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AN INVESTIGATION OF THE RELATIONSHIP BETWEEN APHASIA AND SENSORIMOTOR LEVEL COGNITIVE FUNCTIONS

by

Patty Trapp Earle

A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
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Approved by

Dissertation Advisor

APPROVAL PAGE

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ABSTRACT

EARLE, PATTY TRAPP. An Investigation of the Relationship Between Aphasia and Sensorimotor Level Cognitive Functions. (1977)
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It is the purpose of this study to investigate the relationship between the level of severity of aphasia and the classification of aphasia, as determined by the Boston Diagnostic Aphasia Examination, and the ability to perform sensorimotor level cognitive tasks as determined by the Uzgiris-Hunt Assessment in Infancy: Ordinal Scales of Psychological Development, adapted for use with an adult aphasic population. It is hypothesized that a disturbance of preverbal perceptual functioning is demonstrated in the responses of the aphasic subjects to the measures of sensorimotor function; that there is a positive relationship between the degree of severity of aphasia and the degree of impairment of sensorimotor functions as measured on seven different scales; that the greater the degree of severity of linguistic disturbance in the aphasic, the lower the scores obtained on each of the seven scales; that there is a significant difference between the classifications of aphasia with regard to the scores obtained on the seven measures of sensorimotor function; that the combination of sensorimotor scale measures will explain a significant proportion of the variance in the degree of severity of linguistic disturbances; and that the

combination of sensorimotor scale measures will explain a significant proportion of the variance in classifications of aphasia.

The subjects included medically diagnosed aphasics with functional use of vision, hearing and the unaffected left hand, who were at least six months posttrauma, with no history of prior senile behavior. The subjects were obtained from skilled nursing and intermediate care factilities in Greensboro, North Carolina and volunteers from the community; and from the acute care, skilled nursing care, intermediate care, domiciliary, and outpatient facilities of the Veterans' Administration Center in Dayton, Ohio. A minimum number of five subjects was included in each classification of aphasia and in each level of the Severity of Aphasia Index.

The data were analyzed by means of the Spearman Rank-Order Correlation Coefficients, a Univariant F-Ratio, a stepwise multiple regression analysis, and a discriminant analysis.

All of the hypotheses were supported by the data. The associations in Hypotheses 2, 4, 5, and 6 reached a significance of $p < .05$ and beyond, and were in a positive direction.

The results suggested that sensorimotor disturbances were present in some adult aphasics; that there is a significant positive relationship between the degree of severity of aphasia and degree of sensorimotor disturbance, and between

diagnostic classifications and degree of sensorimotor disturbance.

The best predictor of both severity and classification was the Development of Means for Obtaining Desired Environmental Events, Scale-II.

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CHAPTER I

INTRODUCTION

The cognitive behavior described by Piaget in the sensorimotor and preoperative levels of cognitive development seem to be remarkably similar to the cognitive behavior exhibited by the adult aphasic. This observation suggests several questions about the nature of brain damage and its effect upon cognitive functioning. These questions are the following: (1) Does damage to the dominant hemisphere of the cerebral cortex in the adult result in decompensation of cognitive processes of a preverbal perceptual nature? (2) Is there a relationship between disturbances of linguistic function and disturbances of perception of a preverbal nature? (3) If decompensation of preverbal perceptual cognitive processes occurs, is the language disturbance related to this as well as to the localization of the specific damage to discrete areas thought to control various speech and language functions? (4) Can the descriptions of cognitive functions at each stage, as provided by Piaget, be applied to the behavior of the aphasic to ascertain the level of cognitive development at which he is functioning?

In 1861, Broca defined aphasia as "a loss of speech consequent to lesion of the frontal lobe of the brain" (Eisenson, 1973, p. 22). Jackson, a contemporary of Broca,

also considered aphasia to be an impairment of linguistic formulation and expression, but he directed his attention more to the differences between the kind of language content that remains relatively available for most aphasics and the nature of the speech content that is most severely impaired. Jackson believed that the differences were related tc the intellectual level and the manner in which the linguistic formulations were used. He observed that the aphasic becomes "lame in his thinking" (Eisenson, 1973, p. 23).

Sigmund Freud, very much influenced by Darwin and by the writings of Jackson, viewed aphasic disturbances as evolutionary retrogression of a highly organized apparatus, and therefore corresponding to earlier states of its functional development (Freud, 1891, p. 87).

Perhaps if Freud's views had had more positive influence on his colleagues concerned with aphasia, research and treatment modalities might have been different today, but Freud was virtually ignored. In the historical survey done by Head in 1926, his work is not even mentioned. Head (1926) believed that the aphasic is impaired in the mechanism whereby "various mental activities are brought into play and the intelligence suffers insofar as it requires the integrity of verbal functions" (Wepman, 1976, p. 133). One of Head's contemporaries, Marie (1922) also held that aphasia was a general defect of intelligence.

In 1942, Goldstein proposed that an aphasic individual was one whose behavior revealed a change from the ability to use an 'abstract attitude', to perceive generalizations and deal in concepts, and "to separate and project himself from the 'demands' of the immediate present to broader and nonimmediate considerations toward one of concretism" (Eisenson, 1973, pp. 24-25). Goldstein believed that even though these behavioral changes are expressed in language, they are symptoms of intellectual change associated with cerebral damage and aphasia (Eisenson, 1973, p. 25).

Strauss and Lehtinen (1947) maintained that all brain lesions, wherever they are localized, are followed by a similar kind of disorder of behavior, thinking and perception. These authors described a number of symptoms which include:

> ...constant fluctuations in thinking which the patient attempts to counteract with meticulosity ...undue fixation of attention upon irrelevant external stimuli; and fluctuations in the perception of object and ground, with efforts on the part of the patient to make substitutions and detours in order to make an unconscious adaptation. This is the patient's way of ordering the external world in such a way that a positive result can be obtained (p. 20).

Wepman, (1951) lists 34 nonlanguage deviations observed in the aphasic. Among these were loss of attention and concentration, loss of memory, reduced association of ideas, abstract-concrete imbalance with the loss of ability to abstract, poor organizing ability, constriction of thought

and interest, reduced ability to generalize, categorize, group or plan future action, a reduced general level of intelligence, inability to shift, psychomotor-retardation, and regression to infantile behavior (p. 33). These characteristics seem to describe the cognitive functioning of the child in the sensorimotor or preoperational stages of development.

An additional source for answering the questions at the beginning of this paper is an autobiographical sketch done by a speech pathologist who was also an aphasic, having been wounded during World War II. Hall (1961, p. 174) wrote "My earliest posttraumatic memory started when, one by one, beds with white sheets began to appear. These beds appeared from nearby, extending to what seemed like infinity." Can this be considered as absence of object differentiation from self which is found in substages one and two of the sensorimotor period?

Hall continued writing, "Soon thereafter the tent canopy became isolated from the beds" (p. 174). Could this be the beginnings of object substance, permanence and differentiation as described by Piaget for the third and fourth substages of the sensorimotor period?

"Later, moving forms began to appear in the beds..." (p. 174). Ginsberg and Opper, (1969) in describing the fifth substage of the sensorimotor period stated, "...infant is able to follow the object's movements perceptually and believes in its permanence and continued existence" (p. 63).

He continued to describe the early days of his recovery. One can see continued commonalities between his descriptions and the sensorimotor stage in general.

> An awareness of events involving myself followed when someone approached the foot of my bed and scratched the bottoms of my feet... I heard bedside conversations...These were audible, but without meaning, and did not interest me. Again these things seemed to happen because my world was thus...Sometime later, doctors, nurses, and orderlies...became recognizable by their functions...Their efforts to communicate with me were met with silence. Speech communication appeared to be a function of the general populace. It had neither meaning nor function for me (Hall, 1961, p. 175).

Later, after some time in the hospital, he told of more changes, as if he had begun to move into the early preoperational stage.

> ...When I attempted to talk with others, their facial expressions, as well as vocal tones, changed. Their responses seemed inappropriate. Intermittent comprehension became total comprehension. I understood what they said. They did not understand my speech...Time in terms of hours, minutes, and seconds had no meaning for me (Hall, 1961, p. 175).

Two years after the accident that wounded him, he seemed to have reached the concrete operations stage. He wrote,

> ...While talking during walking were incompatible with my simultaneous thought processes; my penmanship was legible if read in context. In the speech clinic I engaged in semantic discussions...(p. 175).

The question of whether language disturbance is related to the occurrence of decompensation of cognitive

function seems also to depend upon one's concept of the origin of the language development process. Piaget and his followers suggested, "...It is probably fair to say that the child's thought depends less on his language than his language does on thoughts" (Ginsberg & Opper, 1969, p. 85).

Significance of the Study

If it can be shown that disturbances of perception of a preverbal nature are apparent in the individual who suffers aphasia as a result of brain damage, and that these perceptual disturbances are related to disturbances in linguistic function, the findings could conceivably shed light upon the entire process of language acquisition in children. In addition, this information could point the way toward improved methods of speech and language rehabilitation for both adults and children.

CHAPTER II

REVIEW OF LITERATURE

The term aphasia is a general classification. It literally means 'a'--without, 'phasia'--language. However, a complete and total absence of language almost never occurs even in the most extreme cases. The term aphasia shall be used in this paper to refer to an acquired impairment of linguistic function caused by brain damage (Taylor, 1965). The linguistic features impaired are those involved in encoding, processing, or decoding language (Perkins, 1977).

"It is characterized by a reduction and/or dysfunction in vocabulary and/or syntax in oral-aural language use" (Taylor, 1965, p. 101). The term aphasia implies that the patient's linguistic impairment is one of input, or the reception of spoken or written language symbols, and/or output, the transmission of spoken or written symbols of language.

Language is defined as a conventional system of discrete signs representing things, classes of things, aspects of classes, and aspects of things. The words may be written or uttered, read or heard, while the things they represent need not be present (Affolter, 1974). Language in a very narrow sense is rule bound, made up of arbitrary symbols for the purpose of communicating ideas and feelings through vocal

processing to someone who understands the speaker's code.

In order for language to exist, it must contain the following processes: phonology; morphology; syntax; and semantics. Phonology means the significant sounds of a language and the suprasegmental aspects which encompass tonal change, time, juncture, and pitch (Wise, 1968). Just as phonology can be broken down into its parts, semantics, or the intended meaning or full understanding of a word or words can be broken down into units called morphemes. Morphemes follow rules according to the language. Some morphemes are 'free' which means they have full meaning by themselves. Other morphemes are 'bound' and have no meaning unless used with a free morpheme. Bound morphemes may take many forms and be compounded, and can appear as prefixes or suffixes. When morphology becomes ordered it is called syntax, composed of the grammatical rules of a language. The morphological structure combined with syntactical structure become the components of the semantic structure. In order to produce or comprehend language, the human mind must grasp the effects of segmental features or the sounds of the language, supra-segmental features such as intonations and melody pattern, the meanings of words and their subtlties including nuances, and the word order or syntax(Eisenson, 1973). As Brunner (1974) pointed out, human children are able in a startlingly short time to master a language of structural complexity that defies complete formal analysis.

"Any theory that endeavors to explain language development must account for a subtle form of behavior" (Travers, 1977, p. 193).

The Role of Cognition in the Acquisition of Language

In recent years the study of language acquistion has been a source of controversy. At one end of the philosophical question are the nativists represented by such investigators as Lenneburg and Chomsky. At the opposite end of the continuum are the behaviorists, Skinner and Staats. The nativists believe that human beings are born with an intricate innate language mechanism that functions regardless of the environmental influences that exist. The nativists argue that all languages contain common properties of both organization and structure. They call these properties 'universals' and claim that they result from innate mental endowment rather than from learning (Hetherington & Parke, 1975 & Travers, 1977). Lenneberg (1967) proposed that the specific causal elements and the underlying cerebral mechanisms that result in rapid development of language at a specific time period in the child's life are still unknown. However, he suggested that as attention is focused on such occurrences, the direction of research shifts from the external to the internal or from environment to biology. It is therefore possible to perceive language as a biological event which proceeds from genetically determined changes in the maturing child. This capacity for language development

implies that development follows a biological schedule which is activated when a state of 'resonance' exists. The state of resonance occurs when the sounds that he has been hearing suddenly assume a new meaningful pattern (Lenneberg, 1967).

Skinner (1957) took the diametrically opposite point of view. He suggested that the parent first selectively reinforces those parts of the child's spontaneous utterances which are most like adult speech, thereby increasing the frequency of verbalization of these sounds by the infant. He suggested that parental reinforcement serves to shape the child's environment and to shape the child's verbal behavior. At the same time the child becomes capable of self-reinforcement when his utterances match those of his caretaker. The child learns specific sentence frames through generalization. Words and sentences are eventually elicited by appropriate environmental cues through generalization, too.

In Skinner's view the child is portrayed as passively or mechanically responding to environmental stimuli. This theory and similar ones tend to portray language learning as a quantitative increase in learned responses and is not concerned with qualitative changes, nor does it deal with the child's use of abstract rules (Hetherington & Parke, 1975). Staats (1963) suggested a theory similar to Skinner's, proposing that the child learns through secondary reinforcement.

Linguist McNeill (1968) challenged the behavioral theory on the grounds that the rules of language form an

abstract system at the phonological, semantic and syntactic level. They believed rules were never explicitly stated and therefore could not be learned through imitation and/or reinforcement. Stimulus-response mechanisms according to McNeill (1968), are unable to explain how a finite set of rules can generate an infinite system.

The most all-encompassing attack on the entire stimulus-response approach, however, came from the noted linguist, Chomsky (1959). Chomsky argued that the ability to infer deep structure is the critical aspect of language acquisition, and since the deep structure itself is never directly available it cannot possibly be imitated or reinforced.

Linguistic theory has dominated research in language since the appearance of Chomsky's Syntactic Structures (1957). Chomsky maintained that linguistics was part of human cognition and that an adequate theory of language must account for the implicit knowledge that child brings to the task of learning language. In the beginning, research dealt primarily with abstract syntactic structures and viewed these as the basic knowledge underlying competence. This position was greatly revised during the sixties and by the end of that decade the emphasis in language study shifted to meaning and its relation to cognition (Morehead & Morehead, 1976).

Schlesinger (1971) and Bloom (1970) concluded that children's intentional use of language was primarily

important and that these intentions are best described by semantic rather than grammatical relations. Schlesinger and Bloom also agreed with Sinclair (1969, 1971) that these early semantic relations are dependent upon previous developments in cognition. All three of the above investigators believe that the uniformity of early linguistic structures across different children is the result of more general universal cognitive functions. The most complete discussion of these transitions can be found in Brown's A First Language (1973). Brown also observed that cognitive development is closely related to the acquisition of language.

John and Moskovitz (1970) have suggested that systematic studies of language in current literature appear to reflect the developmental theories of Piaget, Brunner and Vygotsky. Current research in the field of psycholinguistics is showing a trend toward analyzing the child's language development in relation to his changing ways of perceiving and thinking about his world. Cognitive theorists, Piaget in particular, have been influential in this regard. The cognitive theorist attempts to link cognitive processes to both the structure and the content of early language (Hetherington & Parke, 1975). "The Piagetian view is that cognitive structures and operations make language acquisition possible" (Cromer, 1976, p. 289).

In terms of structure, a child's linguistic system is just one kind of cognitive system that is not qualitatively

different from other cognitive systems. These cognitive systems are considered to develop in the same way as other cognitive operations. Cognitive theorists also maintain that the content of what children say must also stem from their general cognitive functioning at any given stage in development (Hetherington & Parke, 1975).

"...Language is used to express the child's cognitions of his environment- physical and social...Can one take Piaget as a handbook of psycholinguistic development" (Slobin, 1973, p. 180)?

Piaget's Theory of Cognitive Development

Piaget's theory of cognitive development is based on a set of specific assumptions about the world and man's interaction with it. Some of his major assumptions are (Baldwin, 1967):

1. that biological adaptation occurs in humans;
2. that development is solidly rooted in what already exists and displays a continuity with the past;
3. that structure changes to fit new demands;
4. that adaptations do not develop in isolation, but rather all of them form a coherent pattern so that the totality of biological life is adapted to its environment;
5. that although each species is adapted to its

environment, the particular nature of its adaptation is a function not of its own nature alone, but of the total system;

6. that looking at an object and listening to a sound are actions rather than passive receptive processes;
7. that the external world is independent of a child's perceiving it; and
8. that cognitive equilibrium is necessary to the cognitive process.

Piaget divided the child's development into four main periods (Baldwin, 1967, p. 220): I. Sensorimotor - birth to two years; II. Preoperational - two to seven years; III. Concrete operations - seven to eleven years; and IV. Formal operations - beginning at age eleven years.

The first two stages, Sensorimotor and Preoperational, are the stages critical to the development of language (Ginsburg & Opper, 1969). Piaget described the child as passing through six substages of infancy in the sensorimotor period. These substages are described by Baldwin (1967) as follows:

1. reflex behavior;
2. new schemes that are extensions of these reflex patterns, but have new end results;
3. new behavior patterns which occur accidentally in the course of random movement and reproduce or

prolong an external event;

4. intentional activities and putting together sets of schemas in a means-end relationship;
5. intentional variations of behavior to produce new behavior; and
6. possibility of mental representation.

The preoperational period is the stage when conceptualization takes place and cognitive representation occurs. The first step is the development of mental images and the second step is the development of an imagery mechanism that is servicable for picturing and predicting the effects of various changes. Linguistic structuring is predicated upon this skill (Cromer, 1976).

The Relationship Between Cognitive Development and Language Development

Piaget suggested that language builds upon the cognitive abilities which arise in the sensorimotor period (Cromer, 1976), and therefore does not begin to emerge until about 18 months of age. Cromer cited the work of Sinclair (1971) in defining the sensorimotor schemata that underlie or account for corresponding linguistic abilities observed in language acquisition. These sensorimotor schemata include: (1) the child's ability to put things in a spatial or temporal order which has as its linguistic equivalent the child's ability to later link together a series of linguistic

elements; (2) the child's ability to classify things in action, as he does when he uses a whole category of objects for the same action, or alternatively applies a whole catagory of action schemata to one object, which has as its linguistic counterpart the categorization of linguistic elements into catagories like noun phrases and verb phrases; (3) the ability to relate objects and actions to one another, which develops during the sensorimotor stage, and is the underlying ability that allows for the functional grammatical relations of 'subject of' and'object of'; and (4) those action schematas and their coordination which are available at the end of the sensorimotor period have certain structural properties that make it possible for the child to comprehend and produce language (Sinclair, 1971).

It has already been noted that the components of any language system includes phonology and morphology; syntax; and semantics. Can a cognitive theory of language acquisition account for the way in which these phenomenon evolve?

Phonology and morphology. Ingram (1976) has outlined specific phonological stages that correspond to the stages of development proposed by Piaget and described in Flavell's 1963 work. Ingram suggested that during the sensorimotor period, usually considered to occur from birth to age two years, two specific stages of phonological development occur. The first phonological stage he labeled preverbal vocalization and perception which occurs from birth to one year of

age. Stage two occurs from 12 months to 18 months and is called the phonology of the first 50 words.

During the period labeled preconcept and intuitional subperiod by Flavell (1963) and generally referred to in the literature as the preoperational stage, or the years from two until seven years, Ingram defined two more phonological stages - the stage of phonology of simple morphemes from 1.6 months to four years, during which vocabulary increases rapidly as the child develops a system of speech sounds, using a variety of phonological processes to simplify speech, and the stage of completion of phonetic inventory from four years to seven years by which time simple words are usually pronounced correctly, and more complex words are often poorly pronounced.

Ingram (1976) further suggested that during the concrete operations stage from seven to twelve years, a fifth phonological stage occurs which he called the morphophemic development stage, and during the period of formal operations from 12 to 16 years he described the sixth and last stage of phonological development as that of acquisition of spelling.

In the morphophemic development period more complex derivational morphology of language is acquired and rules such as Vowel Shift become productive. The final stage of phonological development as described by Ingram occurs when the child develops the ability to spell the complex words of his language and also during this period, he/she develops linguistic intuitions.

Semantics. Bloom (1970) and Nelson (1973) provided some empirical support for the position that there is a strong relationship between semantic and cognitive development. This position is also reflected by Furth (1964, 1969), Brown (1972), Cromer (1976), and by implication, even the work of Chomsky (1957).

Syntax. Slobin (1973) postulated a number of basic operating procedures used by children to construct the grammar of a language. He reached this conclusion from cross-cultural studies of children learning different languages. According to Slobin, these procedures are dependent upon the child's level of cognitive function. "...The first linguistic forms to appear in child speech will be those which express meanings consistent with the child's level of cognitive development" (Slobin, 1973, p. 181).

> The major implications of the cognitive approach to language is that the regularities observed in language development around the world may perhaps be accounted for in terms of regularities already demonstrated of a more general cognitive process (Hetherington & Parke, 1975, p. 236).

Clark (1974) reported some interesting ideas regarding the relationship between developing perceptual-cognitive performances and language development which have some clinical correspondence to aphasic language performance.

If a cognitive theory of language acquisition is accepted as an explanation of this developmental phenomenon, then it is also logical to suggest that there is a relationship between disturbances of language function and the

cognitive skills upon which language functions are predicated. Aphasia is a classical condition of disturbance of linguistic function.

The State of Current Knowledge About Aphasia

The theory of aphasiology has produced voluminous literature. This is probably due to the fact that three large and independent groups have participated in aphasiologic research. These groups are the fields of neurology, psychology, and pedagogy (Luchsinger & Arnold, 1975).

The phenomenon of linguistic disturbance due to brain injury is as old as recorded medicine. Benton's review (1964) established that most of the currently recognized aphasia symptoms were described before the nineteenth centure. The modern history of aphasia dates back to 1861 when Broca presented evidence for the localization of motor aphasia in his now classic work "Perte de la parole. Ramollissement chronique et destruction particelle der lobe anérieur gaucha de cerveau", appearing in Bulletin de la Societé d'antropologie, II, 235-238. As a result of the work of such people as Broca, and his contemporary Wernicke, along with other ninteenth-century colleagues, "...certain organic impairments of language functions were finally grouped together under the term 'aphasia' and recognized as distinct from the other intellectual impairments which might accompany them..." (Goodglass & Kaplan, 1972a, p. 1).

Theoretical Foundations

The first professional group to study and classify dysphasic syndromes were the neurologists. They were pathologically oriented, and tended to adhere to a theory of anatomic localization. This localization theory attempted to classify the various aphasic losses according to certain regions of the brain cortex. Freud, who published a classification of aphasias in 1891, was the first to question the centralizing theory. He was joined in his dissent by such well-known neurologists as Marie (1922) and Jackson (1932). They represented a psychodynamic viewpoint (Eisenson, 1973).

In 1948, Goldstein developed his doctrine of psychopathologic interpretation of aphasic language losses and emphasized the loss of abstract behavior and the regression to purely concrete reaction under the pressure of catastrophic brain function following an aphasic language loss (Luchsinger & Arnold, 1965). His was the first regression hypothesis.

Today, in the field of aphasiology, the holistic viewpoint of Gestalt psychology is stressed. It is characterized by a functional-dynamic and global approach (Wepman, 1970).

> Normal humans possess the same basic brain organization with the same type and number of convolutions. What differs individually is the relative size and development of certain functional areas..., (for) all men have the same brain

> anatomy, but they learn to speak, write, and read only when their environment offers these skills, and when they can hear and see enough to perceive them. Hence, specialized function reflects the interplay of generic evolution and individual learning (Luchsinger & Arnold, 1965, p. 707-708).

All aspects of expressive and receptive communications represent both primary and secondary cerebral functions.

> Primary cerebral functions pertain to the original inborn organization of the brain and are carried out by specific effector organs...Secondary brain functions developed at an evolutionary stage when the organization of the human brain was essentially completed (Luchsinger & Arnold, 1965, p. 708).

When damage occurs in the cerebrum, particularly centers within the cortex, integrating functional patterns can be disturbed, resulting in aphasia.

Causes of Aphasia

"In adults, aphasia is caused chiefly by vascular, tumorous, inflammatory, or infectuous brain diseases" (Luchsinger & Arnold, 1965, p. 710). The most common cause is the cerebrovascular accident or stroke. Brain damage resulting in aphasia may also occur as a result of occlusion of the internal carotid artery on the dominant side.

"Aphasia may also occur as a result of any other type of skull injury, when the language areas become damaged by inflammation, hemorrhage, compression, or abscess formation" (Luchsinger & Arnold, 1965, p. 710). The symptoms of

aphasia are the same regardless of the etiology of the brain damage.

Symptoms of Aphasia

Normal language depends upon three things: Complex interaction between sensory-motor skills; symbolic associations; and habituated syntactic patterns. All of these phenomena are at the service of the speaker's intent to communicate and are dependent upon the intellectual capacity of the speaker "which he brings to the task of manipulating them so as to carry out his intent" (Goodglass & Kaplan, 1972a, p. 5).

No two persons have identical speech characteristics; therefore, no two individuals ever have identical aphasic disturbances (Berry & Eisenson, 1956).

> ..., aphasia represents a disorder of symbolic formulation and expression...Aphasic patients retain many words which may be uttered in automatic speech such as word counting, or in emotional speech, but the same words may not be evoked in propositional speech...Aphasics have more difficulty with intellectually significant speech, than they do with evoking affect-laden words.
>
> There are other forms of linguistic contents which for many aphasics may be comparitively undisturbed...(Berry & Eisenson, 1956, pp. 395-396).

These include emotional evocations, automatic and rote content, serial language, and social gesture language. Deficits may occur in any or all of the following areas:

Enumeration of Areas of Deficit

1. Articulation, which is defined as "Vocal tract movements for speech sound production, synonymous with articulation-resonance; a jointing or connecting together loosely so as to allow motion between the parts" (Perkins, 1977, p. 425).
2. Loss of verbal fluency.
3. Word-finding difficulty.
4. Repetition, which in aphasia may be disturbed at any one of three points in the process: (1) failure at the level of recognition; (2) failure at the level of articulation despite the fact that the individual knows the meaning of the word or sentence; (3) or failure because of a selective disassociation between what comes in through the auditory system and what is expressed through the speech-output system (Goodglass & Kaplan, 1972a).
5. Seriatim speech. It has been noted by numerous investigators (Wepman, 1951; Weisenberg & McBride, 1935; Schuell, et al, 1964; Eisenson, 1973) that an occasional patient with little or no functional speech will show unusual retention of the ability to recite familiar word series such as the alphabet or the days of the week and even long poems or prayers that had become a memorized sequence.

6. Loss of grammar and syntax which could include disturbances of verbal retention span; disturbances in the facility to imitate speech, and disturbances in discrimination of relational concepts. Also sometimes apparent is a disturbance in use of grammatical rules.
7. Paraphasia, or the production of unintended syllables, words, or phrases as the aphasic is making an effort to speak. In general, paraphasia is characteristic of patients who have no disturbances of articulation.
8. Auditory comprehension.
9. Reading.
10. Writing.

Behavioral and Intellectual Changes

"As a group...brain damaged persons present several types of behavioral tendencies" (Berry & Eisenson, 1956, p. 390). These are in addition to the language disturbances they manifest and are also present in brain damaged persons who are not aphasic. Brain damaged persons have a tendency to become ego-oriented which results in increased egocentricity, both social and psychological, and may even become pathological. Individuals with cerebrocortical damage frequently exhibit great difficulty in dealing with the abstract.

"When language disturbances are also present, as in the case with the aphasic patient, the tools (linguistic symbols) for dealing with abstractions are also impaired" (Berry & Eisenson, 1956, p. 391). Another phenomenon of brain damage is perseveration. Perseveration is a tendency for a specific act or behavior to continue in operation when it is no longer appropriate to the situation. When a person perseverates, it indicates that he is not readily able to shift his behavioral attitude to make it in accord with the immediate situational requirements. He tends instead to persist according to the demands of the previous situation (Goodglass & Kaplan, 1972a).

Brain damaged persons also show a disturbance in emotional behavior, giving way to impulse more readily than might otherwise be the case. It isn't that he is so much changed in inclination toward emotionality as it is that he/she is suffering from a diminished ability to control his inclinations (Berry & Eisenson, 1956).

Sometimes, brain damaged persons, when confronted with a situation that requires a response not available immediately in their repetoire, may react catastrophically. "A catastrophic response is one characterized by marked vascular changes, irritability, evasiveness, or aggressiveness" (Berry & Eisenson, 1956, p. 393). The aphasic patient whose ability to verbalize is reduced, is even more prone to catastrophic responses than the nonlanguage disturbed.

Wepman (1951) listed 34 nonlanguage disturbances observed in the aphasic. In addition to those already described, he included: loss of attention and concentration; loss of memory; reduced association of ideas; poor organizing ability; poor judgement; constriction of thought and interest; reduced ability to generalize, categorize, group, or plan future action; reduced level of intelligence; inability to shift; psychomotor retardation; feelings of inadequacy; increased irritability and fatigability; euphoria; social withdrawal and seclusiveness; reduced ability to adjust to new situations; reduced initiative; disinterest in the environment, physical and human; externalization of behavior, or lack of introspection or self-criticism; reduced spontaneity; perplexity or a distrust of one's own ability; impulsive behavior; regressive infantile behavior; the inability to correct behavior one knows is wrong; anxiety and tension; hemiplegia; and in some cases, posttraumatic psychotic behavior showing illusions, hallucinations, delusions, and extravagant behavior. Wepman also noted that in some cases convulsive seizures also occur.

In these descriptions of behavioral and intellectual changes associated with aphasia a relationship between aphasia and intelligence is implied.

Intelligence and Aphasia

Piaget defined intelligence in biological terms (Ginsburg & Opper, 1969) as "...a particular instance of biological adaptation" (From Origins of Intelligence, pp. 3-4, cited in Ginsburg & Opper, 1969, p. 14), and that it is a particular form of equilibrium toward which all cognitive structures tend. The term equilibrium is borrowed from physics and implies that there is a balance between a person's mental actions and his environment. However, Piaget suggested that this equilibrium is not immediately achieved. He also defined intelligence as a "...system of living and acting operations" (From Psychology of Intelligence, p. 6; cited by Ginsburg & Opper, 1969, p. 14).

Piaget defined intelligence in terms of what it involved: biological adaptation; equilibrium between the individual and the environment; gradual evolution; and mental activity (Ginsburg & Opper, 1969).

Wepman, who has spent 40 years in the study of aphasia, defined intelligence as "...the innate capacity to utilize one's thought processes" (1976, p. 131). The question that arises from this definition is 'what are thought processes?'

Wepman (1976) described them in detail. He said that thought processes include:

1. The innate capacity to adapt to any or all life situations;
2. to symbolize both verbally and nonverbally at both the level of concrete and abstract operations;

3. to preplan one's actions;
4. to comprehend both verbal and nonverbal stimuli;
5. to retain and recall past associations with present stimuli; and
6. to integrate into thought one's feelings, attitudes, and emotional states (Wepman, 1976, p. 131).

Weisenberg and McBride (1935) reviewed the aphasia literature of their day. Forty years ago they were aware that views about the relationship between intelligence and aphasia had polarized around two extremes.

Polarization of Views

Weisenberg & McBride (1935) reported that some investigators believed that intelligence became disturbed because speech was disturbed, and that other investigators were of the opinion that speech was disturbed because of the intellectual disorder that results from aphasia. This controversy has continued to exist (Wepman, 1976). On the one hand, there has been the view that language and thought are independent characteristics of man's behavior and therefore aphasia is a linguistic disturbance without intelligence being involved. On the other hand, the position has been taken that language and thought are identical. If this view is subscribed to, then aphasia is more than just a linguistic problem. It is also a thought process defect (Wepman, 1976).

Furth (1964) demonstrated in his research with deaf children that man possesses a capacity for nonverbal thought which may or may not take some form of linguistic expression.

Furth's work (1964, 1969) would appear to support Piaget's position that logic does not come about by means of language, but to the contrary, that language is structured by logic (Piaget, 1961). "Without thought language would be simply barren repetition. It would not be meaningful" (Wepman, 1976, p. 131).

Theoretical Implications

Vygotsky (1962) conceptualized brain function in relation to thought and language interaction. He wrote, "We may imagine thought and speech as two intersecting circles. In their over-lapping parts, thought and speech coincide to produce what is called verbal thought" (p. 47).

Wepman conceptualized Vygotsky's assessment of brain function in relationship to thought and language in the following visual model (1976, p. 132).

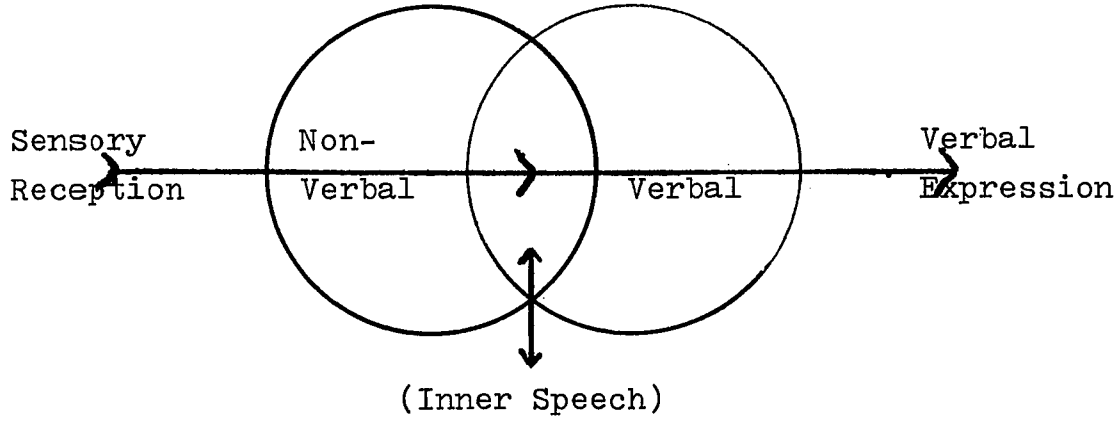

Figure 1. Central integrative thought processes.

Wepman (1976) suggested that thought is essentially the intellectual, emotional, attitudinal internalization of higher mental processes. He continued by noting that "Language is seen as the essential acquired or learned capacity for expression of thought through verbal symbols" (p. 132).

In attempting to explain his view of the interaction between thought and language Wepman (1976) stated

> Inner speech-the overlapping of the two circles-is the attempt by man to put into verbal form the feelings, ideas, and attitudes produced by his conception of the universe. The language sector begins with the deep structure of expression embedded within the formal linguistic frame of semantic and syntactic entities which eventually make up the expressed form...Aphasia within this concept may take the form of a thought process defect ... Intelligence would be seen as deeply involved in global aphasia and least involved in syntactic aphasia with intermediate involvement in the intervening stages (p. 132).

Position of the Investigator

It is therefore the position of the present investigator that:

1. Language usage and thought are inextricably related;
2. language is the product of thought;
3. thought is the highest mental process man achieves;
4. language is a tool for facilitating thought;
5. the ability to think is innate in man;
6. language is not innate but acquired; and

7. language acquisition is dependent upon cognitive functioning.

These views are shared by Joseph Wepman and elaborated in a similar manner in his paper, "Aphasia: Language Without Thought or Thought Without Language" (1976).

Support for the Investigator's Position

The views expressed by the present investigator and Wepman (1976) are supported by other investigations. Wepman (1951) studied World War II soldiers who suffered aphasia. His study showed significant measurable change in the pre- and post- morbidity intelligence quotients.

McFie and Piercy (1952) studied a stratified sample of aphasics representing a range of severity of linguistic disturbances from very slight to severe. They found a significant impairment in 'abstraction ability'. As a result of their investigation, these authors postulated that a slight localized lesion manifests itself as intellectual loss, but with more severe lesions, the verbal loss becomes clinically apparent as aphasia.

In 1957, Alajouanine and his colleagues reported that the concrete, inventive, imaginative thought of an aphasic patient may remain relatively intact, while the symbolic thought of the aphasic is impaired. This impairment inhibited his/her ability to formulate language. They concluded from their studies that abstract thought is requisite to any higher intellectual performance.

Perhaps the most significant support for the relationship between cognitive functioning and aphasia is to be found in the work of Tissot and his colleagues in 1963. The first phase of their research involved the administration of the Wechsler-Bellvue Test of Intelligence to a small, but representative sample of aphasic patients. They found gross intellectual deficits in 25 percent of the subjects and some deficit in all of them. They followed this investigation by administering Piagetian type preoperational tasks to the same population of aphasics. They concluded that the aphasic regresses through dedifferentiation and disintegration to ontogenetically earlier stages.

Kreindler and Fradis (1968) and Weigle and Bierwisch (1970) also wrote in support of these views concerning the relationship of cognitive functioning and linguistic impairment due to aphasia.

The Relationship of Aphasia to Preverbal Perceptual Skills

It has been noted earlier in this review of the literature that language builds upon the cognitive abilities which develop during the sensorimotor period (Piaget, 1961; Sinclair, 1971; and Cromer, 1976). It is during this stage that perceptual processes are at the peak of their development (Affolter, 1974b). Recent research in Genetic Psychology (Piaget, 1961 & Siegenthaler, 1968) confirmed that "... language development follows the development of several neural

systems and processes other than of a verbal nature" (Affolter, 1974b, p. 94).

The acquisition of language is based on the development of at least three levels of perceptual integration. These levels include a level of modality specific processes, a level of intermodality connections and a level of sequential integration. On the basis of these premises, Affolter (1974b) hypothesized that disturbances of language are secondary to disturbances of perception of a preverbal nature.

Affolter tested this hypothesis by comparing the profiles of performance of perceptive and integrative tasks obtained for 30 normal children with 30 language-disturbed children. She found that children with central disturbances of language development can be differentiated from normal children on these nonverbal performances. Her conclusions were: "The findings appear to confirm the basic hypothesis in its full meaning: Deficiencies of language are secondary to disturbances of perception of a preverbal nature" (1974b, p. 96).

Genetic psychology and Piaget's description of the cognitive functioning of the infant suggest that the infant masters first elementary analysis before he/she masters connections among modalities or sequential integration (Piaget, 1961).

Affolter suggested that:

> Sequential processes are characterized by a relatively long development. Modality-specific processes, in the sense of elementary analyses, develop before sequential processes are acquired ...Disturbances of speech and language can be related to such nonverbal sequential processes and/or subsidiary processes of elementary analysis (1974b, p. 96).

Perceptual processing begins to emerge early in the sensorimotor period and covers more than ten-year span (Piaget, 1961; Siegenthaler, 1968; and Affolter, 1974a). The developing child is seen to be operating within the final level or the serial level by the time language begins to emerge at 18 months or age (Affolter, 1974a).

Lashley (1951) and Broadbent (1958) agreed with Affolter that serial integration is the backbone upon which rests the foundations of language acquisition. They further contended that the ability to perform serial integration is the phenomenon that differentiates man from the animals.

Sonderegger, a psychologist at the Center for the Perceptually Disturbed, St. Gallen, Switzerland, has been investigating modality specific perception, intermodality perception and serial integration in adult aphasics. His work has not yet been published, but his investigations are predicated upon the hypotheses presented by Affolter (1974b), that disturbances of language are secondary to disturbances of perception of a pre-verbal nature. His correspondence with Franklin (1976) suggested that in shifting the emphasis to the development of serial integration skills with adult aphasics, results have been dramatically positive.

Conclusion

Based on the evidence in support of a cognitive theory of language acquisition and development, the relationship between thought and language in the aphasic, the relationship of preverbal perception to central language disturbances, and the investigator's knowledge of the phenomenon of aphasia and its linguistic and nonverbal manifestations of behavior, it is the intent of the investigator to explore the nature of sensorimotor level cognitive functions in aphasics, representing the continuum of severity of disturbance and the major diagnostic classifications of aphasia.

CHAPTER III

RESEARCH OBJECTIVES AND PROCEDURES

The aphasic individual demonstrates varying degrees of linguistic impairment. However, he also demonstrates some nonverbal symptoms that suggest to this investigator that cognitive decompensation to a level of preverbal perceptual disturbance may also occur.

Preverbal perceptual skills develop during the sensorimotor stage of cognitive development (Affolter, 1974b). There is some extension of the completion of these skills into the early preoperational stage which is the period of development during which the child begins to acquire functional language (Wadsworth, 1971).

The literature in the area of language acquisition is beginning to validate the view that linguistic development is directly related to cognitive processes (Morehead & Morehead, 1976; Cromer, 1974; Brown & Hanlon, 1970; Lantz & Steffire, 1964; Sachs, 1971; & Slobin, 1973).

Statement of the Problem

The problems considered in the present study are: (1) whether preverbal perceptual disturbances will be suggested by evidence of disturbances of sensorimotor levels of

cognitive function in the adult aphasic; (2) whether there is a relationship between the level of severity of the linguistic disturbances resulting from aphasia and the aphasic's ability to perform at each of the levels of cognitive functioning on seven different scales of sensorimotor development; and (3) whether there is a relationship between the diagnostic classifications of aphasia symptoms and the aphasic's ability to perform at each of the levels of cognitive functioning on seven different scales of sensorimotor development.

Hypotheses

The relationship among the two primary variables, the degree of severity of aphasia and the classification of aphasia, and the levels obtained by each subject on each of seven scales of sensorimotor development will be posited for each of the scales: the development of visual pursuit and the permanence of objects; the development of means for obtaining desired environmental events; verbal imitation; gestural imitation; the development of operational causality; the construction of object relations in space; and the development of schemes for relating to objects.

It is therefore hypothesized that:

1. a disturbance of preverbal perceptual functioning is demonstrated in the responses of the aphasic subjects to measures of sensorimotor function;

2. there is a positive relationship between the degree of severity of aphasia and the degree of impairment of sensorimotor functions as measured on seven different scales;
3. the greater the degree of severity of linguistic disturbance in the aphasic, the lower the scores obtained on each of the seven scales;
4. there is a significant difference between the classifications of aphasia with regard to the scores obtained on the seven measures of sensorimotor function.

The remaining two hypotheses are multivariate in approach and facilitate deriving the relative importance of each of the seven sensorimotor scales with regard to the two primary variables, the degree of severity of linguistic disturbance and the classifications of aphasia.

It is therefore further hypothesized that:

5. the combination of sensorimotor scale measures will explain a significant proportion of the variance in the degree of severity of linguistic disturbances.
6. the combination of sensorimotor scale measures will explain a significant proportion of the variance in classifications of aphasia.

Definition of Terms

The terms in need of definition and/or classification are those related to aphasia, cognition, and sensorimotor stage operations.

Terms Relating to Aphasia

The term aphasia shall be used in this study, as has been noted in Chapter II, to refer to an acquired impairment of linguistic function caused by brain damage. "...the individual's control over the vocabulary and/or syntax of the language is reduced; and disorders of perceptions, mentation, or social behavior may or may not accompany the verbal impairment" (Taylor, 1965, pp. 101-102).

The areas of deficit described in Chapter II, usually appear in clusters of symptoms. "The clustering of these symptoms is, in part, a function of the anatomical organization of the language substrate in the brain" (Goodglass & Kaplan, 1972a, p. 54). Also important is the fact that the locations of cortical and subcortical lesions tend to congregate in certain vulnerable areas of the brain (Goodglass & Kaplan, 1972a).

These clusters of symptoms have become the basis for classifications of aphasia. The principal features of the various syndromes have been uniformly described, but there are about as many classification titles for each cluster as

there are classifiers. The classification system adopted by this investigator is that detailed by Goodglass and Kaplan (1972a) with the addition of one classification described and defined by Wepman (1970), and the division of one of Goodglass and Kaplan's classifications into two subdivisions according to severity and labeled using terms suggested by Wepman (1970).

Broca's Syntactic Aphasia: Broca's Aphasia has been called Verbal Aphasia by Head (1926); Motor Aphasia by Goldstein (1942); Efferent Motor Aphasia by Luria (1964); Expressive Aphasia by Weisenburg and McBride (1935); and Syntactic Aphasia in a milder form and Jargon Aphasia in a more severe form by Wepman (1970). It is characterized by: disturbances in articulation; restricted vocabulary; simplistic grammatical construction with primitive syntax; and relative perseveration of auditory comprehension. It is also characterized often by impaired writing as well as speech; possible mild impairment of reading skills; minimal disturbances of nonspeech oral movements, but some may occur; intact comprehension of single words; an absence of articulatory difficulties during the production of automatic speech such as recitation of the days of the week or the alphabet; transpositions of phonemes in some cases; and inability to evoke syntactic patterns when the patient tries to form complete sentences.

Broca's Jargon Aphasia: This classification of aphasia is a more severe form of Broca's Syntactic Aphasia. All of the characteristics described above exist in this classification plus some additional symptoms which are more severe. They include: the loss of even 'yes' and 'no' at severe levels; inability to initiate articulatory movements in severe forms; inability to repeat any words upon stimulation; articulatory difficulties during the production of automatic speech (unlike the Syntactic Aphasia form where these articulatory efforts are intact); and loss of intelligibility because the verbal utterance is unintelligible. "All phonemes seem to be present, but they are rarely produced in understandable clusters" (Wepman, 1967, p. 5).

Anomic Aphasia: Anomia is also called Nominal Aphasia by Head (1926); Amnesic Aphasia by Goldstein (1942); and Semantic Aphasia by Wepman (1970). Anomia is a fluent aphasia, but is distinct from other fluent aphasias in several distinct ways.

The major features of Anomic Aphasia are: the prominence of word-finding difficulty in the context of fluent speech; grammatically well formed speech; the occurrences of literal and verbal paraphasias; relatively intact comprehension; an "... emptiness of substantive words..." (Goodglass & Kaplan, 1972a, p. 64); the ability to produce elaborate circumlocutions for words they cannot formulate in spontaneous speech (these circumlocutions may be vague and

even sound bizarre); failure on occassion to recognize or accept a proferred word which he is not able to evoke in his own discourse; poorer comprehension of isolated nouns and verbs compared to their over-all comprehension level and compared to other types of classifications (Goodglass & Kaplan, 1972a); the possibility of either functional or impaired reading or writing skills; and the possible ability to spell words that he/she is unable to evoke.

Conduction Aphasia: This classification is also known as Central Aphasia (Goldstein, 1942); Afferent Motor Aphasia (Luria, 1964); and Pragmatic Aphasia (Wepman, 1970).

Conduction Aphasia is also considered a fluent aphasia. The primary characteristics of this type of aphasia are; nearly normal fluency in spontaneous speech events, but severe impairment in attempting repetition; fluency sometimes restricted in brief bursts of speech; normal auditory comprehension; well articulated sequences of English phonemes; normal intonation; the ability to initiate a variety of syntactic patterns; literal paraphasias present which constantly interfere with production; some anomic components; and awareness on the part of the aphasic that his/her attempts are inaccurate and these attempts are often rejected; difficulty with polysyllabic words; the ability to use self correction to improve the final output; little or no improvement of articulation when aided by a model for repetition; normal number repetition in contrast to other speech

repetitions; word substitutions instead of literal paraphasias when number repetition errors occur; intact auditory comprehension; and intact reading and writing skills unless paralysis to the dominant hand impedes motor function for writing.

Anomic aphasia and Conduction aphasia have many similarities which make differential diagnosis difficult. Even the most practiced speech pathologist may have difficulty discerning from the aphasic's response whether he/she is having difficulty in attempting repetition or is failing to recognize or accept a proferred word which he is not able to evoke in his own discourse. Furthermore, literal paraphasias are often difficult to discern from the elaborate circumlocutions of the Anomic aphasic (Helms, 1977). While they are theoretically distinct classifications due to the assumed cite of lesion, practically speaking, it requires an educated subjective professional judgement to differentiate the two classifications from their performance on the Boston Diagnostic Examination of Aphasia (Goodglass & Kaplan, 1972b). Therefore, when possible, this investigator attempted to differentiate between the two classifications, but decided to look at the classifications together in examining the relationship between preverbal perceptual skills as indicated by performance on the Assessment in Infancy: Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975), as adapted for an adult population of aphasics, and classifications of aphasia.

Wernicke's Aphasia: Wernicke's Aphasia has been labeled Syntactic Aphasia by Head (1926); Acoustic Aphasia by Luria (1964); and Receptive Aphasia by Weisenberg and McBride (1935) and Wepman (1951).

"The critical features of this syndrome are impaired auditory comprehension and fluently articulated, but paraphasic speech" (Goodglass & Kaplan, 1972a, p. 59).

Wernicke's Aphasia is characterized by: impairment of auditory comprehension even at the one-word level; fairly accurate, but uncomprehending repetition of words; paraphasias which become meaningless jargon; paraphasias which may include transpositions and word substitutions; word-finding difficulty; reading and writing impairments; incorrect grammar, but free use of verb tenses, embedded subordinate clauses and departures from declarative word order; 'paragrammatic' instead of 'agrammatic' syntax; paraphasic distortion of repeated words; the adding of a word or phrase, or use of form that is more complex than the one given; increased rate of speech; lack of awareness that speech is disordered; normal fluency and normal melodic contour to the speech; and the possibility of paraphasic writing as well.

Global Aphasia: This term or classification of "global" aphasia is not employed by Goodglass and Kaplan (1972a), but is used by Wepman in his exposition of his classification system in his work, "Approaches to the Analysis of Aphasia"

in the NINDS Monographs (1970), "Human Communication and Its Disorders" (pp. 127-138).

Global aphasia is referred to by Schuell (1964, p. 191) as an "irreversible aphasic syndrome characterized by an almost complete loss of language skills."

Paraphasia: Paraphasia has been defined earlier in this study as the production of unintended syllables, words or phrases as the aphasic is attempting to speak. Goodglass and Kaplan (1972b) described paraphasic errors as including neologistic distortion, literal paraphasia, verbal paraphasia, irrelevant speech, and circumlocution.

"(Neologistic distortion) applies only to responses which are spoken as a unit with some fluency of articulation" (Goodglass & Kaplan, 1972b, p. 13). In these cases many of the sounds produced are extraneous to the desired word. When literal paraphasia is present certain sounds or syllables have either slipped out of sequence, are omitted, or are extraneous to the expected response (Goodglass & Kaplan, 1972b). Verbal paraphasia means that the aphasic substitutes an inappropriate word or words while trying to say something specific. Irrelevant speech is exactly what it implies. It is the use of irrelevant words in correct grammatical construction. Circumlocution frequently occurs with the Anomic aphasic and is characterized by a long and round about description in place of the desired word or words he/she cannot formulate.

Terms Relating to Cognition

The term cognition is used to imply cognitive processes. Cognitive processes were defined by Beard (1969), p. ix), as "Mental processes concerned with knowing such as perception, memory, imagery, reasoning, ..."

The assumption was made by Piaget and this investigator, that cognitive processes develop in a systematic way. The term development by Baldwin (1967) was defined as a process of four factors (also called forces). These are: a. maturation; b. experience with the environment; c. social transmission or the result of explicit and implicit teaching of the child by other people in his environment; and d. equilibration. Equilibration is a process set in motion whenever the child's belief system develops far enough to begin to contain self-contradictions (Ginsburg & Opper, 1969).

Perception was defined by Beard (1969, p. x) as the "process of becoming immediately aware of something through the senses." The three developmental levels of perception according to Affolter (1974a) are given as follows:

1. At the modality specific level, the parallel development of each of the senses, visual, auditory and tactile-kinestetic, is independent of the other senses. In other words, "an ordering schemata of the senses" (Affolter, 1974a, p.1). These schemata permit the child to analyze the quality of sensory stimuli.
2. The intermodality level represents "an exchanging and an integration of sensory modality information" (Affolter, 1974a, p. 2). This integration makes possible the combining of the three schemata, visual, auditory, and tactile-kinestetic.
3. The serial level involves the process of combining referent stimuli in an orderly manner and can occur when the infant reaches the serial level (Affolter, 1974a). Affolter says, "It is inferred that the three perceptual levels must be developed to critical degrees before a child engages in language" (1974a, p. 4).

There are some additional concepts related to cognition that need to be defined. The first is "schema" or "schemata" which are used interchangeably and mean a well-defined sequence of either physical or mental action (Beard, 1969). A representational schema is one in which one thing is used to represent another (Beard, 1969).

Representational schemas utilize symbols. A symbol is defined as "an image evoked mentally, or a material object chosen to represent a class of actions or objects" (Beard 1969, p. x).

Language requires the use of "a collective symbol, such as a number, letter, or word" (Beard, 1969, p. x), and this is called a sign. Functional verbal symbols are called semiotic functions (Affolter, 1974b).

The final term to be clarified in relation to cognition is the term operation which is defined by Beard as "an action which takes place in imagination" (1969, p. x).

Terms Relating to Sensorimotor Functions

During the sensorimotor period of human development at least six specific cognitive skills emerge. Uzgiris and Hunt (1975) described these as: (a) the development of visual pursuit and the permanence of objects. The concept of object permanence implies that the infant becomes aware during this stage of development that objects and people do not cease to exist when they disappear from sight (Baldwin, 1969);

(b) the development of means for obtaining desired environmental events; (c) the development of vocal and gestural imitation; (d) the development of operational causality. Operational causality refers to operating upon the environment so as to bring about a means-end relationship (Ginsburg & Opper, 1969); (e) the construction of object relations in space; and (f) the development of schemes for relating to objects.

Description of the Instruments

Two instruments were used in this investigation. The first was the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972b). The second instrument was the Assessment in Infancy; Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975) adapted for use with an adult aphasic population.

The Boston Diagnostic Aphasia Examination

The Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972b) was selected in order to obtain information about each subject's level of severity and a description of his/her major aphasic syndromes for diagnostic classification.

The Boston Diagnostic Aphasia Examination instrument consists of stimuli designed to elicit conversational and expository speech; tests of auditory comprehension; oral expression; comprehension of written language and evaluations

of writing skills. It also provides for analysis of paraphasic behaviors.

On the basis of the structured experiences designed to elicit conversational and expository speech, an Aphasia Severity Rating is assessed. The rating scale goes from 0 - 5. Each rating is defined by the authors, Goodglass and Kaplan (1972b), as follows:

> 0. No usable speech or auditory comprehension.
>
> 1. All communication is through fragmentary expression; great need for inference, questioning and guessing by the listener.
>
> 2. Conversation about familiar subjects is possible with help from the listener. There are frequent failures to convey the idea but patient shares the burden of communication with the examiner.
>
> 3. The patient can discuss almost all everyday problems with little or no assistance. However, reduction of speech and/or comprehension make conversation about certain material difficult or impossible.
>
> 4. Some obvious loss of fluency in speech or facility of comprehension, without significant limitation on ideas expressed or form of expression.
>
> 5. Minimal discernible speech handicaps; patient may have subjective difficulties which are not apparent to listener (p. 6).

For the purposes of this investigation, Rank 5 was eliminated because linguistic disturbances are so slight they frequently cannot be identified by anyone but the patient. For functional usage, his/her speech is essentially intact.

The scores obtained on each of the subtests are transferred to a Z-score Profile of Aphasia Subscores. This permits the examiner to observe a visual graph of clusters of aphasic symptoms, permitting an assignment to one of the basic classifications described earlier in this chapter. (Appendix D)

For each subtest, scores are arranged along a continuum from -2.5 standard deviations to +2.5 standard deviations, providing a quantitative analysis of each area of deficit; fluency, auditory comprehension, naming, oral reading, repetition, automatic speech, reading comprehension, writing and music. In addition, it provides an opportunity to assess quantitative analysis of the degree and type of paraphasic errors present in the aphasic's linguistic output.

Development and standardization of the instrument. Aphasic patients were assigned to the clinically defined severity levels listed earlier in this study. Subtest Z-scores were computed independently for patients at each level of severity.

"This procedure yielded five Z-scores subtest profile charts, the appropriate one to be chosen according to the patient's severity level" (Goodglass & Kaplan, 1972a, p. 14). Kaplan and Goodglass, the developers of the instrument, then proceeded as if the distribution of the aphasic sample represented the population. It is nearly impossible to determine what truly is representative of the aphasia population because

the only access the investigators has was to a population that came to a hospital and stayed for rehabilitation. The original sample included 207 patients. The Z-scores were based on the range, mean and standard deviation of the patients on each of the subtests.

The scores were subjected to factor analysis and orthogonal varimax rotation 1. "Five factors emerged from this analysis. Subtests with loadings of .40 or more for each factor are (those used in the development of the instrument)" (Goodglass & Kaplan, 1972a, p. 19). A second sample of 180 aphasics were similarly evaluated and a second factor analysis performed. On the basis of these two factor analyses, the final test product was published.

Since the Boston Diagnostic Aphasia Examination's publication in 1972, it has been used in a research study by Sparks (1976), and in 30 different journal articles. Such publications as The Journal of Learning Disabilities, Brain-Language, Journal of Speech Disorders, Annals of Research Psychology, and Neuropsychology, have carried articles in which the writers have cited the work of Goodglass and Kaplan in the Assessment of Aphasia and Related Disorders (1972).

The Boston Diagnostic Aphasia Examination is one of the instruments prescribed by the Department of Health, Education, and Welfare, Public Health Service, National Institute of Neurological and Communicative Disorders and

Stroke in a request for Proposal No. NIH-NINCDS-77-04, for a "Comprehensive Study of the Language Recovery Process in Adults with Aphasia".

Nature of the data to be obtained. The two data items will be obtained for each subject in the investigation will be in the nature of categorical data. These are an Aphasia Severity Rating on a scale from 0 - 4, and a classification of the major aphasic syndromes.

Assessment in Infancy: Ordinal Scales of Psychological Development (adapted for use with an adult aphasia population)

The Uzgiris and Hunt (1975) instrument was selected because:

> From the beginning, guided by the hypothesis of definite order in cognitive development, our effort was aimed toward devising ordinal scales for assessing the levels of competence commonly shown during the first two years of life (Uzgiris & Hunt, 1975, p. x);

and this investigator's aim was to assess possible disorders in the levels of competence which ordinarily develop during the first two years of life, as a result of cortical and subcortical damage resulting in aphasia.

This instrument was used to obtain information about seven areas of cognitive functioning that occur in the sensorimotor period. These areas include: the development of visual pursuit and the permanence of objects; the development of means for obtaining desired environmental events; the development of vocal imitation; the development of gestural imitation; the

development of operational causality; the construction of object relations in space and the development of schemes for relating to objects.

The instrument consists of six scales with scale III containing two subscales for a total of seven different measures.

Each scale is constructed ordinally so that the behavior elicited from the subject as the tasks are presented in a prescribed order will represent increasingly mature cognitive operations.

Each scale has a specific number of tasks to be presented to the subject. The directions for presenting these tasks are explicit. Included in the directions for each task are the anticipated actions of the subject in response to the stimulus. The type of response he/she makes determines whether or not the subject is able to function at that level. It is assumed by Uzgiris and Hunt (1975) that inability to respond according to the criterion for passing at any level would preclude any further appropriate responses to the remaining tasks in that scale.

In using this instrument with an adult aphasic population, however, the investigator presented all tasks in each scale in order to determine whether the same kind of ordinal sequencing of cognitive functions is present when brain damage occurs.

Uzgiris and Hunt (1975) classified their ordinal scales in relation to Piaget's stages.

> On the basis of specific criterial achievements, 84 infants...were classified as demonstrating a level of development characteristic of one of Piaget's six stages of general intelligence in the sensorimotor period (p. 136).

The ordinal scale scores of these infants were compared with the specific criterial achievements mentioned above and the authors developed a table of Mean Scale Scores and Average Deviations from the Mean for Infants Classified Within Each of Piaget's Sensorimotor Stages which is given in Table 1.

On the basis of the data presented in Table 1, a profile of ordinal scale scores was devised by the investigator and is shown in Figure 2.

The Roman Numerals across the top of the figure represent each of the seven scales: I. Object Permanence; II. Development of Means; IIIa. Vocal Imitation; IIIb. Gestural Imitation; IV. Operational Causality; V. Construction of Object Relations in Space; and VI. Development of Schemes. The left-hand vertical column represents Piaget's six stages of sensorimotor development described in Chapter II, and one level of preoperational functioning. The stages are labeled Sa, Sb, Sc, Sd, Se, Sf, and P. (S) stands for Sensorimotor period and (P) for Preoperational period.

Table 1

Mean Scale Scores and Average Deviations from the Mean for Infants Classified Within Each of Piaget's Sensorimotor Stages (Uzgiris & Hunt, 1975, p. 137).

Piaget's Stage of Sensorimotor Development	N[a]	Mean and Average Deviation	MEAN SCALE SCORES AND AVERAGE DEVIATIONS ON: Object Permanence	Development of Means	Vocal Imitation	Gestural Imitation	Operational Causality	Construction of Object Relations in Space	Development of Schemes
II	9	$\bar{X}$	1.77	1.33	2.44	0	1.00	1.11	1.55
		AD	.74	.89	.49	0	.66	1.03	.84
III	16	$\bar{X}$	2.56	3.06	3.69	.62	2.80	3.31	3.75
		AD	.94	1.05	1.23	.70	.91	1.27	1.31
IV	26	$\bar{X}$	7.76	6.50	4.77	4.11	4.24	7.19	6.77
		AD	1.64	1.38	1.34	1.89	.40	1.07	1.10
V	12	$\bar{X}$	9.08	7.66	6.17	5.41	4.50	8.00	7.41
		AD	2.41	1.86	1.19	1.94	.58	1.36	.95
VI	20	$\bar{X}$	12.88	10.84	8.50	7.89	5.95	10.50	9.35
		AD	.74	1.97	1.15	1.11	.67	1.10	.84

[a] One infant was classified within Stage 1.

Profile of Ordinal Scale Scores

Uzgiris and Hunt (1975)

Stages of Sensori Motor Devel.	I	II	IIIa	IIIb	IV	V	VI
Sa	1	0	1	0	0	0	1
Sb	2	1	2	0	1	1-2	2
Sc	3	2	3	1	2-3	3-4	3-4
Sd	4-7	3-6	4-5	2-4	4	5-7	5-7
Se	8-10	7-8	6-7	5	5	8	8
Sf	11-14	8-11	8	6-7	6	9-10	9
P	15	12	9	8	7	11	10

Figure 2. Profile of Ordinal Scores.

In the scoring procedure for each scale the scale steps are listed in the left-hand column; the relevant situation number that is designed to elicit the responses necessary to pass that level is listed in the second column and the third column defines the critical action that the subject must take in response to the situation in order to pass that level. A sample scoring sheet is shown in Figure 3.

Scale IV: THE DEVELOPMENT OF OPERATIONAL CAUSALITY

Subject Name _____ Date _____

Examiner _____

DEVELOPMENT OF OPERATIONAL CAUSALITY

SCALE STEP	RELEVANT SITUATION NUMBER	CRITICAL INFANT ACTION	INFANT ACTION OBSERVED (list situation by no. and response by letter)
1	1	b	_____
2	2	c	_____
3	3,5,6, (and 4)	3c or 5c (and 6b, 4c)	_____
4	5,6,7	5d or 6c (and 7c	_____
5	6,7	6d or 7d	_____
6	7	e	_____
7	7	f	_____

Figure 3. Sample Scoring Sheet.

In order to construct the Profile of Ordinal Scale Scores, the level of Scale Steps needed to be passed to place the subject in each of the six Sensorimotor substages or the Preoperational stage was calculated by taking the mean scale found for that stage in that scale plus and minus the average deviation to provide the range of scale scores that would fall within that stage.

For example, using the Object Permanence Scale I, the mean scale score found to fall within Sb was 1.77. The Average Deviation was .74. Scale step 2 would fall within the Sb substage with a score of 1.77 $\pm$ .74. The same procedure was followed for each succeeding substage and each scale as the profile was constructed.

Development of the instrument. Uzgiris and Hunt (1975) believed that in spite of frequent revisions in the development of the instrument the character of these scales is still provisional. Nevertheless, they say, "We believe we have sufficient evidence of the ordinality to justify their use in investigations as ordinal scales" (p. 139).

The authors admit that the uses of these scales are independent of any conventional standardization, but suggest that conventional standardization is entirely feasible. As yet this has not been done, however.

The instrument was developed in three distinct phases.

> The first and probably the most subjective aspect of our investigation entailed selecting which of the many situations described by Piaget in his

> books The Origin of Intelligence in Children (1936) and The Construction of Reality in the Child (1937) should be tried out with our first group of infants for possible inclusion in the assessment we aimed to develop (p. 49).

A sample of 42 infants of both sexes were used in the initial investigation. They ranged in age from one to 22 months and were children of parents who were connected with the University of Illinois.

The experience with the first sample of infants permitted classification of their actions as indicative of the stages of functioning Piaget had described. "The examiner used the narrative records to determine the sensorimotor stage which seemed to be most characteristic of each infant" (Uzgiris & Hunt, 1975, p. 51).

The first version of the instrument was then revised and in the second version the critical actions of each subject were again evaluated in relation to Piaget's stages of sensorimotor development. The form of standardization toward which Uzgiris and Hunt (1975) aimed was for the achievement in all cases of a state of optimal cooperation from the subject.

In Phase II a group of 23 infants was examined. These subjects included both sexes and ranged in age from one to 23 months. The aim of the second phase of the investigation was to determine

> (1) whether the instructions for presenting the eliciting situations could be followed by another examiner; (2) whether the eliciting situations could be successfully presented by another examiner; and (3) whether the critical actions elicited by the situations and observed by another person would agree with those observed by the examiner (Uzgiris & Hunt, 1975, p. 56).

> A high degree of agreement was found between the two examiners: Following this initial reliability study in the second phase, the instrument was revised again to incorporate the suggestions gleaned from having another examiner use the instrument and also from the experience gained by the first examiner in using it with a second group of infants (Uzgiris & Hunt, 1975, p. 58).

In the second revision the examiners also made a basic change in the nature of the quantification to be used, and abolished the division of the instrument into six separate sections under Piaget's stage headings. However, they retained the intent to assess several branches of development. The focus was shifted to those eliciting situations..."with the strongest tendency to evoke actions clearly implying significant transitions between successive levels of sensorimotor development" (Uzgiris & Hunt, 1975, p. 59).

The 63 eliciting situations were divided into five sets representing age levels. (e.g., Set I was for infants 0-4 months of age; Set II was for infants 4-8 months of age).

In Phase III a third sample of infants was examined using the third revision of the instrument. Two examiners, working together, saw each of the infants in this third sample twice.

> One served as the examiner and presented the eliciting situations. The other acted as an observer...The examiner and the observer both recorded their observations during every session, but each recorded his or her own without knowledge of that of the other. This made possible two separate observations for interobserver reliability (Uzgiris & Hunt, 1975, pp. 86-87).

All of the examiners were given very careful training. There were 84 subjects in the third sample, including infants of both sexes. The sample was not representative, but made use of the most readily available subjects. "Overall the interobserver agreement was high" (Uzgiris & Hunt, 1975, p. 90).

The test-retest reliability or stability of infant actions in the eliciting situations over a 48-hour period "... was made in terms of percentages of inter-session consistency was 79.9" (Uzgiris & Hunt, 1975, p. 94). Variations in means according to the ages of the infants examined was slight.

The information gained from Phase III provided the basis for a final revision of the instrument. In the final revision eliciting situations were

> ...grouped according to the specific branches of development to which the actions evoked by them are relevant...We first called these series, and then as evidence of a sequential order of the actions of infants in these situations was obtained, we have come to call them scales, <u>ordinal scales</u> (Uzgiris & Hunt, 1975, p. 101).

As a final step, a scalogram analysis was performed using the 84 subjects in the third sample, to determine

whether these series do, in fact, represent ordinal scales. A modified Guttman's scalogram analysis suggested by Green (1956) was used. The criterion adopted to determine whether or not a scale had been formed was based on Green's index of consistency. When any given set of items occurred for which his index of consistency was above .50 it was considered to form a scale. According to Green's criteria, all seven of the series presented in this instrument could be considered to form ordinal scales.

Support for the choice of this instrument. Because the publication of this instrument is so recent there are few research studies reported in the literature in which it has been used. However, the work of Uzgiris and Hunt has been cited by Miller (1976), Kahn (1976), Rabin (1976) and Silverstein (1976).

The Uzgiris and Hunt Assessment in Infancy: Ordinal Scales of Psychological Development (1975) provides a means of assessing cognitive functioning at the sensorimotor level without dependency upon verbal instructions since it was devised for use with an infant population. This makes it particularly suitable, with certain modifications, for use with an adult aphasic population who may be penalized by other measures of cognitive function that require verbal instructions, because he/she is unable to comprehend, formulate or produce verbal responses.

Adaptation of Assessment in Infancy: Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975) for use with an Adult Aphasic Population

Each item in each scale of the Uzgiris-Hunt (1975) instrument was carefully evaluated by this investigator to determine the feasibility of administering it to an adult aphasic. It became apparent that no change would be needed in the eliciting situations described, nor in the critical actions expected. However, because of the nature of the disability resulting from a stroke, some modifications in location were necessary. Most aphasics will have evidence of mild to severe involvement of the right side and hence have only one useable hand rather than two.

The most significant modification needed was in the selection of the objects or stimuli designed to elicit the response upon which assessment of a critical action was based. Uzgiris and Hunt (1975) suggested the use of a large variety of toys. Since it was deemed by this investigator that infant toys would fail to arouse the interest and thus the motivations to act upon a given stimulus, common objects used by adults were substituted for the infant rattles and shiny objects. Various objects were collected for each different task presentation to insure the subject's continued interest and motivation to respond. These objects were sometimes foods, novelty items, and common household objects.

Brazelton (1973) in discussing the evaluation of neonatoal behavior reminds the reader that

> The primacy of his (the infant's) physiological needs results in brief and often unreproducible responses which probably involve the activity of higher nervous system centers. Hence, we have attempted to account for such variability by urging that the scorer assess the neonate's best performance - not his average performance, since we are interested in predicting his eventual capacities as they have been reinforced by physiological recovery and a fostering environment, these periods of best performance may be more predictive (p. 31).

This basic assumption also underlies the modifications and administration of the scales by this investigator.

Steps taken to insure maximum construct validity. Each task in each scale was carefully modified in terms of suggested objects and location according to the needs and condition present in adult aphasics. These modifications were then compared with the directions given in the original instrument in the following manner: The task as devised by Uzgiris and Hunt (1975) appears on the left side of the page. The right-hand side of the page contains modifications that were made. A sample of modifications made in the Uzgiris-Hunt instrument is given in Figure 4.

The second step in the modification process involved evaluation of the proposed modifications by a panel of experts. Six people, whose backgrounds and experience either with the Uzgiris-Hunt instrument specifically, or with Piagetian concepts of cognitive development, were selected as judges. They were given the entire instrument, laid out as suggested in Figure 4, with the original of each task for each scale on the left, and the modification on the right. They

Scale II: The Development of Means for Obtaining Environmental Events

A. DEVELOPMENT OF EYE-HAND COORDINATION

2. Achievement of Visually Directed Grasping

	Original		Adaptation
Location:	The infant may be supine or propped up in a sitting position, as long as both arms are free to reach out.	Location:	Subject seated upright in a wheelchair, geriatric chair, or straight chair, with non-affected left arm free to reach out.
Object:	Use a small bright object such as a rattle. Make sure at least a portion of it is small enough for the infant's hand to close around.	Object:	Any small object such as a wrapped package of crackers, a candy bar, a silver dollar, a piece of jewelry such as a bracelet, a pocket knife, or whatever seems to have the subject's interest.
Directions:	Hold the object about 12 inches from the infant's face for at least 30 seconds. If the infant does not succeed in grasping the object, move it slowly toward the infant's hand, so that by following the object with his eyes he will come to see both the object and his hand at once. Hold the object a few inches from the infant's hand for at least 20 seconds.		

Figure 4. Sample of modification made in the Uzgiris-Hunt instrument.

were asked to determine whether the modifications in any way violated the intent or integrity of any of the tasks.

Five of the six judges, after making constructive criticisms and suggestions, accepted the modifications as revised and deemed them reliable elicitors of the same kinds of responses intended by Uzgiris and Hunt (1975).

The sixth judge found the task too time-consuming for her present schedule and was only able to evaluate the first two scales. She did offer some valuable criticisms and suggestions which were later adopted, but did not write a testimony as to the construct validity of the modifications made in the instrument.

The panel was composed of people with the following areas of expertise: One member was the director of an infant-mother attachment research project being conducted out of the University of North Carolina at Chapel Hill. She had used the Uzgiris-Hunt (1975) instrument both in its early forms and in its present revised and published form. She was selected because of her explicit knowledge of the instrument itself.

The second member of the panel was a visiting professor at the University of North Carolina at Greensboro, with a dual appointment from the Department of Physics in the College of Liberal Arts, and the School of Education. He had just returned to the United States after having spent three years in Switzerland studying with Piaget and his

colleagues. He was selected because of his extensive knowledge of Piagetian concepts of cognitive development.

The third member of the panel was selected because she was the director of a laboratory school kindergarten-day care center on the University of North Carolina at Greensboro campus which is based upon a cognitive development model, greatly influenced by Piagetian concepts. Her knowledge of Piaget's stages and theory of development, along with her ability to implement and apply these stages to a curriculum development, appeared to qualify her to evaluate the modifications proposed for the Uzgiris and Hunt (1975) instrument.

The two remaining panel members were on the teaching faculty of the Department of Child Development and Family Relations in the School of Home Economics, at the University of North Carolina at Greensboro. Their special area of concentration is Early Childhood Education and they were recognized in their department for their knowledge of Piagetian principles of cognitive development.

From the suggestions and criticisms obtained from this panel of judges it became apparent that prior to administering the adapted instrument, a questionaire providing information about each subject's interests, activities, sensory modalities, and dietary restrictions was needed. The questionaire was then developed by the investigator. (See Appendix A).

Information needed about verbal behaviors was provided the examiner by the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972b).

The third step in the development of the adaptation of the Uzgiris and Hunt (1975) instrument for an adult aphasia population was a preliminary exploratory investigation in which the examiner could: (a) gain experience in the administration of the instrument; (b) learn the mechanics of the scoring of the responses; (c) determine the feasibility of administering these adapted scales to an adult aphasic population; (d) further modify the adapted tasks according to the kinds of responses available within the repertoire of the aphasic individuals; and (e) observe whether or not aphasics could indeed perform at the sensorimotor level of cognitive functioning.

Upon the completion of these three steps the Uzgiris and Hunt (1975) Assessment in Infancy: Ordinal Scales of Psychological Development was considered satisfactorily adapted for use with an adult aphasic population.

In addition to the preliminary investigation, the adapted instrument was administered to a sixth subject, at which time a video tape was made of the entire procedure. The video tape was then shown to three of the experts who had judged the instrument modifications for their evaluation of the tester's adequacy in administering the instrument.

Preliminary Exploratory Investigation

For the reasons cited above, a preliminary exploratory investigation was undertaken. Five subjects from the Evergreens Nursing Home, a skilled nursing and intermediate care facility, were selected from those currently receiving speech and language therapy for treatment of linguistic disturbances resulting from aphasia. They were chosen so as to have one subject from each level of the Aphasia Severity Rating Scale in the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972b).

The adapted ordinal scales from the Uzgiris-Hunt instrument (1975) were administered to each of the five subjects. The procedure was as follows:

1. On the first day, scales IIIa - Verbal Imitation, and IIIb - Gestural Imitation, were administered to each of the five subjects. The order of scheduling the subjects for testing was randomly selected. This permitted testing of all five during the morning hours when each was still alert. It also provided a short enough test period for each subject to rule out fatigability as a factor in the subjects' performance. The testing was done in the office of the examiner which has been designed to eliminate distractions for the patients and provide an optimal environment for maximum attention and response to the speech and language therapy program.

2. Forty-eight hours later, between the hours of 9:00 and 11:30 A.M., scales II - The Development of Means for Obtaining Desired Environmental Events; and IV - The Development of Operational Causality, were administered to the same five subjects. Once again the order of scheduling was randomly selected and differed from the previous testing schedule. The order of presentation of scales was arbitrarily selected by the examiner in order to insure the most efficient manipulation of the objects for presentation, since the purpose in the preliminary exploratory investigation was in part to provide a dress rehearsal for the examiner in the administration of the instrument.
3. Another forty-eight hours elapsed before the investigator tested the five subjects again. The hours were the same. Once again the order of scheduling was randomized. Only scale I - The Development of Visual Pursuit and the Permanence of Objects, was presented because it is a lengthy scale.
4. Two more scales were presented the next day in the manner described above. These included the remaining scales V - The Construction of Object Relations in Space, and VI - The Development of Schemes for Relating to Objects.

5. Following the completion of the administration of the entire instrument to each subject, and the recording of responses (See Figure 3), a profile of Ordinal Scale Scores was developed for each subject (See Figure 2).

Results

The sample was too small to subject to any statistical analysis, but visual inspection revealed some very interesting information.

It was expected by the examiner that all but two of the subjects would perform all of the items in the seven scales in spite of the level of severity of their linguistic disturbances because of the effects of the kinds of activities given in the speech and language therapeutic intervention program.

In Table 2 the data are summarized concerning each subject prior to the administration of the Uzgiris and Hunt Ordinal Scales of Psychological Development (1975), as adapted for an adult aphasic population.

Contrary to the expectations of the examiner, only subject 5 performed all of the tasks successfully. Subject 1 was the only one unable to perform any of the scales at a level beyond the sensorimotor stages.

Table 2

Data for Each Subject in the Preliminary Exploratory Investigation

	Aphasia Severity Rating	Age	Sex	Classification
S_1	0	72 yrs.	F	Global Aphasia
S_2	1	55 yrs.	F	Wernicke's Aphasia
S_3	2	90 yrs.	M	Jargon Aphasia
S_4	3	58 yrs.	F	Conduction Aphasia
S_5	4	60 yrs.	M	Anomic Aphasia

The Uzgiris-Hunt Profiles of Ordinal Scale Scores of each of the five subjects used in the preliminary exploratory investigation, are included. (See Appendix C).

The results of the preliminary exploratory investigation along with the development of support from the literature appeared to justify the further investigation of the relationships between disturbances of preverbal perceptual functioning and disturbances of linguistic functions as a result of aphasia.

Selection of the Sample

As has been noted earlier by Goodglass and Kaplan (1972a), it is difficult to assess exactly what a representative population of aphasics is because most research done with aphasics has been limited to those being treated in hospital and/or rehabilitation center facilities. In order

to achieve as representative a sample of the aphasic population as possible, subjects were obtained from a variety of sources. These included: (a) Licensed skilled nursing home and intermediate care facilities in the Piedmont area of North Carolina; (b) the Veterans' Administration Center in Dayton, Ohio; and (c) volunteers from the community who were not institutionalized patients.

Nursing home facility patients were used to insure the inclusion of the more severe aphasic disturbances, since aphasia is frequently accompanied by severe disability from right hemiplegia (paralysis of the right arm and leg) which requires care at a level which cannot be provided at home. Veterans' Administration Center patients were used because it was expected that this would provide a broader age range than could be obtained from nursing home facilities alone. Volunteers from the community were used in order to provide access to the less severly involved aphasics who have remained at home and are cared for by their families.

Criteria for Selection of the Sample

1. All subjects had a medical diagnosis of left hemisphere brain damage resulting in aphasia;
2. all subjects were at least six months posttrauma to control for the possible effects of spontaneous recovery. No upper limit was placed on the selection, since once spontaneous recovery had

occured, very little change takes place;

3. all aphasic subjects were judged by their familes to have been free of senile behavior prior to the onset of the brain damage;
4. all subjects had functional vision and hearing;
5. all subjects had good use of the left hand.

Sample Size

Due to the limited availability of subjects, no random sampling techniques were used. In order to have a large enough number of subjects for statistical analysis, all available aphasics meeting the above criteria were tested until a total of at least five in each degree of severity catagory and at least five in each classification catagory were obtained.

The total number of subjects used in this investigation was thirty. Family members and care-taking personel of forty-seven subjects were interviewed. Eleven of these failed to meet one or more of the criteria items and were not tested. Three subjects, or their families, declined to participate. One subject expired before testing could be completed, and the remaining two were tested on the Boston Diagnostic Examination of Aphasia (Goodglass & Kaplan, 1972b) but suffered another stroke before the second instrument could be administered.

The breakdown of numbers of subjects in each level of severity is shown in Table 3. The number of subjects in each classification category is shown in Table 4.

Table 3

Number of Subjects in Each Level of Severity.

Severity Index Rank	0	1	2	3	4	Total
Number of Subjects	6	8	5	5	6	30

Table 4

Number of Subjects in Each Classification.

Classification	Global	Wernicke's	Jargon	Anom./ Cond.	Syntactic
Number of Subjects	6	5	5	6	8

Sample Characteristics

The subjects ranged in age from 28 years to 91 years of age. The mean age of the sample was 58.03 years. The subjects ranged in number of years of formal education from none (a 72-year-old black female had never attended school) to twenty years (a 52-year-old white male had a Ph.D. degree in nuclear physics). The mean number of years of formal education was eleven.

Fifty-seven percent of the subjects were obtained from skilled nursing facilities; twenty percent from intermediate care facilities; seventeen percent were volunteers from the community; and six percent were residents of the Veterans' Administration Domiciliary in Dayton, Ohio, which is a nonmedical residential care placement.

Twenty-one subjects suffered brain damage which caused aphasia as a result of a cerebral vascular accident. Five were brain damaged due to trauma to the head as a result of automobile accidents. Two subjects were aphasic due to subdural hemotomas requiring surgical intervention. One patient suffered brain damage from anoxia following an overdose of barbituates, and one subject received a gunshot wound to the head while serving as a career noncommissioned officer in Viet Nam.

The length of time since the onset of the trauma ranged from six months to 130 months with a mean of 37 months. Five subjects had had no speech therapy. The remaining twenty subjects had a range in number of months of speech therapy from six to 120. The mean length of speech therapy for the entire sample was 26.03 months.

Twenty-five different occupations were represented by these subjects.

The characteristics of the subjects ranked by age are summarized in Table 5.

Table 5

Characteristics of the Subjects: Ranked by Age.

Subject	Age	Education	Sex	Race	Facility Type	Cause	Posttrauma	Speech Ther.	Occupation
S6	28	12	F	B	S.N.F.*	Tumor	19 mos.	0 mos.	Housewife
S11	36	11	M	W	Domiciliary	Trauma	130 mos.	120 mos	Sailor
S23	37	15	M	W	Out-patient	Trauma	30 mos.	24 mos.	Radar Tech.
S7	41	12	M	W	I.C.F.**	C.V.A.+	50 mos.	46 mos.	Machinist
S16	44	16	M	W	S.N.F.	Trauma	58 mos.	38 mos.	U.S.A.F.
S22	45	14	M	B	Out-patient	C.V.A.	102 mos.	73 mos.	T.V. Repair
S13	45	9	M	W	Domiciliary	C.V.A.	6 mos.	5 mos.	Tree Care
S12	45	18	M	W	I.C.F.	C.V.A.	15 mos.	8 mos.	Engineer
S24	46	13	M	W	S.N.F.	Trauma	21 mos.	9 mos.	U.S. Army
S19	47	12	M	W	Out-patient	Trauma	15 mos.	8 mos.	Photograph.
S17	51	10	M	W	S.N.F.	Anoxia	46 mos.	36 mos.	Laborer
S18	52	20	M	W	S.N.F.	Trauma	20 mos.	19 mos.	Physicist
S20	53	8	M	W	Out-patient	C.V.A.	66 mos.	60 mos.	Laborer
S25	54	8	M	B	I.C.F.	C.V.A.	31 mos.	12 mos.	Laborer
S2	55	14	F	W	S.N.F.	C.V.A.	32 mos.	30 mos.	R.N.
S26	56	16	M	W	Out-patient	C.V.A.	46 mos.	38 mos.	Store owner
S21	56	12	F	W	I.C.F.	C.V.A.	18 mos.	16 mos.	Waitress
S30	57	16	F	B	S.N.F.	C.V.A.	7 mos.	0 mos.	Teacher
S4	58	12	F	W	S.N.F.	C.V.A.	17 mos.	8 mos.	Sales
S5	60	12	M	W	S.N.F.	C.V.A.	34 mos.	15 mos.	Veneerer
S14	65	12	M	W	S.N.F.	C.V.A.	9 mos.	8 mos.	Machinist
S15	67	14	M	B	S.N.F.	C.V.A.	28 mos.	25 mos.	Laborer
S10	67	4	M	B	S.N.F.	C.V.A.	10 mos.	9 mos.	Gardener
S1	72	0	F	B	S.N.F.	C.V.A.	22 mos.	0 mos.	Domestic
S28	77	4	M	B	I.C.F.	C.V.A.	9 mos.	0 mos.	Laborer
S29	82	4	F	W	I.C.F.	C.V.A.	25 mos.	0 mos.	Housewife
S9	82	6	M	B	S.N.F.	C.V.A.	91 mos.	38 mos.	Custodian
S8	83	4	M	W	S.N.F.	C.V.A.	81 mos.	79 mos.	Farmer
S27	89	7	F	W	S.N.F.	Tumor	25 mos.	14 mos.	Housewife
S3	91	15	M	B	I.C.F.	C.V.A.	47 mos.	42 mos.	Engineer

* S.N.F. = Skilled Nursing Facility
** I.C.F. = Intermediate Care Facility
\+ C.V.A. = Cerebral Vascular Accident

Collection of the Data

All subjects meeting the criteria for selection of the sample were given the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972b) according to the procedural criteria described in the preliminary exploratory examination, from which was obtained the Aphasia Severity Rating Rank and a Classification label.

They were then given the Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975) as adapted for use with an adult aphasic population. Each subject's scale score level for each scale was transferred to a Profile of Scale Scores (see Figure 2).

The data were then subjected to statistical analysis.

Analysis of the Data

Spearman correlations were used to derive the association between the level of severity and each of the seven ordinal scales of sensorimotor functions. They are also used to derive the association between the classifications of aphasia and each of the sensorimotor scales.

The Spearman Rank-order Correlation (r_s) was deemed an appropriate measure of association because the variables provided ordinal-level data. This statistic is used when the variables are on an ordinal scale and is considered to be a powerful statistic for nonparametric data (Roscoe, 1969).

A Univariate F-Ratio was calculated to determine the degree of significance of differences between the classifications of aphasia with regard to the mean scores obtained on the seven measures of sensorimotor function.

The two final hypotheses required a multivariate approach. Two different analytic methods were selected: the stepwise multiple regression analysis to test Hypothesis 5; and discriminant analysis to test Hypothesis 6.

The stepwise multiple regression analysis is defined as a "general technique through which one can analyse the relationship between a dependent or criterion variable and a set of independent or predictor variables" (Nie, et al., 1975, p. 321). The dependent variable was the severity index level. The independent or predictor variables were the scores on the seven scales of sensorimotor functions. This technique regressed the severity index measure on the measure of the scales of sensorimotor function and indicated whether the combined measures accounted for a significant proportion of the variance in severity of linguistic disturbance in the aphasic.

"The mathematical objective of discriminant analysis is to weigh and linearly combine the discriminating variables ...in some fashion so that the groups are forced to be as statistically distinct as possible" (Nie, et al., 1975, p. 294). The research objectives of this technique are analysis and classification. The analysis aspects of this technique

provide the investigator tools for interpreting the data by identifying the data. The use of this technique as a classification technique permits the deriving of information about the probability of membership in a group. The objective of a discriminant analysis is to classify the dependent variable by a set of independent variables into one or more mutually exclusive catagories (Morrison, 1969). It was therefore deemed an appropriate statistical technique for explaining the proportion of variance in the classifications of aphasia in regard to the combination of sensorimotor scale measures.

Conclusion

Two instruments, the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972b) and the Assessment in Infancy, Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975) as adapted for use with an adult aphasic population, were used to collect data from a sample population of 30 aphasics in order to investigate the relationship between disturbances of linguistic function and disturbances of preverbal perceptual functioning as determined by assessment of levels of sensorimotor functioning.

The results of the analysis of the data are reported in the next chapter.

CHAPTER IV

ANALYSIS OF THE DATA

The following chapter provides information regarding tests of the six hypotheses presented in Chapter III. Each hypothesis is stated and the results, in terms of support or lack of support of the hypotheses, are given.

The hypotheses dealing with primary relationships were tested by the Spearman Rank-order Correlation Coefficient (r_s). The hypothesis concerned with differences between catagories of one dependent variable with regard to the seven independent variables is tested by means of a Univariant F-Ratio. Stepwise multiple regression analyses were used to test the hypothesis regarding the significance of the combination of seven measures of sensorimotor function to the degree of severity of linguistic disturbances in aphasia. Discriminant analysis was used to test the significance of the combination of seven measures of sensorimotor function to five classifications of aphasia.

For hypotheses 2,4,5, and 6 to be supported, the associations had to reach a significance level of at least $p < .05$, and be in a positive direction. The final hypotheses were considered supported if the overall F test on the proportion of variance explained by the independent variables was significant at the $p < .05$ level or better.

It is apparent from the data in Table 6 that all but two of the independent measures were significantly intercorrelated.

Table 6

Spearman Rank-Order Correlations Between Independent Variables

	Permanance	Means	Vocal	Gesture	Causality	Space	Schemes
Perm.		.53***	.29	.36*	.28	.43**	.55***
Means			.56***	.57***	.54***	.73***	.57***
Vocal				.73***	.34*	.51*	.61***
Gesture					.49*	.62***	.62***
Causality						.41*	.43**
Space							.54***
Schemes							

*p < .05
**p < .01
***p < .001

Examination of the Hypotheses

H_1. A disturbance of preverbal perceptual functioning is demonstrated in the response of the aphasic subjects to measures of sensorimotor function.

No statistical technique was available to test this hypothesis, but the examination of raw data reveals that only five out of thirty subjects passed all of the scales at the preoperational level. It appears to suggest that aphasic subjects have deficits in sensorimotor level functions and

hence disturbances of preverbal perceptual function are seen. The data are compiled and presented in Table 7 to support Hypothesis 1.

Table 7

Ordinal Scales Upon Which Preoperational Level was Reached

Ordinal Scales Passed	7	6	5	4	3	2	1	0
Number of Subjects	5	4	4	2	5	2	6	2

H_2. There is a positive relationship between the degree of severity of aphasia and the degree of impairment of sensorimotor functions as measured on seven different scales.

Table 8 contains evidence to support this hypothesis. The degree of severity of linguistic disturbances is positively correlated with the degree of disturbance of sensorimotor function and is significant in five of the seven measures at the $p < .001$ level and the the $p < .05$ level on the remaining two.

Table 8

Spearman Rank-Order Correlations for Independent and Dependent Measures

Variable	Degree of Severity	Classification
Permanence	.40*	.41*
Means	.74***	.70***
Vocal	.72***	.75***
Gestural	.58***	.68***
Causality	.36*	.38*
Space	.59***	.64***
Schemes	.62***	.49**

* $p < .05$
** $p < .01$
*** $p < .001$

H_3. The greater the degree of severity of linguistic disturbance in the aphasic, the lower the scores obtained on each of the seven scales.

Hypothesis 3 is considered supported by the data shown in Table 9. On every scale the mean scores for sensorimotor measures decrease as the severity measures increase. However, there were only two measures on which the difference was significant at $p < .05$ or beyond.

H_4. There is a significant difference between the Classifications of aphasia with regard to the scores obtained on the seven measures of sensorimotor function.

A Univariate F-Ratio was used to test hypothesis four. There was a statistically significant difference in the classifications in five of the seven measures of sensorimotor

Table 9

Means for Sensorimotor and Severity Measures.

Severity Index	0	1	2	3	4	Total	
No. of Subjects	6	8	5	5	6	30	
Means							F Ratio
Object Permanence	5.333	6.0	6.20	6.80	6.833	6.20	1.0501--
Means	4.0	5.75	5.80	6.80	7.0	5.833	6.6454*
Vocal Imitation	4.0	5.25	6.60	7.0	7.0	5.8667	5.7560*
Gestural Imita.	4.0	5.38	5.80	7.0	7.0	5.90	3.2146--
Causality	5.667	5.63	5.60	6.60	7.0	6.0667	0.9773--
Space	4.6667	5.63	5.80	6.60	7.0	5.90	3.1072--
Schemes	4.0	5.0	5.2	5.4	6.661	5.2333	4.1313--

Degrees of Freedom = 4 & 25 -- + Not Significant * = significant $p < .05$

function, at $p < .05$ level or beyond. The data are summarized in Table 10.

Table 10

Differences Between Classifications of Aphasia

Group			0*	1*	2*	3*	4*	Total
No. in each Group			6	5	5	6	8	30
Variable	Wilk's Lambda	F	Means					
Perman.	0.8031	1.5326--5.33	5.8	5.8	7.0	6.75	6.2	
Means	0.4656	7.1741**4.0	5.4	5.8	7.0	6.3	5.83	
Vocal	0.4893	6.5227**4.0	4.8	6.0	7.0	7.0	5.87	
Gesture	0.5410	5.3020**4.67	4.8	5.4	7.0	7.0	5.87	
Causal.	0.8006	1.5563--5.67	5.0	5.6	6.7	6.88	6.07	
Space	0.5752	4.6151**4.67	4.8	6.2	6.7	6.75	5.9	
Schemes	0.6291	3.6843* 4.0	5.2	4.6	6.33	5.75	5.23	

Degrees of freedom = 4 & 25
F is significant at 2.76 (p .05)
4.18 (p .01)
-- = Not Significant
* = (p .05)
** = (p .01)

0 = Global Aphasia
1 = Wernicke's Aphasia
2 = Jargon Aphasia
3 = Anomic/Conduction
4 = syntactic Aphasia

On the basis of the data given in Table 10, this hypothesis is also considered supported.

H_5. The combination of sensorimotor scale measures will explain a significant proportion of the variance in the degree of severity of linguistic disturbances.

Table 11 contains the regression analysis of sensorimotor level predictors of severity of aphasia. It is indicated in Table 11 that approximately 67 percent of the variance in the degree of severity was accounted for by the combination of the seven independent variables. The accompanying F statistic indicated that the proportion of the variance explained was significant ($F = 7.83$, $p < .01$). Therefore, Hypothesis 5 is supported by the data.

It is evident from Table 11 that the Development of Means for Obtaining Desired Environmental Events was the strongest predictor of severity of linguistic disturbance. All of the other independent measures except Gestural Imitation, contributed some to the variance in severity. Gestural Imitation had an F-level that was insufficient for inclusion in the equation, and so did not explain a significant amount of the variance that was not previously explained by the other dependent measures.

Table 11

Stepwise Multiple Regression Analysis of Sensorimotor Level Predictors of Severity of Aphasia

Sensorimotor Variable	Multiple R	R^2	R^2 Change	Simple R	B	Beta
Means	0.66	.44	.44	.66	.64	.66
Vocal	.72	.53	.09	.64	.31	.37
Permanence	.78	.61	.08	.37	-.44	-.45
Schemes	.81	.66	.05	.60	.35	.33
Causality	.82	.67	.02	.33	-.18	1.20
Space	.82	.67	.001	.56	.059	.06

R=819 R^2 = .67134 DF = 6, 23 F=7.83 R^2 Adjusted = .5856

H_6. The combination of sensorimotor scale measures will explain a significant proportion of the variance in classifications of aphasia.

Discriminant analysis was applied to classifications of aphasia variables and measures of sensorimotor functions to derive the relevant proportion of subjects correctly grouped in the classification catagories. In Table 13 the predicted results are presented. Eighty-three percent of the grouped cases were correctly classified. The portion of the variance explained was significant at ($p < .001$) level.

The strongest factors in predicting classifications of aphasia were The Development of Means for Obtaining Desired Environmental Events. The Development of Operational Causality and Vocal Imitation were moderately strong predictors. The remaining scales contributed little to the predictions of classifications of aphasia.

Table 12

Summary Table From Discriminant Analysis

Step Number	Variable	F to Enter or Remove	Number Included	Wilk;s Lambda	Significance	Roa'sV.	Change in Roa's V.	Sig.of Change
1	Means	7.17411	1	0.4655	0.001	28.70	28.70	0.000
2	Causal	3.56766	2	0.2919	0.000	51.51	22.81	0.000
3	Vocal	3.35071	3	0.1844	0.000	88.76	37.26	0.000
4	Space	1.26999	4	0.1498	0.000	95.58	6.82	0.146
5	Schemes	1.97561	5	0.1088	0.000	108.70	13.12	0.011

Discriminant Function	Eigenvalue	Relative Percentage	Canonical Correlation	Function Derived	Wilk's Lambda	Chi Sq.	D.F.	Sig.
1	3.36714	77.44	0.878	0	0.1089	53.22	20	0.000
2	0.83600	19.23	0.675	1	0.4755	17.84	12	0.121
3	0.14299	3.29	0.354	2	0.9731	3.257	6	0.776
4	0.00206	0.05	0.045	3	0.9979	0.049	2	0.976

Table 13

Predicted Results

		Predicted Group Membership				
Actual Group	Number of Cases	Group 0	Group 1	Group 2	Group 3	Group 4
Group 0 (Global)	6	5 83.3%	1 16.7%	0 0.0%	0 0.0%	0 0.0%
Group 1 (Wernicke)	5	0 0.0%	5 100.0%	0 0.0%	0 0.0%	0 0.0%
Group 2 (Jargon)	5	0 0.0%	0 0.0%	4 80.0%	0 0.0%	1 20.0%
Group 3 (Anomic/Cond.)	6	0 0.0%	0 0.0%	0 0.0%	6 100.0%	0 0.0%
Group 4 (Syntactic)	1	1 12.5%	0 0.0%	0 0.0%	2 25.0%	5 62.5%

Percent of "grouped" cases correctly classified = 83.33%

Summary of Results

All of the hypotheses were supported by the data. Hypothesis 4 is considered supported because five of the sensorimotor scales contain statistically significant differences in classifications of aphasia. The remaining hypotheses appear to this investigator to be clearly supported.

A discussion of these results and the implications of the study as well as the conclusions reached by the investigator are included in the next chapter.

CHAPTER V

SUMMARY AND CONCLUSIONS

This investigation examined the relationship between the degree of severity of linguistic disturbance in the aphasic and seven measures of sensorimotor level cognitive functioning; and between the classifications or types of aphasia and these same seven measures. Though there was a vast body of literature concerning aphasia and numerous studies had been conducted regarding the relationship of intelligence to aphasia, a review of the literature suggested that sensorimotor level cognitive skills had been assumed to exist intact in the aphasic and had not been examined. The theoretical framework indicated that language and thought are inextricably related; that language is a product of thought; that the acquisition of language is based on the development of at least three levels of perceptual integration; and that disturbances of language are related to disturbances of perception of a preverbal nature. The cognitive skills examined were: visual pursuit and the permanence of objects; means

for obtaining desired environmental events; vocal imitation; gestural imitation; operational causality; construction of object relations in space; and schemes for relating to objects.

The data were collected from the responses obtained from aphasic subjects on the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972b), and the Assessment in Infancy: Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975), as adapted for an adult population of aphasics. The subjects were obtained from nursing homes providing skilled nursing and intermediate care in Greensboro, North Carolina, and volunteers from the community, as well as patients in skilled nursing, intermediate care and outpatient facilities of the Veterans' Administration Center in Dayton, Ohio. Thirty subjects were found who met the criteria for sample selection. The six hypotheses, tested by correlation, univariate and multivariate techniques, focused upon the relationship between the two primary variables - severity of linguistic disturbance, and the classification of aphasia- and the seven areas of sensorimotor cognitive functions that were measured.

Discussion

Four questions were posed in Chapter I concerning the nature of brain damage and its effect upon cognitive functioning. The first one - does damage to the dominant hemisphere of the cerebral cortex in the adult result in decompensation of cognitive processes of a preverbal nature?- is also the first problem considered. The second question - is there a relationship between disturbances of linguistic function and disturbances of perception of a preverbal nature?- is examined as essentially the second and third problems considered in this investigation.

The problems as stated in Chapter III are: (1) whether preverbal perceptual disturbances are suggested by evidence of disturbance of sensorimotor levels of cognitive functioning; (2) whether there is a relationship between the level of severity of the linguistic disturbances resulting from aphasia and the aphasic's ability to perform at each of the levels of cognitive functioning on seven different scales of sensorimotor development; and (3) whether there is a relationship between the diagnostic classifications of aphasia symptomes and the aphasic's ability to perform at each level of

sensorimotor development; and (3) whether there is a relationship between the diagnostic classifications of aphasia symptoms and the aphasic's ability to perform at each level of cognitive functioning on seven different scales of sensorimotor development. The first section of this chapter comments on the findings in relation to these problems.

The second section of this chapter relates the findings in this investigation to questions three and four in Chapter I, which ask: If decompensation of preverbal perceptual cognitive processes occurs, is the language disturbance related to this as well as to the localization of the specific damage to discrete areas thought to control various speech and language functions? and (4) can the descriptions of cognitive functions at each stage, as provided by Piaget, be applied to the behavior of the aphasic to ascertain the level of cognitive development at which he is functioning?

The third section discusses the individual scales of sensorimotor development and their significance as predictors, and the remaining discussion is focused upon the implications of the findings and recommendations for further study.

Conclusions Regarding the Research Problems

Based on inspection of the data as summarized in Tables 7, 9, 10, 11, 12,and 13, it is evident that disturbances in sensorimotor functions were found. Since the criteria for sample selection restricted the inclusion of any subjects in the sample whose damage was diagnosed as occurring in the right cerebral hemisphere (or nondominant hemisphere), and since it was established that preverbal perceptual skills develop during the sensorimotor stage of cognitive development, the subjects' responses to the sensorimotor measures would suggest that there is support for the position that preverbal perceptual functions are also disturbed.

The degree of severity of linguistic disturbances is positively correlated with the degree of disturbance of sensorimotor function and is significant at the $p < .05$ level in the measures of visual pursuit and object permanence, and operational causality. The correlations on the remaining five scales are significant at the $p < .001$ level. The measure of means for obtaining desired environmental results is the most highly correlated with the degree of severity of

linguistic disturbances in the aphasic.

The ranking of classifications of aphasia is also positively correlated with the degree of sensorimotor function and is also significant at the $p < .05$ level in the measures of visual pursuit and object permanence, and operational causality. In this relationship as in the one described above, the remaining scale score correlations were also significant at the $p < .001$ level. The highest correlation between these variables occurred in the measure of vocal imitation.

The investigator assigned the following ranks to the aphasia classifications: 0 - Global aphasia; 1 - Wernicke's aphasia; 2 - Jargon aphasia; 3 - Anomic or Conduction aphasia; and 4 - Syntactic aphasia, expecting that the lowest scores would be obtained by the Global aphasics and the highest by the Syntactic aphasics, with the other three falling between in the order presented above. Examination of the mean scores of sensorimotor and severity measures in Table 9 suggested that the Anomic and Conduction classification demonstrated less sensorimotor disturbance than the Syntactic aphasic on the visual pursuit and object permanence scale, on the means for obtaining desired environmental events, and on schemes for relating to objects. None of the aphasic subjects classified as either Syntactic or Anomic/Conduction aphasia showed any disturbance in either the Vocal or Gestural Imitation Scale. The mean scores for each scale in each classification are presented in Figure 5.

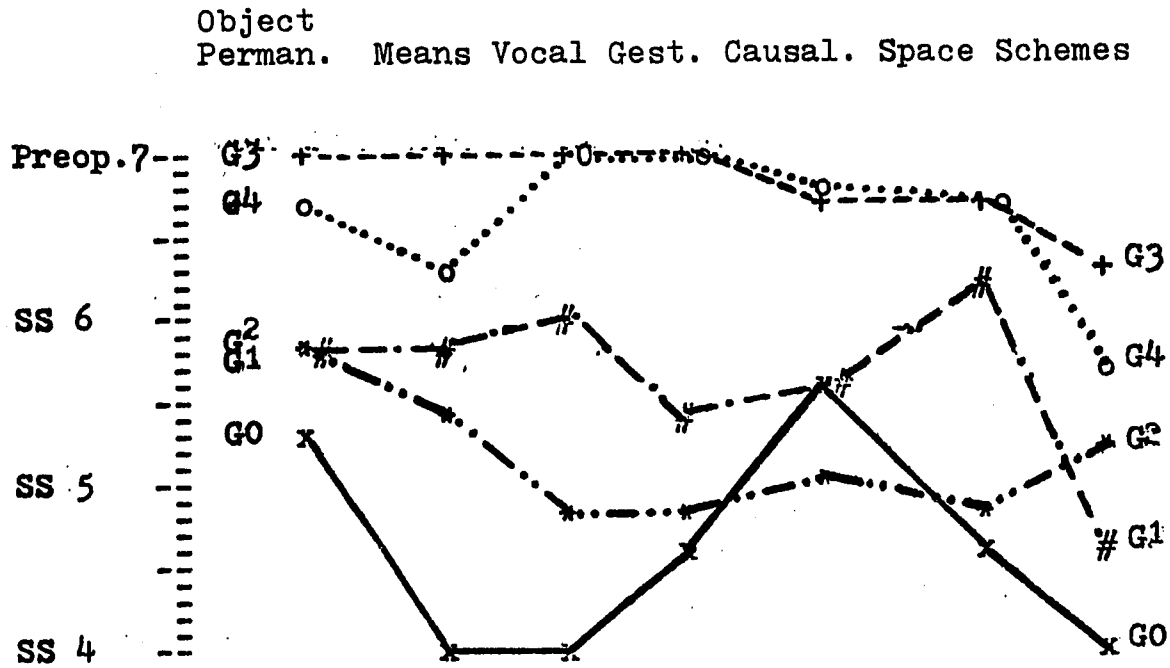

Figure 5. Mean Scores for each scale.

Although on five of the seven measures of sensorimotor function there was a statistically significant difference between classifications of aphasia at the $p < .05$ level or beyond (see Table 10), examination of Figure 5 would suggest that perhaps Anomic and Conduction Aphasics have a pattern of sensorimotor dysfunction that is similar to that of the Syntactic Aphasic.

It would appear then, that based on the data obtained from 30 aphasic subjects, there is evidence of preverbal perceptual dysfunction and that the greater the degree of

severity of linguistic disturbance, the greater the degree of severity of sensorimotor cognitive disturbance. Furthermore, the data also support the position that different types of aphasia will manifest different degrees of sensorimotor disturbance.

Conclusions Regarding Remaining Questions About the Nature of Brain Damage and Its Effect Upon Cognitive Functions

The investigator raised the question: If decompensation of preverbal perceptual cognitive processes occurs, is the language disturbance related to this as well as to the localization of the specific damage to discrete areas thought to control various speech and language functions?

From the time of Broca and Wernicke and others at the end of the nineteenth century, attempts were made to classify the various aphasic losses according to specific regions of the brain cortex.

> Beyond a doubt, the causative factors consist in acquired deficits of the forebrain. Almost similarly unapposed is the predominant localization of the defects in the major hemisphere (Luchsinger & Arnold, 1965, p. 796).

It is also generally accepted that expressive language formulation disturbances suggest lesions in Broca's area (the third frontal convolution of the dominant or left hemisphere); auditory perceptual disturbances suggest lesions in Wernicke's area of the second temporal convolution in the left hemisphere and visual perceptual impairment suggests lesions in

the most posterior aspects of the occipital lobe (Penfield & Roberts, 1959). However, all aspects of expressive and receptive language represent both primary and secondary functions as has been noted in Chapter II. Therefore, it is the position of this investigator that primary cerebral functions may be localized in discrete areas, but catagories of symbolic, syntactic, and semantic functions may be dependent upon secondary brain functions which are not localized, but instead reflect an interaction of generic evolution, genetic endowment, and individual learning. This position permits the investigator to approach the phenomenon of aphasia from the holistic viewpoint of Gestalt psychology as does Wepman (1970, 1976), Subirana (1956) and Bay (1952), and to explain the decompensation of preverbal perceptual cognitive processes found in this investigation as a consequence of related disturbances in secondary brain functions without denying the effect of the localization of the specific damage to discrete areas thought to control various speech and language functions.

The evidence obtained from this investigation seems to support the position that decompensation of preverbal perceptual cognitive functions does exist, and that there is a positive significant relationship to the linguistic disturbances manifested by the adult aphasic, and that decompensation.

The remaining question raised by the investigator is: Can the descriptions of cognitive functions at each stage, as provided by Piaget, be applied to the behavior of the aphasic to ascertain the level of cognitive development at which he is functioning?

> ...The cognitive functioning of the aphasic has been a topic of much interest and debate for many decades. Part of the problem has been one of assessing cognitive functioning in the adult aphasic (Wachtel, 1976, p. 8).

Wachtel continued by pointing out that:

> If levels of cognitive development could be objectively ascertained and evaluated in the normal organisms, and if a means of testing the aphasic's cognitive functioning could be developed so that the extent and form of impairment in this area could be determined, then we might be able to ascertain whether or not the aphasic's cognitive loss was regressive in nature. If indeed the loss were found to be regressive, then a knowledge of cognitive development...might be a useful tool for the speech pathologist (p. 9).

At this point in time it is difficult to objectively ascertain cognitive development in the normal organism because measures of cognitive stage levels are highly subjective, not standardized, and couched in general rather than specific terms. "...Piaget's stages are a theoretical taxonomy" (Ginsburg & Opper, 1969, p. 71). It has also been found that children may display wide individual differences in physical and social environments, physiological factors, and genetic endowment. "What is important is the regular order of succession of the stages, regardless of the

particular ages at which they appear" (Ginsburg & Opper, 1969, p. 29).

It naturally follows that if it is difficult to ascertain quantitative measures of cognitive development in the normal organism it would be even more difficult to obtain these measures in the adult aphasic so that the extent and form of impairment could be determined.

> ...The more fundamental difference lies in the fact that the developmental progression of the child represents the product of a normal neural system whereas the aphasic systems are a reflection of a disordered neural mechanism (Helmick, 1976, p. 17).

Therefore, it cannot be assumed that both the normal organism and the pathological organism behave according to the same rules of either cognitive and/or linguistic learning (Helmick, 1976). The brain-injured aphasic individual operates according to a different set of rules. This is because the aphasic symptoms of the brain-injured adult reflect a breakdown of the learned linguistic rules rather than an absence of rules still to be learned. It is suggested by the present investigator that the aphasic's symptoms may also reflect a breakdown of cognitive functions rather than a developmental phenomenon. It therefore seems possible that some of the cognitive stage level behaviors in children may appear comparable to cognitive behaviors in adult aphasics in isolation. It is important to remember, however, that unlike the limited sensory and motor experiences of the child, the adult aphasic has experienced a multitude of

these sensory and motor experiences (Bollinger, 1976). It is therefore the position of this investigator that aphasic adults do not fall specifically within Piagetian catagories as do children, but that as Clark (1974), and Affolter (1974) noted, development of perceptual-cognitive performances and language development have some clinical correspondence in the aphasic's linguistic performances. Their position is supported in the findings of this study. It would then appear that knowledge of cognitive development as described by Piaget would still be a useful tool for the speech pathologist and descriptions of cognitive functions could be applied to the behavior of the aphasic not to ascertain the level of cognitive development at which he is functioning, or to which he has regressed, but to suggest the extent and form of his/her impairment in terms of preverbal perceptual cognitive functioning.

Significance of the Individual Scales of Sensorimotor Development

It is apparent from examination of Figure 5 that the mean scores for each scale achieved by the 30 subjects fell within the fifth and sixth substages of the period of sensorimotor development primarily. It is therefore necessary to examine the attributes of cognitive functioning at sensorimotor stages five and six in order to discuss them in terms of the aphasic and the individual measures of sensorimotor function.

"...Intellectual behavior at any age evolves directly from prior levels of behavior. Thus the roots of all intellectual development are in sensorimotor behavior" (Wadsworth, 1971, p. 33). In the stages leading up to sensorimotor substage 5, the child has developed coordination between schemes for vision and hearing, vision and touch, and hearing and touch, which enable him/her to prolong unusual events. Affolter (1974) calls this period the stage of intermodality perceptual development. When sensorimotor stages are applied to children, "(the attainment of sensorimotor stage five) marks the beginning of truly intelligent behavior..." (Wadsworth, 1971, p. 54). Stage five is sometimes called the Tertiary Circular Reactions Stage.

> The term 'tertiary circular response' describes the kind of repetitive behavior that engages and fascinates the child of about one year of age where he repeats an action over and over again, but not in any stereotyped form...(Baldwin, 1967, p. 214).

A classic characteristic of aphasia is the phenomenon of perseveration. As was noted in Chapter III, perseveration also is a kind of repetitive behavior that engages the adult aphasic, but unlike the child, his repetitions are in stereotyped form. These perseverations are largely noted in terms of verbal output, but may be observed in nonverbal behaviors,too (Wepman, 1951).

When an individual has the tertiary circular response he becomes aware of the continuous nature of space, begins

to see that variations in acts correlate with variations in results, and becomes able to put schemes in some kind of order so that they can be changed on the basis of feedback (Baldwin, 1967).

Sensorimotor stage five is the last stage that does not involve actual mental representation of the external world. Even though the child continues to develop more elaborate and complex sensorimotor schemes, beyond stage five no new principles are involved (Baldwin, 1967).

In this stage there is a concept of 'before' and 'after' (Beard, 1969), but the infant cannot predict true cause-effect relationships. The individual begins to be able to handle sequential displacements and is aware that objects beyond himself are a source of actions (Wadsworth, 1971). The desire to reproduce an interesting event involves the principle of functional assimilation (Ginsburg & Opper, 1967). There is no pure accommodation in the fifth stage (Beard, 1969). At this level the child is capable of systematic imitation of new models. Affolter equates these cognitive skills with the arrival of the serial or sequential integration stage of preverbal perceptual development.

Individuals operating out of sensorimotor stage six are capable of the beginnings of representational intelligence. At the sixth stage he/she

> ...Becomes capable of reconstructing causes in the presence of effects alone, and without having perceived the action of those causes. Inversely,

> given a certain perceived object as the source of potential actions, he becomes capable of foreseeing and representing to himself its future effects (Piaget, 1954, p. 293).

"This ability to form a mental representation of events is the hallmark of stage six..." (Baldwin, 1967, p. 21).

The infant is then able to imitate more quickly (Ginsburg & Opper, 1969), and to pretend (Baldwin, 1967). Both pretending and language are predicated upon the ability to execute deferred imitation. Affolter (1974) suggested that deferred imitation is developed out of serial integration skills and Sinclair (1969, 1971) supports this assumption.

Stage six represents the primacy of accommodation over assimilation which is in reality imitation, which leads to reproductive imagination and representative imitation, which is speech and language (Beard, 1969). "Stage six forms the transition to the next period (the Preoperational Stage) of development" (Ginsburg & Opper, 1969, p. 63).

Uzgiris and Hunt developed seven ordinal scales of sensorimotor development to obtain information about the level of the infant's cognitive functioning. These scales were modified to be applied to adult aphasics. The rationale and method of accomplishing this were detailed in Chapter III. The seven scales are: Visual Pursuit and the Permanance of Objects; Development of Means for Obtaining Desired Environmental Events; Vocal Imitation and Gestural

Imitation; The Construction of Object Relations in Space; The Development of Operational Causality; and the Development of Schemes for Relating to Objects. Each of these scales is discussed relative to the aphasic subject's performance on them. The sequence of cognitive development in each scale is included in Appendix E.

Visual Pursuit and the Permanence of Objects

Eighteen out of thirty subjects, or 60 percent, were able to reverse the order of search suggesting no sensorimotor level cognitive dysfunction. Eight of the aphasic subjects or 27 percent were able to follow a series of invisible displacements under three covers, but were not able to reverse the order of search. One subject was able to locate an invisible displacement, but could not follow invisible displacements through a series. One subject was also unable to locate objects that had been invisibly displaced, but could locate the objects when visible displacement was employed. One subject was unable even to follow an object through a 180-degree arc and the remaining subject appeared unable to attend visually to the objects in spite of the fact that her vision was described by her physician as being functional with glasses.

The stepwise multiple regression analysis of the primary variable, severity of linguistic disturbance, and the measures of sensorimotor function showed that the object

permanence measure accounted for about five percent of the variance with an F of 1.0501 with 4 and 25 degrees of freedom, which was not significant.

In the discriminant analysis of the primary dependent variable, classifications of aphasia, and the sensorimotor measures, the Visual Pursuit and Object Permanence Scale yielded an F-Ratio that was insufficient for further computation.

Development of Means for Obtaining Desired Environmental Events

> The eliciting situations in this series are directed mainly at what infants do to cause events or obtain objects which they have come to desire. In such situations, they combine the use of one behavior pattern as a means with another as an end or goal (Uzgiris & Hunt, 1975, p. 108). Increasing differentiation of actions-as-means from actions-as-ends, increasing determination of means by the envisioned end leading to subordination of means to ends, and increasing anticipation regarding the appropriateness of particular means seem to characterize progress along the sequence (p. 109).

Fourteen out of the 30 aphasic subjects, or 47 percent, were able to select appropriate means even in novel circumstances, demonstrating foresightful behavior. Their performance of Scale II did not suggest sensorimotor level cognitive deficiency. Seven of the aphasic subjects or 23 percent were able to use well-developed action schemes in novel circumstances, but did not appear to demonstrate foresightful behavior, which was exemplified in their responses to item 12 in this scale. A set of plastic rings was used

which could be stacked on an unmounted rod. One of the rings had been made solid by filling the hole. The fourteen subjects who did not demonstrate any sensorimotor deficits on the second scale, set the solid ring aside and did not attempt to stack it, but the subjects described as being in substage six used force in their attempts to stack the solid ring on repeated attempts.

These seven subjects were apparently operating with mental representation however, because imitation was readily employed in obtaining the desired end.

Two subjects, or seven percent of the aphasics, were able to make accommodative modifications in familiar circumstances, but not in novel ones, and did not understand the relationship of support. Six subjects (20 percent) attempted to maintain or regain interesting environmental events by using well-developed action schemes, but could not coordinate them to achieve a desired end in the presence of novel circumstances. They did not let go of one object in order to reach for another, nor use locomotion (within the limits of their handicaps) as a means. The remaining patient did not even engage in hand-watching behavior.

In the stepwise multiple regression analysis of the primary variable severity of linguistic disturbance, and measures of sensorimotor functioning, scores on the Means for Obtaining Desired Environmental Events accounted for approximately 44 percent of the variability and was

significant at the $p < .01$ level with an F of 6.5454 with 4 and 25 degrees of freedom.

The Means scale was the best predictor of the dependent variable, severity of linguistic disturbance, but it was also the best predictor of classification of aphasia as derived from a discriminant analysis.

On the discriminant analysis, scale two accounted for 77 percent of the variance of the dependent variable, classifications of aphasia. The F-Ratio was 7.1741 with 4 and 25 degrees of freedom and was significant at the $p < .01$ level.

Development of Imitation - Vocal

Nineteen of the aphasic subjects or 63 percent, were able to imitate all novel words directly, and thus were judged to be free of sensorimotor level disturbance on scale three. One subject was able to imitate one of the novel words, but not all, though the responses resembled quite closely those of the examiner. Three of the subjects (10 percent) were able to vocalize in response to the examiner with close approximation when unfamiliar sound patterns were introduced or novel words, but could not imitate directly. Four of the aphasic subjects, or 13 percent, were able to vocalize in response to the examiner with sounds and words that were familiar, but could not imitate the unfamiliar words modeled by the examiner, even with close approximation.

One subject showed a change in expression, a smile, and some mouth movements, but did not vocalize in response to any of the presentations, and the remaining two (.07%) made no response at all.

In the stepwise multiple regression analysis of the primary variable, severity of linguistic disturbance and measures of sensorimotor functions, scores on the Vocal Imitation scale accounted for approximately .09 percent of the variance with an F-Ratio of 5.7560 with 4 and 25 degrees of freedom and was significant at the $p < .05$ level.

In the discriminant analysis of the primary variable classification of aphasia subjects and sensorimotor measures, with regard to the scale Vocal Imitation, 3.29 percent of the variance was accounted for, with an F-Ratio of 5.7560 with 4 and 25 degrees of freedom and was significant at the $p < .05$ level.

Development of Imitation - Gestural

Gestural imitation follows a sequence similar to that of vocal imitation. Eighteen or sixty percent of the thirty aphasic subjects passed all of the gestural imitation items and appeared to be free of sensorimotor disturbance in that area. One subject was able to imitate one invisible gesture, but not more. Five subjects or seventeen percent, were able to imitate familiar complex schemes, but only imitate modeled unfamiliar gestures through gradual approximation.

Four subjects (thirteen %) could imitate simple familiar schemes and attempted complex actions, but could not come closer to success even on repeated attempts. The remaining two subjects or seven percent, did not attempt to try any of the examiner's actions.

In neither the stepwise multiple regression analysis, nor the discriminant analysis, was the F-Ratio of the scores obtained for Gestural Imitation sufficient for further computation and thus this variable was not used in either analysis.

The Development of Operational Causality

The term 'operational' is used "in the sense of 'practical' or 'effective' to contrast with conceptual understanding of some causal principles" (Uzgiris & Hunt, 1975, p. 116). Nineteen of the aphasic subjects, or sixty-three percent were able to activate all of the objects directly and did not appear to evidence sensorimotor level disturbance in this cognitive function. Four (thirteen percent) of the subjects were able to exercise operational causality but only after a demonstration. They appeared to be functioning at the sixth substage of sensorimotor development. Three subjects, or ten percent, were able to appreciate the center of causality, the examiner, and repeatedly handed the objects back to the examiner in a gesture of request. One subject pushed the objects toward the examiner, but did not attempt

to hand them back for reactivation. One patient used what appeared to be a 'procedure', but did not appear to see the examiner's role in effecting a cause. One subject demonstrated hand-watching behavior, but nothing else, and the final subject made no response whatsoever to any of the tasks.

In the multiple regression analysis of severity of linguistic disturbance and measures of sensorimotor function, the development of operational causality explained .015 percent of the variance with an F-Ratio of 3.2146 with 4 and 25 degrees of freedom which was not significant.

In the discriminant analysis, the operational causality variable, explained 19.23 percent of the variance with an F-Ratio of .9773 and 4 and 25 degrees of freedom, which was not significant.

Development of Construction of Object Relations in Space

Scale V concerns the infant's developmental transformations in appreciation of and construction of object relations in space. Sixteen of the aphasic subjects, or 53 percent, were able to perform all the tasks on Scale V, the Development of Construction of Object Relations in Space. This suggested that sensorimotor level functions were intact for this cognitive function. Four subjects (13%) were able to perform the tasks satisfactorily up to the one concerning the absence of a familiar person. They failed to comprehend

the question. This may indicate damage to the auditory perception centers rather than lack of mental representations for the person who was absent. Three of the subjects, or ten percent, failed to act with an appreciation of gravity. Six subjects (20%) were unable to go beyond the relationship of the container to the contained. The remaining subject failed to even look at the objects, but did localize the source of sound visually. This was one of only two instances where a subject was able to perform a task out of the ordinal sequence.

The multiple regression analysis of the relationship between the severity of linguistic disturbance and the measures of sensorimotor function indicated that the scale of development of construction of object relations in space accounted for only .00113 percent of the variance in the severity index, and obtained an F-Ratio of 3.1072 with 4 and 25 degrees of freedom which was not significant.

In the discriminant analysis of the relationship between the classifications of aphasia and the sensorimotor scale measures, the Space variable accounted for .05 percent of the variance and had an F-Ratio of 3.1072 at 4 and 25 degrees of freedom which was not significant.

The Development of Schemes for Relating to Objects

> Unlike the sequences in the construction of operational causality, and the construction of object relations in space, this series concerns the ways through which infants interact with objects (Uzgiris & Hunt, 1975, p. 122).

Only eight of the aphasic subjects or twenty-seven percent, responded to the objects by naming them. An additional subject responded by showing the objects to the examiner as he manipulated them in appropriate ways. Fifteen subjects or fifty percent of the sample demonstrated approximately appropriate socially instigated behaviors, but made no attempts to share or name objects as they manipulated them. Four patients or thirteen percent, manipulated the objects by turning them over and over, and examining them carefully, but made no attempt to put them together in a socially instigated manner. One patient picked up all the objects, shook them, and replaced them one by one, and the remaining patient did not respond to the objects in any way, but simply sat in the chair.

The stepwise multiple regression analysis of the relationship between the severity of linguistic disturbance and the measure of sensorimotor function indicated that the scale of development of schemes for relating to objects accounted for approximately five percent of the variance in the severity of disturbance of linguistic functions, with

an F-Ratio of 4.1313 with 4 and 25 degrees of freedom which was not significant.

In the discriminant analysis of the relationship between the classifications of aphasia and the sensorimotor measures, the schemes variable accounted for too small a relative percentage to be entered as a function. The F-Ratio was 3.6843 with 4 and 25 degrees of freedom which was significant at the $p < .05$ level.

Summary of the Significance of the Sensorimotor Measures

It would appear that the disturbances of sensorimotor functions across all scales suggest that when sensorimotor deficits exist, they are primarily characterized by behaviors consistent with sensorimotor levels five and six. It would further appear that the most useful scale in predicting both severity of linguistic disturbance and classifications of aphasia is Scale II, the Development of Means for Obtaining Environmental Events. The least useful predictor appears to be IIIb, the Development of Gestural Imitation, for either degree of linguistic disturbance, or classification of aphasia. The scale most highly correlated with the degree of severity is also the measure of Means for Obtaining Desired Environmental Events, but the scale most highly correlated with the classification ranks is the Vocal Imitation Scale. This is not unexpected because of the

nature of the speech and language dysfunctions present in the five classification catagories.

Implications of the Findings

Wepman (1976) published a paper which attempted to present a rationale for the conception of aphasia as a thought process handicap. His rationale is based on the assumption

> that man has an internalized idosyncratic will, a logic, and a capacity for control of associations with his past experience and the ability to formulate meaningful expressions at least approximating his thought processes. Verbal language as expressed is seen as fulfilling imperfectly this role and needs to call upon nonverbal gesture, facial expressions, bodily posture, and vocal intonation patterns to aid in more adequate transmission of the intended message (p. 132).

He then described aphasia within this concept as taking the form of a thought process defect in global aphasia; an inner speech handicap in pragmatic aphasia (which was termed conduction aphasia in this paper); a breakdown of verbal formulations in its phonological aspects in jargon aphasia; in substantive word selection in semantic aphasia (called anomic aphasia in this paper); and in the use of syntax in syntactic aphasia. He described these as five stages of a regression phenomena with the severity of the handicap seen as "being in direct relation to the amount of regression" (Wepman, 1976, p. 132), in which syntactic aphasia would involve little if any disturbance of thought

process; semantic or anomic aphasia would involve disturbance of abstract thought processes only; pragmatic or conduction aphasia would involve deficits in abstract thought and perhaps in concrete thought processes; jargon aphasia would be characterized by marked involvement of thought processes, and global aphasia would always be characterized by serious disturbances of thought process. Wepman does not include the classification of Wernicke's aphasia which is a receptive aphasia because he regards it as an agnosia. It was, however, included as a classification in the present investigation.

The findings in this study tend to support Wepman's proposed relationship. In terms of Wepman's system, a comparison of linguistic typology and cognitive features is made in Figure 6.

Language Involvement	Thought Process Involvement	Sensorimotor Disturbance
Syntactic	Little if any	Little if any
Semantic (Anomic)	Concrete retained, abstract effected	Little if any
Pragmatic (Conduction)	Indeterminate	(Used in same catagory as Anomic)
Jargon	Marked	Moderate
Wernicke's	(not included)	Marked
Global	Always serious	Always serious

Figure 6. Comparison of linguistic typology and psychological cognitive features.

Goldstein (1948) proposed that the effect of brain damage alters the thought processes from 'abstract' to 'concrete'. His concept of the effect of brain damage seems more and more evident as cognitive changes are identified and explored.

The therapeutic implications of these findings would seem to lie in a shift of focus from direct linguistically oriented methods of treatment to a regimen which would center on the "thought processes (of the aphasic) by extending content and substance" (Wepman, 1976, p. 132).

Weigle and Bierwisch (1970) propose a similar paradigm in the description of their "deblocking" technique, which is a process that follows reorganization of lower levels of function so that higher levels of function are able to emerge. Implicit in this approach would be embellishment of thought or thought process stimulation (Wepman, 1976).

Language Acquisition Implications

If further research continues to support the theory that linguistic disturbances in the aphasic are related to cognitive disturbances it would lend support to the cognitive theorist's attempt to link cognitive processes to both the structure and the content of early language development, tending to confirm the position that a child's linguistic system is just one kind of cognitive system that is not qualitatively different from other cognitive systems in either structure or content.

Affolter (1974) and Clark (1974) argued that there is a direct relationship between preverbal perceptual development and the acquisition or disturbance of linguistic functions, and supported their arguments with empirical evidence. Sinclair (1969, 1971) also lent support to this position in her studies relating sensorimotor development to language acquisition. A cognitive-developmental concept of language acquisition was also espoused by Kohlberg (1968) and McNeill (1968)

Implications for Further Research

It was noted earlier by Wachtel (1976) that assessing cognitive functioning in the adult aphasic is a serious problem. Most of the available measures depend upon language which is obviously deficient in the aphasic. The nonverbal measures are often in the form of tasks which are thought to be under the control of the nondominant hemisphere, such as spatial relationships, design, and automatic rote memory learning. The nondominant hemisphere is rarely involved when the brain damage results in adult aphasia. It would therefore follow that further research is needed to develop an instrument that could quantitatively assess cognitive functioning of the adult aphasic and the extent and form of the impairment if it is found to exist.

Much more research of the type presented here is necessary to support or refute the theory that there is a

link between cognitive disturbance and linguistic disturbance. Basing on the assumption that such a relationship exists, this investigator chose to begin by examining sensorimotor level cognitive functions to determine whether they exist intact in the adult aphasic. While the evidence is by no means conclusive, it does suggest that those preverbal perceptual functions which appear to be necessary to the normal acquisition of language are also disturbed in some adult aphasics, depending upon the degree of severity of the linguistic disturbance and the type of aphasia present.

It would be interesting to continue the present investigation with a study of preoperational level cognitive tasks. Tissot, Lhermitte, and DuCarne (1963) have done some investigating and have concluded that an aphasic regresses through dedifferentiation and disintegration to ontogentically earlier stages.

The difficulty in such research lies in the need for language as a tool to reveal the cognitive processes taking place. Furth (1964, 1969) has developed nonverbal preoperational level tasks for use with deaf children. A replication of his studies with adult aphasics might also provide some interesting data relative to cognitive decompensation.

Finally, there is great implication for research in the area of therapeutic intervention. First, it would be necessary to develop a regimen designed to stimulate and embellish thought processes. The treatment plan could then be administered

experimentally to a group of aphasics while a matched group received a more conventional plan incorporating direct linguistic orientation. Pretest and posttest quantitative measures of a precise aspect of language function could then be analyzed to determine whether or not a statistically significant difference in the responses to the treatment plans did indeed exist.

Though every effort was made by the investigator to control for confounding effects, limitations of time and funds made a more rigorous control impossible. In addition, the variety of sources from which subjects were obtained, while it provided a more representative sample, discouraged the use of sophisticated electronic equipment such as video tape instruments, or specially designed rooms in which more than one examiner could record his or her assessment of the subject's performance and the results analysed for inter-observer agreement.

Both instruments yield quantitative type data, but are dependent upon subjective assessment on the part of the investigator. Steps were taken by the writer to insure objectivity by consulting with three speech pathologists who are experts in aphasiology, about the decisions of placement in each diagnostic classification and level of severity. Verbal portions of the aphasia examination were recorded on audio cassette tapes and played for these consultants. The judgements of performance on the Uzgiris-Hunt instrument were

strictly those of the investigator. Since, in spite of precautions against it, biases could have crept into the assessments of the discrete behaviors, these findings would be more significant if supported by other investigators replicating the study both as it was done here and with the use of more sophisticated electronic equipment.

Conclusions

Basing on the assumptions that there is a direct relationship between cognitive development and language acquisition; that preverbal perceptional cognitive skills, particularly perceptual and sequential or serial integration perceptual skills, are necessary to the acquisition of both linguistic structure and content; that preverbal perceptual functions develop and are present during the sensorimotor period of cognitive development; that aphasia is a disorder of linguistic functions; that language usage and thought are inextricably related; and that aphasia is also a disorder of thought processes, the investigator explored the nature of sensorimotor level cognitive functions in the adult aphasic through the use of the Assessment in Infancy: Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975) adapted for use with an adult aphasic population, and related the findings by means of statistical analysis, to a rank-order assessment of severity of linguistic disturbances and to the major diagnostic classifications of aphasia, both of which

were assessed by use of the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972b).

It was hypothesized that (1) a disturbance of preverbal perceptual functioning is demonstrated in the responses of the aphasic subjects to measures of sensorimotor function; (2) there is a positive relationship between the degree of severity of aphasia and the degree of impairment of sensorimotor functions as measured on seven different scales; (3) that the greater the degree of severity of linguistic disturbances in the aphasic, the lower the scores obtained on each of the seven scales; (4) that there is a significant difference between the classifications of aphasia with regard to the scores obtained on the seven measures of sensorimotor functions; (5) the combination of sensorimotor scale measures will explain a significant proportion of the variance in the degree of linguistic disturbances; and (6) the combination of sensorimotor scale measures will explain a significant proportion of the variance in classifications of aphasia. All six hypotheses were supported. They were tested by means of Spearman rank-order correlations, a Univariant F-Ratio, and two multivariate techniques, stepwise multiple regression and discriminant analysis. For hypotheses 2, 4, 5 and 6 to be supported the associations had to reach a significance level of at least $p < .05$, and be in a positive direction.

The results suggest that sensorimotor disturbances are present in some adult aphasics; that there is a significant positive relationship between the degree of severity of linguistic disturbance and the degree of sensorimotor disturbance, and that there is also a significant relationship between diagnostic classifications of aphasia and degree of sensorimotor disturbance. The sensorimotor scale that appeared to be the best predictor of both severity and classification was The Development of Means for Obtaining Desired Environmental Events.

There are implications for further research apparent in this study. They include development of an instrument that would quantitatively assess cognitive function in terms of amount and form of impairment; examination of the cognitive skills usually associated with the preoperational period of cognitive development in terms of the same two primary dependent variables, severity of linguistic disturbance and classifications of aphasia, and the development and testing of treatment plans for the aphasic that would stimulate and embellish thought processes rather than provide direct linguistic orientation. It is also hoped that the research reported here will be replicated by more sophisticated means that will provide additional support or refutation of these findings.

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APPENDIX A

INTERVIEW QUESTIONNAIRE: SUBJECTS' INTERESTS, ACTIVITIES, LIMITATIONS, AND RESTRICTIONS

Subject _____ Respondent_____

Date of interview_____Location of interview_____

_____

1. Does subject have glasses?

   Does subject wear them?

2. Does subject seem to hear you?

   Does subject wear a hearing aid?

3. Does subject have any dietary restrictions? Diabetic___
   Low Sodium__
   Soft diet__
   Edentulous__
   What are subject's favorite foods? Low Fat_____

4. What words and/or phrases have you heard subject use regularly?

5. What activities does subject engage in when not eating, sleeping, or receiving treatment?

6. Additional information:

APPENDIX B

CASE HISTORY AND MEDICAL INFORMATION

Case History and Medical Information

Subject: Date:

Residence: Age:

Date of Birth:

Attending Physician:

Education: Occupational history:

Grade completed:

Language background:

At what age?

English only _____

Dominant hand: Bilingual _____

Medical history:

Medical diagnosis: Hemiplegia Right _____
Left _____
Recovered _____
Absent _____

Vision: Functional with glasses _____
Functional without glasses _____
Not functional _____

Hemianopsia: Right _____
Left _____
Recovered _____
Absent _____

Hearing: Functional _____
Functional with hearing aid _____
Non-functional _____

Left hand use: Functional
Non-functional

Speech and language therapy history:

Was subject senile prior to present illness?

Information obtained from _____

Date of trauma resulting in aphasia _____
Duration of illness:

APPENDIX C

PRELIMINARY EXPLORATORY INVESTIGATION

DATA SHEETS

PROFILE OF ORDINAL SCALE SCORES

Subject S_1 (S. F.) Severity Index 0

Classification Global

Piaget's Stages of Sensori-Motor Develop.	Scale I Object Perm.	Scale II Means	Scale IIIa Vocal	Scale IIIb Gest.	Scale IV Oper.	Scale V Space	Scale VI Scheme
Ia	1	0	1	0	0	0	1
Ib	2	1	2	0	1	1-2	2
Ic	3	2	3	1	2-3	3-4	3-4
Id	4-7	3-6	4-5	2-4	4	5-7	5-7
Ie	8-10	7-8	6-7	5	5	8	8
If	11-14	8-11	8	6-7	6	9-10	9
II	15	12	9	8	7	11	10

PROFILE OF ORDINAL SCORES

Subject S_2 (R. S.) Severity Index 1

Classification Wernicke's

Piaget's Stages of Sensori-motor Develop.	Scale I Object Perm.	Scale II Means	Scale IIIa Vocal	Scale IIIb Gest.	Scale IV Oper.	Scale V Space	Scale VI Scheme
Ia	1	0	1	0	0	0	1
Ib	2	1	2	0	1	1-2	2
Ic	3	2	3	1	2-3	3-4	3-4
Id	4-7	3-6	4-5	2-4	4	5-7	5-7
Ie	8-10	7-8	6-7	5	5	8	8
If	11-14	8-11	8	6-7	6	9-10	9
II	15	12	9	8	7	11	10

PROFILE OF ORDINAL SCALE SCORES

Subject S_3 (H. F.) Severity Index 2

Classification Jargon

Piaget's Stages of Sensori motor Develop.	Scale I Object Perm.	Scale II Means	Scale IIIa Vocal	Scale IIIb Gest.	Scale IV Oper.	Scale V Space	Scale VI Scheme
Ia	1	0	1	0	0	0	1
Ib	2	1	2	0	1	1-2	2
Ic	3	2	3	1	2-3	3-4	3-4
Id	4-7	3-6	4-5	2-4	4	5-7	5-7
Ie	8-10	7-8	6-7	5	5	8	8
If	11-14	8-11	8	6-7	6	9-10	9
II	15	12	9	8	7	11	10

PROFILE OF ORDINAL SCALE SCORES

Subject S_4 (Z. F.) Severity Index 3

Classification Conduction

Piaget's Stages of Sensori-motor Develop.	Scale I Object Perm.	Scale II Means	Scale IIIa Vocal	Scale IIIb Gest.	Scale IV Oper.	Scale V Space	Scale VI Schemes
Ia	1	0	1	0	0	0	1
Ib	2	1	2	0	1	1-2	2
Ic	3	2	3	1	2-3	3-4	3-4
Id	4-7	3-6	4-5	2-4	4	5-7	5-7
Ie	8-10	7-8	6-7	5	5	8	8
If	11-14	8-11	8	6-7	6	9-10	9
II	15	12	9	8	7	11	10

PROFILE OF ORDINAL SCALE SCORES

Subject S_5 (J. B.) Severity Index 4

Classification Anomic

Piaget's Stages of Sensori-motor Develop.	Scale I Object Perm.	Scale II Means	Scale IIIa Vocal	Scale IIIb Gest.	Scale IV Oper.	Scale V Space	Scale VI Scheme
Ia	1	0	1	0	0	0	1
Ib	2	1	2	0	1	1-2	2
Ic	3	2	3	1	2-3	3-4	3-4
Id	4-7	3-6	4-5	2-4	4	5-7	5-7
Ie	8-10	7-8	6-7	5	5	8	8
If	11-14	8-11	8	6-7	6	9-10	9
II	15	12	9	8	7	11	10

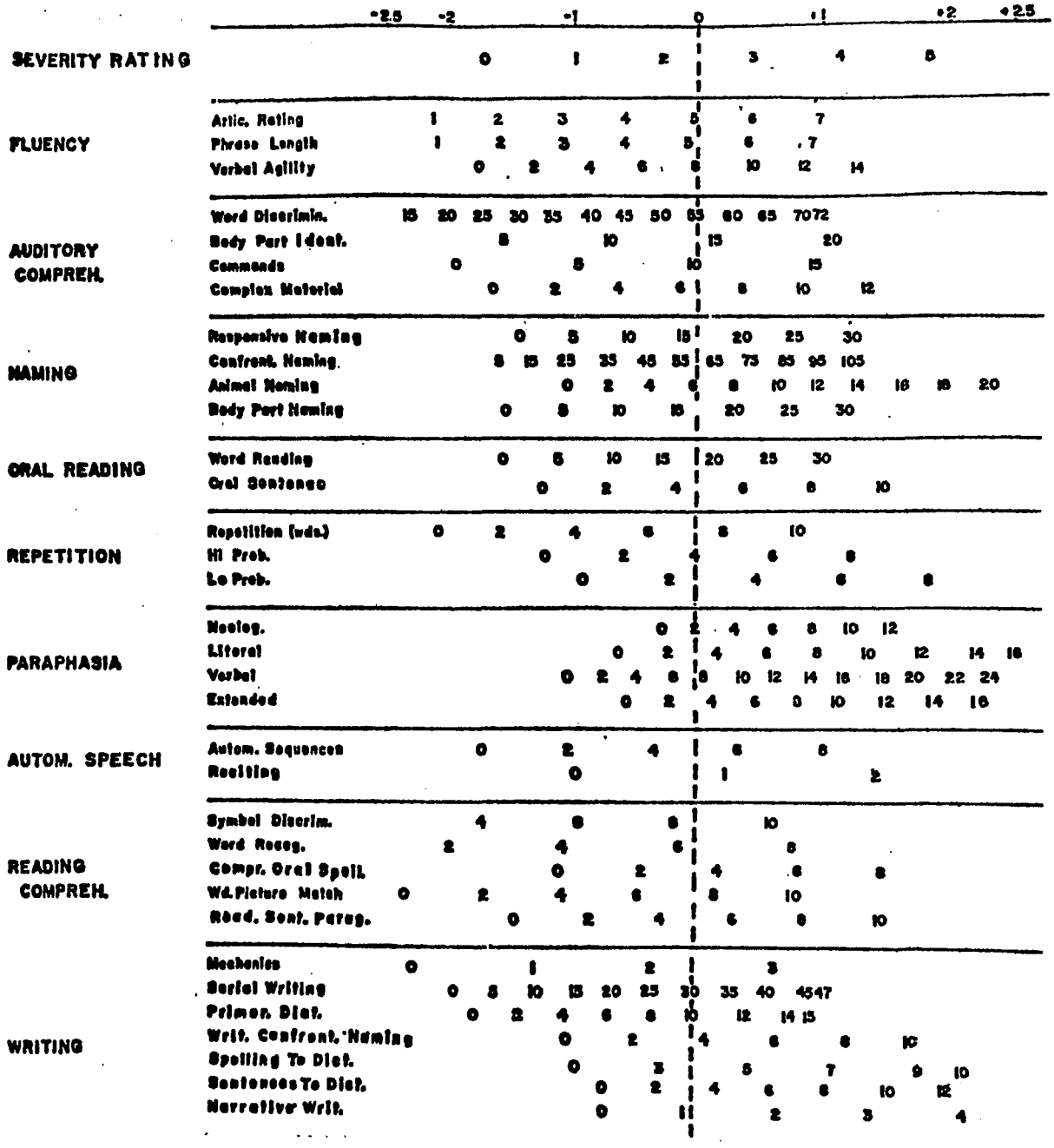
APPENDIX D

BOSTON DIAGNOSTIC APHASIA EXAMINATION

Z-PROFILE OF APHASIA SUBSCORES

Z-SCORE PROFILE OF APHASIA SUBSCORES

NAME: DATE OF EXAM:



APPENDIX E

ORDINAL SCALES OF PSYCHOLOGICAL DEVELOPMENT - SEQUENCE OF COGNITIVE STEPS FOR EACH SCALE

Scale I - Visual Pursuit and the Permanence of Objects

Sequence of Steps

1. Development of this cognitive function begins with a scheme of looking.

2. It procedes through progressive accomodative changes which permit moving faster through wider arcs.

3. Later the individual begins to focus his/her gaze at the point of dissappearance which implies that representative central processes have develcped out of repeated visual encounters.

4. Out of this is developed the skill of reaching for the visually presented object.

5. Later, the infant responds to the whole object from seeing only a small portion of it.

6. Even later he/she can recover objects that are completely removed from view. When the infant has witnessed the dissappearance it is termed visible displacement.

7. Still later, infants show an even higher level of object permanence by following desired objects through a series of visible displacements.

8. Finally, the infant can follow an object through a series of invisible displacements, a skill which begins to emerge in substage five and becomes refined in substage six.

9. Eventually the child can even reverse the order of search. When they are able to do this, they appear to be into the earliest stages of preoperational cognitive behavior (Uzgiris & Hunt, 1975).

Scale II - The Development of Means for Obtaining Desired Environmental Events

Sequence of Steps

1. The most rudimentary coordination is hand watching behavior.

2. "A further differentiation of the means-end relationship appears in the attempts of infants to maintain or regain perceptual contact with interesting environmental events by use of well-developed action schemes" (Uzgiris & Hunt, 1975, p. 108-109.

3. The next level of differentiation is the use of well-developed action schemes in somewhat novel circumstances where some accomodative modifications are required.

4. Finally, there is an emergence of foresightful behavior. At this point the accommodative grouping is implicit and the appropriate means are selected directly, even in novel circumstances (Uzgiris & Hunt, 1975).

Scale III-a Development of Imitation - Vocal

Sequence of Steps

1. Vocal imitation begins with the ready-made scheme of vocalizing which manifests in the cry.

2. The first differentiation occurs when in addition to distress vocalizations the child begins to engage in playful vocalizations such as cooing.

3. The third level of differentiation occurs when the sound patterns become familiar enough that the infant responds with widening of the eyes and pupils and/or with movements of the mouth.

4. Further differentiation occurs when the infant attempts to vocalize in response.

5. Later, by a process of gradual imitation, they imitate more and more unfamiliar sound patterns until they do it directly.

6. Imitation of familiar words and phrases occurs next.

7. Finally, he/she can systematically repeat nearly all new words and short phrases (Uzgiris & Hunt, 1975).

Scale III-b Development of Imitation - Gestural

Sequence of Steps

1. "Infants begin by imitating simple gestures which are well within their behavioral repertoires..." (Uzgiris & Hunt, 1975, p. 113).

2. Following this they imitate more complex action still utilizing most familiar schemes, but demanding accommodative modifications.

3. The third level of development involves the imitation of unfamiliar gestures which they can see themselves perform.

4. The final level evolves when they can imitate unfamiliar gestures which they cannot see themselves perform. This level implies some mental representation of the face and its features (Uzgiris & Hunt, 1975).

Scale IV - The Development of Operational Causality

Sequence of Steps

1. With the appearence of handwatching behavior operational causality begins.

2. It is later accompanied by grasping of interesting objects. These two behaviors represent an appreciation of causality.

3. Soon after, a more definite control over the source of input is made possible by the immediate repetition of effective actions. Generalization of these effective actions then occurs.

4. At the fourth level of development the infant begins to show some appreciation for the centers of causality outside the self by taking direct action against such centers.

5. Further appreciation of centers of causality are implied by the substitution of request for direct action from another person such as handing a toy back to the examiner after the examiner's demonstration has stopped.

6. The sixth level is indicated by behavioral recognition of direct ways for activation of objects, but the behavior only occurs following a demonstration, by way of imitation.

7. The final step in the development of operational causality involves spontaneous behavioral construction of direct ways for activating objects without demonstration (Uzgiris & Hunt, 1975).

Scale V - Construction of Object Relations in Space

Sequence of Steps

1. The first step is accommodation of two loci of input in space implied by the infant's successive shifting of the glance between two objects.

2. This is followed by anticipation which is implied when the infant can alternate glances between two visual targets.

3. Intermodality perception is present when the child can localize the source of sound.

4. Further accommodation is indicated in the next level when the individual is able to grasp an object that is directly within reach.

5. When the child can reconstruct the trajectory of a falling object and direct the eyes to the approximate place where it comes to rest he/she has developed construction of movement of objects in surrounding space.

6. Further construction is implied when he/she leans forward to search for a dropped object.

7. When the child recognizes the reversal of an object he/she is appreciating the rotation of three-dimensional objects in space.

8. Construction of interrelationships between objects occurs when he/she can use one object as a container for another.

9. The next step in the sequence is anticipation of natural forces acting on the objects which enable him/her to build a tower by placing one block in equilibrium over another.

10. The tenth step involves appreciation for the effects of gravity.

11. The final level of the sensorimotor stage is reached when the child is able to indicate knowledge of visual whereabouts of familiar persons and recognize their current absence.

Scale VI - The Development of Schemes for Relating to Objects

Sequence of Steps

1. At first objects serve to elicit schemes already present within the child's repertoire. The earliest scheme is mouthing.

2. This is followed by intent visual inspection.

3. Gradually, accommodation of these schemes occurs and is characterized by hitting, shaking, and waving.

4. Following this is the acquisition of the scheme of examining objects while manipulating them.

5. From the point of manipulation on, a rapid differentiation of schemes occurs. This forms the basis for acquiring new schemes as a result of studying various properties of objects. The most common of these is dropping and throwing.

6. As the infant approaches the fifth substage he/she begins to appreciate the social uses of objects and socially instigated behaviors begin to appear.

7. The beginning of the representation of objects typifying the sixth sensorimotor substage follows this and is characterized by the shared interaction found in showing.

8. As the child moves into the preoperational stage he has developed representation of objects in a symbolic system and demonstrates this with naming of the objects (Uzgiris & Hunt, 1975).