Fish	0.177
VC Horse	0.167
VC(HO) Cat	0.160
FG(HO) Saw	0.154
FG Boat	-0.146
FG(HO) Mitten	0.126
FG Book	0.123
FG Duck	-0.123
FG Bottle	0.114
FG Basket	-0.108
VC Engine	-0.100
VC Baby	-0.090
FG(HO) Ice Cream	0.070
FG(HO) Bowl	-0.068
VC Airplane	-0.056
VC(HO) Truck	0.055
VC Man	-0.054
VC(HO) Bed	0.022
FG Cup	0.021
VC(HO) Boy	0.020
FG Chicken	0.019
VC Boat	-0.009
FG Hat	-0.005

*FG = Figure Ground; VC = Visual Closure; (HO) = Homogeneous

STAGE I

Clinical Judgments: TABLES 36-39

(2 VARIABLES)

N (RANGE) 260 - 295

TABLE 36. Means and standard deviations of clinical judgments (signs of organicity) for total sample where all data were available (N = 260).

Variable	Mean*	Standard Deviation
Judgment 1	0.14	0.353
Judgment 2	0.26	0.440
Judgment 3	0.15	0.357

*Judgments were assigned a value of 0-1; zero indicated that in the judgment of the examiner, signs of organicity were not evident.

TABLE 37. Means and standard deviations of clinical judgments (language proficiency ratings) for total sample (N = 295).

Variable	Mean*	Standard Deviation
Judgment 1	2.80	0.761
Judgment 2	2.60	1.096
Judgment 3	2.60	0.877

*Judgments were assigned a 1-5 value; 1 = poor language proficiency, 2 = below average language proficiency, 3 = average language proficiency, 4 = above average language proficiency, 5 = superior language proficiency.

TABLE 38. Ordered loadings of language proficiency judgments on Component I (Language Proficiency) for total sample.

Variable	Ordered Loadings
Judgment 3	0.925
Judgment 2	0.919
Judgment 1	0.869

TABLE 39. Ordered loadings of signs of organicity judgments on Component I (Signs of Organicity) for total sample.

Variable	Ordered Loadings
Judgment 2	0.786
Judgment 1	0.758
Judgment 3	0.750

STAGE II

<u>Component Analysis: TABLES 40-51</u>

TOTAL SAMPLE

(N = 260)

TABLE 40. Ordered loadings of composite variables on Component I (General Clinical Judgment) for total sample.

Composite Variable	Ordered Loadings
Language Proficiency Judgments	0.856
Symbol Facility	0.759
Signs of Oragnicity	-0.624
Visual Closure II	0.537
Spatial Awareness	0.536
Follows Instructions	0.490
Visual Motor Coordination	0.423
Verbal-Performance Differential	-0.423
Articulation Distortions	-0.417
Articulation Substitutions	-0.388
Visual Closure Homogeneous II	0.357
Figure-Ground	0.329
Willing to Participate	0.300
Signs of Involuntary Motor Behavior	-0.277
Figure-Ground Homogeneous	0.271
Participates Only When Encouraged	-0.237
Attention	0.217
Visual Closure Homogeneous I	0.216
Chronological Age	0.197
Gross Motor Development	0.193
Fine Motor Control	0.189
Motor Dominance	0.187
Visual Closure I	0.167
Presence of Tics	0.115
Articulation Omissions	0.114
Good Posture	-0.026

TABLE 41. Ordered loadings of composite variables on varimax rotation of Component I (Primary Language Evaluation) for total sample.

Composite Variable	Ordered Loadings
Symbol Facility	0.813
Language Proficiency Judgments	0.785
Follows Instructions	0.704
Visual Closure II	0.655
Signs of Organicity Judgments	-0.421
Signs of Involuntary Motor Behavior	-0.389
Articulation Distortions	-0.360
Spatial Awareness	0.271
Visual Closure Homogeneous II	0.248
Visual Motor Coordination	0.247
Figure-Ground Homogeneous	0.227
Articulation Substitutions	-0.166
Chronological Age	-0.164
Visual Closure Homogeneous I	0.156
Willing to Participate	0.125
Verbal-Performance Differential	-0.116
Presence of Tics	0.080
Attention	0.070
Gross Motor Development	0.058
Motor Dominance	0.058
Fine Motor Control	-0.056
Articulation Omissions	-0.037
Participates Only When Encouraged	-0.022
Good Posture	-0.011
Visual Closure I	-0.006
Figure-Ground	-0.004

TABLE 42. Ordered loadings of composite variables on varimax rotation of Component II (Chronological Age) for total sample.

Composite Variable	Ordered Loadings
Chronological Age	0.755
Visual Motor Coordination	0.655
Fine Motor Control	0.548
Visual Closure I	0.421
Visual Closure Homogeneous I	0.381
Figure-Ground	0.280
Visual Closure II	-0.203
Follows Instructions	0.185
Articulation Distortions	-0.175
Signs of Organicity Judgments	-0.167
Visual Closure Homogeneous II	0.160
Figure-Ground Homogeneous	0.136
Articulation Substitutions	-0.134
Good Posture	-0.115
Spatial Awareness	0.107
Attention	0.101
Willing to Participate	0.085
Language Proficiency Judgments	-0.078
Articulation Omissions	-0.069
Signs of Involuntary Motor Behavior	-0.052
Motor Dominance	-0.052
Verbal-Performance Differential	0.031
Participates Only When Encouraged	-0.019
Symbol Facility	-0.018
Gross Motor Development	-0.011
Presence of Tics	0.000

TABLE 43. Ordered loadings of composite variables on varimax rotation of Component III (Secondary Language Evaluation) for total sample.

Composite Variable	Ordered Loadings
Verbal-Performance Differential	0.770
Willing to Participate	-0.472
Language Proficiency Judgments	-0.391
Visual Closure Homogeneous I	-0.346
Visual Closure I	0.308
Figure-Ground	-0.289
Articulation Distortions	0.258
Fine Motor Control	-0.228
Articulation Substitutions	0.216
Visual Closure Homogeneous II	-0.201
Spatial Awareness	-0.192
Signs of Organicity Judgments	0.173
Signs of Involuntary Motor Behavior	-0.160
Visual Closure II	-0.127
Chronological Age	0.104
Articulation Omissions	0.081
Gross Motor Development	0.076
Attention	0.061
Symbol Facility	0.034
Motor Dominance	-0.031
Visual Motor Coordination	0.029
Good Posture	-0.025
Participates Only When Encouraged	0.018
Figure-Ground Homogeneous	0.017
Presence of Tics	0.004
Follows Instructions	0.001

TABLE 44. Ordered loadings of composite variables on varimax rotation of Component IV (Gross Motor Development) for total sample.

Composite Variables	Ordered Loadings
Gross Motor Development	0.774
Figure-Ground	0.556
Signs of Organicity Judgments	-0.456
Visual Motor Coordination	0.364
Visual Closure Homogeneous II	-0.278
Attention	0.201
Visual Closure Homogeneous I	-0.181
Language Proficiency Judgments	0.130
Chronological Age	0.111
Fine Motor Control	-0.111
Follows Instructions	-0.107
Articulation Distortions	-0.089
Symbol Facility	-0.086
Visual Closure II	0.080
Verbal-Performance Differential	-0.073
Spatial Awareness	-0.061
Figure-Ground Homogeneous	-0.058
Motor Dominance	0.051
Articulation Substitutions	-0.041
Participates Only When Encouraged	-0.038
Willing to Participate	-0.026
Signs of Involuntary Motor Behavior	-0.021
Visual Closure I	0.018
Articulation Omissions	-0.016
Good Posture	0.011
Presence of Tics	-0.004

TABLE 45. Ordered loadings of composite variables on varimax rotation of Component V (Test Adaptation) for total sample.

Composite Variable	Ordered Loadings
Participates Only When Encouraged	0.714
Spatial Awareness	-0.520
Visual Closure Homogeneous II	-0.484
Signs of Involuntary Motor Behavior	0.329
Chronological Age	-0.327
Figure-Ground	-0.246
Visual Closure Homogeneous I	0.231
Symbol Facility	-0.180
Verbal-Performance Differential	0.141
Motor Dominance	-0.134
Gross Motor Development	0.116
Language Proficiency Judgments	-0.108
Visual Closure I	-0.097
Good Posture	0.094
Articulation Distortions	0.092
Willing to Participate	0.066
Follows Instructions	0.064
Attention	-0.061
Articulation Omissions	-0.058
Fine Motor Control	0.051
Visual Motor Coordination	0.051
Presence of Tics	0.036
Visual Closure II	-0.027
Figure-Ground Homogeneous	0.016
Articulation Substitutions	-0.014
Signs of Organicity Judgments	0.000

TABLE 46. Ordered loadings of composite variables on varimax rotation of Component VI (Test Attitude) for total sample.

Composite Variable	Ordered Loadings
Good Posture	0.738
Willing to Participate	-0.482
Articulation Distortions	-0.427
Signs of Involuntary Motor Behavior	0.221
Signs of Organicity Judgments	-0.219
Visual Motor Coordination	-0.213
Spatial Awareness	0.164
Figure-Ground Homogeneous	0.162
Articulation Omissions	0.133
Motor Dominance	-0.126
Visual Closure I	0.117
Fine Motor Control	-0.110
Attention	0.101
Presence of Tics	0.091
Visual Closure II	-0.081
Participates Only When Encouraged	0.075
Articulation Substitutions	0.072
Verbal-Performance Differential	-0.061
Language Proficiency Judgments	0.054
Visual Closure Homogenoeus I	0.042
Chronological Age	0.028
Visual Closure Homogeneous II	-0.016
Follows Instructions	-0.012
Symbol Facility	0.010
Gross Motor Development	0.008
Figure-Ground	0.001

TABLE 47. Ordered loadings of composite variables on varimax rotation of Component VII (Articulation Substitutions) for total sample.

Composite Variables	Ordered Loadings
Articulation Substitutions	0.663
Visual Closure I	-0.487
Spatial Awareness	-0.394
Visual Closure II	-0.252
Follows Instructions	0.248
Visual Closure Homogeneous II	0.232
Chronological Age	-0.194
Signs of Organicity Judgments	0.188
Language Proficiency Judgments	-0.171
Symbol Facility	-0.171
Articulation Distortions	-0.162
Figure-Ground	0.153
Verbal-Performance Differential	0.138
Fine Motor Control	-0.126
Willing to Participate	-0.096
Presence of Tics	-0.096
Gross Motor Development	-0.070
Visual Closure Homogeneous I	0.057
Good Posture	-0.041
Visual Motor Coordination	0.035
Attention	-0.030
Motor Dominance	0.028
Figure-Ground Homogeneous	0.021
Signs of Involuntary Motor Behavior	-0.017
Articulation Omissions	-0.015
Participates Only When Encouraged	0.005

TABLE 48. Ordered loadings of composite variables on varimax rotation of Component VIII (Articulation Omissions) for total sample.

Composite Variables	Ordered Loadings
Articulation Omissions	0.795
Figure-Ground Homogeneous	-0.429
Visual Closure Homogeneous I	0.424
Symbol Facility	-0.180
Signs of Involuntary Motor Behavior	-0.162
Visual Closure Homogeneous II	-0.152
Fine Motor Control	-0.151
Willing to Participate	-0.145
Language Proficiency Judgments	-0.132
Visual Closure II	0.098
Follows Instructions	0.096
Presence of Tics	-0.094
Articulation Distortions	0.092
Good Posture	0.084
Figure-Ground	-0.082
Motor Dominance	0.080
Visual Motor Coordination	0.077
Attention	0.074
Participates Only When Encouraged	-0.063
Visual Closure I	-0.054
Chronological Age	-0.051
Spatial Awareness	-0.048
Articulation Substitutions	-0.025
Gross Motor Development	-0.011
Signs of Organicity Judgments	-0.007
Verbal-Performance Differential	-0.004

TABLE 49. Ordered loadings of composite variables on varimax rotation of Component IX (Attention to Task) for total sample.

Composite Variable	Ordered Loadings
Attention	0.798
Articulation Distortions	0.345
Visual Closure I	-0.268
Fine Motor Control	0.257
Signs of Organicity Judgments	-0.218
Visual Closure II	-0.193
Gross Motor Development	0.181
Visual Closure Homogeneous II	0.179
Signs of Involuntary Motor Behavior	0.138
Language Proficiency Judgments	0.131
Symbol Facility	0.126
Visual Motor Coordination	0.120
Good Posture	0.117
Spatial Awareness	0.116
Figure-Ground	-0.113
Articulation Omissions	0.096
Articulation Substitutions	-0.093
Chronological Age	-0.087
Verbal-Performance Differential	0.086
Figure-Ground Homogeneous	0.081
Motor Dominance	0.045
Willing to Participate	0.042
Visual Closure Homogeneous I	-0.040
Participates Only When Encouraged	0.020
Follows Instructions	0.010
Presence of Tics	0.008

TABLE 50. Ordered loadings of composite variables on varimax rotation of Component X (Presence of Tics) for total sample.

Composite Variable	Ordered Loadings
Presence of Tics	0.854
Figure-Ground Homogeneous	-0.470
Visual Closure Homogeneous II	0.230
Visual Closure I	0.181
Follows Instructions	0.179
Visual Closure II	-0.165
Signs of Organicity Judgments	-0.127
Spatial Awareness	-0.119
Articulation Substitutions	-0.106
Articulation Distortions	0.096
Signs of Involuntary Motor Behavior	-0.090
Articulation Omissions	-0.069
Good Posture	0.054
Chronological Age	-0.052
Willing to Participate	-0.049
Participates Only When Encouraged	0.048
Figure-Ground	0.046
Fine Motor Control	-0.045
Visual Closure Homogeneous I	-0.043
Motor Dominance	0.042
Gross Motor Development	-0.040
Visual Motor Coordination	0.033
Verbal-Performance Differential	-0.030
Symbol Facility	-0.020
Attention	-0.016
Language Proficiency Judgments	0.007

TABLE 51. Ordered loadings of composite variables on varimax rotation of Component XI (Motor Dominance) for total sample.

Composite Variable	Ordered Loadings
Motor Dominance	0.821
Figure-Ground Homogeneous	0.332
Visual Closure I	0.287
Signs of Involuntary Motor Behavior	0.279
Visual Closure Homogeneous I	0.218
Fine Motor Control	-0.177
Participates Only When Encouraged	-0.136
Signs of Organicity Judgments	-0.134
Willing to Participate	0.123
Language Proficiency Judgments	0.102
Symbol Facility	0.102
Presence of Tics	0.082
Articulation Substitutions	0.082
Attention	0.076
Articulation Distortions	-0.070
Good Posture	-0.064
Articulation Omissions	0.062
Follows Instructions	-0.031
Visual Motor Coordination	0.019
Visual Closure II	-0.015
Verbal-Performance Differential	0.013
Figure-Ground	0.013
Visual Closure Homogeneous II	-0.012
Gross Motor Development	0.009
Spatial Awareness	-0.006
Chronological Age	0.001

STAGE II

Component Analysis: TABLES 52-63

EXPECTED LOW LANGUAGE PROFICIENCY SUBGROUP

(N = 116)

TABLE 52. Means and standard deviations of composite variable factor scores for the expected low language proficiency sample (N = 116).

Composite Variable	Mean	Standard Deviation
Articulation Distortions	53.36	10.866
Articulation Substitutions	52.08	8.865
Articulation Omissions	50.69	8.906
Figure-Ground	49.73	11.753
Visual Closure I	52.54	11.451
Visual Closure II	42.86	7.904
Figure-Ground Homogeneous	47.01	11.043
Visual Closure Homogeneous II	47.95	10.842
Visual Closure Homogeneous I	49.25	10.746
Motor Dominance	48.94	11.273
Gross Motor Development	50.48	8.379
Signs of Involuntary Motor Behavior	51.22	13.232
Presence of Tics	49.50	9.081
Fine Motor Control	51.12	9.737
Good Posture	49.50	13.142
Spatial Awareness	46.97	7.789
Visual Motor Coordination	50.76	9.247
Symbol Facility	42.87	5.688
Verbal-Performance Differential	53.92	8.011
Chronological Age	53.34	5.540
Willing to Participate	48.16	12.011
Attention	50.36	9.300
Follows Instructions	46.43	12.367
Participates Only When Encouraged	51.51	7.996
Signs of Organicity Judgments	52.31	11.269
Language Proficiency Judgments	42.42	7.181

TABLE 53. Ordered loadings of composite variables on varimax rotation of Component I (Gross Motor Development) for the expected low language proficiency sample.

Composite Variable	Ordered Loadings
Gross Motor Development	0.771
Visual Motor Coordination	0.732
Signs of Organicity Judgments	-0.491
Figure-Ground	0.445
Visual Closure Homogeneous II	-0.292
Articulation Substitutions	-0.291
Articulation Omissions	0.286
Willing to Participate	0.274
Chronological Age	0.249
Motor Dominance	0.231
Language Proficiency Judgments	0.144
Symbol Facility	0.135
Attention	0.124
Fine Motor Control	0.123
Spatial Awareness	-0.117
Figure-Ground Homogeneous	0.114
Good Posture	-0.101
Visual Closure II	0.097
Participates Only When Encouraged	-0.093
Presence of Tics	-0.082
Verbal-Performance Differential	0.070
Visual Closure Homogeneous I	-0.050
Articulation Distortions	-0.040
Signs of Involuntary Motor Behavior	0.020
Visual Closure I	0.017
Follows Instructions	-0.008

TABLE 54. Ordered loadings of composite variables on varimax rotation of Component II (Primary Language Evaluation) for expected low language proficiency sample.

Composite Variable	Ordered Loadings
Language Proficiency Judgments	0.771
Symbol Facility	0.725
Chronological Age	-0.566
Attention	0.318
Signs of Organicity Judgments	-0.297
Follows Instructions	0.291
Motor Dominance	0.248
Fine Motor Control	-0.200
Figure-Ground Homogeneous	0.189
Visual Closure II	0.182
Figure-Ground	0.155
Articulation Distortions	-0.149
Participates Only When Encouraged	-0.147
Presence of Tics	0.124
Good Posture	0.085
Visual Closure Homogeneous II	0.066
Signs of Involuntary Motor Behavior	0.059
Visual Closure I	0.054
Willing to Participate	0.051
Verbal-Performance Differential	-0.047
Gross Motor Development	0.044
Articulation Substitutions	0.026
Visual Motor Coordination	-0.024
Spatial Awareness	-0.013
Articulation Omissions	-0.005
Visual Closure Homogeneous I	0.003

TABLE 55. Ordered loadings of composite variables on varimax rotation of Component III (Test Adaptation) for expected low language proficiency sample.

Composite Variable	Ordered Loadings
Participates Only When Encouraged	0.721
Spatial Awareness	-0.613
Chronological Age	-0.449
Visual Closure Homogeneous II	-0.443
Articulation Omissions	-0.370
Attention	-0.222
Language Proficiency Judgments	-0.180
Signs of Involuntary Motor Behavior	0.178
Articulation Distortions	0.174
Symbol Facility	-0.169
Signs of Organicity Judgments	0.154
Visual Closure I	-0.138
Verbal-Performance Differential	0.137
Articulation Substitutions	0.125
Fine Motor Control	0.122
Gross Motor Development	0.098
Presence of Tics	-0.079
Follows Instructions	0.078
Good Posture	0.068
Visual Closure II	0.065
Visual Closure Homogeneous I	0.061
Motor Dominance	0.059
Figure-Ground Homogeneous	0.048
Figure-Ground	0.045
Willing to Participate	-0.044
Visual Motor Coordination	-0.023

TABLE 56. Ordered loadings of composite variables on varimax rotation of Component IV (Secondary Language Evaluation) for expected low language proficiency sample.

Composite Variable	Ordered Loadings
Verbal-Performance Differential	0.894
Willing to Participate	-0.516
Language Proficiency Judgments	-0.391
Symbol Facility	0.346
Attention	-0.293
Visual Motor Coordination	-0.211
Visual Closure II	-0.176
Gross Motor Development	0.165
Figure-Ground	-0.147
Visual Closure Homogeneous I	0.138
Articulation Omissions	0.136
Chronological Age	0.122
Visual Closure Homogeneous II	-0.120
Spatial Awareness	-0.116
Fine Motor Control	-0.111
Articulation Substitutions	0.100
Follows Instructions	0.095
Signs of Organicity Judgments	0.088
Signs of Involuntary Motor Behavior	0.070
Figure-Ground Homogeneous	-0.064
Visual Closure I	-0.060
Participates Only When Encouraged	0.056
Presence of Tics	0.052
Articulation Distortions	-0.049
Motor Dominance	-0.037
Good Posture	0.012

TABLE 57. Ordered loadings of composite variables on varimax rotation of Component V (Primary Language Evaluation "B") for the expected low language proficiency sample.

Composite Variable	Ordered Loadings
Follows Instructions	0.721
Signs of Involuntary Motor Behavior	-0.678
Visual Motor Coordination	0.361
Symbol Facility	0.256
Gross Motor Development	-0.253
Visual Closure Homogeneous II	0.198
Articulation Substitutions	-0.194
Visual Closure Homogeneous I	0.193
Visual Closure II	0.192
Chronological Age	0.191
Language Proficiency Judgments	0.186
Motor Dominance	-0.171
Fine Motor Control	0.167
Attention	-0.165
Spatial Awareness	0.093
Participates Only When Encouraged	0.089
Willing to Participate	0.074
Good Posture	-0.059
Articulation Distortions	0.059
Visual Closure I	0.050
Figure-Ground Homogeneous	0.045
Figure-Ground	0.032
Verbal-Performance Differential	0.029
Articulation Omissions	0.026
Presence of Tics	-0.009
Signs of Organicity Judgments	0.006

TABLE 58. Ordered loadings of composite variables on varimax rotation of Component VI (Articulation Distortions) for the expected low language proficiency sample.

Composite Variable	Ordered Loadings
Articulation Distortions	0.818
Fine Motor Control	-0.510
Signs of Organicity Judgments	0.426
Visual Closure Homogeneous I	-0.297
Attention	0.240
Chronological Age	-0.202
Articulation Substitutions	-0.194
Language Proficiency Judgments	-0.191
Articulation Omissions	0.187
Visual Motor Coordination	-0.180
Visual Closure Homogeneous II	-0.174
Motor Dominance	0.165
Symbol Facility	-0.153
Figure-Ground	-0.134
Willing to Participate	0.117
Good Posture	-0.082
Gross Motor Development	0.070
Visual Closure I	-0.066
Verbal-Performance Differential	0.057
Visual Closure II	0.048
Signs of Involuntary Motor Behavior	-0.048
Spatial Awareness	-0.047
Participates Only When Encouraged	0.040
Follows Instructions	-0.033
Presence of Tics	0.033
Figure-Ground Homogeneous	-0.008

TABLE 59. Ordered loadings of composite variables on varimax rotation of Component VII (Test Attitude) for the expected low language proficiency sample.

Composite Variable	Ordered Loadings
Good Posture	0.828
Articulation Substitutions	-0.554
Signs of Organicity Judgments	-0.329
Willing to Participate	-0.287
Attention	0.261
Spatial Awareness	0.221
Articulation Omissions	0.216
Participates Only When Encouraged	0.158
Visual Closure Homogeneous II	-0.142
Visual Motor Coordination	-0.135
Verbal-Performance Differential	-0.132
Visual Closure I	-0.118
Language Proficiency Judgments	0.110
Visual Closure II	-0.110
Motor Dominance	-0.100
Presence of Tics	0.099
Gross Motor Development	0.050
Visual Closure Homogeneous I	-0.049
Signs of Involuntary Motor Behavior	-0.042
Symbol Facility	0.026
Articulation Distortions	0.024
Fine Motor Control	0.014
Follows Instructions	0.004
Chronological Age	-0.001
Figure-Ground Homogeneous	0.001
Figure-Ground	-0.000

TABLE 60. Ordered loadings of composite variables on varimax rotation of Component VIII (Presence of Tics) for the expected low language proficiency sample.

Composite Variable	Ordered Loadings
Presence of Tics	0.805
Articulation Omissions	-0.499
Fine Motor Control	0.443
Articulation Substitutions	-0.242
Attention	0.227
Figure-Ground Homogeneous	-0.223
Symbol Facility	0.222
Visual Closure II	-0.184
Willing to Participate	0.184
Chronological Age	0.145
Visual Closure I	0.117
Gross Motor Development	-0.108
Figure-Ground	-0.094
Verbal-Performance Differential	0.073
Visual Closure Homogeneous II	0.069
Signs of Organicity Judgments	0.069
Language Proficiency Judgments	0.055
Motor Dominance	0.049
Participates Only When Encouraged	0.049
Visual Closure Homogeneous I	-0.040
Spatial Awareness	0.029
Good Posture	-0.027
Signs of Involuntary Motor Behavior	-0.023
Articulation Distortions	0.020
Visual Motor Coordination	0.015
Follows Instructions	-0.009

TABLE 61. Ordered loadings of composite variables on varimax rotation of Component IX (Figure-Ground Homogeneous) for the expected low language proficiency sample.

Composite Variable	Ordered Loadings
Figure-Ground Homogeneous	0.760
Visual Closure II	-0.669
Visual Closure Homogeneous II	0.290
Willing to Participate	0.289
Participates Only When Encouraged	0.241
Signs of Involuntary Motor Behavior	0.171
Visual Closure Homogeneous I	0.160
Verbal-Performance Differential	0.146
Spatial Awareness	0.146
Figure-Ground	0.122
Chronological Age	0.118
Fine Motor Control	-0.095
Articulation Omissions	-0.089
Attention	0.088
Symbol Facility	0.087
Follows Instructions	0.082
Articulation Distortions	-0.078
Good Posture	0.074
Motor Dominance	-0.057
Language Proficiency Judgments	0.057
Signs of Organicity Judgments	0.049
Presence of Tics	-0.044
Visual Motor Coordination	0.027
Articulation Substitutions	0.027
Visual Closure I	0.022
Gross Motor Development	-0.006

TABLE 62. Ordered loadings of composite variables on varimax rotation of Component X (Attention to Task) for the expected low language proficiency sample.

Composite Variable	Ordered Loadings
Visual Closure I	0.889
Attention	-0.431
Signs of Involuntary Motor Behavior	-0.255
Motor Dominance	0.255
Fine Motor Control	-0.246
Visual Closure II	0.233
Figure-Ground Homogeneous	0.174
Articulation Distortions	-0.172
Articulation Omissions	-0.158
Spatial Awareness	0.140
Follows Instructions	-0.137
Willing to Participate	0.114
Chronological Age	0.105
Articulation Substitutions	-0.090
Presence of Tics	0.074
Visual Closure Homogeneous II	-0.071
Language Proficiency Judgments	0.067
Symbol Facility	0.067
Figure-Ground	-0.051
Visual Motor Coordination	-0.040
Gross Motor Development	0.040
Visual Closure Homogeneous I	-0.039
Signs of Organicity Judgments	0.035
Good Posture	0.033
Participates Only When Encouraged	-0.014
Verbal-Performance Differential	0.011

TABLE 63. Ordered loadings of composite variables on varimax rotation of Component XI (Motor Dominance) for the expected low language proficiency sample.

Composite Variable	Ordered Loadings
Visual Closure Homogeneous I	0.667
Motor Dominance	0.515
Figure-Ground	-0.505
Articulation Omissions	0.326
Follows Instructions	0.206
Signs of Organicity Judgments	-0.170
Chronological Age	-0.152
Good Posture	-0.150
Signs of Involuntary Motor Behavior	0.143
Attention	0.130
Symbol Facility	-0.115
Visual Closure I	0.110
Articulation Substitutions	-0.108
Figure-Ground Homogeneous	0.097
Gross Motor Development	-0.085
Participates Only When Encouraged	0.080
Fine Motor Control	0.077
Visual Motor Coordination	0.076
Visual Closure II	0.075
Language Proficiency Judgments	0.060
Presence of Tics	0.058
Verbal-Performance Differential	-0.044
Spatial Awareness	0.036
Willing to Participate	-0.019
Visual Closure Homogeneous II	-0.018
Articulation Distortions	-0.001

STAGE II

Component Analysis: TABLES 64-74

EXPECTED HIGH LANGUAGE PROFICIENCY SUBGROUP

(N = 144)

TABLE 64. Means and standard deviations of composite variable factor scores for the expected high language proficiency sample (N = 144).

Composite Variable	Mean	Standard Deviation
Articulation Distortions	47.30	8.293
Articulation Substitutions	48.32	10.537
Articulation Omissions	49.44	10.775
Figure-Ground	50.01	8.692
Visual Closure I	47.83	8.156
Visual Closure II	55.79	7.240
Figure-Ground Homogeneous	51.99	8.610
Visual Closure Homogeneous II	51.43	8.978
Visual Closure Homogeneous I	50.28	9.304
Motor Dominance	50.72	8.805
Gross Motor Development	49.34	11.332
Signs of Involuntary Motor Behavior	49.03	6.184
Presence of Tics	50.33	10.742
Fine Motor Control	49.13	10.276
Good Posture	51.20	11.852
Spatial Awareness	52.44	10.883
Visual Motor Coordination	49.38	10.532
Symbol Facility	55.84	8.871
Verbal-Performance Differential	47.11	10.167
Chronological Age	47.33	11.824
Willing to Participate	51.49	7.713
Attention	49.71	10.525
Follows Instructions	52.88	6.237
Participates Only When Encouraged	48.78	11.210
Signs of Organicity Judgments	48.13	8.396
Language Proficiency Judgments	56.11	7.457

TABLE 65. Ordered loadings of composite variables on varimax rotation of Component I (Chronological Age) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Visual Closure I	0.764
Chronological Age	0.732
Articulation Substitutions	-0.519
Spatial Awareness	0.459
Symbol Facility	0.415
Fine Motor Control	0.358
Visual Motor Coordination	0.348
Figure-Ground	0.281
Signs of Involuntary Motor Behavior	0.261
Participates Only When Encouraged	-0.254
Visual Closure II	0.240
Signs of Organicity Judgments	-0.218
Figure-Ground Homogeneous	0.193
Language Proficiency Judgments	0.171
Attention	0.166
Good Posture	-0.147
Visual Closure Homogeneous I	0.105
Motor Dominance	0.086
Presence of Tics	0.085
Gross Motor Development	-0.078
Willing to Participate	-0.075
Articulation Distortions	-0.067
Articulation Omissions	0.059
Visual Closure Homogeneous II	-0.041
Verbal-Performance Differential	0.030
Follows Instructions	0.002

TABLE 66. Ordered loadings of composite variables on varimax rotation of Component II (Primary Language Evaluation) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Signs of Organicity Judgments	0.808
Gross Motor Development	-0.729
Language Proficiency Judgments	-0.634
Attention	-0.522
Symbol Facility	-0.440
Signs of Involuntary Motor Behavior	0.308
Spatial Awareness	-0.284
Participates Only When Encouraged	-0.273
Visual Motor Coordination	-0.201
Articulation Substitutions	0.159
Articulation Omissions	0.153
Follows Instructions	-0.141
Visual Closure I	-0.139
Figure-Ground	-0.131
Fine Motor Control	-0.102
Good Posture	-0.102
Presence of Tics	-0.095
Visual Closure II	-0.062
Chronological Age	0.060
Verbal-Performance Differential	0.054
Visual Closure Homogeneous I	-0.044
Articulation Distortions	0.042
Visual Closure Homogeneous II	-0.032
Figure-Ground Homogeneous	0.017
Willing to Participate	0.014
Motor Dominance	-0.001

TABLE 67. Ordered loadings of composite variables on variamx rotation of Component III (Primary Language Evaluation "B") for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Visual Motor Coordination	0.737
Follows Instructions	0.720
Symbol Facility	0.394
Visual Closure Homogeneous II	0.358
Language Proficiency Judgments	0.335
Chronological Age	0.324
Visual Closure II	0.265
Attention	0.203
Spatial Awareness	-0.194
Figure-Ground	0.191
Articulation Substitutions	0.166
Visual Closure I	0.161
Presence of Tics	0.151
Visual Closure Homogeneous I	0.128
Articulation Omissions	-0.107
Figure-Ground Homogeneous	-0.099
Signs of Involuntary Motor Behavior	-0.094
Good Posture	-0.093
Motor Dominance	-0.067
Participates Only When Encouraged	-0.061
Fine Motor Control	0.052
Gross Motor Development	0.052
Signs of Organicity Judgments	-0.040
Willing to Participate	-0.036
Articulation Distortions	0.007
Verbal-Performance Differential	-0.005

TABLE 68. Ordered loadings of composite variables on varimax rotation of Composite IV (Test Attitude) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Willing to Participate	0.828
Good Posture	-0.542
Fine Motor Control	0.484
Articulation Substitutions	-0.303
Visual Closure Homogeneous II	0.289
Articulation Omissions	-0.237
Language Proficiency Judgments	0.234
Participates Only When Encouraged	0.195
Figure-Ground Homogeneous	-0.166
Gross Motor Development	-0.157
Attention	-0.154
Presence of Tics	-0.146
Symbol Facility	0.144
Spatial Awareness	0.104
Visual Closure II	0.102
Verbal-Performance Differential	-0.102
Figure-Ground	0.098
Articulation Distortions	0.088
Signs of Involuntary Motor Behavior	-0.082
Follows Instructions	-0.082
Visual Motor Coordination	0.066
Signs of Organicity Judgments	-0.066
Visual Closure I	-0.058
Motor Dominance	0.039
Chronological Age	0.037
Visual Closure Homogeneous I	-0.008

TABLE 69. Ordered loadings of composite variables on varimax rotation of Component V (Secondary Language Evaluations) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Verbal-Performance Differential	0.759
Visual Closure Homogeneous I	-0.588
Figure-Ground	-0.510
Symbol Facility	0.334
Chronological Age	-0.274
Attention	0.188
Spatial Awareness	-0.188
Language Proficiency Judgments	-0.184
Articulation Substitutions	0.180
Fine Motor Control	-0.179
Visual Closure II	0.177
Good Posture	-0.146
Articulation Distortions	0.131
Willing to Participate	-0.125
Visual Motor Coordination	-0.108
Visual Closure I	0.097
Participates Only When Encouraged	0.095
Signs of Involuntary Motor Behavior	-0.090
Articulation Omissions	0.089
Gross Motor Development	-0.086
Follows Instructions	-0.080
Signs of Organicity Judgments	0.052
Visual Closure Homogeneous II	-0.046
Motor Dominance	0.020
Figure-Ground Homogeneous	0.015
Presence of Tics	0.005

TABLE 70. Ordered loadings of composite variables on varimax rotation of Component VI (Test Adaptation) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Signs of Involuntary Motor Behavior	0.669
Participates Only When Encouraged	0.533
Spatial Awareness	-0.505
Symbol Facility	-0.303
Good Posture	0.295
Visual Closure Homogeneous II	-0.280
Figure-Ground	-0.232
Fine Motor Control	0.187
Language Proficiency Judgments	-0.159
Visual Motor Coordination	0.141
Attention	0.140
Follows Instructions	-0.134
Chronological Age	-0.121
Verbal-Performance Differential	-0.108
Signs of Organicity Judgments	0.101
Visual Closure II	-0.089
Motor Dominance	-0.076
Presence of Tics	0.074
Visual Closure I	0.071
Articulation Distortions	-0.057
Articulation Omissions	0.044
Articulation Substitutions	-0.041
Visual Closure Homogeneous I	-0.037
Gross Motor Development	-0.032
Figure-Ground Homogeneous	-0.028
Willing to Participate	0.009

TABLE 71. Ordered loadings of composite variables on varimax rotation of Component VII (Articulation Omissions) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Figure-Ground Homogeneous	0.766
Articulation Omissions	-0.637
Visual Closure Homogeneous I	-0.414
Visual Closure II	-0.243
Good Posture	-0.243
Participates Only When Encouraged	-0.177
Fine Motor Control	0.159
Chronological Age	0.158
Verbal-Performance Differential	-0.155
Presence of Tics	-0.152
Gross Motor Development	0.145
Willing to Participate	-0.099
Spatial Awareness	-0.074
Visual Motor Coordination	0.063
Symbol Facility	-0.060
Articulation Distortions	-0.058
Articulation Substitutions	-0.051
Follows Instructions	-0.050
Figure-Ground	0.045
Motor Dominance	-0.032
Signs of Involuntary Motor Behavior	-0.019
Language Proficiency Judgments	-0.005
Attention	-0.005
Signs of Organicity Judgments	-0.004
Visual Closure Homogeneous II	0.004
Visual Closure I	0.003

TABLE 72. Ordered loadings of composite variables on varimax rotation of Component VIII (Motor Dominance) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Motor Dominance	0.754
Visual Closure Homogeneous II	0.441
Visual Closure II	-0.394
Attention	0.227
Articulation Substitutions	0.222
Figure-Ground	0.217
Participates Only When Encouraged	-0.206
Good Posture	0.178
Signs of Organicity Judgments	-0.171
Chronological Age	0.168
Articulation Distortions	-0.167
Gross Motor Development	-0.164
Willing to Participate	0.138
Fine Motor Control	0.119
Follows Instructions	-0.113
Visual Closure Homogeneous I	-0.088
Language Proficiency Judgments	-0.082
Symbol Facility	0.080
Signs of Involuntary Motor Behavior	-0.064
Spatial Awareness	0.059
Verbal-Performance Differential	0.054
Visual Motor Coordination	0.045
Articulation Omissions	0.042
Presence of Tics	0.037
Visual Closure I	0.023
Figure-Ground Homogeneous	0.015

TABLE 73. Ordered loadings of composite variables on varimax rotation of Component IX (Articulation Distortions) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Articulation Distortions	0.789
Visual Closure II	-0.540
Visual Closure Homogeneous I	0.278
Participates Only When Encouraged	-0.244
Verbal-Performance Differential	0.220
Articulation Substitutions	-0.204
Attention	0.204
Chronological Age	-0.190
Spatial Awareness	-0.144
Fine Motor Control	0.123
Good Posture	-0.121
Language Proficiency Judgments	-0.103
Motor Dominance	0.082
Visual Closure I	-0.082
Presence of Tics	0.067
Visual Closure Homogeneous II	-0.058
Willing to Participate	-0.051
Follows Instructions	-0.044
Signs of Organicity Judgments	0.039
Symbol Facility	-0.033
Gross Motor Development	-0.030
Articulation Omissions	-0.030
Visual Motor Coordination	0.013
Figure-Ground Homogeneous	-0.012
Signs of Involuntary Motor Behavior	0.009
Figure-Ground	0.005

TABLE 74. Ordered loadings of composite variables on varimax rotation of Component X (Presence of Tics) for the expected high language proficiency sample.

Composite Variable	Ordered Loadings
Presence of Tics	0.755
Attention	-0.373
Follows Instructions	0.300
Articulation Substitutions	-0.273
Visual Closure Homogeneous II	0.256
Visual Closure Homogeneous I	-0.248
Visual Closure II	-0.230
Signs of Organicity Judgments	-0.211
Figure-Ground Homogeneous	-0.195
Fine Motor Control	-0.186
Verbal-Performance Differential	-0.170
Visual Motor Coordination	-0.145
Willing to Participate	-0.143
Good Posture	-0.137
Chronological Age	-0.127
Visual Closure I	0.097
Language Proficiency Judgments	0.060
Figure-Ground	-0.052
Spatial Awareness	-0.051
Signs of Involuntary Motor Behavior	0.047
Motor Dominance	-0.043
Participates Only When Encouraged	0.034
Gross Motor Development	-0.025
Symbol Facility	-0.008
Articulation Omissions	0.005
Articulation Distortions	-0.005

STAGE II

Coefficient of Factor Invariance:

TABLES 75-78

TABLE 75. Product moment correlation matrix of factor scores on 26 composite variables for the total sample.

Variable Number	Variable	1	2	3	4	5	6	7	8	9	10	11
1	Articulation Distortions	1.000	0.001	0.001	-0.108	0.057	0.227	0.133	0.191	0.097	0.037	-0.012
2	Articulation Substitutions	0.001	1.000	0.001	0.118	-0.139	-0.111	-0.047	-0.075	-0.081	-0.004	0.076
3	Articulation Omissions	0.001	0.001	1.000	-0.075	0.041	-0.009	0.130	0.060	-0.072	-0.042	-0.014
4	Figure-Ground	-0.108	0.118	-0.075	1.000	-0.021	0.005	0.066	-0.032	-0.050	-0.071	0.159
5	Visual Closure I	0.057	-0.139	0.041	-0.021	1.000	-0.005	0.052	0.028	0.042	0.097	-0.024
6	Visual Closure II	0.227	-0.111	-0.009	0.005	-0.005	1.000	0.026	0.015	0.024	0.062	-0.019
7	Figure-Ground Homogeneous	0.133	-0.047	0.130	0.066	0.052	0.026	1.000	0.017	0.017	0.091	-0.044
8	Visual Closure Homogeneous II	0.191	-0.075	0.060	-0.032	0.028	0.015	0.017	1.000	0.009	0.043	0.130
9	Visual Closure Homogeneous I	0.097	-0.081	-0.072	-0.050	0.042	0.024	0.017	0.009	1.000	0.042	0.036
10	Motor Dominance	0.037	-0.004	-0.042	-0.071	0.097	0.062	0.091	0.043	0.042	1.000	-0.021
11	Gross Motor Development	-0.012	0.076	-0.014	0.159	-0.024	-0.019	-0.044	0.130	0.036	-0.021	1.000
12	Signs of Involuntary Motor Behavior	-0.058	0.067	-0.008	0.046	-0.101	-0.119	0.034	-0.140	0.009	-0.002	-0.010
13	Presence of Tics	0.006	0.079	-0.024	0.022	-0.134	0.021	0.142	-0.044	0.013	0.010	-0.010
14	Fine Motor Control	0.053	-0.141	0.119	-0.067	0.040	-0.073	0.017	0.037	0.064	0.006	0.018
15	Good Posture	0.075	0.023	-0.074	0.022	0.014	-0.013	-0.012	-0.087	-0.008	-0.029	-0.008
16	Spatial Awareness	-0.150	0.195	-0.019	0.142	-0.127	-0.229	-0.130	-0.210	-0.075	-0.068	0.028
17	Visual Motor Coordination	0.064	-0.113	0.011	-0.252	0.208	0.115	0.054	0.081	0.134	0.046	-0.224
18	Symbol Facility	-0.271	0.235	-0.102	0.130	-0.048	0.526	-0.211	-0.244	-0.028	-0.119	0.083
19	Verbal-Performance Differential	-0.172	0.183	-0.067	0.164	0.039	-0.266	-0.088	-0.159	-0.131	-0.050	-0.000
20	Chronological Age	-0.073	0.145	-0.057	0.293	-0.394	0.098	-0.063	-0.113	-0.074	0.000	0.029
21	Willing to Participate	-0.064	0.114	-0.123	0.093	0.014	-0.137	-0.068	-0.150	-0.123	-0.056	-0.025
22	Attention	0.087	0.032	0.079	0.073	-0.008	0.006	-0.061	-0.047	-0.017	-0.058	0.202
23	Follows Instructions	0.126	-0.096	0.002	-0.087	-0.067	0.287	0.132	0.201	0.193	0.063	0.00[illegible]
24	Participates when Encouraged	-0.042	0.023	-0.005	0.084	-0.056	-0.074	-0.071	-0.165	-0.028	-0.091	-0.031
25	Signs of Organicity Judgments	0.304	0.264	0.009	0.180	-0.140	-0.176	-0.090	-0.112	-0.128	-0.108	-0.371
26	Language Proficiency Judgments	-0.319	0.270	-0.123	0.182	0.009	0.546	-0.236	-0.250	-0.145	-0.129	0.105

2	13	14	15	16	17	18	19	20	21	22	23	24	25	26
58	0.006	0.053	0.075	-0.150	0.064	-0.271	-0.172	-0.073	-0.064	0.087	0.126	-0.042	0.304	-0.319
67	0.079	-0.141	0.023	0.195	-0.113	0.235	0.183	0.145	0.114	0.032	-0.096	0.023	0.264	0.270
08	-0.024	0.119	-0.074	-0.019	0.011	-0.102	-0.067	-0.057	-0.123	0.079	0.002	-0.005	0.009	-0.123
46	0.022	-0.067	0.022	0.142	-0.252	0.130	0.164	0.293	0.093	0.073	-0.087	0.084	0.180	0.182
01	-0.134	0.040	0.014	-0.127	0.208	-0.048	0.039	-0.394	0.014	-0.008	-0.067	-0.056	-0.140	0.009
19	0.021	-0.073	-0.013	-0.229	0.115	0.526	-0.266	0.098	-0.137	0.006	0.287	-0.074	-0.176	-0.546
34	0.142	0.017	-0.012	-0.130	0.054	-0.211	-0.088	-0.063	-0.068	-0.061	0.132	-0.071	-0.090	-0.236
40	-0.044	0.037	-0.087	-0.210	0.081	-0.244	-0.159	-0.113	-0.150	-0.047	0.201	-0.165	-0.112	-0.250
09	0.013	0.064	-0.008	-0.075	0.134	-0.028	-0.131	-0.074	-0.123	-0.017	0.193	-0.028	-0.128	-0.145
02	0.010	0.006	-0.029	-0.068	0.046	-0.119	-0.050	0.000	-0.056	-0.058	0.063	-0.091	-0.108	-0.129
10	-0.010	0.018	-0.008	0.028	-0.224	0.083	-0.000	0.029	-0.025	0.202	0.002	-0.031	-0.371	0.105
00	0.000	-0.009	0.042	0.142	-0.092	0.183	0.055	-0.003	0.064	-0.016	-0.238	0.127	0.088	0.183
00	1.000	0.005	-0.030	0.026	-0.032	0.091	0.041	-0.007	-0.030	0.022	-0.149	0.016	0.113	0.087
09	0.005	1.000	-0.088	-0.125	0.272	-0.045	-0.102	-0.278	-0.127	-0.078	0.023	-0.025	-0.123	-0.029
42	-0.030	-0.088	1.000	-0.007	-0.101	0.009	-0.032	0.103	0.171	-0.102	-0.005	0.076	-0.092	-0.032
42	0.026	-0.125	-0.007	1.000	0.001	0.358	0.213	0.269	0.094	0.103	-0.138	0.216	0.230	0.409
92	-0.032	0.272	-0.101	0.001	1.000	-0.189	-0.065	0.431	-0.158	-0.214	0.202	-0.067	-0.293	-0.203
183	0.091	-0.045	0.009	0.358	-0.189	1.000	0.013	0.001	0.141	0.148	0.390	0.166	-0.408	0.769
055	0.041	-0.102	-0.032	0.213	-0.065	0.013	1.000	-0.000	0.190	-0.004	-0.114	0.091	0.158	-0.465
003	-0.007	-0.278	0.103	0.2[illegible]	0.431	0.001	-0.000	1.000	-0.005	0.081	0.029	0.170	0.050	-0.165
064	-0.030	-0.127	0.171	0.094	-0.158	0.141	0.190	-0.005	1.000	0.001	0.001	0.001	0.102	0.240
016	0.022	-0.078	-0.102	0.103	-0.214	0.148	-0.004	0.081	0.001	1.000	0.001	0.001	0.238	0.174
238	-0.149	0.023	-0.005	-0.138	0.202	0.390	-0.114	0.029	0.001	0.001	1.000	0.002	-0.189	0.416
127	0.016	-0.025	0.076	0.216	-0.067	0.166	0.091	0.170	0.001	0.001	0.002	1.000	0.075	0.099
088	0.113	-0.123	-0.092	0.230	-0.293	-0.408	0.158	0.050	0.102	0.238	-0.189	0.075	1.000	-0.484
183	0.087	-0.029	-0.032	0.409	-0.203	0.769	-0.465	-0.165	0.240	0.174	0.416	0.099	-0.484	1.000

TABLE 76. Matrix of coefficients of invariance between rotated components for total sample and expected low language proficiency sample.

Total Sample Component Numbers	Expected Low Language Proficiency Sample Component Numbers I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Sum of Squared R's
I	0.075	<u>0.802</u>	0.092	0.033	<u>-0.665</u>	-0.209	-0.000	0.064	-0.130	-0.086	-0.050	1.175
II	<u>-0.429</u>	<u>0.473</u>	-0.163	-0.075	<u>0.337</u>	<u>0.403</u>	-0.037	0.284	<u>-0.303</u>	0.068	0.163	0.921
III	-0.023	0.108	-0.006	<u>0.729</u>	0.033	<u>-0.334</u>	-0.019	0.011	0.018	0.182	-0.026	0.921
IV	<u>0.696</u>	0.130	-0.055	0.030	0.184	-0.064	-0.094	0.037	-0.122	-0.024	<u>0.318</u>	0.670
V	-0.063	0.076	<u>0.801</u>	0.032	-0.058	0.007	0.153	0.034	-0.059	-0.095	0.270	0.766
VI	0.217	-0.102	-0.025	0.157	-0.256	<u>0.406</u>	<u>0.656</u>	-0.217	-0.086	0.054	-0.010	0.801
VII	0.179	-0.081	0.170	0.121	0.036	0.147	<u>-0.389</u>	-0.259	-0.153	<u>-0.426</u>	-0.088	0.536
VIII	-0.067	0.163	-0.159	0.116	0.141	-0.131	0.183	<u>-0.334</u>	<u>0.357</u>	-0.204	<u>0.478</u>	0.649
IX	0.188	0.158	0.157	0.032	0.084	0.243	-0.194	-0.247	0.192	<u>0.554</u>	-0.162	0.622
X	0.036	-0.037	-0.031	0.070	0.061	-0.090	0.100	<u>0.600</u>	0.192	0.027	0.036	0.429
XI	-0.157	-0.234	-0.078	0.023	<u>-0.332</u>	-0.066	-0.182	0.041	-0.216	<u>0.337</u>	<u>0.498</u>	0.645
Sum of Squared R's	0.823	1.026	0.766	0.599	0.803	0.596	0.730	0.736	0.406	0.702	0.716	7.903

TABLE 77. Matrix of coefficients of invariance between rotated components for expected high language proficiency sample and expected low language proficiency sample.

Expected High Language Proficiency Sample Component Numbers	Expected Low Language Proficiency Sample Component Numbers I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Sum of Squared R's
I	-0.200	0.091	-0.375	0.121	-0.021	0.079	0.245	0.179	0.016	0.361	0.107	0.444
II	0.436	0.470	-0.051	0.129	0.079	-0.092	-0.424	-0.081	0.052	0.061	-0.057	0.641
III	-0.122	-0.187	0.103	-0.026	0.565	0.121	-0.366	0.068	-0.013	-0.199	-0.001	0.573
IV	-0.040	0.024	0.124	-0.352	0.180	0.026	-0.385	0.292	-0.012	-0.025	0.005	0.408
V	0.102	-0.170	0.075	0.557	-0.037	-0.286	-0.155	0.125	0.109	0.128	-0.062	0.510
VI	-0.175	0.109	0.599	-0.120	-0.385	0.075	0.201	0.252	-0.136	-0.186	0.180	0.758
VII	-0.048	0.055	0.159	-0.069	-0.081	0.096	-0.206	0.068	-0.406	0.055	-0.341	0.382
VIII	-0.065	-0.129	-0.235	-0.031	-0.246	0.154	0.018	0.196	-0.298	-0.048	0.143	0.312
IX	-0.058	0.094	0.064	0.088	0.002	-0.442	0.061	0.230	-0.173	-0.379	0.140	0.470
X	0.219	-0.091	-0.104	0.111	0.037	-0.010	0.143	0.461	0.029	0.181	-0.035	0.349
Sum of Squared R's	0.346	0.342	0.628	0.506	0.576	0.347	0.654	0.516	0.318	0.407	0.208	4.847

TABLE 78. Matrix of coefficients of invariance between rotated components for total sample and expected high language proficiency sample.

Total Sample Component Numbers	Expected High Language Proficiency Sample Component Numbers I	II	III	IV	V	VI	VII	VIII	IX	X	Sum of Squared R's
I	0.021	0.438	-0.467	0.150	0.082	0.434	0.093	0.208	-0.459	-0.072	0.897
II	0.451	0.081	0.385	0.086	-0.294	0.172	0.129	0.192	0.136	0.159	0.579
III	0.134	0.138	0.074	-0.402	0.685	-0.037	0.067	-0.033	0.234	0.034	0.735
IV	0.024	-0.510	-0.008	-0.182	-0.148	0.067	0.125	-0.001	0.064	-0.108	0.352
V	-0.219	-0.142	-0.031	0.084	0.065	0.726	0.053	-0.305	0.121	0.056	0.720
VI	0.127	-0.210	-0.217	-0.609	-0.162	0.171	-0.061	0.132	-0.308	-0.073	0.656
VII	-0.592	0.212	0.430	-0.138	-0.061	-0.014	0.118	0.277	-0.012	0.133	0.715
VIII	-0.005	-0.054	-0.009	0.239	-0.140	0.103	0.712	-0.047	-0.145	0.165	0.648
IX	0.031	0.410	-0.043	0.027	-0.132	0.244	0.008	-0.273	0.468	0.202	0.583
X	0.006	0.053	-0.157	0.004	0.010	-0.118	0.235	-0.188	-0.165	0.736	0.702
XI	0.195	0.027	0.067	0.084	-0.028	-0.106	-0.005	0.514	0.037	0.007	0.328
Sum of Squared R's	0.676	0.764	0.636	0.686	0.655	0.875	0.629	0.645	0.667	0.680	6.915

STAGE II

Analysis of Factor Score Variance:

TABLES 79-81

TABLE 79. Differences between factor scores on experimental and standard components of expected low language proficiency sample (N = 116) and expected high language proficiency sample (N = 144).

Component	Expected Low Language Proficiency Sample Mean	Expected Low Language Proficiency Sample Standard Deviation	Expected High Language Proficiency Sample Mean	Expected High Language Proficiency Sample Standard Deviation	F Value
Primary Language Evaluation	42.61	8.212	55.96	6.827	204.83
Chronological Age	53.54	8.458	47.36	10.183	27.46
Secondary Language Evaluation	53.37	9.453	47.22	9.701	26.43
Gross Motor Development	50.61	11.039	49.50	9.013	.80
Test Adaptation	51.06	9.507	49.15	10.276	2.37
Test Attitude	49.38	11.092	50.48	8.982	.78
Articulation Substitutions	49.00	10.249	50.80	9.707	2.10
Articulation Omissions	51.06	9.870	49.19	10.006	2.27
Attention to Task	50.59	10.981	49.73	9.685	.45
Presence of Tics	51.39	9.446	48.81	10.3^4	4.34
Motor Dominance	49.46	11.905	50.44	8.111	.62

TABLE 80. Differences between factor scores on experimental and standard components of male (N = 52) and female (N = 64) subjects for expected low language proficiency sample.

Component	Male Sample Mean	Male Sample Standard Deviation	Female Sample Mean	Female Sample Standard Deviation	F Value
Primary Language Evaluation	41.92	8.867	43.17	7.590	.67
Chronological Age	52.18	9.897	54.65	6.873	2.50
Secondary Language Evaluation	53.24	10.507	53.48	8.494	.02
Gross Motor Development	48.42	14.658	52.39	6.257	3.84
Test Adaptation	52.39	9.884	49.98	9.040	1.87
Test Attitude	50.32	9.276	48.62	12.317	.68
Articulation Substitutions	49.15	10.558	48.89	9.984	.02
Articulation Omissions	50.38	9.826	51.61	9.866	.45
Attention to Task	50.53	11.697	50.64	10.359	.00
Presence of Tics	51.35	12.485	51.42	5.917	.00
Motor Dominance	48.91	13.372	49.90	10.538	.20

TABLE 81. Differences between factor scores on experimental and standard components of male (N = 71) and female (N = 73) subjects for expected high language proficiency sample.

Component	Male Sample		Female Sample		F Value
	Mean	Standard Deviation	Mean	Standard Deviation	
Primary Language Evaluation	54.72	6.961	57.16	6.457	4.72
Chronological Age	46.30	10.942	48.38	9.264	1.51
Secondary Language Evaluation	46.34	10.582	48.08	8.667	1.16
Gross Motor Development	48.33	9.295	50.65	8.567	2.41
Test Adaptation	48.70	11.237	49.60	9.217	.27
Test Attitude	51.69	11.548	49.30	5.146	2.57
Articulation Substitutions	50.79	9.954	50.81	9.453	.00
Articulation Omissions	51.14	12.722	47.30	5.718	5.45
Attention to Task	48.49	11.302	50.93	7.595	2.30
Presence of Tics	47.88	13.564	49.71	5.359	1.13
Motor Dominance	51.80	7.994	49.11	7.996	4.05

APPENDIX B

Experimental Battery Items

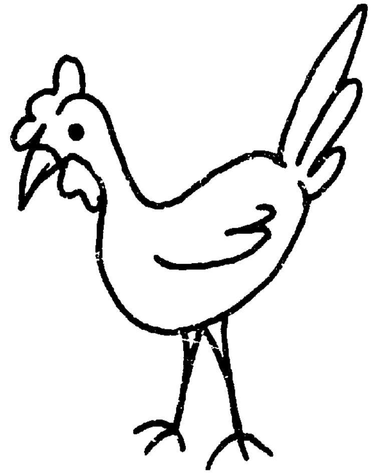
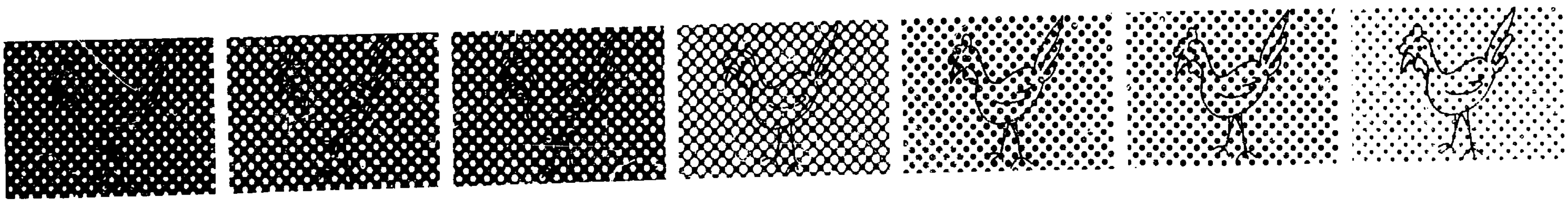
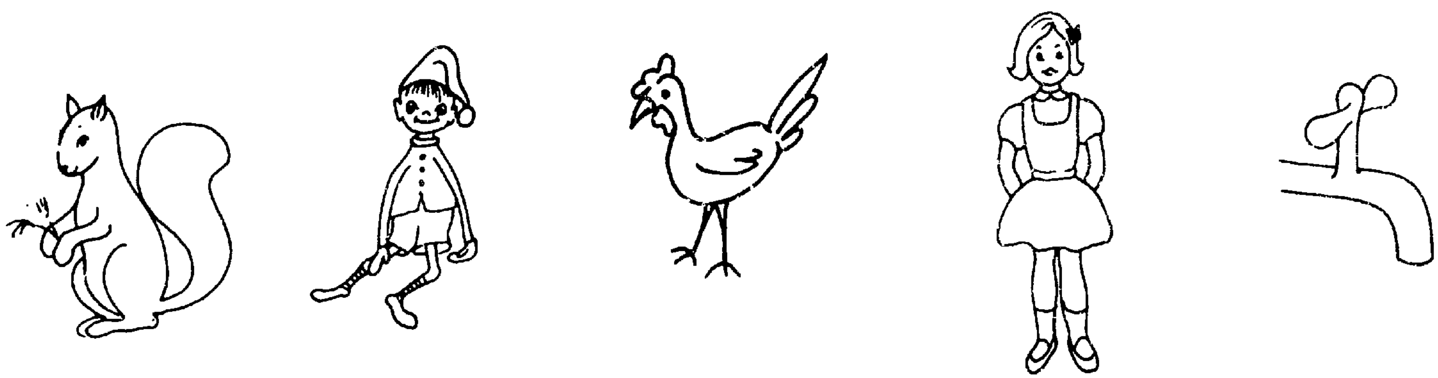


FIGURE-GROUND (CHICKEN)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

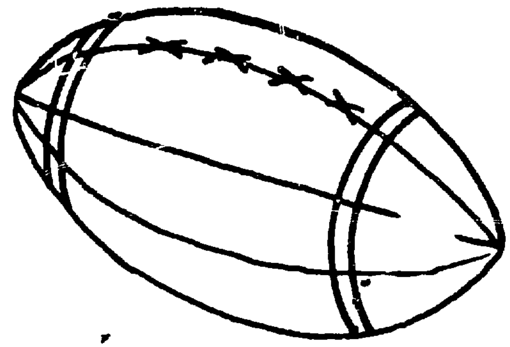
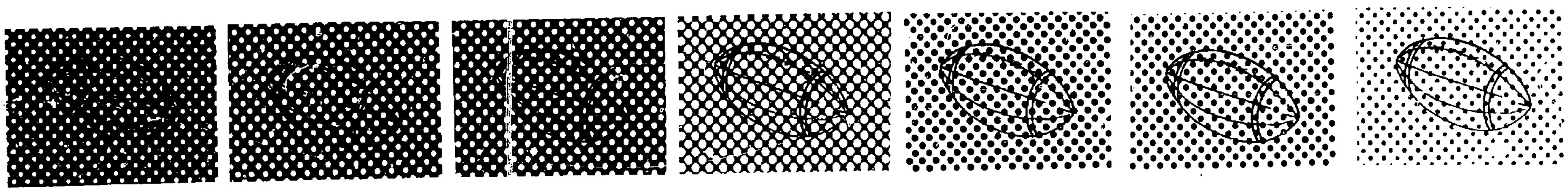
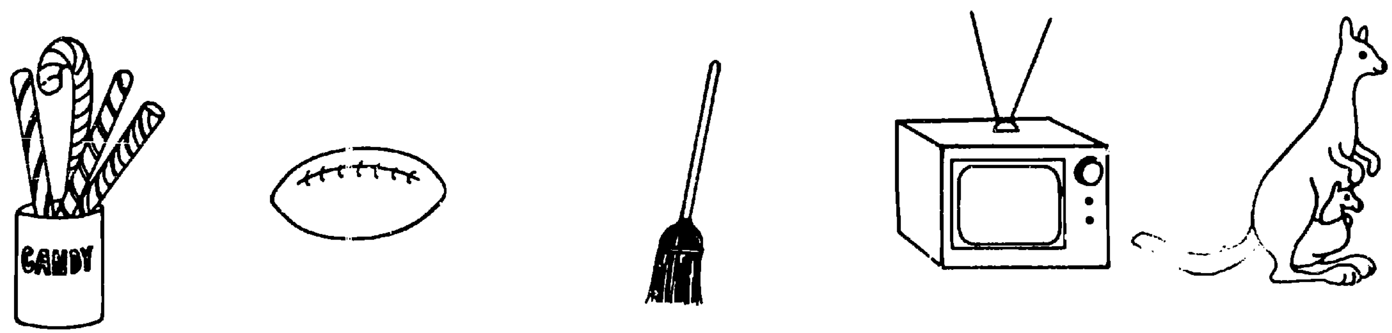


FIGURE-GROUND (FOOTBALL)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

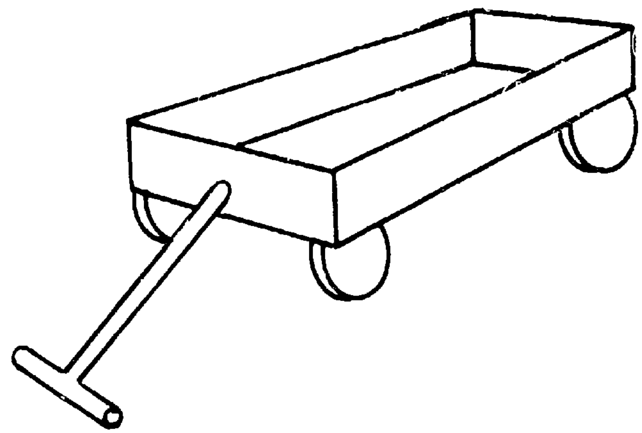
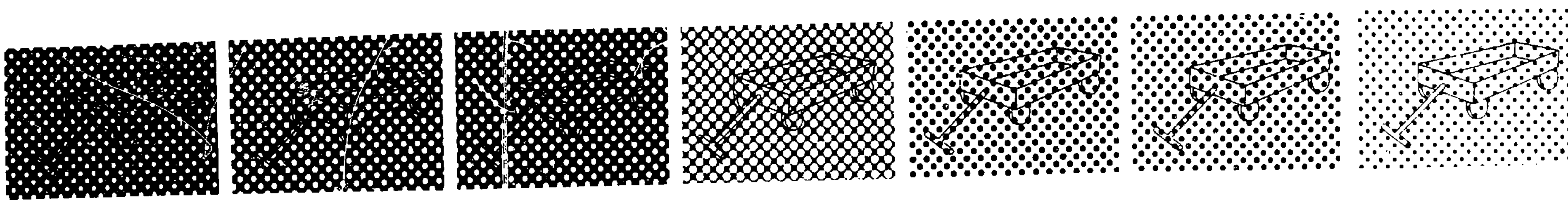
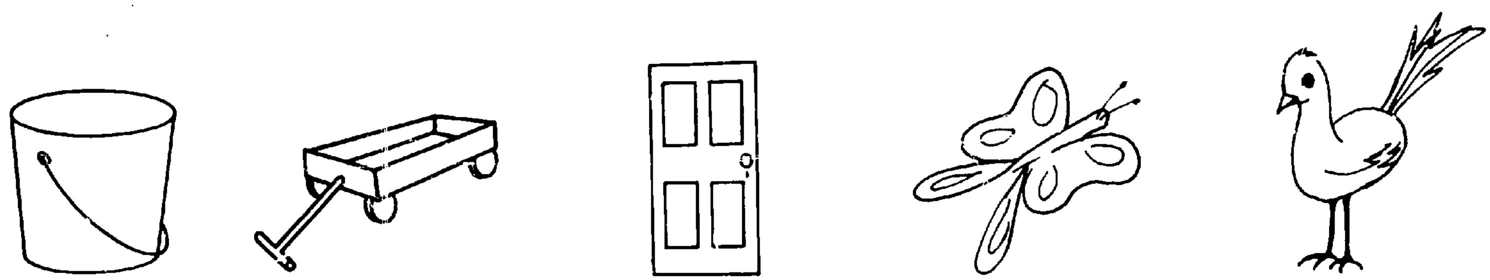


FIGURE-GROUND (WAGON)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

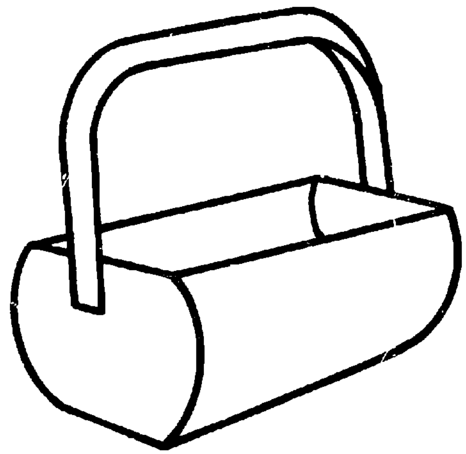
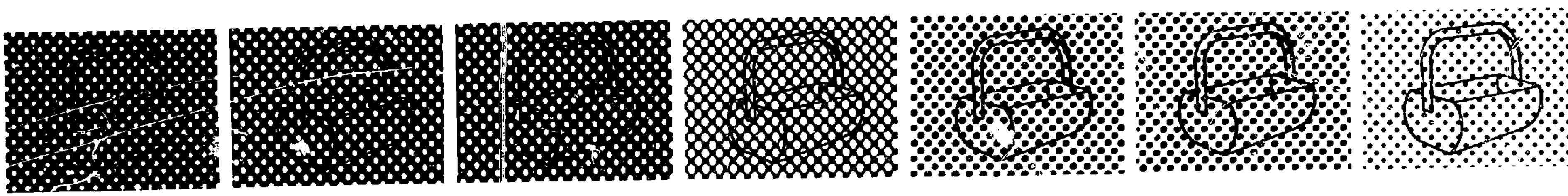
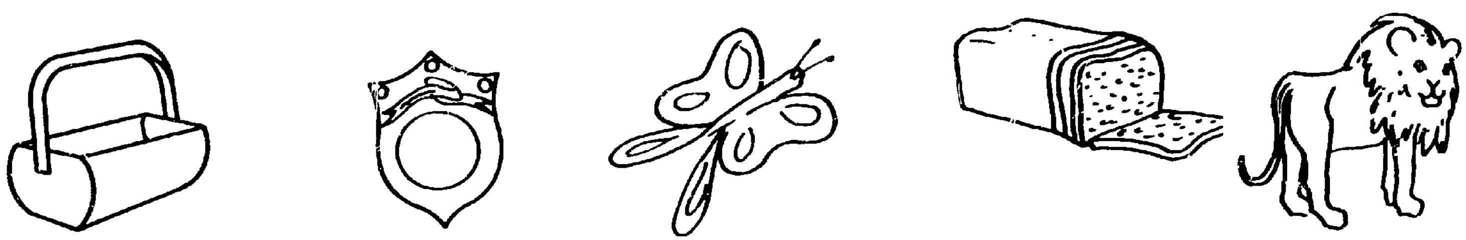


FIGURE-GROUND (BASKET)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

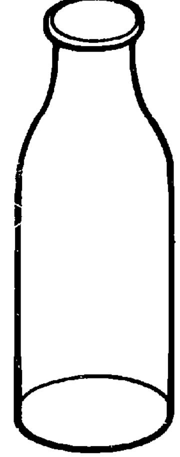
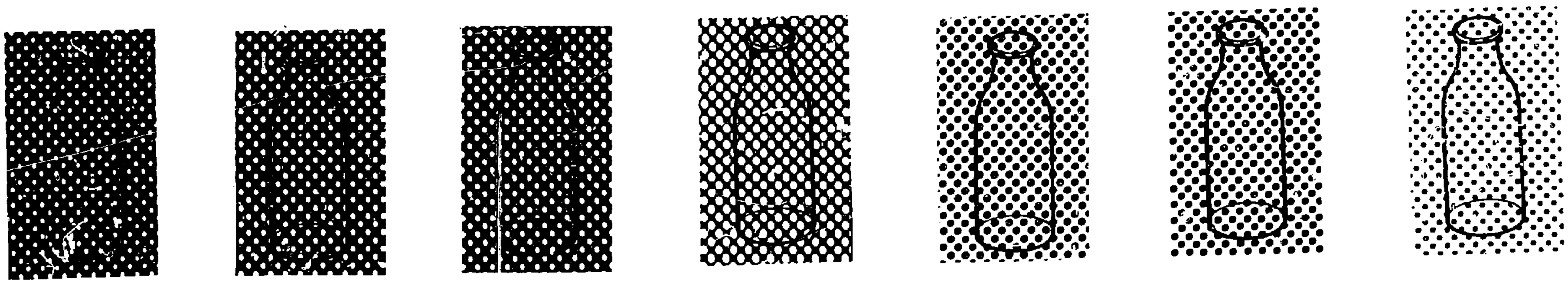
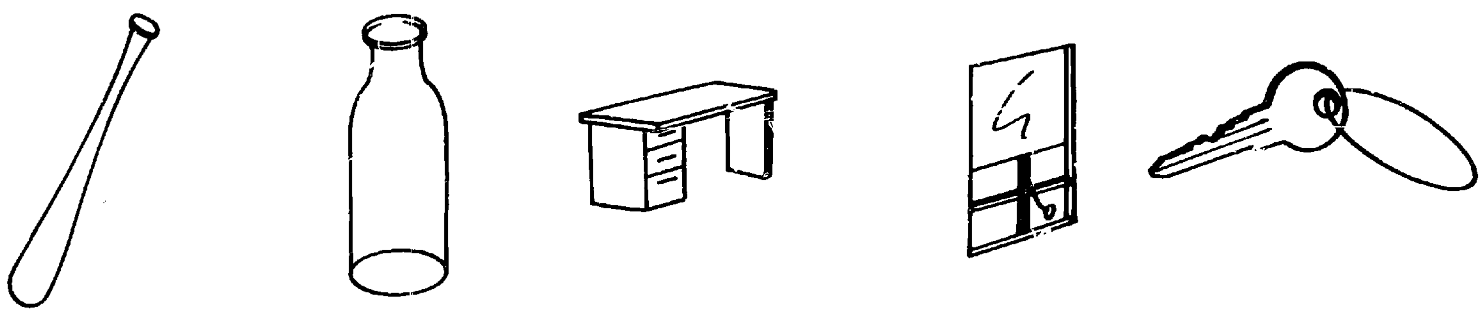


FIGURE-GROUND (BOTTLE)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

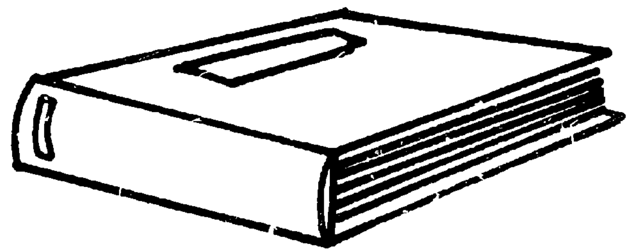
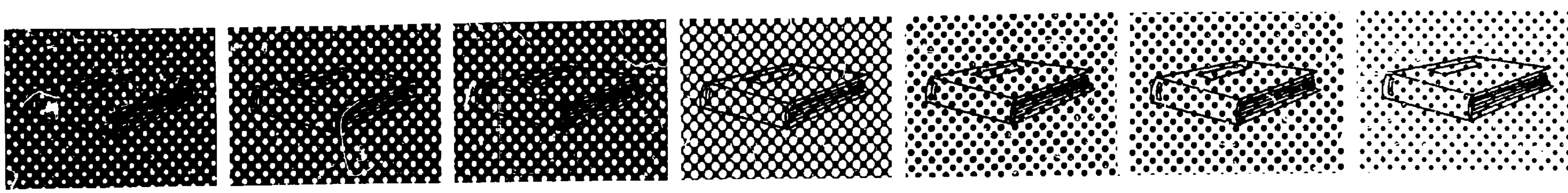
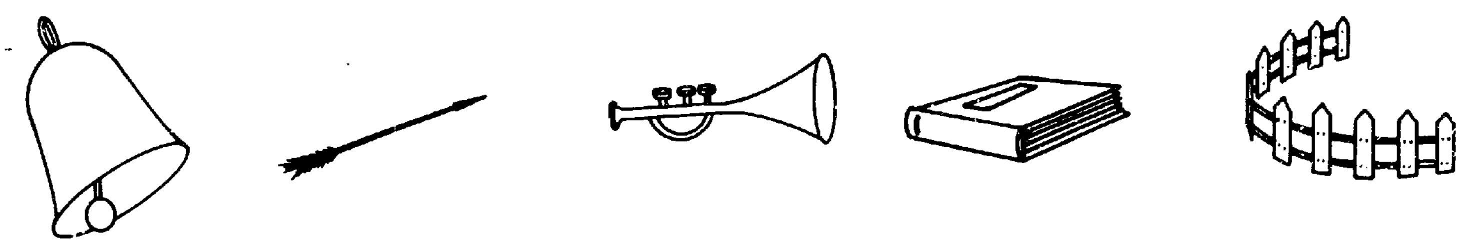


FIGURE-GROUND (BOOK)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

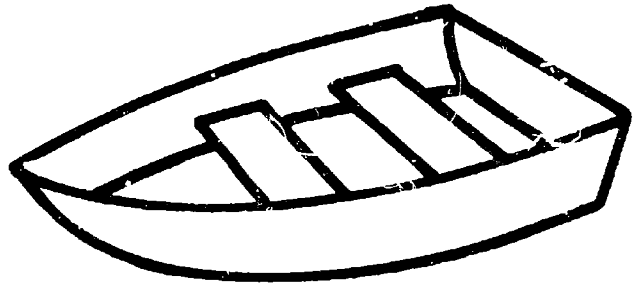
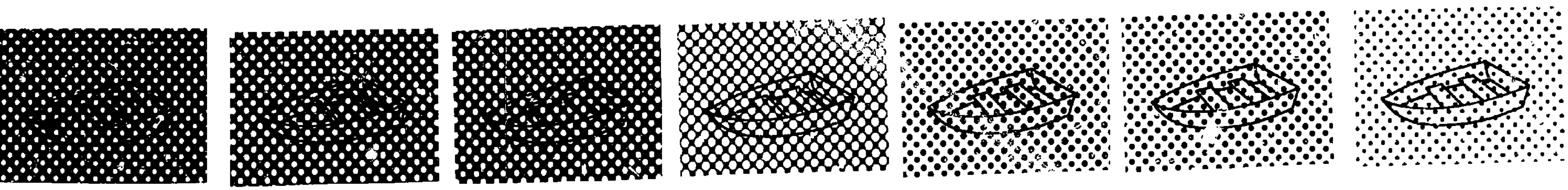
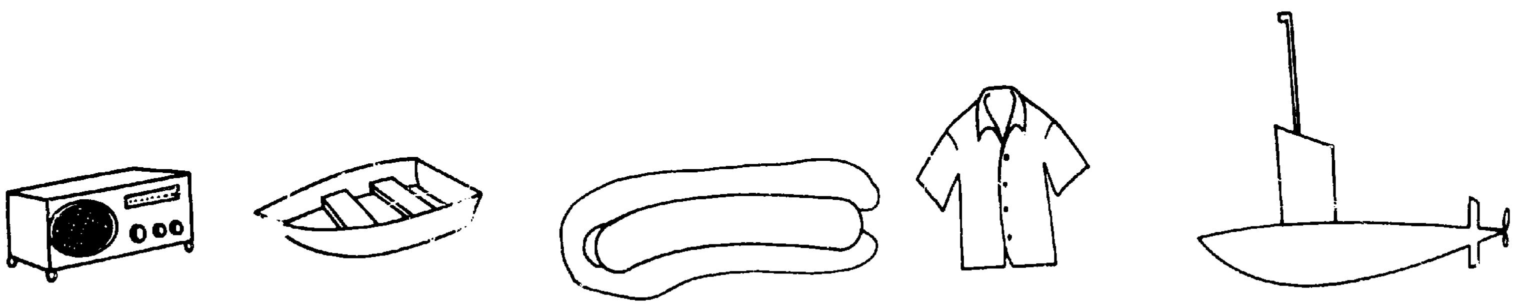


FIGURE-GROUND (BOAT)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

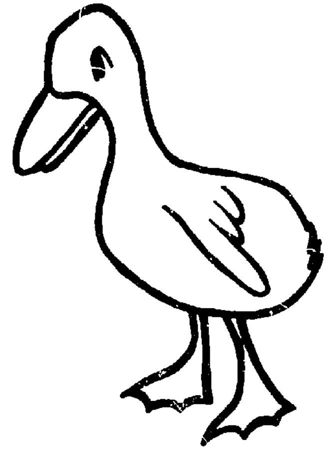
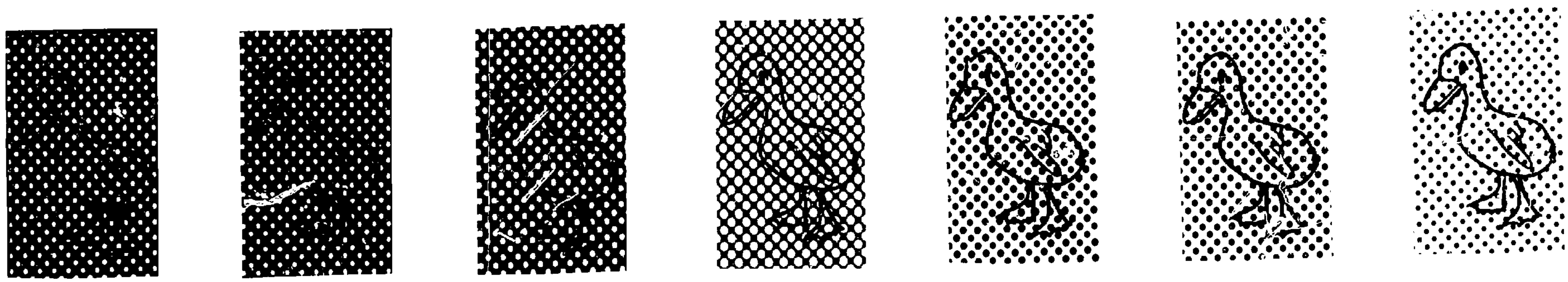
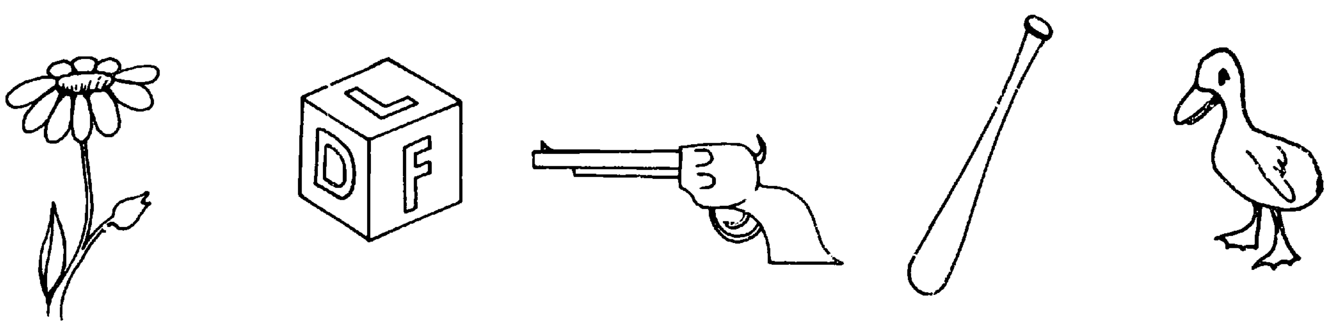


FIGURE-GROUND (DUCK)



SLIDE PRESENTATIONS DEGREES 8 - 2



RESPONSE CARD POSITIONS 1-5

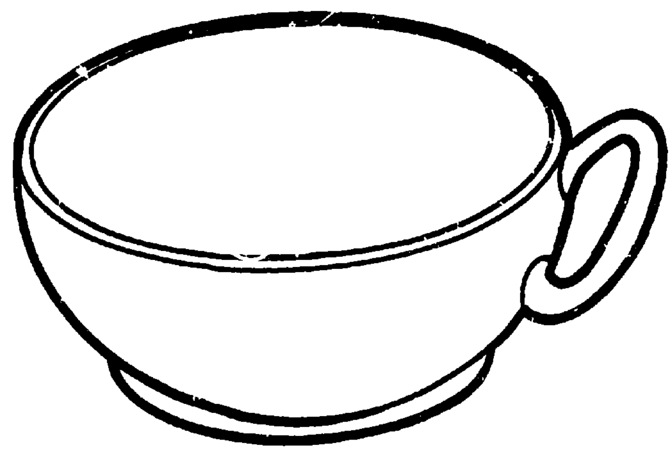
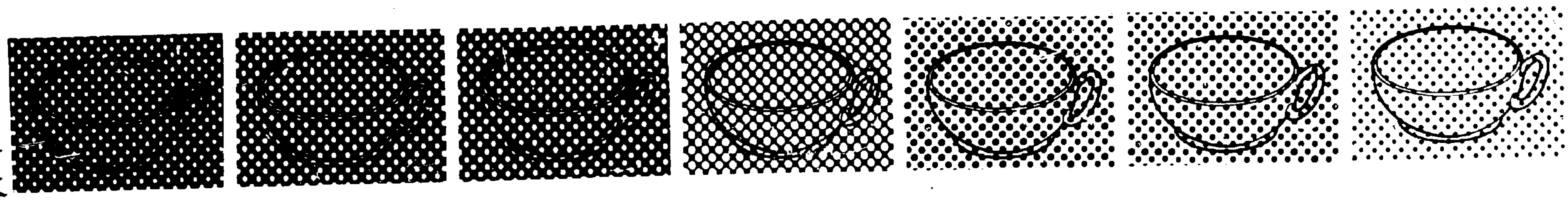
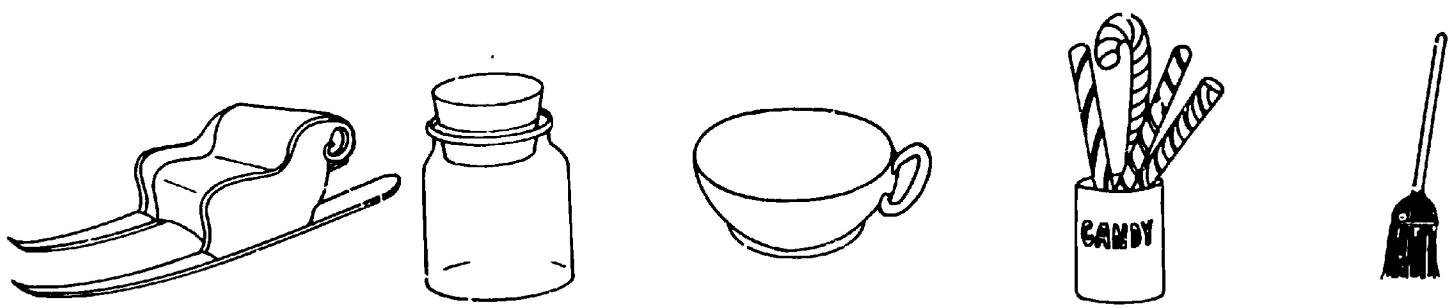


FIGURE - GROUND (CUP)



SLIDE PRESENTATIONS DEGREES 8 - 2



RESPONSE CARD POSITIONS 1 - 5

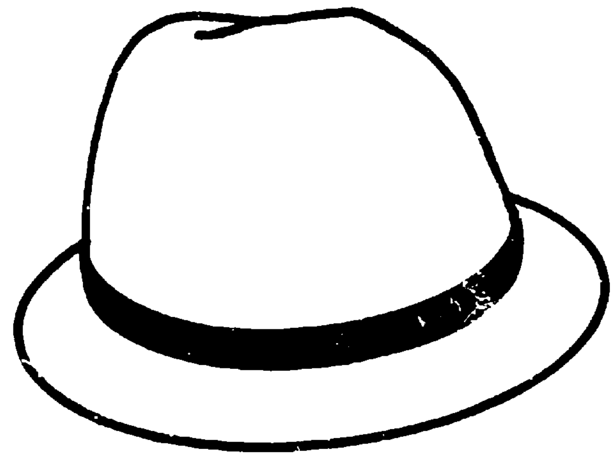
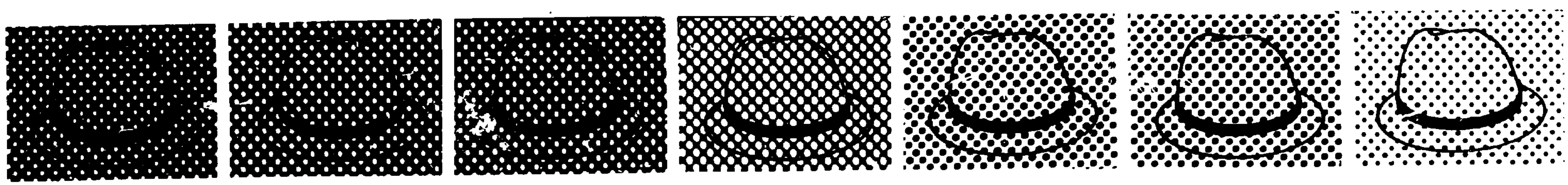
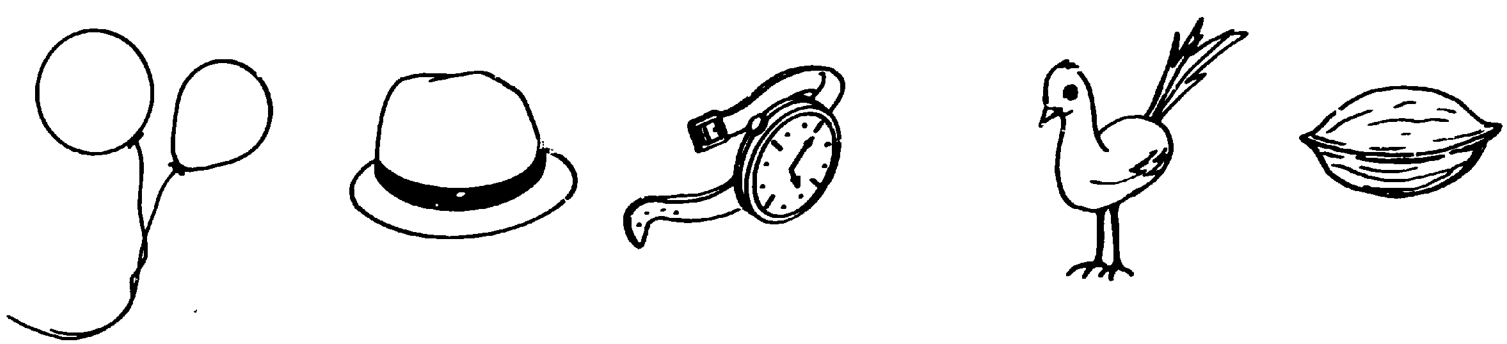


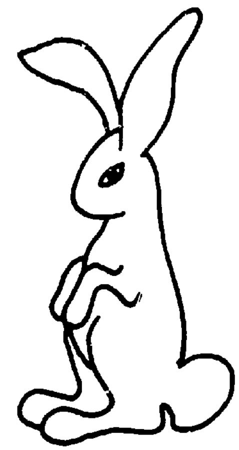
FIGURE - GROUND (HAT)



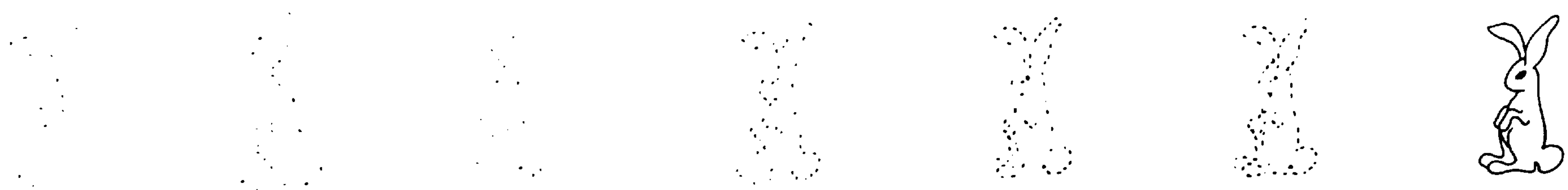
SLIDE PRESENTATIONS DEGREES 8-2



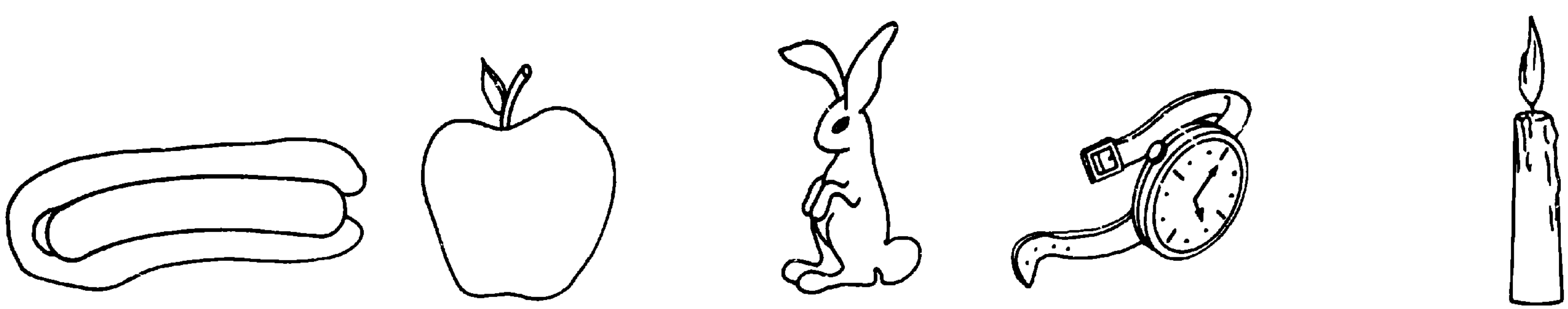
RESPONSE CARD POSITIONS 1-5



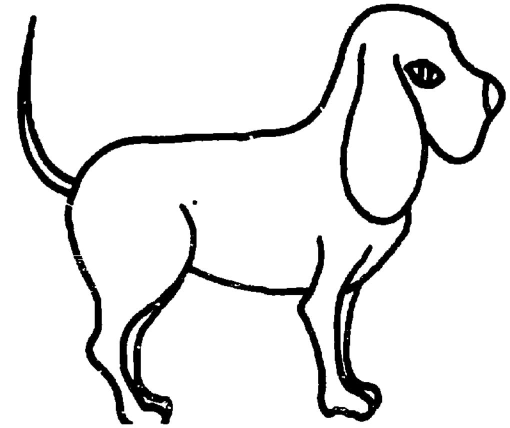
VISUAL CLOSURE (BUNNY)



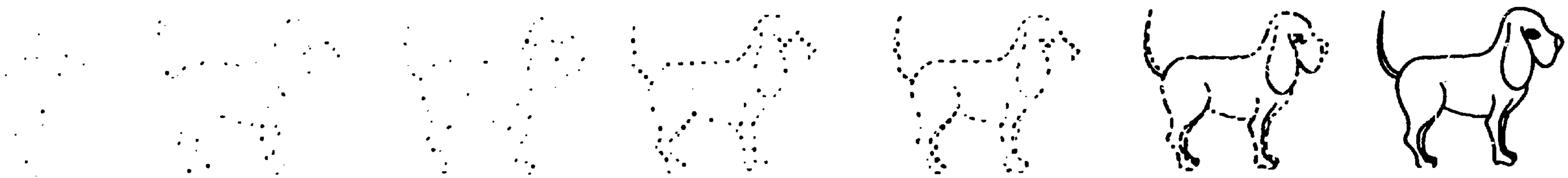
SLIDE PRESENTATIONS DEGREES 7-1



RESPONSE CARD POSITIONS 1-5

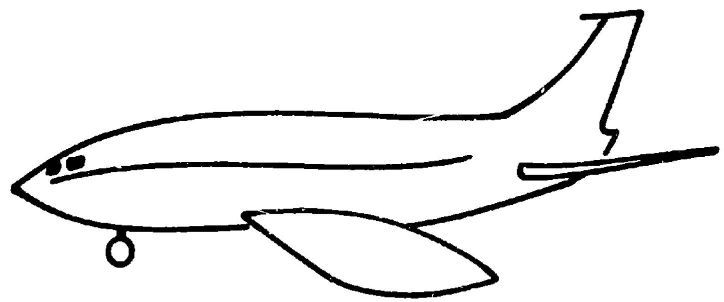


VISUAL CLOSURE (DOG)

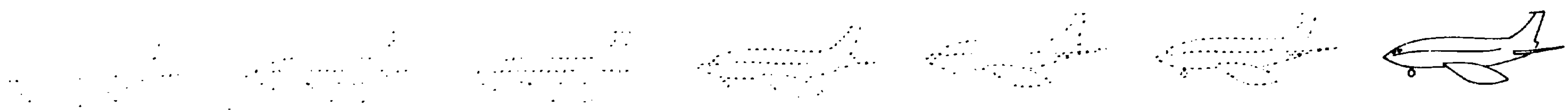


SLIDE PRESENTATIONS DEGREES 7-1

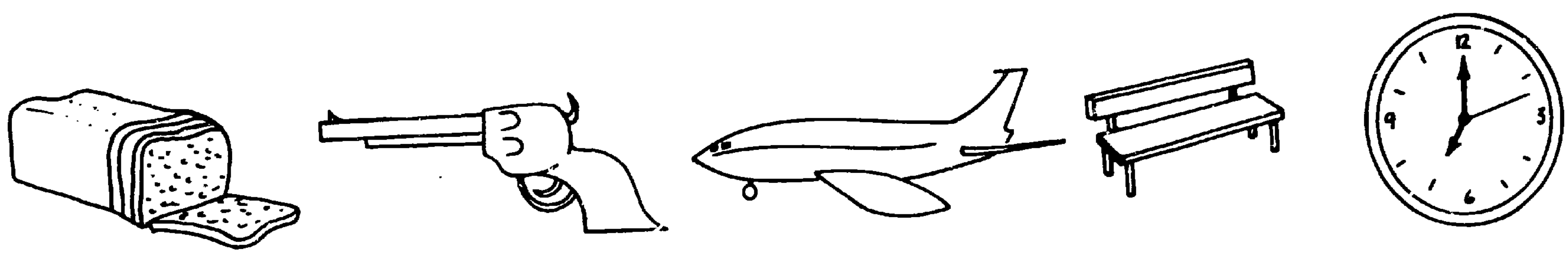
RESPONSE CARD POSITIONS 1-5



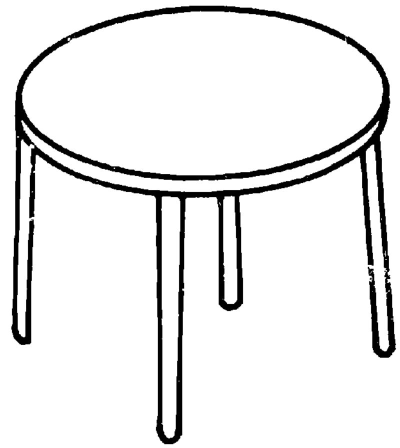
VISUAL CLOSURE (AIRPLANE)



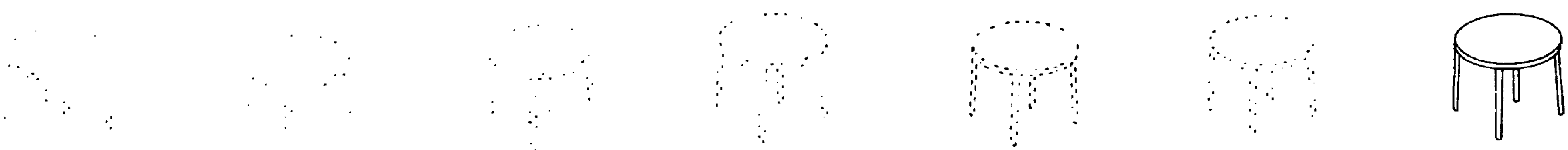
SLIDE PRESENTATIONS DEGREES 7-1



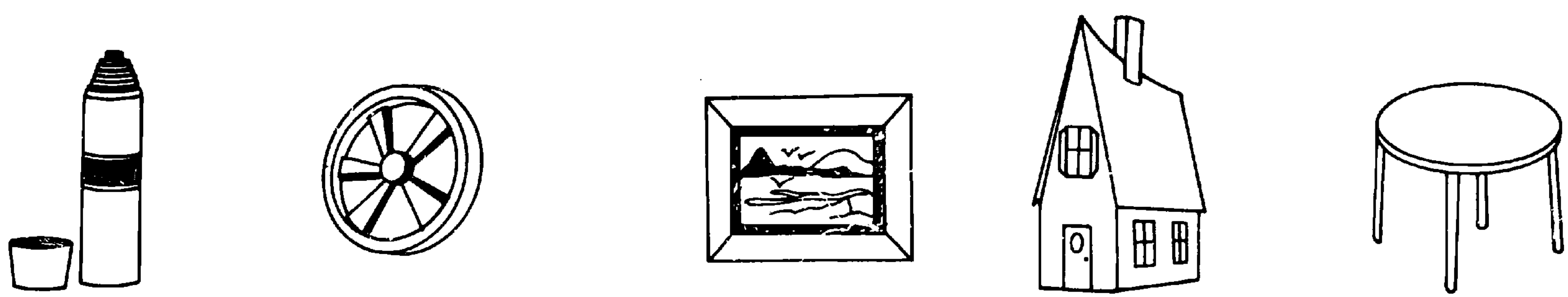
RESPONSE CARD POSITIONS 1-5



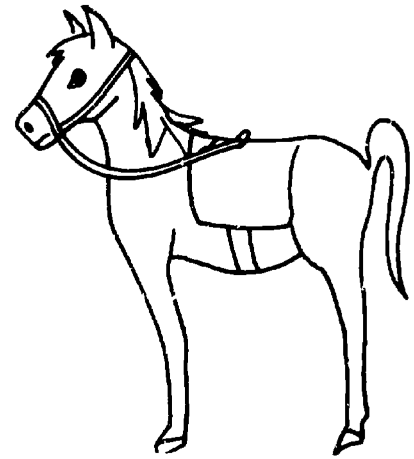
VISUAL CLOSURE (TABLE)



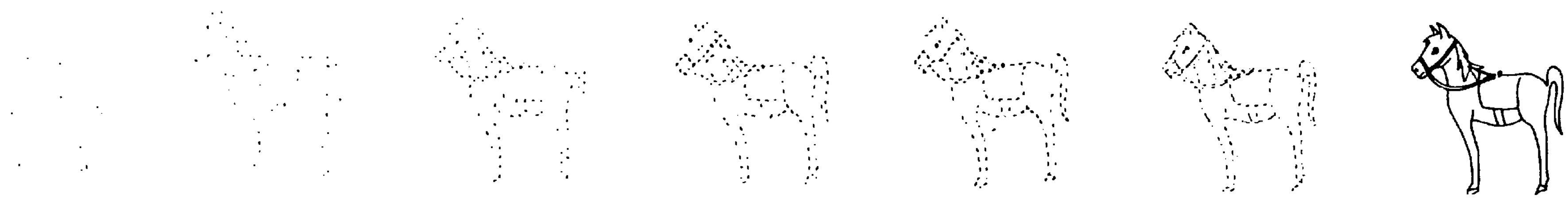
SLIDE PRESENTATIONS DEGREES 7-1



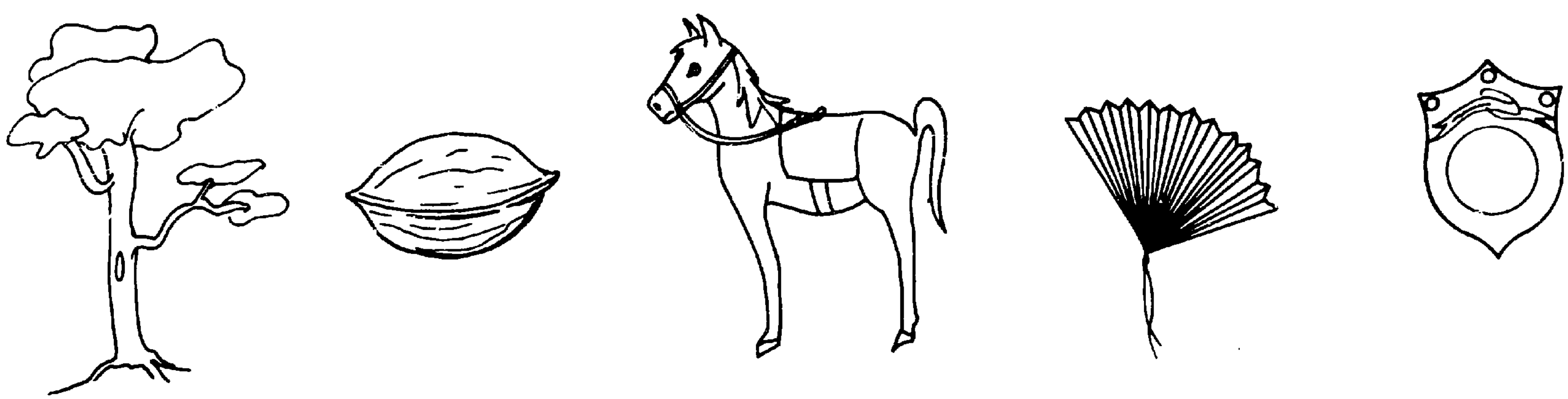
RESPONSE CARD POSITIONS 1-5



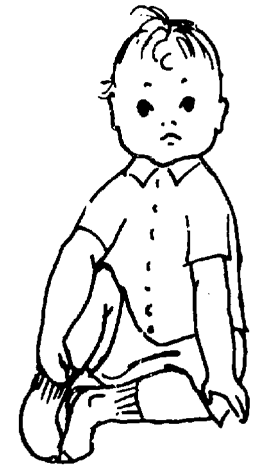
VISUAL CLOSURE (HORSE)



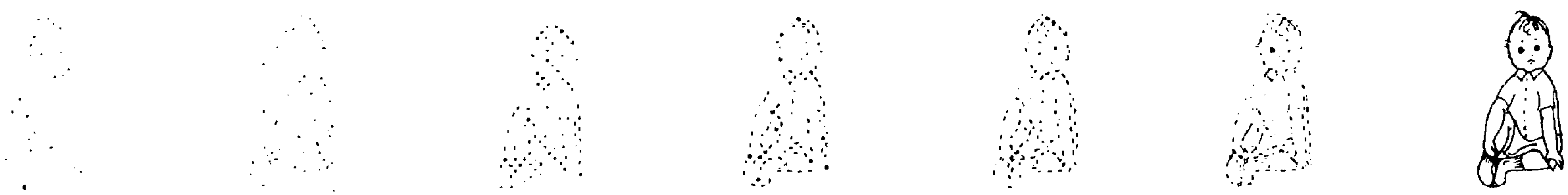
SLIDE PRESENTATIONS DEGREES 7-1



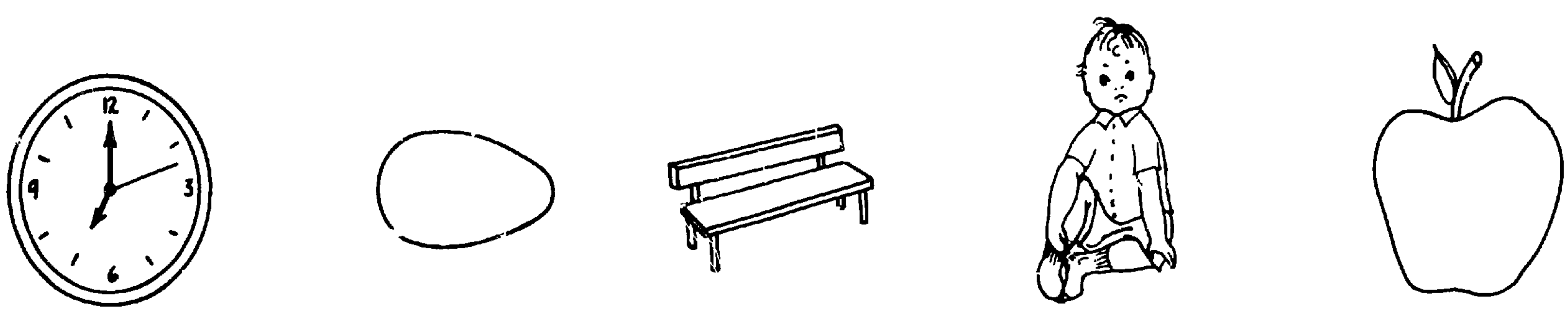
RESPONSE CARD POSITIONS 1-5



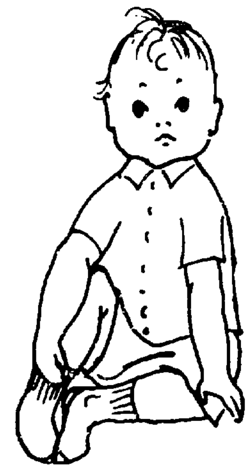
VISUAL CLOSURE (BABY)



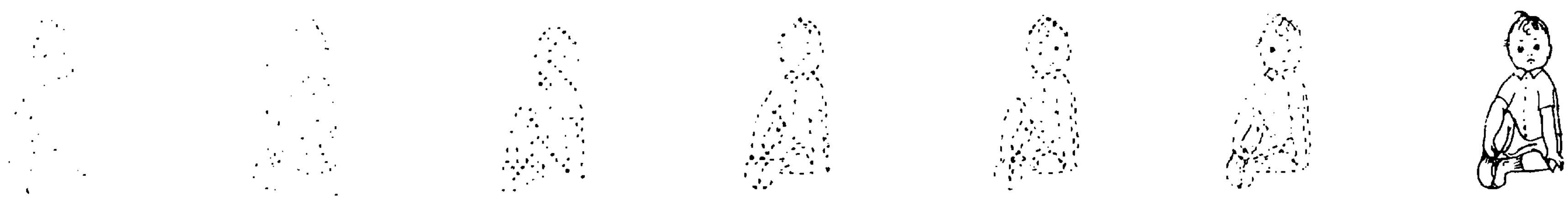
SLIDE PRESENTATIONS DEGREES 7-1



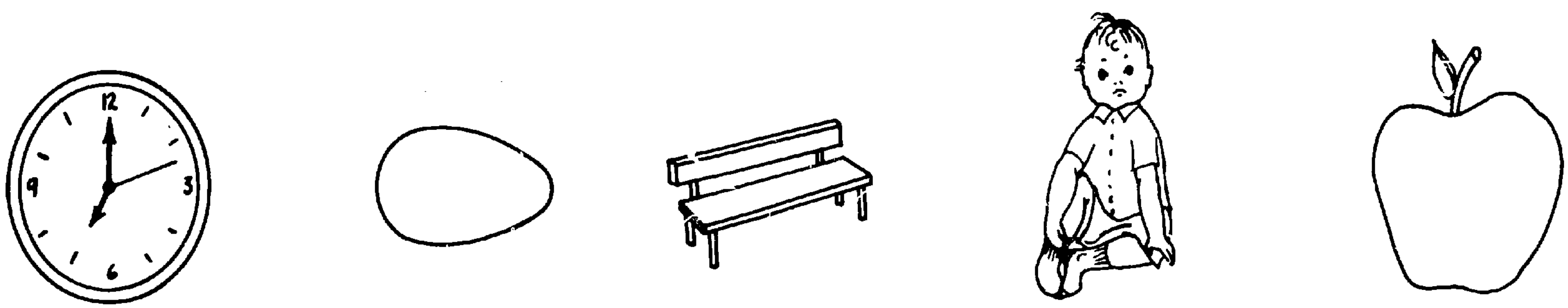
RESPONSE CARD POSITIONS 1-5



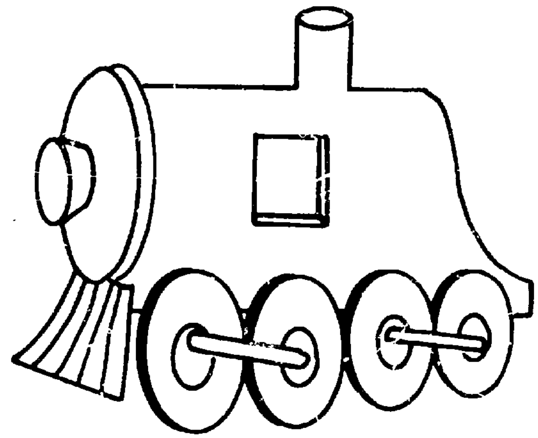
VISUAL CLOSURE (BABY)



SLIDE PRESENTATIONS DEGREES 7-1



RESPONSE CARD POSITIONS 1-5



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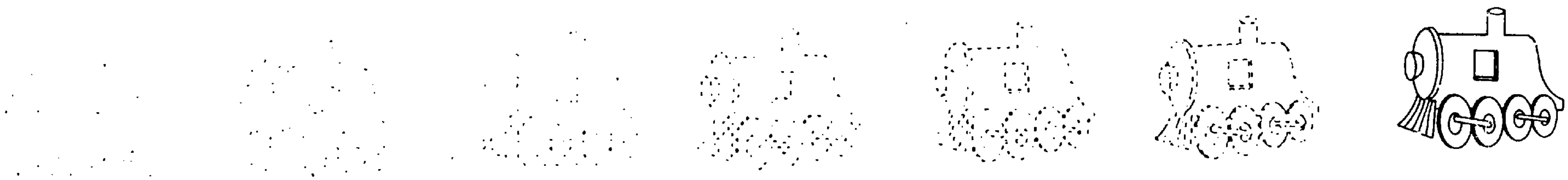
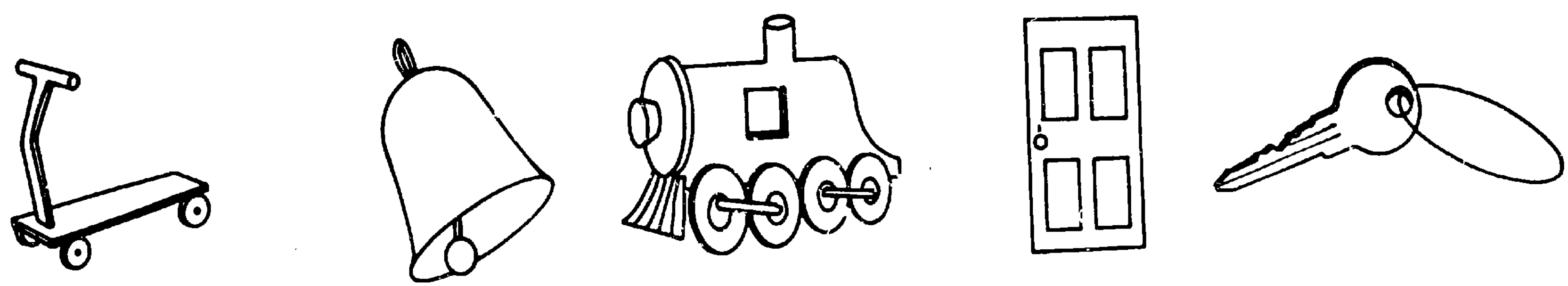
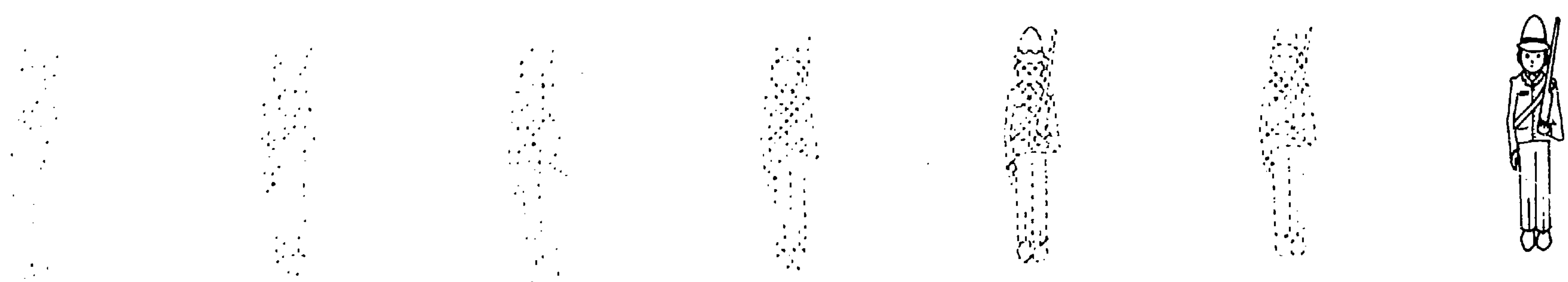


SLIDE PRESENTATIONS DEGREES 7-1



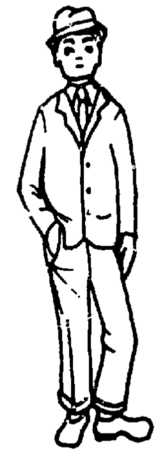
RESPONSE CARD POSITIONS 1-5

VISUAL CLOSURE (SOLDIER)

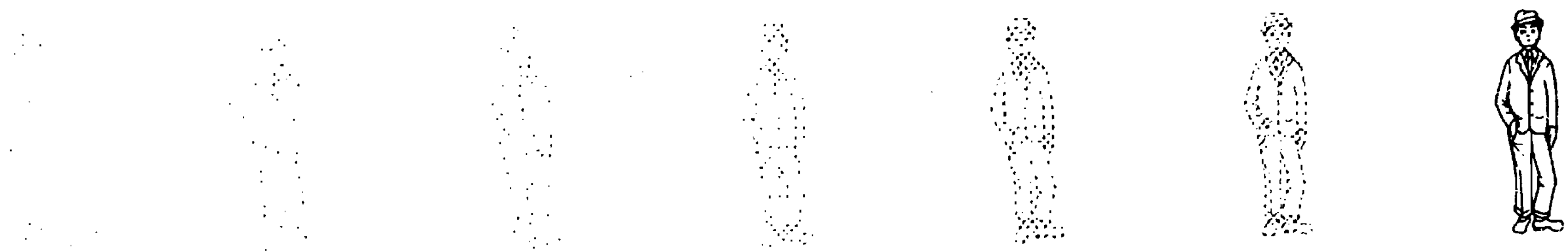


SLIDE PRESENTATIONS DEGREES 7-1

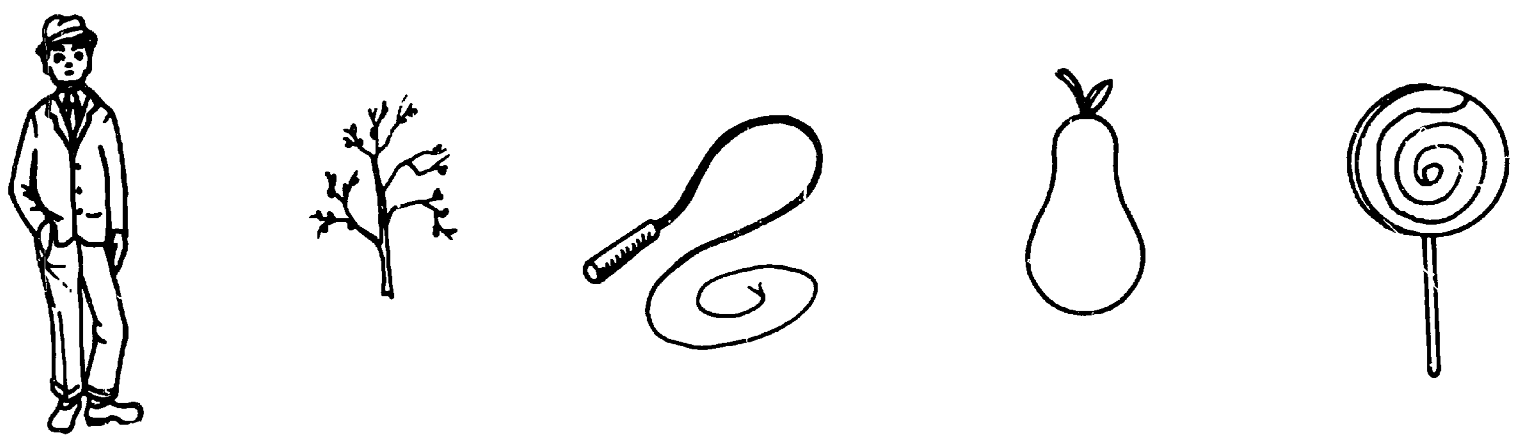
RESPONSE CARD POSITIONS 1-5



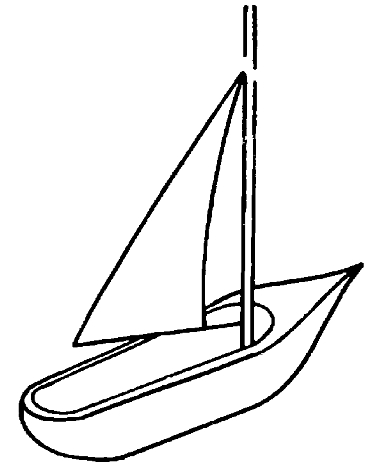
VISUAL CLOSURE (MAN)



SLIDE PRESENTATIONS DEGREES 7-1

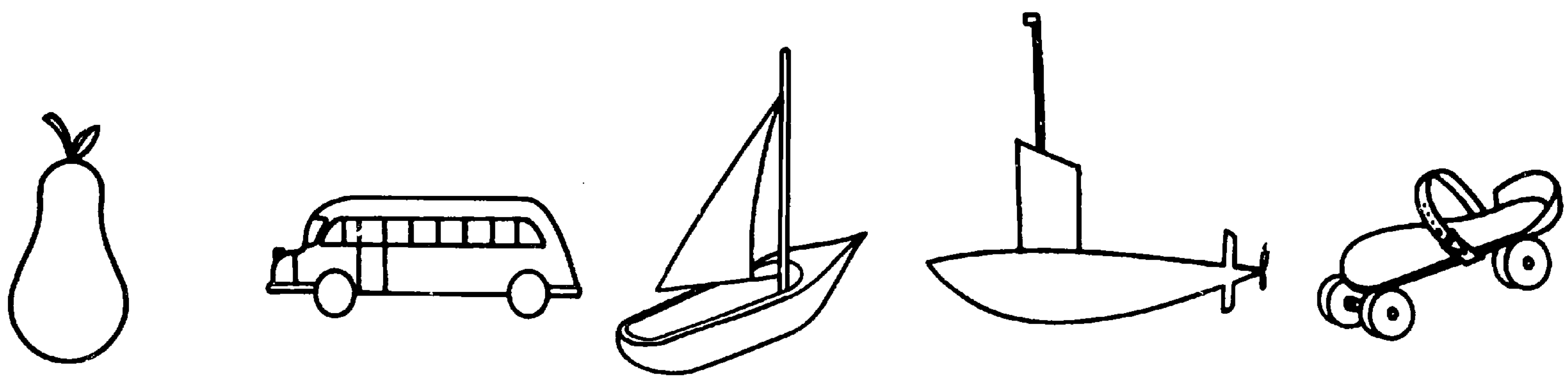


RESPONSE CARD POSITIONS 1-5



VISUAL CLOSURE (BOAT)

SLIDE PRESENTATIONS DEGREES 7-1



RESPONSE CARD POSITIONS 1-5

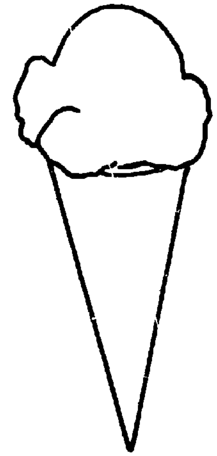
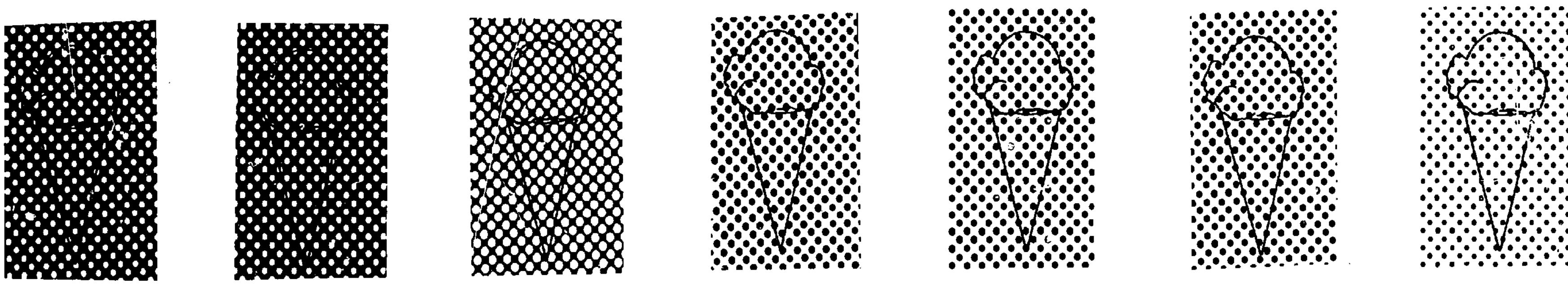
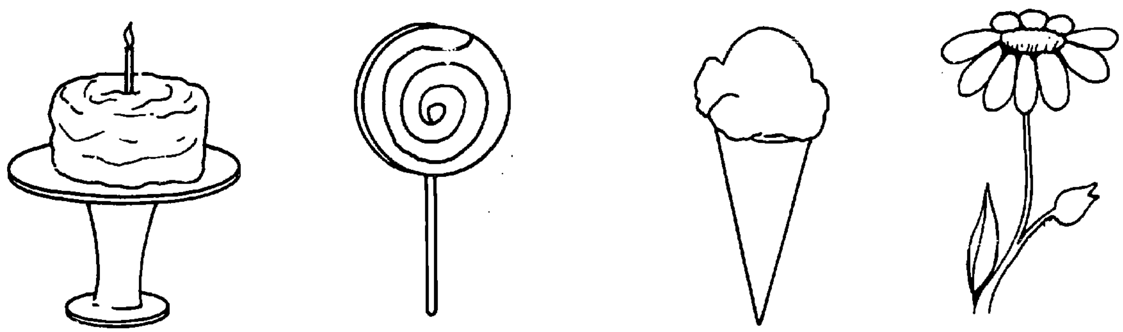


FIGURE-GROUND HOMOGENEOUS (ICE CREAM)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

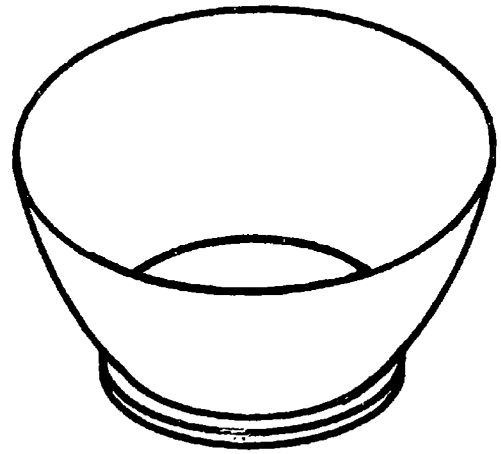
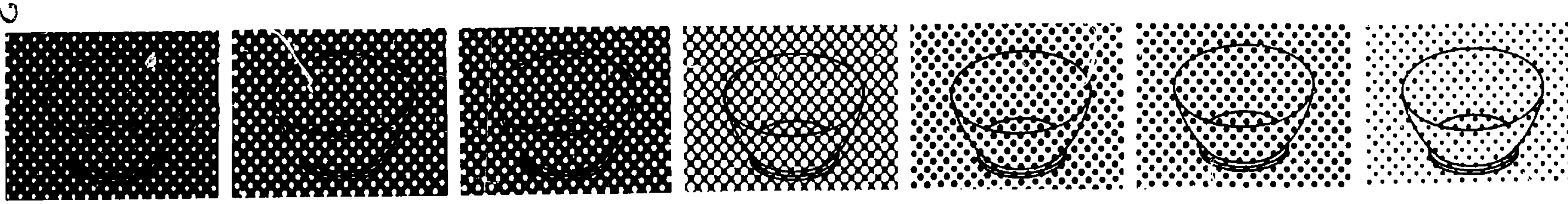
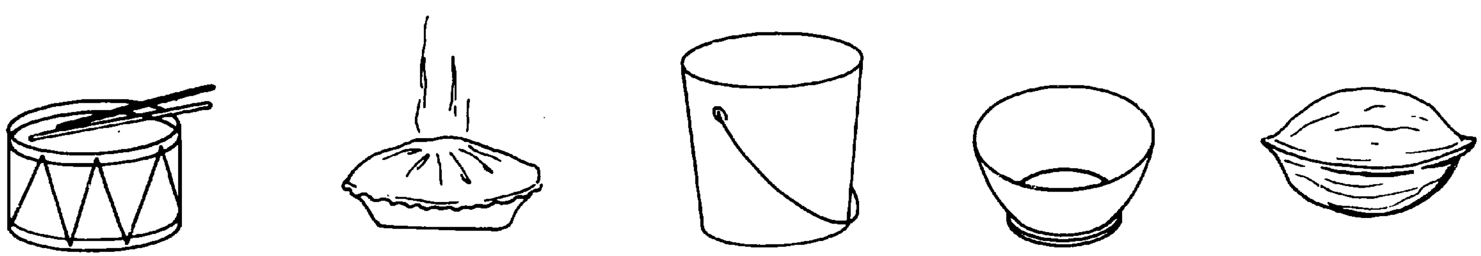


FIGURE-GROUND HOMOGENEOUS (BOWL)



SLIDE PRESENTATIONS DEGREES 8-2



RESPONSE CARD POSITIONS 1-5

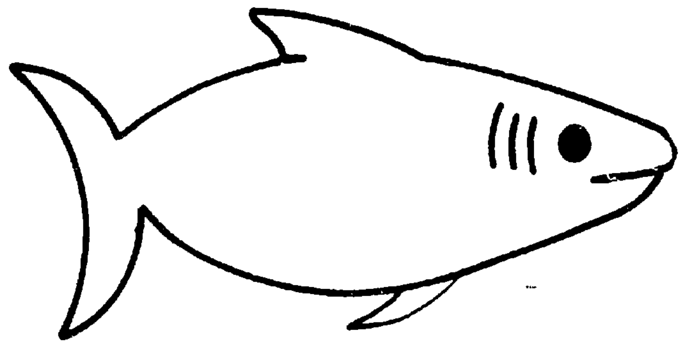
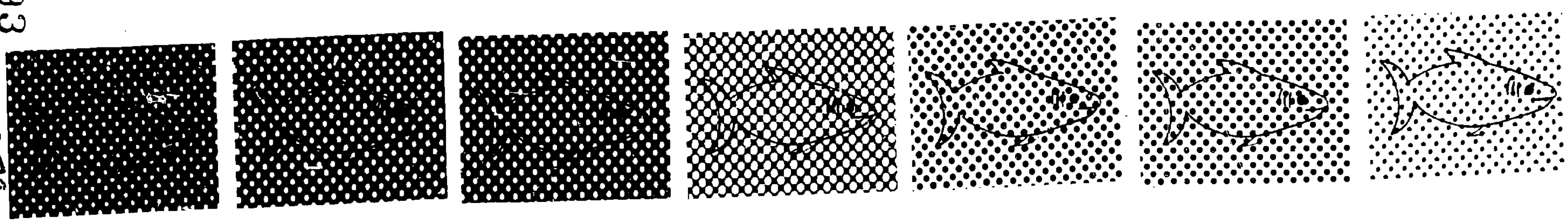
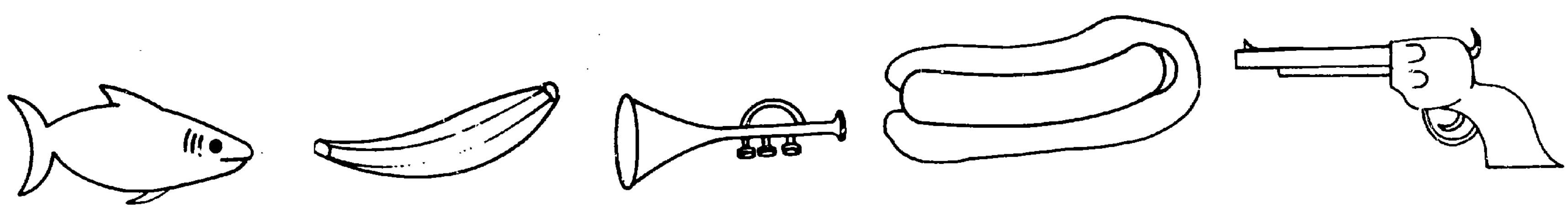


FIGURE-GROUND HOMOGENEOUS (FISH)



SLIDE PRESENTATIONS DEGREES 8 - 2



RESPONSE CARD POSITIONS 1-5

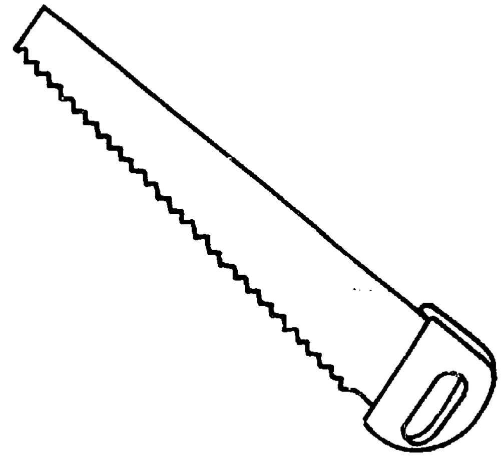
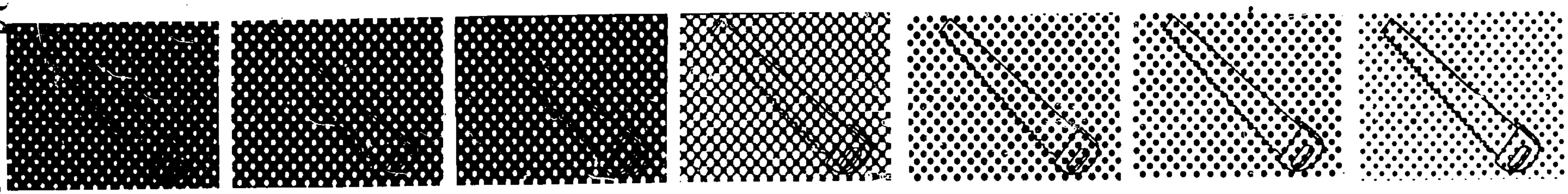


FIGURE-GROUND HOMOGENEOUS (SAW)



SLIDE PRESENTATIONS DEGREES 8 - 2

RESPONSE CARD POSITIONS 1-5

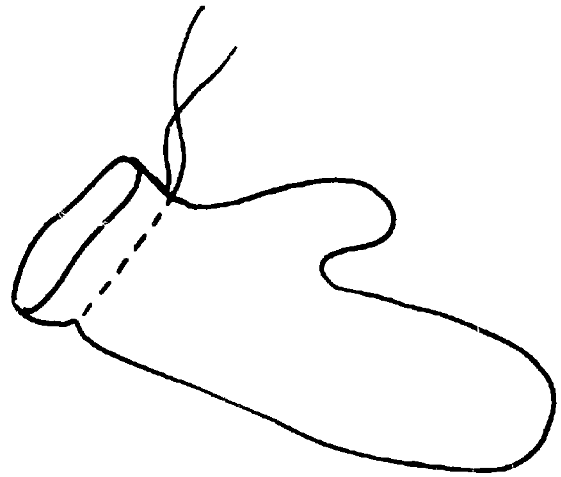
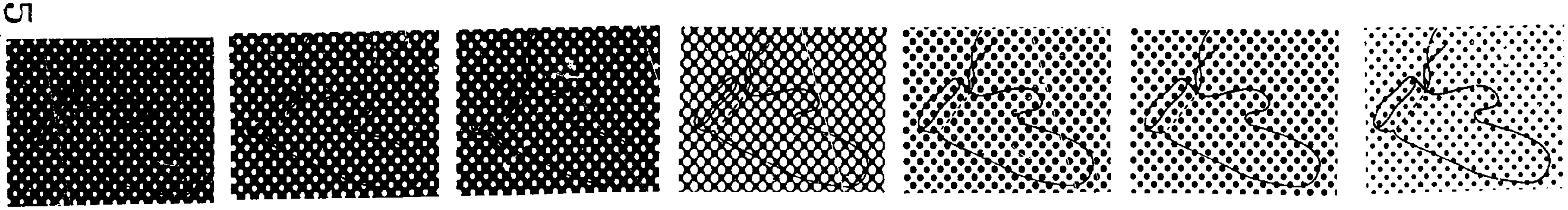
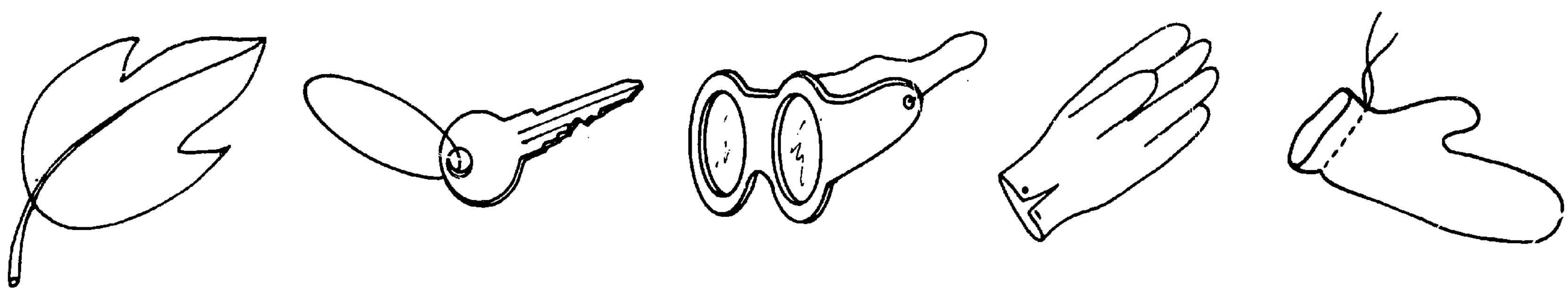


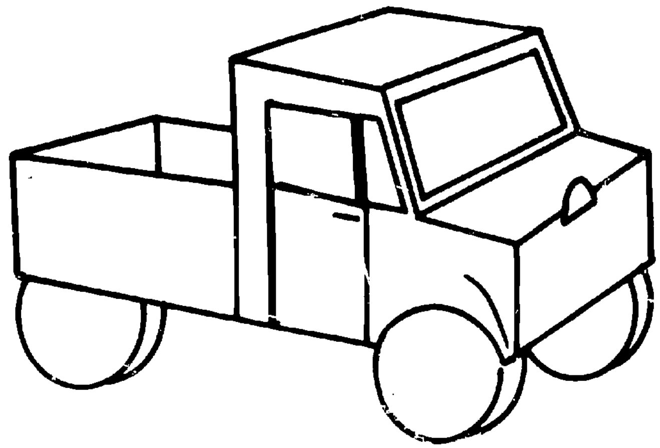
FIGURE-GROUND HOMOGENEOUS (MITTEN)



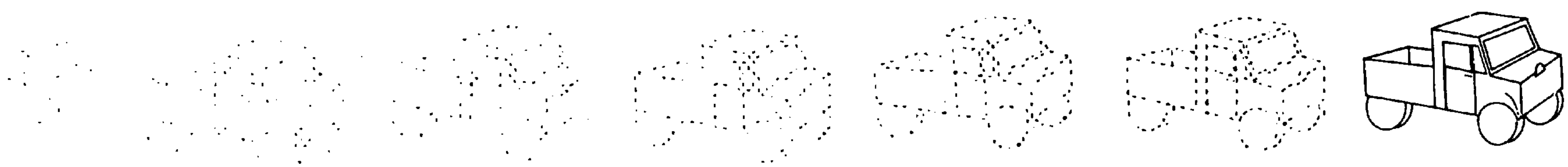
SLIDE PRESENTATIONS DEGREES 8 - 2



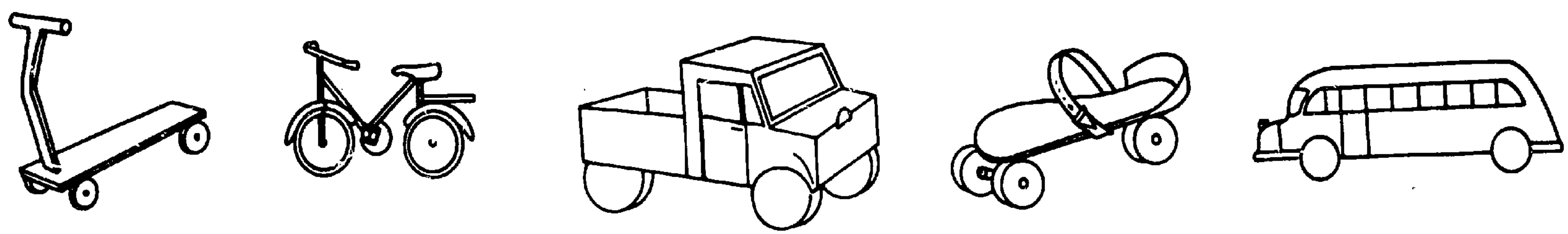
RESPONSE CARD POSITIONS 1-5



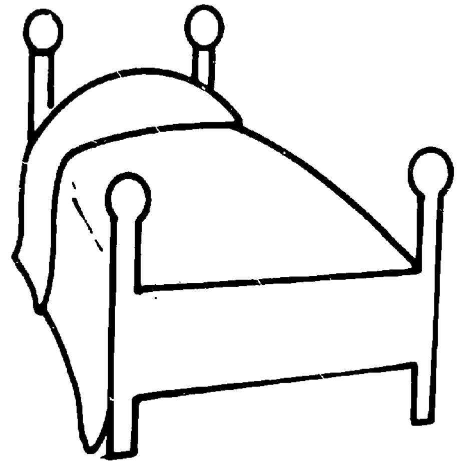
VISUAL CLOSURE HOMOGENEOUS (TRUCK)



SLIDE PRESENTATIONS DEGREES 7-1

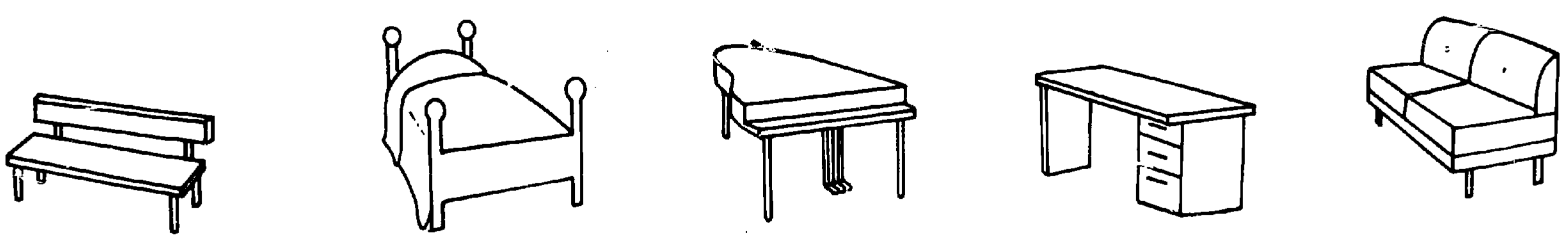


RESPONSE CARD POSITIONS 1-5

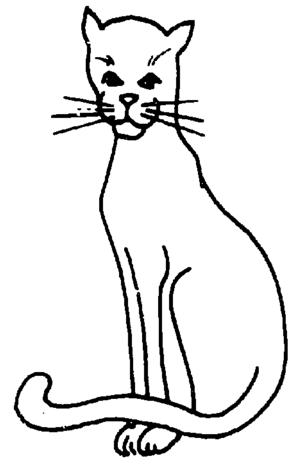


VISUAL CLOSURE HOMOGENEOUS (BED)

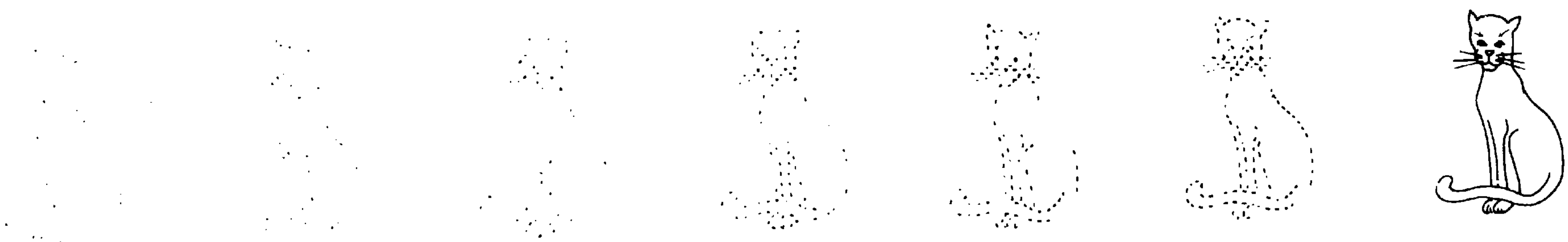
SLIDE PRESENTATIONS DEGREES 7-1



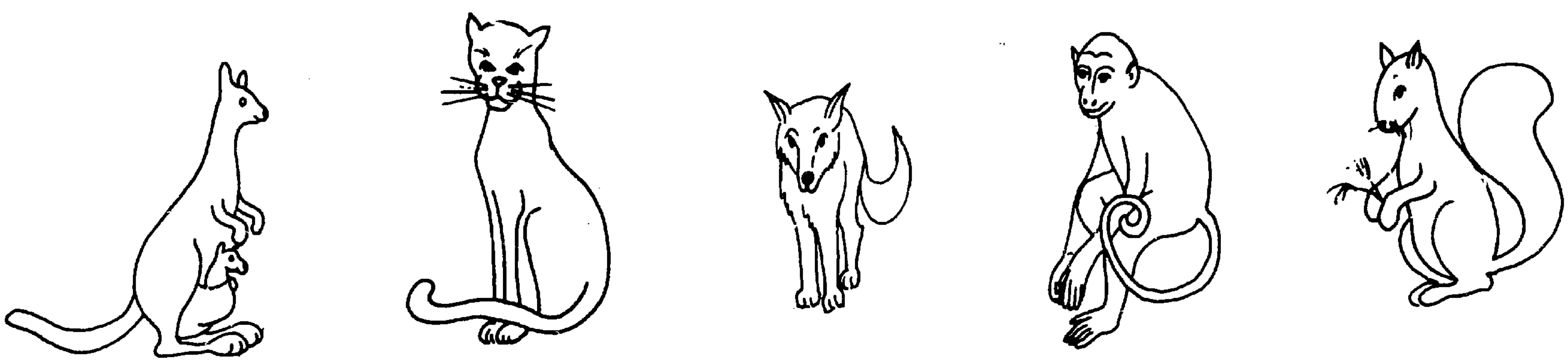
RESPONSE CARD POSITIONS 1-5



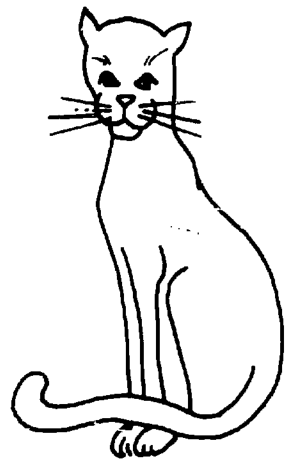
VISUAL CLOSURE HOMOGENEOUS (CAT)



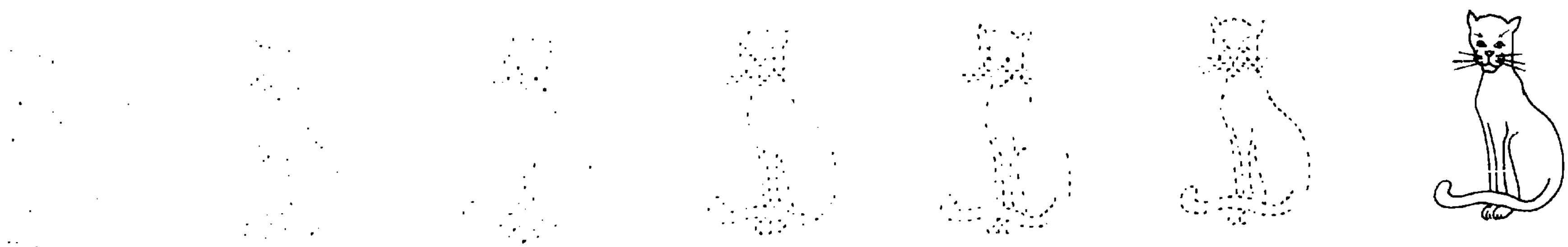
SLIDE PRESENTATIONS DEGREES 7 - 1



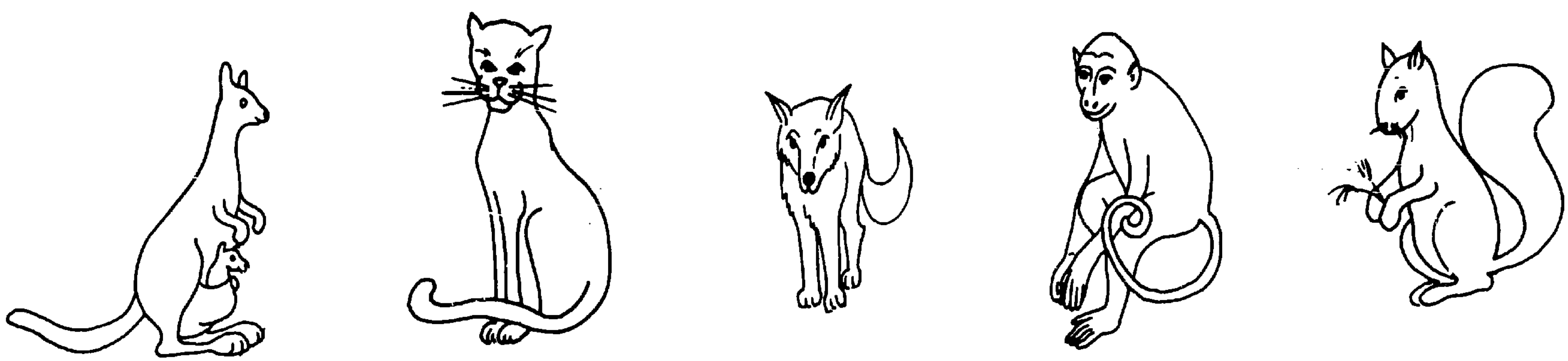
RESPONSE CARD POSITIONS 1 - 5



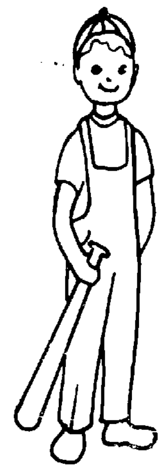
VISUAL CLOSURE HOMOGENEOUS (CAT)



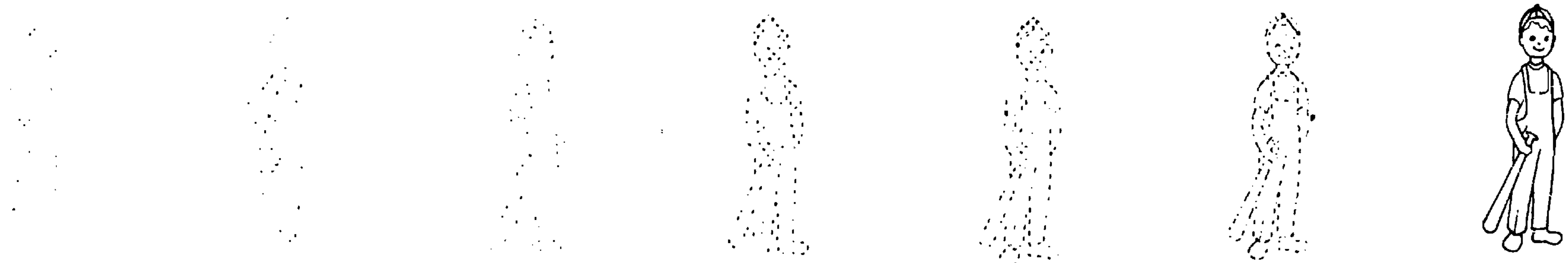
SLIDE PRESENTATIONS DEGREES 7 - 1



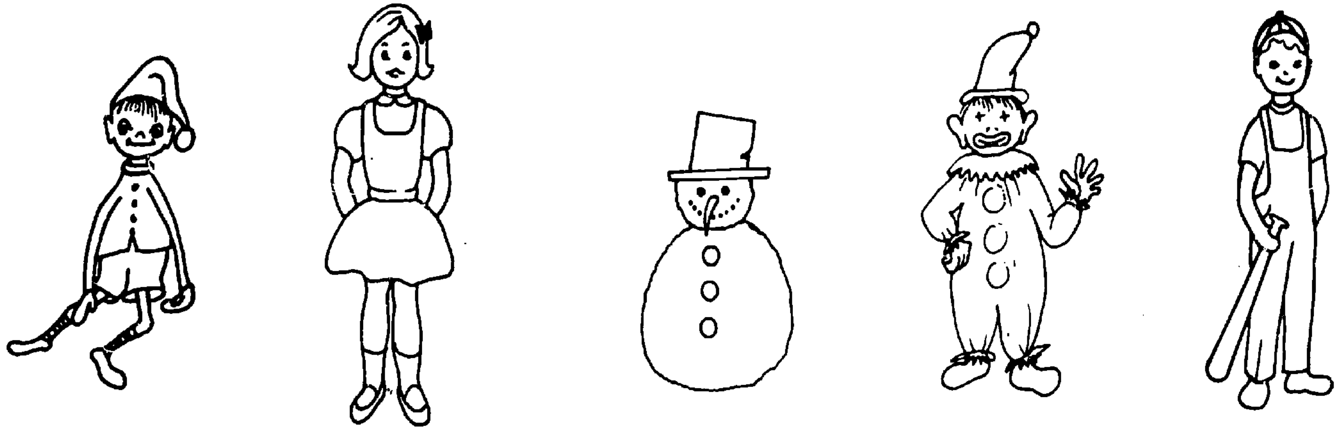
RESPONSE CARD POSITIONS 1 - 5



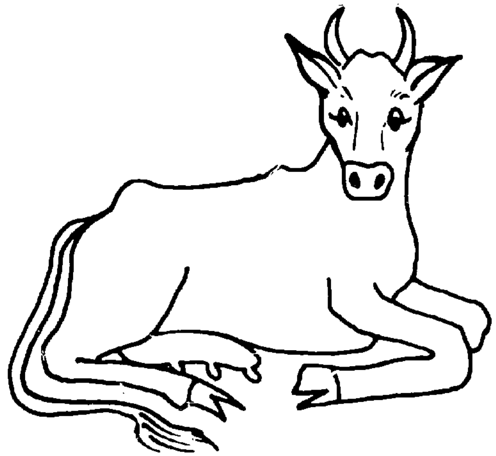
VISUAL CLOSURE HOMOGENEOUS (BOY)



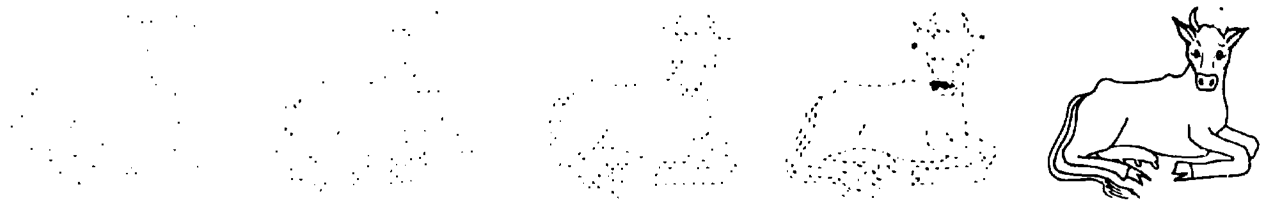
SLIDE PRESENTATIONS DEGREES 7-1



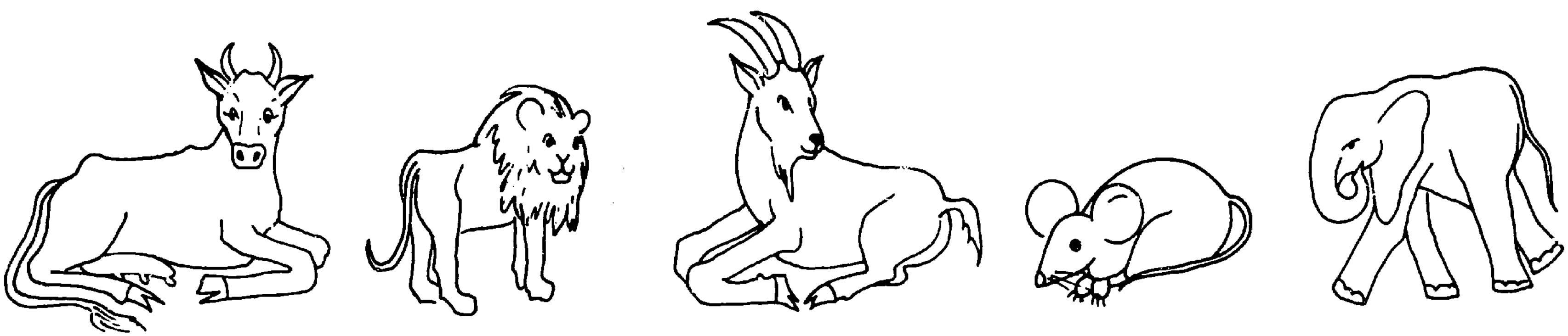
RESPONSE CARD POSITIONS 1-5



VISUAL CLOSURE HOMOGENEOUS (COW)



SLIDE PRESENTATIONS DEGREES 7-1



RESPONSE CARD POSITIONS 1-5

APPENDIX C

Report of the First Year Study

Report of the First Year Study

I. Description of the Initial Experimental Battery

One of the major undertakings of this study involved the development of a series of slides designed to measure degrees of visual closure and figure-ground discrimination. The initial experimental battery consisted of 110 slides divided in three categories:

A. Visual Closure (VC) slides totaled 45, with 15 at complete closure; 15 with less closure; and 15 with still less closure. Closure was reduced in the drawings by applying standardized hyphenated grids to original drawings so that the outlines of the objects became less discernable as the spaces between the hyphens were increased in size. This method of preparing stimulus material was selected in an attempt to retain the perceptual aspect of the task, rather than using three-dimensional figures or partial pictures which tend to embrace a conceptual level of identification.

B. Figure-Ground Discrimination (FGD) slides also totaled 45. In 15 of the slides the ground was predominant; in 15 the figure and ground were equally weighted; and in 15 the figure was predominant. The three degrees of "figureness" were achieved by increasing the line weight of the figure or ground. Different ground grids were used for each of the 15 sets of slides.

C. Perceptual Speed (PS) slides consisted of 20 entirely different and completely closed figures, each of which was presented at 1/2, 1/5, and 1/10 seconds. This totaled 60 presentations.

In brief, the 45 slides of VC, the 45 slides of FGD, and the 20 slides presented at three perceptual speeds gave a total of 110 slides and 150 presentations. This required a total of 150 response cards, each of which contained five possible responses or 750 pictures, 600 of which were new items. The response cards were prepared on heavy cardboard and sprayed with a protective covering. The selected items were photographed from the slide stimuli to eliminate even small variations in drawings. The position of the selected stimuli were assigned randomly on each card according to the table of Random Digits (Hodgman, 1959).

II. The First Test Run

The first test run of the experimental battery was carried out in the Inglewood School System where school speech and hearing specialists of five schools selected 29 children (5-8 years) suspected of having moderate to severe language learning problems. Each child was tested individually on both the selected and the experimental test batteries. The selected subjects averaged approximately six years ten months of age with standard deviation of 11.59 months, indicating that roughly two-thirds of this group of 29 were within one year of the mean.

A. Results:

1. The Standard Battery: Results obtained with the three measures of ability used with this group are presented in Table I. The obtained mean IQ of 101.6 for the Peabody Picture Vocabulary Test (PPVT) idnicated that the subjects were of average ability. The discrepancy between the means and between the standard deviations for the PPVT and the Columbia Mental Maturity Scale (CMMS) were sufficiently marked that the question was raised as to whether the standardization samples for these two tests were comparable at this age or whether the tests were measuring different kinds of ability. The statistics for the Goodenough Draw A Person (DAP) were intermediate with respect to the results obtained with the other two instruments.

2. The Experimental Battery: Scorings on each of the nine subdivisions of the experimental battery were based upon the total number of errors in response to 15 slides at three separate degrees of difference in the case of both the Closure and the Figure-Ground tasks and in response to 20 slides, each at three different time intervals in the case of Perceptual Speed. In no instance did this group of subjects average more than two errors per each set of slides and in six of the nine cases the group averaged less than one error per slide set. These findings suggested that each set contained an insufficient number of slides of average or greater-than-average difficulty for the subjects tested.

3. Intra-correlations for Fourteen Variables: Intra-correlations for the first sample for fourteen variables: sex, age, three measures of ability,

TABLE I. Means and standard deviations for 14 variables of the first test run (N = 29).

Variable	Mean (Scores)	Standard Deviation
Sex	1.483	0.508
Chronological Age	82.483	11.593
PPVT	101.552	20.383
CMMS	91.928	10.495
DAP	95.483	15.670
Closure Items		
Unstructured	0.586	1.210
Midstructure	0.310	0.712
Complete	0.379	0.622
Figure-Ground Items		
Accented Ground	1.000	1.309
Midpoint	0.690	1.004
Accented Figure	0.655	1.010
Perceptual Speed (seconds)		
.20	2.000	1.648
.50	1.310	1.339
1.00	0.862	1.381

three of closure, three of figure-ground, and three of perceptual speed were obtained, showing the typically positive relations of age with ability and the anticipated tendency of older children making fewer errors on the perceptual tasks than younger children. Scores on the ability tests were similarly related to scores on the perceptual tasks; the more mature child (i.e. the child with the higher scores on the ability tests) tended to make fewer errors.

In general, as presented in Table II the relations among scores on the perceptual tasks were positive; however, there was little if any tendency evident for scores on a given perceptual task to be more highly related to scores on other divisions of the same task than with scores on divisions of the other two tasks. Such a finding would be expected if, functionally, the three tasks (closure, figure-ground, and perceptual speed) were different measures of the same basic ability. Such a finding would also be expected if the measures were unreliable.

Obviously, the number of subjects making up this test sample was too small, and the distribution of response was too limited (especially in the case of the variables of the experimental battery) to expect any stability of clustering of the variables for the experimental battery. Despite these conditions a principal component analysis of the data was employed primarily to test out the analytic procedure and also to see if any tendencies in direction were evident. Therefore, those components whose eigenvalues equaled or exceeded 1.00 were rotated by the varimax procedure. The four factors, if they can be dignified in this way, are presented in Table III. Factor I was almost completely determined by response to one of the sets of closure slides. Factor II had high loadings on one of the sets of figure-ground slides, on two of the perceptual speed measures, and on performance on the PPVT. Factor III had high loadings on all of the perceptual tasks. The last factor loaded highly on age, the three measures of ability, and one of the sets of closure slides.

B. Discussion:

Analysis of the first set of data suggested that the three perceptual tasks were measured by items which were consistently too easy for the subjects tested. It was decided that the items could be made

TABLE II. Intracorrelations matrix for the 14 variables of the first test run.

Variable	Sex	C.A.	Ability Tests: PPVT (raw)	Ability Tests: CMMS (raw)	Ability Tests: DAP (raw)	Closure: Unstructured	Closure: Midstructured	Closure: Complete	Figure-Ground: Accented Ground	Figure-Ground: Midpoint	Figure-Ground: Accented Figure	Perceptual Speed (seconds): .20	Perceptual Speed (seconds): .50	Perceptual Speed (seconds): 1.00
Sex	1.000	-.204	.098	-.252	-.248	.220	.065	.304	-.107	.164	.266	.128	-.018	-.004
C. A.	-.204	1.000	.470	.733	.634	-.204	-.023	-.418	-.332	-.426	-.592	-.396	-.231	-.321
Ability Tests														
PPVT (raw)	.098	.470	1.000	.423	.433	-.037	.019	-.294	-.376	.129	-.422	-.380	-.518	-.389
CMMS (raw)	-.252	.733	.423	1.000	.577	-.231	-.270	-.456	-.456	-.327	-.486	-.458	-.328	-.358
DAP (raw)	-.248	.634	.433	.577	1.000	-.234	-.148	-.378	-.200	-.204	-.483	-.250	-.190	-.328
Closure														
Unstructured	.220	-.204	-.037	-.231	-.234	1.000	.237	.453	-.045	.478	.609	.645	.060	.520
Midstructure	.065	-.023	.019	-.270	-.148	.237	1.000	.289	.421	.140	.005	.183	.158	.299
Complete	.304	-.418	-.294	-.466	-.378	.453	.289	1.000	.088	.252	.500	.418	.111	.146
Figure-Ground														
Accented Ground	-.107	-.332	-.376	-.456	-.200	-.045	.421	.088	1.000	.217	.108	.265	.407	.553
Midpoint	.164	-.426	.129	-.327	-.204	.478	.140	.252	.217	1.000	.419	.475	.032	.457
Accented Figure	.266	-.592	-.422	-.486	-.483	.609	.005	.500	.108	.419	1.000	.644	-.024	.400
Perceptual Speed														
.20	.128	-.396	-.380	-.458	-.250	.645	.183	.418	.265	.475	.644	1.000	.130	.439
.50	-.018	-.231	-.518	-.328	-.190	.060	.158	.111	.407	-.032	-.024	.130	1.000	.506
1.00	.004	-.321	-.389	-.358	-.328	.520	.299	.146	.553	.457	.400	.439	.506	1.000

TABLE III. Factors extracted from correlation matrix for 29 subjects of the first test run.

Variable	FACTOR I	II	III	IV
Sex	.384	.395	.045	.559
Age	.128	.279	-.237	-.771
PPVT (raw)	.395	.698	-.014	-.439
CMMS (raw)	-.171	.363	-.193	-.739
DAP (raw)	.011	.214	-.104	-.758
Closure				
Unstructured	.093	.064	.874	.138
Midstructure	.810	-.260	.158	.066
Complete	.140	.047	.361	.638
Figure-Ground				
Accented Ground	.344	-.765	.774	.122
Midpoint	.224	.009	-.052	.140
Accented Figure	-.262	-.032	.576	.565
Perceptual Speed (seconds)				
.20	-.044	-.231		.263
.50	.068	-.748		.138
1.00	.158	-.647		.052

more difficult in a number of ways. Greater complexity could be obtained by decreasing the amount of structure in the closure slides, by further accenting the ground in the figure-ground slides, and by increasing the speed of the perceptual speed presentations. By the same token, the items could be made more difficult by making more similar the alternatives from which the child is to select his answers. A third means of increasing the apparent difficulty of the tasks would be to use the present slides with a younger age group.

These findings were discussed with a number of seasoned researchers concerned with similar study objectives. A specialist on learning theory, for example, suggested that possibly children with known learning problems may have less difficulty responding accurately and correctly to the kinds of stimuli presented because they would have less interfering information to scan than children who normally would associate complex and abstract identifications with each stimulus prior to response. Another suggestion was to view perceptual speed from the opposite end of the continuum, where delay in response would be controlled by increasing the amount of the time interval between the projection of the stimulus and the presentation of the response card, providing a measurement of retention rather than speed of response. A specialist on child development recommended using the experimental battery with younger children to test lower developmental levels, since the limited age distribution at the upper levels may not be enough to render differences in response. These variations in interpretation led to a series of discussions by the project staff terminating in the following conclusions:

C. Conclusions:

1. The experimental battery should be run on a small pilot sample of younger children (3- to 6-year olds) to obtain added information about the lower developmental levels of the experimental items.

2. If, with a younger group of children, the current experimental battery still failed to differentiate between groups, then the complexity of the experimental battery should be increased in one of several ways: (a) by adding

to the abstract quality of both the closure and figure-ground slides to include more obtuse stimuli (e.g. symbols, abstract forms, variations in the size and shape of familiar objects, letters, words, nonsense forms, etc.); or (b) by varying the speed of the presentation along at least two dimensions: increasing the selected speeds of presentation to 1/50 and 1/100 of a second and increasing the time lag between the presentation of the stimuli and the presentation of the response card for subject identification of stimulus; or (c) by increasing the degrees of closure and figure-ground to seven or eight degrees rather than the original three, providing a wider range of limit for all items.

III. The Second Test Run

Data on the same test instruments were collected on a group of children who were approximately two and one-half years younger than the first group tested. The second group of subjects was much more homogeneous in age than the first group; approximately two-thirds of the group were within four months of the average age of 53 months.

A. Results:

1. The Standard Battery: The mean of 78 on the PPVT indicated that this group was performing at a low average level (cf. Table IV). As was true in the first group, a marked difference was present between the mean scores of this group on the PPVT and on the CMMS, however, the discrepancy at this younger age was in the opposite direction. Again the question was raised as to whether these tests were standardized on comparable groups or whether the instruments were measuring quite different abilities. The average score for the DAP, as for the first sample, fell approximately halfway in between the means for the other two instruments.

2. The Experimental Battery: The means and standard deviations for the nine sets of slides in the initial Experimental Battery for this group were compared with those obtained on the first 28 subjects, and in every instance the mean number of errors and the standard deviation of the error scores were greater for the younger group. Nevertheless, the average number of errors did

TABLE IV. Means and standard deviations for the 14 vairables of the second test run (N = 20).

Variable	Mean	Standard Deviation
Sex	1.500	.513
Age	53.100	4.154
PPVT	77.750	15.657
CMMS	94.556	13.187
DAP	87.231	10.872
Closure		
Unstructured	1.700	1.976
Midstructure	0.400	0.821
Complete	0.600	0.995
Figure-Ground		
Accented Ground	1.850	1.663
Midpoint	1.900	2.426
Accented Figure	2.500	2.965
Perceptual Speed (seconds)		
.20	2.800	2.118
.50	2.842	2.672
1.00	1.684	2.162

not exceed three out of fifteen in any of the nine tasks. Thus, it appeared that even for four-year olds the slide sets lacked sufficient complexity.

3. Intra-correlations for Fourteen Variables: The intra-correlations among the 14 variables for the second group (cf. Table V) as for the first group, showed a positive relation was present between age and scores on the ability tests, but the relations were much smaller. In contrast to the finding on the first group, a consistent relation was not evident between age and scores on the perceptual tasks. This could be explained in terms of the homogeneity of the younger sample with respect to age (the standard deviation of age was only one-third of that of the first group).

The change in the relation between scores on the ability tests and scores on the perceptual tasks were less easily explained. One explanation could be the homogeneity of the group in maturity, a fact reflected both in reduced variability in test performance as well as in chronological age.

Somewhat higher intra-relationships tended to characterize the nine perceptual measures for the second than for the first group. Again age changes in dispersion could be an important factor in accounting for changes in the magnitude of the relations. Except in the case of the measures of closure, the variability of performance was markedly increased rather than decreased. As noted earlier, this could be due to the relative increase in the difficulty of these items for this younger age group.

The number of subjects involved in this group was even smaller than in the first set of data, and although still very limited, the distribution of response was less restricted in this second sample for the nine variables of the experimental battery. Neither of these conditions could be considered to lead to more stable clustering of the variables although principal components analysis was again employed. Using the same criteria as in the first set of data (cf. Table VI), the question of dignifying these factors notwithstanding, five factors were obtained. Loading highest on Factor I were the three figure-ground and three perceptual speed measures. The second factor was predominantly

TABLE V. Intracorrelations matrix for 14 variables of the second test run.

Variable	Sex	C.A.	Ability Tests			Closure			Figure-Ground			Perceptual Speed (seconds)		
			PPVT (raw)	CMMS (raw)	DAP (raw	Unstruc-tured	Midstruc-ture	Com-plete	Accented Ground	Mid-point	Accented Figure	.20	.50	1.00
Sex	1.000	.173	-.116	-.320	-.427	-.208	-.000	.309	.092	-.169	-.173	-.291	-.098	-.142
C.A.	.173	1.000	.287	.434	.408	-.291	.281	.061	-.082	.058	.184	.074	.250	.158
Ability Tests														
PPVT (raw)	-.116	.287	1.000	.446	.451	-.429	-.141	-.139	-.204	.173	.072	.213	.328	.084
CMMS (raw)	-.320	.434	.446	1.000	.504	-.049	.055	-.378	-.241	-.080	.036	-.029	.102	.050
DAP (raw	-.427	.408	.451	.504	1.000	-.346	-.120	.264	.492	.156	.286	.528	.566	.240
Closure														
Unstruc-tured	-.208	-.291	-.429	-.049	-.346	1.000	.305	-.171	.082	-.018	.090	-.015	-.142	.069
Midstruc-ture	-.000	.281	-.141	.055	-.120	.305	1.000	.142	.162	-.005	.108	-.012	.106	.507
Complete	.309	.061	-.139	-.378	.264	-.171	.142	1.000	.344	-.148	-.196	-.115	.097	.088
Figure-Ground														
Accented Ground	.092	-.082	-.204	-.241	.492	.082	.162	.344	1.000	.440	.518	.215	.326	.229
Midpoint	-.169	.058	.‗73	-.080	.156	-.018	-.005	-.148	.440	1.000	.827	.559	.606	.602
Accented Figure	-.173	.184	.072	.036	.286	.090	.108	-.196	.518	.827	1.000	.696	.624	.650
Perceptual Speed (seconds)														
.20	-.291	.074	.213	-.029	.528	-.015	-.012	-.115	.215	.559	.696	1.000	.813	.593
.50	-.098	.250	.328	.102	.566	-.142	.106	.097	.326	.606	.624	.813	1.000	.606
1.00	-.142	.158	.084	.050	.240	.069	.507	.088	.229	.602	.650	.593	.606	1.000

TABLE VI. Factors extracted from correlation matrix for 20 subjects of the second test run.

Variable	FACTOR I	II	III	IV	V
Sex	-.340	-.085	-.855	-.150	-.064
Age	.058	.037	-.390	.741	.082
PPVT (raw)	.377	-.434	-.227	.736	-.071
CMMS (raw)	-.036	-.176	.209	.929	.105
DAP	.300	.574	.164	.656	-.304
Closure					
Unstructured	-.093	-.197	.800	-.342	.229
Midstructure	-.026	.054	.176	.055	.956
Complete	-.180	.868	-.262	-.167	.074
Figure-Ground					
Accented Ground	.450	.802	.159	-.184	.063
Midpoint	.952	-.037	-.055	-.114	.101
Accented Figure	.930	-.019	.102	.089	.027
Perceptual Speed (seconds)					
.20	.878	.056	.201	.172	-.250
.50	.830	.149	.012	.243	-.205
1.00	.798	.118	.107	.105	.477

determined by loadings on one of the closure measures and one of the figure-ground variables. The variables characterizing Factor III were sex and response to one of the sets of closure slides. Factor IV appeared as basically a maturity dimension with high loadings on age and on the three ability measures. The fifth factor appeared to reflect, almost completely, the closure variable not included in the earlier factors.

B. Discussion:

The analysis of the second set of data indicated that the three perceptual tasks, as designed, were consistently too easy, even for children at the earliest age at which it could be expected that they typically would be used. Consequently, it appeared necessary to increase the difficulty of the tasks if they were to have general value for use with older children. It appeared possible to do this by systematically decreasing the structure in the closure slides and adding more degrees of interference to the figure-ground slides. In addition, if the response cards were to contain more similar alternatives from which to select, the difficulty level could be increased additionally.

C. Recommendations:

The following recommendations were made as the result of a review of the study by invited consultants from various disciplines (psychology, medicine, special education, school administration, speech pathology).

1. The experimental battery should be adapted to provide additional items of average and greater-than-average difficulty. The method recommended for adaptation was to increase the complexity of the slides to provide seven or eight degrees of closure and figure-ground discrimination, instead of the original three degrees, in order to provide a wider range of limit for all items. The aspect of perceptual speed should be set aside for subsequent study.

2. The adapted experimental battery and the selected battery should be run on a much larger sample (approximately 200 subjects) of young children (3- to 6-year olds) to obtain additional information about the lower developmental levels of the experimental items.

APPENDIX D

Forms Used for Recording Raw Data

Information Form Used with
Nursery School Sample

Subject No.___

HEALTH AND FAMILY HISTORY

Name of Child_______________________ Birth Date______________

Has child been under regular supervision of a physician?_____

Immunizations: Please indicate whether given and approximate date.

Diptheria__________________ Tetanus____________________
Small pox__________________ Whooping cough______________

Past Illnesses: Check those child had has--give approximate date:

Chicken pox________________ Epilepsy____________________
Hay fever__________________ Asthma______________________
Whooping cough_____________ Diabetes____________________
Measles____________________ Rheumatic fever_____________
Mumps______________________
Other serious or severe illnesses or accidents:______________

____

Does child have frequent colds?___ How many during last year?

Is child allergic to fruit juices or wheat in crackers?______

List child's brothers and sisters:

Name	Age	Grade in School	Health

Marital status of child's parents:
Married___ Widowed____ Separated____ Divorced______

Has child had group play experiences?____ Type______________

How does child get along with other children?_______________

With brothers and sisters?__________________________________

Does child have any special problems--fears?________________

____

List other members of household:

Name	Relationship

Father's Occupation:____

Information Form Used with Head Start Sample

Subject No.___ Site No.___ Teacher____________________

Child's Name________________________ Birthdate______________
Last First Middle Month Day Year

Child's Address______________________________________
Street City County

Date Tested_______________

Parent or Guardian____________________ C.A. Tested_____ ___

Child's Sex: ___Male ___Female

Ethnic Group:
- __Mexican-American Caucasian
- __Other Caucasian
- __Negro
- __American Indian
- __Oriental
- __Puerto Rican
- __Other

Child's Birthplace:____________________

Speaks English: ___Yes ___No
If no, what language is spoken?__________

Father living in home: __Yes __No

Father's Education:___________ Father's Occupation:_________

Mother living in home: __Yes __No

Mother's Education:_________ Mother's Occupation:___________

Guardian's Education:_______ Guardian's Occupation:__________

Average monthly family income (in dollars)_______________

Number of persons in child's family, including child:________

Number of children in home of school age:_______________

Number of months child enrolled in Head Start Program:_______

Results of other examinations available:

Medical:______________________________

Psychological:_________________________

Other:________________________________

Other pertinent information:___________________

____

____

Form For Recording
Observation of Behavior During Testing

Subject No. ____

Name of Child ______________________ Date Tested ____________________

Examiner(s) ____________________ Birth Date ______________ C.A. ________

Geometric Designs

A. Hand Preference:
__1R __2L __3A __4B

B. Reproduction of forms:

A ○	B +	C □	D △	E ◇	
					1. Can draw form with standard instructions
					2. Must observe examiner's copy
					3. Requires motor patterning
					4. Unable to perform
					5. Perseveration

C. Posture:
__1. Normal __2. Abnormal
Describe ____________________

D. Pencil Control (Fine Motor):
__1. normal grasp
__2. abnormal grasp
__3. tremors
Describe ____________________

E. Extraneous Motor Behavior:
__1. Overflow (tongue, hands, mouth, head)
__2. Tics (head, mouth, eyes)
__3. Tapping (foot, hands, fingers)
__4. None
Describe ____________________

F. Dominance (3 trials):

	1	2	3	
A.	__	__	__	Hand Preference
B.	__	__	__	Foot Preference
C.	__	__	__	Eye Preference

Describe ____________________

Response to Test Situation
(circle "yes" or "no")

G. Locomotor Function

	A. Gait	B. Stance	C. Balance
Normal			
Abnormal			

Describe: ____________________

H. Participation in Test Situation:
yes no 1. refuses to participate
yes no 2. reluctant to participate
yes no 3. participates when encouraged
yes no 4. unconcerned but does not volunteer to participate
yes no 5. volunteers to participate

I. Attention to Task:

	C	G	P
yes no 1. distractible			
yes no 2. hyperactive			
yes no 3. perseverative			
yes no 4. short attention span			
yes no 5. attention fluctuates			

J. Test Performance:

	C	G	P
yes no 1. destructive to test materials			
yes no 2. aggressive toward examiner			
yes no 3. conforms to test requirements			
yes no 4. eager to participate			

(C = Columbia; G = Geometric Designs
P = Peabody)

K. Record other observations on back of page; check below:
yes no Additional observations recorded

Form for Recording Articulation

Name ______________________ Subject No. ______________________

Date ______________________ Examiner ______________________

Have the child read the words or repeat them after you. Indicate substitutions by writing the substitution following the word. Use a dash to indicate omissions. Test one sound at a time. After completing test, repeat each error sound and circle to determine if it can be produced adequately in isolation. S=substitution; D=distortion; O=omission

3½ YEAR LEVEL

		S	D	O		S	D	O		S	D	O
P	pin				apple				nap			
B	boy				baby				Bob			
M	map				mama				home			
H	home				••••				••••			
W	win				away				••••			

4½ YEAR LEVEL

		S	D	O		S	D	O		S	D	O
T	tine				kitty				hat			
D	dog				daddy				mud			
N	no				ant				pin			
K	come				O.K.				book			
G	go				wagon				dog			
NG	••••				ink				king			
Y	yes				••••				••••			

5½ YEAR LEVEL

		S	D	O		S	D	O		S	D	O
F	fan				coffee				muff			

6½ YEAR LEVEL

		S	D	O		S	D	O		S	D	O
V	vine				oven				five			
TH	that				mother				bathe			
ZH	••••				measure				garage			
SH	shoe				washing				wish			
L	lady				yellow				ball			

7½ YEAR LEVEL

		S	D	O		S	D	O		S	D	O
CH	church				matches				watch			
J	jump				magic				edge			
TH	thin				birthday				bath			
S	zun				sister				bus			
Z	zero				busy				buzz			
R	robin				cherry				bear			
HW	white				••••				••••			

Blends:

	S	D	O		S	D	O		S	D	O
play				twenty				class			
pray				truck				glass			
blank				dress				green			
bread				quick				flower			
								fry			
TOTAL SDO											

Form for Recording Responses on
Experimental Battery

Subject No.__

SET I*

Name ______ Date ______ Examiner(s) ______

Figure-Ground	0	1	2	3	4	5	6	7	8	Row Total
	Degrees									
1. chicken										
2. football										
3. wagon										
4. basket										
5. bottle										
6. book										
7. boat										
8. duck										
9. cup										
10. hat										
									Total	

Figure-Ground Homogeneous	0	1	2	3	4	5	6	7	8	Row Total
	Position									
1. ice cream										
2. bowl										
3. fish										
4. saw										
5. mitten										
									Total	

Visual Closure	0	1	2	3	4	5	6	7	8	Row Total
	Degrees									
1. bunny										
2. dog										
3. airplane										
4. table										
5. horse										
6. baby										
7. engine										
8. soldier										
9. man										
10. boat										
									Total	

Closure Homogeneous	0	1	2	3	4	5	6	7	8	Row Total
	Position									
1. truck										
2. bed										
3. cat										
4. boy										
5. cow										
									Total	

N.B. Place check (✓) in box at which correct response made.
Two consecutive correct responses necessary before proceeding to next slide in series.
*Items randomized to provide three orders of presentation: i.e. SET I, SET II, SET III.