



THESIS



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AN ANALYSIS OF THE ACQUISITION OF SIGNS
BY FIVE NON-VERBAL AUTISTIC CHILDREN

presented by

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Major professor

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AN ANALYSIS OF THE ACQUISITION OF SIGNS
BY FIVE NON-VERBAL AUTISTIC CHILDREN

By

Rebecca Sue Kost

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ABSTRACT

AN ANALYSIS OF THE ACQUISITION OF SIGNS BY FIVE NON-VERBAL AUTISTIC CHILDREN

By

Rebecca Sue Kost

This thesis is an application of the techniques of linguistic science to the study of autistic children. Background information on Early Infantile Autism is presented in Chapter II and special attention is given to a description of various levels of language disorders in autistic children. Various theories about the causes of autism and explanations of the language disorder are discussed. Implications of these theories for the development of language training techniques are suggested in Chapter III. In addition, this chapter reviews projects designed to train autistic children in the use of language. Both oral and manual projects are discussed. It is concluded that manual projects are well-founded for both physiological and structural reasons. In Chapter IV, the structure of manual signs is explained in detail to provide evidence for this conclusion as well as a theoretical basis for the error analysis undertaken in this study. Chapter V outlines the methods of data collection and analysis and presents the results. It was found that the error analysis mirrors in part the autistic disturbance. Several problems within the accepted structural analysis of signs were discovered. Chapter VI summarizes these conclusions and presents suggestions for future research.

DEDICATION

Zu den Kindern

Ich hoffe, daß meine Arbeit ihr eines Tages hilft.

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CHAPTER I

INTRODUCTION

Linguistic competence is frequently inferred by linguists from the performance of competent adult native speakers who are psychologically and physically healthy. Chomsky 1964 defines linguistic competence as the knowledge of a language possessed by an idealized adult native speaker in a homogeneous speech community. Other researchers have examined disordered linguistic performance in order to draw inferences about linguistic competence. Work with aphasics, for example, has provided valuable information about the language centers in the brain.

Autism, a different type of disorder from aphasia, also involves disturbances of language production and comprehension. Since such disturbances and the accompanying disturbances of social relating abilities are major symptoms of the syndrome, research on autism has often centered on language disabilities of autistic children.

An analysis of the strategies used by autistic children to process language may reveal aspects of a more central disorder which underlies the behavioral symptoms. An examination of differences between the strategies of autistic and normal children may provide evidence for the form of the underlying linguistic competence of both groups. Of particular concern to this study is the way in which autistic children process and produce signs of a manual language, some of which are identical with signs of American Sign Language (henceforth ASL), and what that implies about the structure of those signs.

The first three chapters of the body of the thesis present information necessary for an understanding of the theoretical foundations and implications of this study. Chapter II presents background information on Early Infantile Autism giving special attention to describing the various levels of language disorders in autistic children. Various theories about the causes of autism and explanations of the language disorder are discussed. Implications for the development of language training techniques are suggested in Chapter III. In addition, this chapter reviews projects designed to train autistic children in the use of language. Both oral and manual projects are discussed. It is concluded that manual projects are well-founded for both physiological and structural reasons. In Chapter IV, the structure of manual signs is explained in detail to provide evidence for this conclusion as well as a theoretical basis for the error analysis undertaken in this study.

The final two chapters discuss various aspects of this study. Chapter V outlines the methods of data collection and analysis and presents the results. It was found that the error analysis mirrors in part the autistic disturbance. Several problems within the accepted structural analysis of signs were discovered. Chapter VI summarizes these conclusions and presents suggestions for future research.

CHAPTER II

EARLY INFANTILE AUTISM

Background information about the syndrome of Early Infantile Autism is made clear to provide an understanding of the subjects observed in this study.

1. The Syndrome of Early Infantile Autism

First, the term "autism" is clarified by reviewing some of the essential literature on the syndrome. Particular attention is paid to the language defect since it is primary to this study and tends to be the major reason why parents seek help for their children; that is, it tends to be the most obvious symptom of early infantile autism (henceforth EIA).

1.1. Definition of the Syndrome

EIA can be defined as a cluster of behavioral symptoms, which are present at birth or which are clearly identified by the age of two years. The term "autistic" was first used to describe a symptom of adult schizophrenia, namely the self-isolation into a highly imaginative fantasy world (Bleuler 1950, J. Wing 1976).

Kanner 1943 used the term "autistic" in the phrase "autistic disturbances of affective contact" to describe a group of symptoms of children who suffer from the syndrome which he later termed early infantile autism. His use of this term stressed the peculiar isolation of these children from their environment, although they had "good

cognitive potentialities." They were unable to form normal relationships to people, objects and situations. Their behavior indicated that they were unable to distinguish people from objects. This autistic aloneness and an obsessive insistence on sameness in the environment were considered primary features (Eisenberg and Kanner 1956). Other aspects, such as abnormal language development, were seen as derivative of the basic disturbance in "human relatedness."

More recently, researchers have isolated and classified other behaviors as part of a cluster of symptoms. Creak 1961 and 1964 organizes these under nine diagnostic points (Creak 1961:533-535).

- 1) Gross and sustained impairment of relationships with people,
- 2) Apparent unawareness of personal identity to a degree inappropriate to age,
- 3) Pathological preoccupation with particular objects or certain characteristics of them, without regard to their function,
- 4) Sustained resistance to change,
- 5) Abnormal perceptual experience,
- 6) Acute, excessive and seemingly illogical anxiety,
- 7) Loss of speech or failure of speech to develop,
- 8) Distortion in motility patterns,
- 9) A background of serious retardation in which inlets of normal, near normal or exceptional intellectual function or skill may appear.

Ornitz and Ritvo 1976 re-classified the symptoms into five categories of disturbances: (1) perception, (2) developmental rate, (3) relating, (4) speech and language and (5) motility. In the 1977 definition of EIA for the National Society for Autistic Children,

Ritvo and Freeman collapse the first and fifth categories under the rubric "disturbances of response to sensory stimuli." This type of re-classification shows a re-evaluation of which symptoms are related to each other, which are primary and what is a likely cause of the symptoms. However the symptoms are classified, the basic autistic syndrome is defined by these symptoms. A diagnosis of EIA is made when some of the symptoms occur and onset is prior to 30 months. The following discussion of EIA follows the schema of Ritvo and Freeman 1977. Unless otherwise noted, reference is to Ritvo and Freeman 1977 and Ornitz and Ritvo 1976.

1.1.1. Disturbances of Developmental Rates and Sequences

Development overall occurs in spurts and lags. For example, a child may precociously stand but may not walk until the age of three. Development is also characterized by regressions, arrests and delays. For example, motor development may be normal until the age of two when walking stops. Within one pathway there may be uneven development. For example, gross motor milestones may be achieved at normal rates while fine motor development is delayed. Some cognitive skills may occur at unusual times while others may be delayed. The child may utter his first words before the age of one year and not use two word utterances until five or six years of age.

1.1.2. Disturbances of Responses to Sensory Stimuli

An alternation of hyper- and hypo-reactive states occurs within time periods ranging from hours to months. Visual symptoms of these states include intense staring or sighting along objects, regarding of hands or other body parts, and flapping hands in front of the eyes.

Eye contact is rarely if ever apparent; rather, it must be explicitly taught. Occasionally, there is an overreaction of intense anxiety, screaming and crying to changes in illumination. Auditory symptoms include self-induced stimulation, e.g. holding the ear close to a surface while scratching it. Other symptoms are over-reaction to sounds in the environment. Tactile symptoms include self-stimulation, prolonged rubbing of surfaces with hands, face or mouth, over- or under-reaction to touching and pain, and sensitivity to food textures, e.g. refusal of junior foods which may result in a maintenance of bottle feeding well beyond normal limits. Vestibular symptoms include spinning and whirling without dizziness and an intense interest in tops, which often results in all objects being used as tops. An opposite over-reaction to rough-housing which includes spinning may also occur. Olfactory and gustatory symptoms include excessive sniffing and smelling, specific food preferences and licking of objects. Proprioceptive symptoms include darting, lunging, toe walking, hand flapping, flicking objects against the body, posturing and unusual facial grimaces.

1.1.3. Disturbances of Speech, Language and Non-verbal Communication

Speech as well as the ability to understand speech may not develop at all. The children may respond more to gestures than to words. In more advanced children, echolalia, both immediate and delayed, is common; this is also rigid and shows exact reproduction of pronouns (called pronominal reversal). There is a general lack of abstraction, words being used only in the first specific context in which they were learned. A rigidity is characteristic of the use of language; this may be related to the insistence on sameness of autistic children noted by Kanner 1943.

Intonation and pitch are generally flat. Non-verbal communication in the form of gestures and body postures is not used. These symptoms are discussed in greater detail in Section 2. below.

1.1.4. Disturbances in Relating

Autistic children fail to develop appropriate relationships to both people and objects. With regard to people, there are absent or delayed smiling responses, stranger anxiety, anticipatory responses to being picked up, playing "peek-a-boo" or "patty-caked," and response to physical contact. Parents and caretakers may be treated indifferently, with panic on separation, or in both ways alternately. Such clinging behavior was termed "symbiotic psychosis" by Mahler 1952 who made a distinction between this syndrome and autism. Ornitz and Ritvo 1968 view these two behaviors as "different expressions of a failure in these children to delineate the boundaries between themselves and their environment" (p. 87). Ornitz 1969 sees this failure as a result of the fluctuation of hyper- and hypo-aware states discussed above in Section 1.1.2., which he terms perceptual inconstancy.

Relationships with objects ususally show stereotyped or idiosyncratic use. Little understanding of the function or type of an object is shown. Appropriate play rarely occurs.

1.1.5. Other Disturbances

Ritvo and Freeman list such behaviors as self-injury, biting and head banging, aggressiveness, occasional delusions, lack of appreciation of real danger, and the increase of EEG abnormalities with age as associated features. It is also noted that IQ's are generally low; 60 per cent of autistic children have an IQ below 50, 20 percent between 50

and 70, and 20 percent over 70. IQ's are generally lower in verbal than in production tasks.

The question of IQ has been debated. Kanner insisted that autistic children have a normal IQ which is imprisoned by other behaviors. More recently, researchers have argued that this has not been demonstrated, and, in fact, that mental retardation across all cognitive capacities commonly co-occurs with autism.

1.2 Differential Diagnosis

Diagnosing autism, however, is not so clear cut, since many of the symptoms listed above overlap with those of other childhood disorders such as organic brain disorders, mental retardation, seizure disorders and environmental deprivation syndromes. In addition, several of these disorders may co-occur with autism, making diagnosis difficult.

1.2.1. Sensory Deficits

Although various types of gesturing similar to autistic motor disturbances occur in blind children, they generally do not have the stereotyped repetitiveness of autistic flapping. Blind children usually develop an interest in the environment and appropriate relationships with adults while autistic children typically do not. Deaf children may show some of the other characteristics of EIA, such as inappropriate responsiveness. However, adequate intervention measures to compensate for the lack of language stimulus in deaf children generally reverse the inappropriate behavior. Autistic children are often originally diagnosed as deaf, since they often do not respond to noises (Ornitz and Ritvo 1976).

1.2.2. Congenital and Developmental Aphasia

Primary childhood aphasia (congenital, developmental and acquired) is usually defined as failure to develop, or extreme difficulty in using, language or speech in the absence of mental retardation, deafness, or emotional disorders (Cohen et al. 1976:605). The three subtypes listed above are distinguished by the time of onset, and by the occurrence of specific injuries to the brain.

Various features serve to distinguish aphasia from autism. Autistic language shows a lack of communicative intent which is not found in aphasic language. Autistic children listen and respond equally to real and nonsense words whereas aphasic children reject nonsense words. Aphasic speech does not usually have the odd flat intonation characteristic of autistic speech. Aphasic children imitate and use gestures for communication; autistic children do not. Autistic children show little or no imaginative play or fantasy life in contrast to aphasic children. In particular, Cohen et al. 1967 stress the fact that autistic children exhibit social and linguistic difficulties throughout life, whereas aphasic children exhibit a desire to communicate and an understanding of the social relationships underlying many linguistic devices.

1.2.3. Seizure Disorders

Autism and seizures frequently co-exist. Autistic children often develop seizures when entering adolescence. Most of these children had normal EEGs when younger. However, behaviors due to epileptic seizures such as momentary posturing and hand flapping can be distinguished from similar behaviors associated with EIA which are more pervasive and of longer duration (Ornitz and Ritvo 1976:613).

1.2.4. Environmental Deprivation

A sometimes hypothesized cause of EIA is lack of stimulation from "refrigerator parents" (e.g., Kanner 1943). However, it has been shown that maternal deprivation must be distinguished from autism. Although children whose mothers died or were hospitalized while they were infants show many of the relating, developmental and motility disturbances of autistic children, they respond well to proper intervention and progress rapidly (Ornitz and Ritvo 1976).

1.2.5. EIA and Schizophrenia

Certain similarities between EIA and adult schizophrenia have led researchers to view these disorders on a continuum, differentiated on the basis of age of onset. Eisenberg 1956:610 writes that "the peculiarities of language and thought [of autistic children] while somewhat different share the general features of schizophrenia;" he therefore classifies the syndrome as a type of schizophrenia. Ornitz 1969 discusses similarities between the faulty modulation of sensory input in autistic children and the heightened awareness to sensory stimuli (especially auditory stimuli) in some schizophrenic adults. He concludes that the differences between the two groups "represent secondary manifestations of the disease process and are determined in part by the developmental and maturational level of the patient during the time that the breakdown in homeostatic regulation of sensory input is active" (p. 270). The fact that some autistic children have hallucinations and exhibit metaphorical uses of language and that some schizophrenic adults have a history of autism in childhood lends support to this analysis (Ornitz and Ritvo 1976:614).

On the other hand, there are some important differences between the two groups. Rutter 1969 lists several characteristics that distinguish the two groups. The sex ratio is quite different; EIA occurs approximately four times as often in males as in females, whereas the ratio in schizophrenic individuals is approximately even. There is a high incidence of schizophrenia in the families of schizophrenic, but not of autistic individuals. Mental subnormality, a common accompaniment of EIA, occurs much less frequently with schizophrenia. The pattern of IQ testing with autistic children (high in performance, low in verbal) is not found in schizophrenic individuals. Halluncinations are very rare in autistic children and common in schizophrenic individuals. Schizophrenic individuals are more prone to relapses than are autistic children.

On the basis of these differences, it seems infelicitous to use the term "childhood schizophrenia" to refer to EIA, since there is a group of children to whom this term more aptly applies, i.e., to those whose onset of the disorder is before puberty, but after age five, and who show the basic symptoms of adult schizophrenia and not those of EIA.

1.3. Etiology

Various theories have been proposed to explain the cause of EIA. These can be classified into two general cateories, those suggesting a psychological origin and those proposing an organic origin.

1.3.1. Psychological Etiologies

These theories of the causes of autism assume that the children could have been normal but became abnormal because of factors in their emotional environment. Abnormalities in the personalities of the

parents and in their child-rearing practices have been postulated as the cause of autistic development (Kanner 1943, Kanner and Eisenberg 1956, and Goldfarb 1961). However, as Wing 1976 and Rutter 1969 report, research has shown no abnormalities in the parents' personalities nor in their relationship to the child that cannot be explained by the fact that they have a handicapped child. Studies comparing the language of mothers of autistic and of aphasic children show no significant difference between the two groups except a significantly higher amount of affectionate remarks by mothers of autistic children than those of aphasic children (Baker et al. 1976).

1.3.2. Organic Etiologies

Since Kanner's interpretation of a psychological cause of the syndrome, it has been shown that autistic children are born to parents from all socio-economic and racial backgrounds. Parents of one autistic child may have other, normal children. In addition, studies, such as those cited above, of the parent-child relationship and of the parents themselves in other samples of autistic children have not confirmed Kanner's original hypothesis. This has led many researchers to conclude that EIA is the result of an organic disorder of the central nervous system rather than caused by a rejecting mother. Based on this assumption investigators have proposed various theories to explain the etiology of EIA.

1.3.2.1. Theory of a Cognitive Defect

Various researchers hypothesize that autistic children suffer from a cognitive defect which inhibits their acquisition of language (Rutter et al. 1972, and Shapiro 1972 and 1974). It is further hypothesized

that the social and physical disorders are caused by the autistic child's difficulties in comprehending and using communicative language (see also Churchill 1978). However, Tubbs 1966 demonstrated that autistic children can manipulate linguistic symbols provided they are confined to visual input, and there are various theories which propose a perceptual basis for EIA.

1.3.2.2. Theory of Perceptual Inconstancy

Ornitz and Ritvo 1968 assume that the perceptual disorder is the basic disorder and causes the other symptoms. The perceptual disturbances are of the type that the child suffers from a defect in the regulation of sensory input and motor output, so that his cognitive centers receive too much or too little information. As a result the child fails to construct a stable inner representation of the environment and therefore is unable to learn to interact or to communicate normally.

Their evidence comes mainly from two sources. When whirled in a chair in a lighted room there is a marked decrease in the duration of rapid oscillations of the eyes (nystagmus) in autistic as compared to normal children. This effect is not found in the absence of light. They conclude that the effect is the result of an abnormal reaction between the light and vestibular stimuli.

The second source of evidence comes from studies of rapid eye movements in "dreaming" sleep. These do not tend to cluster into bursts in autistic children. Thus, autistic children two to three years old resemble normal six to 12 month old babies.

Both of these activities are mediated by the vestibular nuclei in the brainstem, suggesting an organic source of the perceptual

disorder, which is hypothesized to underlie the other disorders.

Caparulo and Cohen (1977) suggest an explanation that also fits in this category: autistic children may have a dysfunction in the regulation of arousal and attention and therefore are in a state of sensory rejection, i.e., there is too much input for them to process any of it well (p. 630).

1.3.2.3. Theory of Overselectivity

Lovaas et al. 1971 investigated the response of autistic children to multiple sensory input. Autistic children were conditioned to respond to packages of sensory input containing visual, auditory and tactile stimuli. After training was completed, their response to each of the stimuli were tested. Contrary to previous research (Goldfarb 1956), the children did not prefer one mode over another, but they did respond to only one of the stimuli rather than all three. Which stimulus elicited response varied from child to child. The investigators suggested that this overselectivity inhibits the autistic child from learning, especially in training situations which are designed to aid the child by adding large numbers of extra cues to the skill to be learned.

1.3.2.4. Theory of Hemisphere Specialization

Hermelin 1972 and 1976 also showed that the basic impairment in autism is not a preference for visual over auditory input. She asserts that it is difficult to maintain that autistic children do not process auditory input well, since many autistic children love music and often hum or sing to themselves, a few even becoming piano tuners because of their perfect pitch. "The central problem in autism appears to involve

not stimuli in a particular modality, but stimuli requiring organization into particular codes which are modality independent" (Hermelin 1976:163).

In an experiment designed to elicit the strategies the children were using, Hermelin presented deaf, normal and autistic children with a stimulus that could be stored in a temporal or spatial sequence. Sequences of three numbers were presented in three boxes, one number at a time, in such a fashion that the temporal order of presentation and the spatial order differed. When asked to recall the numbers, both autistic and deaf children recalled their spatial ordering while the normal hearing children recalled their temporal order. This led the investigator to conclude that it is not the modality, but the organization of speech in a temporal sequence that makes it difficult for autistic children to process its meaning. Instead, the children process it by storing it precisely as it occurred, if they process it at all.

Tanguay 1976 advances a theory to explain this finding of Hermelin. The disabilities of autistic children are primarily with those capacities located in the left hemisphere (language and processing temporal information) and their abilities are those predominantly in the right hemisphere (spatial processing). Tanguay proposes that the differentiation of function between the two hemispheres has not occurred in the normal manner in autistic children, leaving them "with two sides of the brain which are relatively immature and plastic, able at best to process information in a relatively holistic and spatially-oriented way" (p. 80). Studies of the response of normal and autistic children to auditory stimuli during sleep showed larger responses over the right hemisphere

in normal children during rapid-eye-movement sleep and no consistent hemispheric differences in autistic children.

Levy et al. 1978 propose a somewhat different theory to explain these facts. They hypothesize that EIA is associated with a unilateral left hemisphere disorder which prevents both development of language in the left hemisphere and transfer of language function to the right hemisphere as occurs after left hemispherectomies.

Levy et al. conducted a series of experiments with autistic, disturbed but not autistic, and normal children, to test whether "autistic children manifest a unilateral neglect of the right sensory-motor field" (p. 8). Manifestations in autistic children that were examined were eye, head and body turns to the left side, failure to respond to stimuli on the right side and drawings in which the figure is displaced to the left. A significant preference for the left side was found in the autistic group while a tendency to right preference which was not significant was found for the other two groups. These findings support the hypothesis that the right hemispheres of autistic children almost completely control central processing and response.

If it is the case that autistic children lack all the specialized functions of the left hemisphere, including language, logical dependencies and temporal causality, Levy et al. speculate that such a child's "model of reality might lack the temporal dimensions altogether and events might be nothing more than reorganization of objects in space" (p. 4). Other behavioral abnormalities would be seen as a secondary consequence of this cognitive disorder. When the research on the use of sign language with autistic children is considered, both this theory and Tanguay's theory provide explanations for the success

of such training over operant speech training (see below Chapter III Section 2.3).

2. The Language Disorder in EIA

Speech and language abilities in autistic children vary widely from complete mutism to repetition of the speech of others and to the rudiments of communicative language. The development of the ability to use language is an important factor in the recovery of the child. The lack of useful speech by age five is generally prognostic of relatively little improvement. In a follow-up study of 63 autistic children, Eisenberg 1956 found only one of a group of non-speaking autistic children at age five, who as a teenager achieved a fair level of social relatedness (i.e., attending normal classes but still obviously deviant). Thirty were at a poor level (not emerged at all). Of the speaking group, three achieved a good level (functioning well and accepted by peers), 13 a fair and 16 a poor level.

2.1. Non-verbal Children

Non-verbal autistic children emit vocal noises in a wide range of intensity, frequency and voice quality. Shrieking, screaming, and giggling are quite common. Syllables can be recognized in some of these utterances and these are generally of the form stop followed by a vowel. The vowels are often not recognizably American and many of the sounds are not transcribable at all. None of these vocalizations seem directed at communication, but rather appear to be accompaniments of inner states or forms of auditory self-stimulation much in the style of other motor behaviors which provide sensory input.

Parents often report being able to distinguish the sounds their children make from those of other autistic children and from normal children. They also can often distinguish a "happy" from an "unhappy" sound. This is apparently the result of the parents accustoming themselves to the sounds, since it is also reported that the parents were not able to distinguish a "hungry" cry from others when the child was an infant.

Autistic children are observed to have deficiencies in fine motor control of their tongues and lips, often losing much of their food while being fed. They are also unable to perform such learned activities which require precise control of their breathing mechanism as inflating balloons, extinguishing matches and blowing bubbles. (See Goldfarb 1955 and Provonost et al. 1966.)

2.2. Verbal Children

Kanner 1946-7 noted several features of the speech of autistic children: echolalia, pronoun reversal, metaphorical substitution, literalness, and negation used as a magical means of protection. Pronoun reversal can be seen as a direct result of the tendency to echo exactly what is heard and is not necessarily a distinct feature.

2.2.1. Echolalia

Echolalia is the repetition or imitation of speech in the child's environment. The term "echolalia" is used to describe autistic imitation because of the exactness with which the imitation is made. Echolalia may be immediate, exact or partial (usually the last words uttered) or delayed (repetition of a phrase heard earlier). Some of

the delayed echoes may be used appropriately: the child may say "do you want a cookie?" in order to ask for a cookie. Other delayed echoes may be uttered in inappropriate contexts and may not be recognized as echoes unless further information on the child's environment is available.

2.2.2. Spontaneous Speech

Ricks and Wing 1975 comment on the rather infrequent occurrence of spontaneous speech in some autistic children. Spontaneous speech can be recognized by the great effort necessary for production and the immaturity or ungrammaticality of the constructions in comparison to that of echoes. Function words are generally dropped. "Letter order in words and word order in sentences were confused.... Words of similar sound or related meaning were muddled.... In some cases the children described objects by their use or else invented words of their own (Ricks and Wing 1975:208). Phrases and words are telegraphed. (See also Weiland and Legg 1964.)

A small portion of the children achieve fairly normal levels of ability in the use of language, although their speech is marked by an odd flatness of intonation and a tendency to use words very specifically, concretely and inflexibly (see also Goldfarb 1955). Little understanding of the use of different registers is shown, formal and colloquial lexical items often being mixed in a single sentence. Conversations are generally held on the same topics and repeat the same information, but without personal commentary. Reading ability may be acquired, although it is often little more than scrutinizing the individual words and sentences without regard to content or overall import (see also Wolff and Chess 1965).

2.2.3. Comprehension of Non-verbal Communication

An inability to mimic or use non-verbal communication devices is noted in the literature. Little imitation of facial expressions or gestures is seen (Ricks and Wing 1975). However, it has also been noted that autistic children often respond more to gestures than to the words which they accompany (Provonost et al. 1966, Webster et al. 1973). Ricks and Wing emphasize the point that the lack of understanding of both verbal and non-verbal communication is not due to intent on the part of the children, that is, as comprehension improves it becomes clearer that the children are trying to perform as expected but that they do not understand what is expected or that they are unable to perform as is expected. Particular difficulties in understanding idioms, abstract usage, and humor is typical even of the most advanced children and adults (see also Provonost 1961).

2.2.4. Inner Language

Ricks and Wing also comment on the apparent lack of inner language. This is shown in the early years by a lack of imaginative play and later by an inability to enjoy or produce fiction.

The basic problem, as Ricks and Wing see it, is the limited, concrete and inflexible understanding and use of language, which they see as the basis of the social disabilities. Social interaction is determined by a set of flexible rules. When autistic children or adults are faced with a situation that demand flexibility, they are unable to deal with it.

2.3. Experimental Studies of the Speech of Autistic Children

Several researchers have examined and categorized the speech of autistic children in various ways. The following sections report on several of those studies and, where relevant, discuss their implications for the understanding of the autistic syndrome.

2.3.1. Quantitative and Qualitative Analysis

Cunningham and Dixon 1961 and Cunningham 1966 and 1968 studied the speech of autistic children under two major aspects, quantity and quality. The methodology and classification were modelled on McCarthy 1930 who studied the language of normal children in play sessions with an adult. The speech in both studies was analyzed quantitatively for average length, variety of words used and number of parts of speech. Length of utterance was used by Cunningham primarily to provide a basis for comparing the autistic children to normal children at approximately the same stage in language development.

Qualitatively, the speech samples were classified according to comprehensibility, grammaticality, and function. Function was divided into three types as distinguished by Piaget 1923:

- 1) Repetition or echolalia
- 2) monologue
- 3) dual or collective monologue, i.e. an outsider is associated with the action but is not expected to understand or participate.

These constitute the three categories of Piaget's "egocentric speech." Egocentric speech and socialized speech form the two major functions of speech which Piaget analyzed in the speech of six year old children. Social speech in Piaget's schema consists of informative utterances,

personal commentary, and commands, requests and threats. Cunningham's study deals primarily with egocentric speech because the autistic children produced very few socialized utterances.

Cunningham found it necessary to sub-divide the categories of egocentric speech further to account for the utterances of autistic children more adequately. Repetition was divided into two sections, monologue into four and socialized speech into three.

Using this schema Cunningham and Dixon compared speech samples collected in 12 interviews with an autistic boy at the age of seven to those of 24, 30 and 36 month old normal children from McCarthy's study who had the same average length of utterance as the autistic child. The results showed that the autistic speech was much less comprehensible than the normal. Many incomplete sentences were uttered, generally omitting function words, such as copulas, prepositions and conjunctions. The autistic child made more egocentric responses than the normal children, many of which were repetitions. The most frequent type of egocentric remark of the autistic child was action accompaniment. Irrelevant and purposeless remarks were less frequent than remarks which accompanied actions. Of socialized speech, the autistic child made considerably fewer remarks giving information, gave fewer answers and asked fewer questions than McCarthy's comparison group.

Cunningham and Dixon list two general findings of the study that tend to confirm previous research on the speech of autistic children:

- 1) Speech is used to a lesser extent for communication.
- 2) There is a tendency to repeat the same phrase rather than to construct original remarks.

The investigators did not find a complete failure to use personal pronouns or a confusion of "you" and "I" as previous research suggested. Rather, the subject tended to refer to himself and the experimenter more often by proper names (Cunningham and Dixon 1961:201).

In a follow-up study at age 12, Cunningham 1966 reports little change in this analysis of this child's speech.

Wolff and Chess 1965 tried to analyze speech samples of autistic children using Cunningham and Dixon's schema. The samples were obtained from 14 children diagnosed as childhood schizophrenics* observed in the classroom during one and a half hour periods. They found Cunningham and Dixon's qualitative schema to be inadequate and instead organized their speech samples into the following three categories: (1) non-communicative repetition conveying no obvious message or purpose, (2) communicative repetition, and (3) original communicative speech characterized by oddities of content and syntax.

Comparison of clinical rankings with the proportion of types of utterances showed that the amount of repetitive speech was a better index of the severity of the disorder than the amount of non-communicative speech. The use of repetition for communication demonstrates the children's reliance on stored forms rather than on a knowledge of the rules used to produce those forms. Wolff and Chess also conclude that the use of metaphor and symbolic language is the result of a "relatively advanced level of language development distorted by repetitive clinging to former modes of expression and to former phrases and ideas, and

*Wolff and Chess use the term childhood schizophrenia to describe children with the characteristics of EIA.

the inability to attend adequately to external cues and to modify behaviour accordingly" (p. 40).

2.3.2. Form and Function Analysis

A slightly different approach to categorization of utterances has been developed by Shapiro and his colleagues in various experiments (Shapiro and Fish 1969, Shapiro et al. 1970, 1972, 1974a, 1974b, and Shapiro 1977). Shapiro and Fish 1969 established two basic categories: morphology (form) and function. Morphology was divided into two major categories: pre-speech and speech. Pre-speech consisted of seven categories of various types of unrecognizable vocalizations. Speech consisted of 13 categories divided into four major groupings: conventional sequences (ABC's), single words, complex phrases and sentence fragments, and disjunctive syntax.

Function was subdivided into noncommunicative and communicative functions. Non-communicative utterances were classified according to four types which also had further refinements: isolated expressive speech, context disturbance (complete), imitative speech, and context disturbance (partial). Communicative speech was separated into appeal speech (wish oriented) and signal/symbol speech (propositional), each of which had further subdivisions as well (Shapiro and Fish 1969).

Shapiro and Fish 1969 used this schema to study the severity and type of disorder of autistic children. They hypothesize that the language disorder reflects defects in the ego organization of the children and that analysis of the speech of groups of autistic children over a period of time will enable a categorization of subgroups of children and the description of "the limitations and variations of the reality to which their language refers" (p. 39).

From their study of two autistic children aged two and four years over a period of one year, they conclude that the amount of echoing was not the significant indicator of the severity of the disorder as Wolff and Chess 1965 found. Instead, the crucial factor was the stage at which the echoing occurred and whether the repetitions were later incorporated flexibly into communicative speech.

Shapiro et al. 1970 used the schema to compare the speech of normal and eight autistic children with the same mean length of utterance. They found a significant difference in the amount and quality of imitation in the two groups. The autistic children imitated more and their imitations were more inflexible (i.e., more congruent to what was said). Shapiro et al. suggest that autistic imitation is the result of a defect in central integrative mechanisms which prevents the organization of incoming information. The rigidity in language structure is proposed as an index to the general rigidity of identification and ego structure.

Shapiro et al. 1972, 1974a, and 1974b studied one child, 30 children and one child respectively, in all cases using the schema developed by Shapiro and Fish 1969. In these studies, the same general conclusions are drawn as in the two studies reported on above. Difficulty in establishing the language behaviors as central and underlying is emphasized. It is concluded instead that "the language behaviors are part of a syndrome which involves a core cognitive and ego-disturbance that is distinguishable from retardation and aphasia" (Shapiro et al. 1974a:824).

2.3.3. Contextual Explanation of Echolalia

Fay 1969 studied the comprehension of simple commands by an autistic child at the age of four, using a Verbal Comprehension sub-test of a

standardized test. This format was used since previous work had shown that the sub-test triggered echoes in autistic children. The echoing of the autistic child was compared to that produced by a children with developmental echolalia and by another with delayed language development. Bi-monthly testing occurred over a period of one year. The interviews were recorded and the data were analyzed for numbers of errors, numbers of echoes, words per echo and linguistic and "paralinguistic" (i.e. social) variables (grouped under the rubric qualitative variables by Fay 1969: 41). Linguistic variables included intonation. Social variables were the types of relationships established with the investigator.

In all three cases there was a correlation between high error scores and high echo scores. The distinguishing factor was the occurrence of pronominal reversal (i.e., rigid echoing) in the autistic child and not in the other two children.

Fay concludes that the correlation between number of errors and number of echoes can be explained sociolinguistically. The child lacks comprehension and therefore echoes the investigator in order "to sustain rather than reject social contact" (p. 45). Caparulo and Cohen 1977 also emphasize "the importance of understanding the autistic child's symptoms as meaningful responses to underlying cognitive, social, and perceptual disturbances," as a type of defense mechanism to compensate for his disabilities (p. 641). Echoes are a way of saying that the child knows something is expected from him, but that he does not know how to respond appropriately. Instead, he repeats what the person said and hope that will be satisfactory.

2.3.4. Summary

All of these schemas have examined the speech of autistic children in order to reveal aspects of the disorder underlying the behaviors. The Cunningham, Wolff and Chess, and Shapiro studies concentrated on categorizing the utterances according to form and use. Fay, on the other hand, concentrated on one category of form, echolalia, and attempted to determine its context of use, admittedly in an experimental setting, but interesting for its different viewpoint nonetheless.

All of the research presented discusses the rigidity of the children's speech which, as Caprulo and Cohen 1977 suggest, is related to the ability of the children to deal better with objects than with people, since objects are less flexible than people. This fact also suggests that the obsession with sameness and echoing have the same basis. An inability to formulate rules for remembering serial positions of objects was shown by Hermelin 1976. Instead, autistic children rely on a strategy of rote memorization which is again a reliance on properties of sameness. The inability to formulate rules disrupts, in turn, the ability to form social relationships which are based on flexible rules and a recognition that other people's desires may not be the same as one's own (Hermelin 1976 and Ricks and Wing 1975). What the basis for this insistence on sameness is, remains an open question, but it may be related to the difficulty autistic children have with temporally organized information. Spatial organization tends to provide a more permanent framework than temporal organization which is more abstract than spatial organization. Thus, the basis for the insistence on sameness may be related to the basis for the difficulty with temporally organized information.

CHAPTER III

LANGUAGE TRAINING PROGRAMS

The studies reviewed in the previous chapter examine the quantity and quality of speech already possessed by autistic children and try to deduce the strategies employed by the children from the observations. Another important step is to apply the knowledge gained by such studies to develop techniques for speech and language training for autistic children who exhibit no speech behavior. One such group of techniques is based on behaviorist theories of learning and language processing (see Skinner 1957 and 1958).

1. Operant Speech Training for Non-verbal Autistic Children

Most programs for teaching language to autistic children make use of some form of operant training. Those programs designed to promote speech skills in autistic children center around the response-reinforcement model of learning and use techniques developed by behavioral psychologists as the core of their language training programs.

1.1. The Imitation Hypothesis

Operant speech training is based on the false assumption that normal children learn to speak by imitating. Indeed, Lovaas 1968, a primary originator of many of the current techniques, states this hypothesis as a proven fact and uses it as a basis to develop his techniques (see also Schell et al. 1967:53).

This basic hypothesis is faulty for several reasons. Studies of normal child language acquisition provide evidence for creativity in

the child's acquisition of language. Many of the utterances of children could not have been produced from the environment, e.g., byebye TV, byebye car (Falk 1978). Some sentences that a child can produce spontaneously in an appropriate context are longer than those he can imitate in elicited imitation tasks outside of an appropriate context (Bloom and Lahey 1978:249-251). The fact that comprehension in general precedes production also argues against an imitation theory of acquisition. In addition, the order of acquisition of morphemes does not parallel the frequency with which they occur in the environment (Brown 1973). Even more damaging is the fact that some children simply do not imitate (Ferguson and Farwell 1975). Finally, the creative use of language of normal adults (which appears to be governed by rules which are not observable) would be impossible if they had learned to speak by imitation (see Chomsky 1959). Thus, the evidence seems conclusive that language acquisition--and therefore the acquisition of speech which is dependent on an underlying knowledge of the structure of language--does not progress solely nor even mainly by means of the strategy of imitation. If, as is emphasized by operant speech training advocates, autistic children only learn by imitation, it might be implied that there is a basic difference between their strategies and cognitive capacities and those of normal children.

1.2. Training Techniques

Before actual speech training can begin, the child must be made familiar with and compliant to the reinforcement procedures to be used to train speech. First, disruptive behaviors such as motor disturbances and self-destructive behavior must be limited and controlled. Lovaas

et al. 1966 successfully used negative reinforcement, i.e. punishment, in the form of spankings and shouting to curb this behavior. Risley and Wolf 1967 used a "time-out" technique wherein positive reinforcement is removed until the behavior stops. This includes ignoring the child, leaving the child alone in the training room, or isolating the child in a special "time-out" room.

The environment in which the initial training is carried out must be carefully constructed to contain a limited number of distractions. A small room with simple furniture is helpful to the instructor in controlling the child's behavior more easily. Hewett 1965 developed a special isolation booth with two compartments separated by a movable shutter. The instructor sat on the side with the only source of light and controlled the shutter. The child had a device by which he signaled to the instructor that he wanted to resume contact. Because of its small size, disruptive behavior was almost impossible inside the booth.

Once the behaviors are under control, attention and eye contact must be conditioned. This is done by drawing the attention of the child to the instructor's face. Holding food reinforcers in front of the face, physically holding the child's head to look at the instructor, and calling the child's name loudly are all techniques used to accomplish this (Hartung 1970:207). The child is reinforced under these conditions and gradually the prompts are removed (fading).

When the child's behaviors are controlled and he attends to the instructor, speech training can begin.

1.2.1. Imitation Training

Lovaas et al. 1966 and Lovaas 1968 devised a four step program for establishing verbal imitation. First the child is reinforced for all

vocalizations to increase their frequency. Reward is also given for fixating on the adult's mouth. The next step involves the acquisition of temporal discrimination. The child is rewarded only for vocalizations emitted within six seconds following an utterance by the instructor.

Step three is similar to step two, but is designed to mold the child's vocalizations to an approximation of the adult's words. Sounds to be trained first were selected on the basis of the following criteria:

- 1) Ease of manual manipulation of the vocal apparatus, e.g. [b] can be manipulated by holding the child's lips shut and releasing the lips quickly as he exhales. [k] on the other hand, is not so easy to manipulate.
- 2) Visual components of the sounds, e.g. [m] and [a] are easily seen.
- 3) The production of the sound by the child in stage one.

During this stage, the instructor first manipulates the production, then prompts the child while producing the sound himself. Prompts consist of touching the lips in the case of [b]. Prompts are gradually faded until the child imitates the adult's production by himself.

Step four is a repetition of step three with a new sound, as maximally distinct from the first as possible. Once the child produces the new sound, the old one is repeated randomly with the new one to train discrimination. Each new step is a repetition of steps three and four.

Once the child has learned to imitate a few words, he often begins to echo most of the instructor's utterances and such reinforcement training is no longer necessary to train the child to say new words (see Hartung 1970:210-11).

1.2.2. Naming

It must be emphasized at this point that imitation is trained in the absence of any appropriate context and that it is only after a word can be produced that the child is instructed in its meaning and use. Such training basically consists of responses to objects and pictures with appropriate vocalizations which are then rewarded. Once nouns are learned, prepositions and pronouns are introduced in a similar fashion. Lovaas 1968 generally recommended the avoidance of negative reinforcement for incorrect responses.

1.2.3. Spontaneous Speech Training

Once imitative speech and naming skills have been established in such a manner, it is often difficult to effect a transfer to contexts outside of the training sessions. Any transfer that does occur is simple repetition of what is heard.

1.2.3.1. Requests

Lovaas 1968 used a technique to encourage the child to use speech to express his wants and needs; the technique consisted of prompting the utterance, fading it, and then "waiting the child out." This meant that the child had to ask for the reinforcers before being given them. Once the child learned names for objects, for example, milk, those objects would be withheld until the child uttered the appropriate name. When the child made commands to adults, e.g. sit down, stand up, these were followed out immediately. As the child became more able to use this kind of speech, rewards were given less frequently or were postponed in order to teach the child not to expect to receive all desired objects whenever he wanted them.

1.2.3.2. Asking Questions

Lovaas 1968 discusses training children to ask questions by teaching them to imitate questions which the instructor answered. A process of fading and extinguishing the prompt was used until the instructor merely told the child to "ask me some questions."

1.2.3.3. Answering Questions

Hartung 1970 outlines a program for training the child to answer certain specific questions. The child was trained to imitate question/answer pairs, e.g. How are you? Fine. The question was gradually faded by first lengthening the pause between the question and answer, then emphasizing the answer and saying the question softly. Soon the child began to response only by saying Fine.

1.2.3.4. Some Reservations

The unasked question in all of this work is how "spontaneous" this kind of speech actually is. It is doubtful whether the term spontaneous is appropriately applied to speech which has been programmed as detailed in the fore-mentioned studies. These children are not showing a creative, rule-governed use of language, but are repeating stored phrases, cued by the adult's speech. Some children do achieve a rudimentary level of linguistic competence and can use speech to obtain certain desired objects and goals, but it may be a result of the training technique combined with the autistic tendency to store vocal information rather than process it which prevents them from progressing beyond this stage.

2. Sign Language Training with Non-verbal Autistic Children

For a subset of autistic children, operant speech training is unsuccessful. With such children, many teachers and researchers have tried using sign language. At first, such a move is often made out of frustration and perhaps inspiration, but there are also several reasons based both on the nature of the autistic disorder and on the structure of sign language that make the use of sign language a well-founded procedure.

2.1. Motivations for Sign Language Training

As noted by many who work closely with autistic children, these children respond better and sometimes solely to gestures (see Provonost et al. 1966). Other factors make sign language a good choice as an alternate communication system. As noted in Chapter II, Section 2.1. above, autistic children lack motor control of their vocal and breathing apparatus (Goldfarb et al. 1955 and Provonost et al. 1966). Sign language is produced in a medium in which it is easier for the child to perform. A similar situation occurred in language experiments with chimpanzees. In attempting to produce speech, chimpanzees failed almost completely since they physically could not produce the sounds of human languages (Hayes and Hayes 1951). However, they made great progress when taught signs of American Sign Language since they could manipulate their fingers well (Gardner and Gardner 1969).

Since signs are made with the hands, the instructor can manipulate the production mechanism (molding), giving the child necessary tactile feedback. Such feedback is difficult to provide with the vocal apparatus. Some research shows that autistic children have a preference for the proximal receptors, touch, smell, and taste (Goldfarb 1956 and Ritvo

1976). Thus, molding the hands may reach the children through a sensory mode in which they can learn more readily. Research on perception also shows that autistic children tend to be more receptive to visual rather than auditory stimuli. This tendency can be exploited by a visually based language such as American Sign Language. Other researchers, notably Lovaas et al. 1971, found differences in modality preference across children, so that this tendency may be advantageous for only a subset of autistic children.

Other researchers suggest that the high iconicity of many signs makes them easier to learn (Brown 1978 and Konstantareas et al. 1978). Konstantareas experimentally showed a high correlation between iconicity and ease of acquisition suggesting that "the iconic nature of some signs makes them accessible to the concrete representational capacities of autistic children" (p. 232). In that study, iconicity was measured by asking normal children and adults who were given the meaning of the signs used in the training program to rate those signs as being iconic or non-iconic. Such a measurement is questionable for two reasons:

1. No standards expect the individuals's personal opinion were used;
2. the subjects were told the meaning of the sign as they saw it.

Children, both normal and autistic, trying to understand signs in a natural learning situation do not know the meaning of the signs beforehand. They must guess the meaning. The child's situation is similar to a linguist who is attempting to analyze a language he has not encountered before using data elicited from a native speaker.

In such a situation, the first data to be elicited tend to be object names, since these are most readily available. However, even with such concrete items, the task is not so straightforward as it may

appear. The linguist, or child, may assume that the symbol stands for the object he is pointing to, but it may in fact stand for a part of the object, an attribute of the object, the proper name of this particular object, the state of the object or the reaction of the speaker to the object. The list of alternate possibilities for the meaning of any such datum could be extended much further. Inevitably, the linguist or child must guess what the speaker intended; he forms a hypothesis and tests it against future data.

Konstantareas et al. 1978 argue that the iconicity of a few signs, their physical resemblance to their referent, provides the autistic child with a means of circumventing what Quine 1969 has called the inscrutability of reference or indeterminacy of translation of many signs. However, their method of determining iconicity does not reflect how effective this property is in enabling a naive individual to make an accurate association of meaning and referent. Their subjects were not naive but were informed of the relationship before making judgments on the relationship. To determine a sign's guessability one must examine the relationship of a sign to its meaning and determine how transparent that relationship is. If the meaning of a sign is guessable from the sign's form alone, then it may be easier to learn. Formulating the hypothesis in these terms may allow for a more precise definition of what is being measured.

2.1.1. Iconicity and Transparency

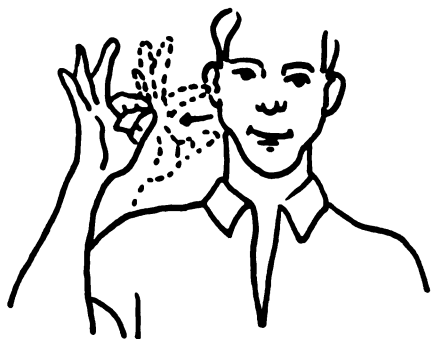
It is important at this point to make a distinction between iconicity and transparency, two concepts which at first may appear to be synonymous. Cohen et al. 1977 define transparency as "the degree to

which the meaning of a sign can be guessed, without prior knowledge, from its physical appearance" and iconicity as "the [physical] similarity between the sign and its base" (p. 20).

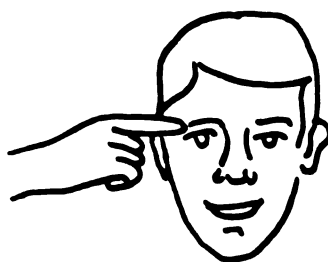
Spoken languages consist in part of a set of signs: sequences of arbitrary sounds which through convention correspond to some meaning. De Saussure 1959 distinguishes two aspects of a spoken sign: *signifié* (concept) and *signifiant* (reference) which through convention are related by means of the arbitrary sign. Cohen et al. 1977 distinguish three aspects of the manual sign: meaning, reference and base. Meaning and reference correspond to *signifié* and *signifiant*, but the base of a sign has no counterpart in adult spoken languages. The base is the concept directly described by the sign. For example, CAT* in ASL is signed by touching thumb and index finger tips with the other fingers spread and moving them from a point beside the nose to the side (see Figure 1). This sign's base, then, is the whiskers of the cat. The relationship between the linguistic form and the object can be described as synecdochical (the part representing the whole) rather than iconic. The relationship between the sign and its base, the whiskers, is iconic. The transparency of the sign is how easily these relationships can be perceived.

A manual/visual language can exploit other types of visual imagery as well. Meaning, base, referent triads can be formed on other types of relationships of the base to the referent, e.g., metonymy in the sign for BLACK (extended index finger brushing across an eyebrow, i.e.,

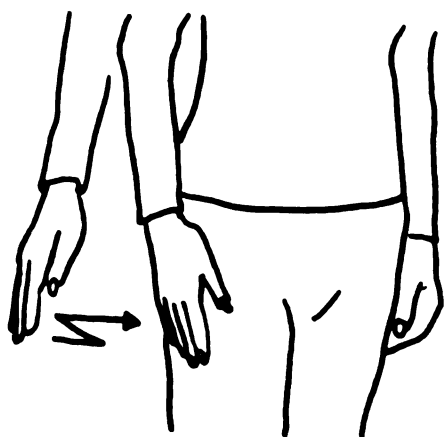
*English translations of signs of ASL are typed in upper case letters.



CAT



BLACK



DOG



TREE

Figure 1: The Signs CAT, BLACK, DOG and TREE

something that is black. See Figure 1). Social and contextual information can also form this relationship; e.g., DOG is signed by snapping the fingers and patting the thigh as if calling a dog (see Figure 1). In some cases, the base and the referent are identical, as in TREE (one arm bent at the elbow with its fingers spread and moving as if branches waving in the breeze; this arm rests on the back of the other hand--the ground; see Figure 1).

Many such relationships have been invented and resemble folk etymologies devised by speakers of a language to explain the development of certain words. For example, bridegroom developed from OE brydguma meaning 'bride's man.' When guma was lost from the vocabulary, brydgroom appeared by analogy with groom and the meaning of bridegroom is more likely to be interpreted as 'bride's caretaker' rather than as 'bride's man.' An ASL example is GIRL which is signed by grazing the extended thumb of a clenched fist down the cheek (see Figure 2). Two different folk etymologies of this sign occur. Some people say the thumb is tracing a bonnet string, others a side curl. Regardless, it would be difficult in this example to guess the meaning of the sign without such etymological information.

Triadic signs form a subset of ASL signs. Hoemann (1975) carried out a study of the guessability (transparency) of signs of ASL. One-hundred signs were randomly chosen from a group of 500 common ASL signs. Fifty-two undergraduates with no previous experience in ASL were asked to guess the meanings of these signs. Four judges rated the answers, two using a key which listed only one possible exact word answer. The other two used a key which included words listed as synonyms in a conventional thesaurus. A sign was considered transparent if twenty-five



Figure 2: The Sign GIRL

percent of the subjects guess its meaning correctly. The results showed that a conservative estimate of transparency (based on the first two judges ratings) would be ten to fifteen per cent. A liberal estimate from the second key would be from twenty to thirty percent.

An analysis of the errors showed that for many signs the same incorrect meaning was guessed more often than the correct one. Using the same criterion level of twenty-five per cent as for transparency, thirty-six signs were found to be misleading. Thus approximately one-third of the signs were transparent, one-third opaque, and one-third misleading.

Hoemann lists five factors which he feels account for the difficulty of subjects in guessing the signs:

1. The motivation of the sign [the relationship of the base to the referent] is not a certain clue as to its meaning.
2. The field of meaning may generalize over time and go beyond the constraints of the original motivation.
3. Signs may become shortened over time or a difficult movement modified so that it is easier to execute.
4. Influences from English have modified the ASL lexicon so that signs are virtually impossible to identify from their outward appearance.
5. The outward appearance of many signs [can] bear a superficial resemblance to a number of possible referents most of which will not correspond to the meaning of the sign. (p. 160)

Thus it is evident that subjective evaluations of a vague concept such as iconicity, as Konstantareas et al. have collected, will not measure the complex relationship of signifiant to signifié in manual signs.

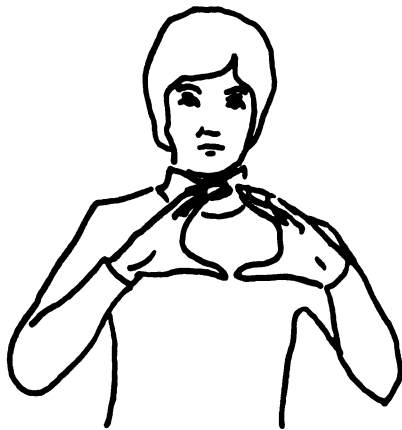
It is not, however, arguable that the transparency of some signs should make them easy to learn, e.g., BALL, made with finger tips of both hands touching in the shape of a ball. BOY, the hand at the forehead shaping the brim of a cap, is highly iconic with its base, but cannot be guessed without further knowledge about the habits of boys, and should not be as easy to learn as BALL (see Figure 3).

Schlesinger and Meadow 1972 discuss data from the vocabulary of a deaf child which illustrates this argument:

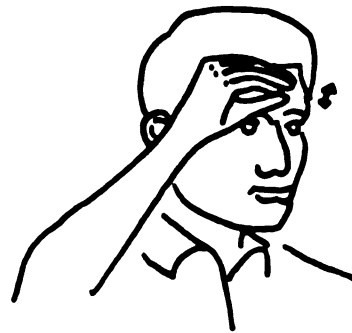
Certainly when we study Ann's total sign vocabulary at age 18 months it is difficult to imagine that even with her intelligence she was able to pursue the etymology of such signs as MILK (hands as in movement of milking a cow), and GIRL.... She might, however, have had enough experience with life to reason out the signs such as DOG...ICE CREAM (hand held to mouth with slight licking protrusion of tongue), or RAIN (both hands held above head with fingers moving individually and downwards). Even giving Ann great credit for remarkable etymological talent at 18 months, at least one-half of her repertoire can have had not ideographic meaning to her at that tender age. (p. 59)

Figure 3 provides drawings of these signs. Only later, when children learn more about their environment, may the relationship of the base of a sign and the sign's referent become clear.

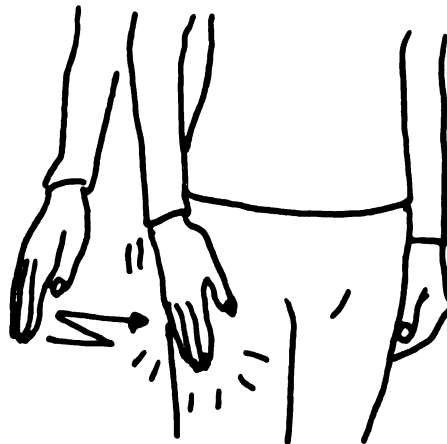
Schlesinger and Meadow's study, however, supports the initial hypothesis that some signs may be easier to learn. They report on normal deaf children who have vocabularies of over 100 signs in the one word utterance stage when hearing children have vocabularies of one to 50 words. They also report on normal hearing children in a spoken and signed language environment whose first words were expressed as signs. One can still make the argument that since some signs are immediately transparent, the leap from object to symbol is not so great as is the case of spoken languages. There is evidence that hearing



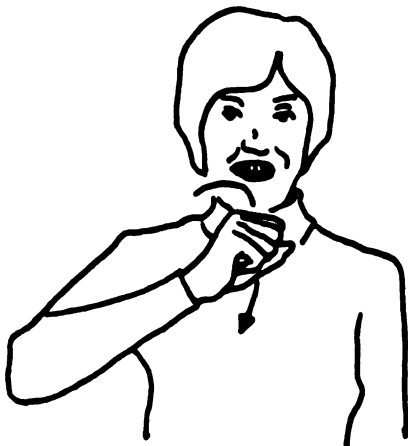
BALL



BOY



DOG



ICE CREAM



RAIN

Figure 3: The Signs BALL, BOY, DOG, ICE CREAM, and RAIN

children before the one to 50 word stage formulate their own words for some objects by imitating the sound that object makes, e.g. [čú čú] for train and [baw waw] for dog (Ricks and Wing 1975). This fact indicates that children may go through different stages in the process of developing abstract symbols for objects. Iconic representations may be a necessary prelude to more abstract representations. In sign language acquisition, such a stage can be a part of actual language acquisition rather than the invention of a preliminary set of forms which must be abandoned for more conventional adult forms. Thus, the iconicity of some signs may be a further explanation for the success of sign language training with autistic children.

2.2. Research on the Use of Sign Language with Intellectually Handicapped, Aphasic, and Autistic Children

Bricker 1972 investigated the development of initial word meaning, i.e., the ability to name or respond to the names of objects in the environment, by young low-functioning children. In this experiment, the response of the child to the name of an object was selecting the named object when presented with a pair of objects, for which they were rewarded with food tokens. The purpose of the study was to determine the effect of a sequence of training sessions using signed as well as auditory cues on the development of such a response.

Matched control and experimental groups were used. The experimental group received three phases of training with probe tests administered between each phase. The control group received the probe tests with no training sessions.

Training consisted of 1) imitative sign training, where the child was shown how to make the signs, 2) sign-word training where the signs

were paired with the corresponding English words, and 3) sign-object training where the signs were paired with the objects named.

Pretest and posttest were the same for each group. Analysis of the change in scores between the pre- and post-test showed a reliable difference in favor of the experimental group. No attempt is made to explain this effect.

Based on the fact that previous investigations indicated that severely handicapped children failed to acquire word-object associations after extensive training, the investigator suggests manual sign training with these children as an avenue for further exploration.

Kopchick et al. 1975 briefly report on a "total communication" project in an institutional setting. The pilot project compared a group of 11 residents who received the total communication of signed speech (signed utterances simultaneously accompanied by the corresponding spoken utterance), with a group of nine who received no sign input. Each resident had been in the institution 20 years or more. Aides were selected and trained in the use of signs that would be used frequently in an institutional setting. The aides were to communicate with residents in the experimental group and with other staff members using signed speech at all times.

At the end of six months, pre- and post-testing results indicated that the control group remained about the same, whereas the experimental group increased their language level by an average of 20 months.

Richardson 1975 reports on a program for teaching sign language to severely and profoundly retarded individuals. Difficulties in teaching speech led the staff to explore sign language as an alternative. Nine students were selected on the basis of their lack of expressive or

receptive language. At the end of the first year significant progress was made by all students, although further details as to the nature and extent of the improvement are not given.

Levett 1969 describes a project conducted with five to 16 year-old severely subnormal cerebrally palsied children, some of whom had additional handicaps such as deafness, partial sightedness, visual perceptual problems, hyperactiveness and severe motor dysfunction. When speech training failed with 15 per cent of the children, an alternate method of communication was chosen to be taught to the children. Few details are given, but the author cites several alternatives considered: picture board, written word, finger spelling, British Sign Language, and mime. The picture board was found to be too limiting, and the written word and fingerspelling were too complex for the children to discriminate enough words well. Mime was chosen over sign language since, as the author states, "although some of the signs from the language of the deaf were very useful, on the whole they were too abstract for [the] children ...to understand" (p. 65). The author states that progress was being made using pantomime, but no detailed results are given.

Success with aphasic children has also been noted in the literature. Cohen et al. 1976 worked with a child who lost both receptive and expressive speech at the age of four. By age 10, the receptive facility was good but the child still could not produce speech. At this time ASL was introduced and the child mastered its production while remaining unable to produce speech.

Researchers of the use of sign language with autistic children have reported some of the most dramatic improvements in behavior and communicative ability. Creedon 1973 (see also Offir 1976) has used the signed

speech system called "total communication." This consists of using a system of signed English, which mirrors English grammar while using ASL signs for content words, and speaking the corresponding English sentence simultaneously.

The children had to be taught to attend to the instructor. Once this behavior was established the children were taught signs which were related to their personal needs and desires. Children who were not at all successful in speech training programs soon learned labels for things, which, in turn, reportedly enabled them to develop socially and intellectually. After being trained to produce a few signs, the children began to spontaneously use signs to make requests. Creedon suggests that autistic children need as many language cues as possible. Using two sensory modalities to carry the language signal improves the chances of reaching such children.

Schaeffer et al. 1977 also report on the use of signed speech with autistic children. Their approach is somewhat different than that of Creedon. Their purpose in teaching signed speech is to transfer to speech the spontaneity that manual language promotes. They teach the children to use signed speech themselves, not only to respond to it as does Creedon.

Children taught sign language in Creedon's program make spontaneous statements using sign language. Autistic children who are taught only verbal language do not speak spontaneously. Schaeffer 1978 suggests that spontaneous signing occurs because of the goal directed grasping functions for which autistic children spontaneously use their hands prior to any training. Autistic children often grasp the hand of an adult and direct it to a desired object. The spontaneous grasping

function of the hands is adapted by the insertion of a conventionalized motor behavior and spontaneity is transferred to this new motor behavior (Schaeffer 1978:325). Such goal directed functions are not associated with the vocal apparatus and thus spontaneity does not readily transfer to speech. Schaeffer et al. 1977 decided to incorporate training both in sign language and spoken English in an attempt to promote spontaneous verbal communication and hypothesized that the spontaneity which had transferred to signing could also be transferred to speech.

Schaeffer et al. 1977 began a program with three autistic boys aged five, five and a half, and four and a half. These relatively young ages should be noted since some of their success may be due to early intervention (see Miller and Miller 1973, discussed below). The treatment consisted of four 45 minute language sessions a day. Initially, two of the language sessions were devoted to sign language training and two to imitative speech training. After four to five months, when the children began adding signs to their lexicons by themselves, the investigators began explicitly teaching signed speech in place of the sign language sessions and reduced the number of imitative sessions. After about five months of signed speech training, the children began to speak spontaneously without signing. To encourage this, the investigators instructed the children not to sign and refrained them from signing overlearned constructions, which they later extended to other constructions as well.

All three children successfully progressed from being completely non-verbal to using spontaneous speech to express wishes through the intermediate stage of signed speech. The investigators suggest that spontaneity was encouraged by sign training because it allowed the

children to express needs and desires through hand movements which was merely a refinement on the methods they had already been using: grasping, grabbing or pushing an adult toward a desired object (see also Schaeffer 1978). The investigators' experience with one of the children who was somewhat echolalic led them to conclude that the technique may also be useful with this sub-group of autistic children.

Miller and Miller 1973 used a somewhat more complex training program to facilitate cognitive development in autistic children. Based on the assumption that autistic children are relatively unaware of their bodies and body parts in relation to objects, they designed an environment to teach such awareness. This environment consisted of parallel boards elevated three to six feet above the ground. "These boards constituted 'edges' highlighting the children's body experience in relation to their immediate experience" (p. 70).

The investigation was conducted with 19 autistic children, 12 boys and seven girls, 13 in a residential school and six in a day care school. When placed in the new environment, the children became more aware of their surroundings and their autistic behavior suddenly ceased. Along the boards various obstacles and tasks were placed to induce the children to perform intentional acts.

The investigators hypothesized that children who could perform intentional acts but who could not understand or produce language, might be able to transfer the meanings of their actions to signs which resembled the actions and later to the spoken word which accompanied the signs. Thus they introduced signs closely related to the children's activities in three different contexts. The first context was its use

on the boards. The second was a training session with films illustrating the signs introduced on the boards, and the third was to encourage generalization to everyday environments. Signs were accompanied by spoken words at all times. No attempt at conventional speech therapy methods was made, but the children were encouraged when they made appropriate utterances.

All the children became able to respond first to signs paired with spoken words and later to spoken words alone. Spontaneous use was much more limited and only one child learned to understand and use appropriate syntactically correct spoken language.

Chronological age and length in the program had high positive correlations with language achievement. In addition, Creak scores (a rating of severity of autistic disturbance, 50 being highly disturbed, 30 mildly) correlated negatively with language achievement. The day care children's expressive use of signs was significantly greater than the residential children. Both aides at the residential school and parents were instructed in sign language.

The use of boards was found to be necessary with some children to teach gross action verbs, e.g., open, shut, walk, whereas nouns and other verbs requiring less motion could be taught outside this environment.

The investigators conclude that the usefulness of teaching signs to autistic children is not invalidated by the fact that some children do not progress to spoken language since signing provides them with a means of communication and for achieving human contact.

Webster et al. 1973 report on the use of a spoken word/sign system with an autistic boy who failed to respond to operant speech training. Manual signs were introduced in the training after analysis of video-tapes of speech sessions with the child indicated he was responding more to gestures than to words. Improvement in communication after introduction of signing was marked and a reduction in bizarre behaviors occurred. The child showed a tendency to use the signs himself and responded to directions from adults he did not know.

Benyora et al. 1977 report on a project to teach signed English to six autistic children aged five to 12 using a multi-sensory intrusion approach. The children's progress was measured in both free play and teaching sessions.

The technique consisted of three basic steps. The first step was intrusion play. The teacher tickled and touched the child, and manipulated the child's limbs to make the child aware of her presence. The second step involved teaching the child to imitate bodily movements. The teacher made gross movements, such as touching her head while saying head and moved the child's arm to touch his head while repeating the word.

The third step involved the pairing of signs with objects in the school environment. First the child's hands were manipulated to make the sign and then the child was rewarded for ever closer approximations of the sign. Playing with the objects was then contingent upon using the sign. Once the child was using signs in this way, generalization to pictures was begun. If the child was able to use simple sentences to express basic needs and understand short phrases which were signed to him, the teacher began more formalized teaching sessions with him.

Changes in the children's behavior were observed in both the structured and unstructured sessions. A higher level of attentiveness in structured situations and a higher level of interaction in play situations is noted. In addition, four of the six children were observed to use signs spontaneously in one to two sign utterances with adults and other children. A significant decrease in the use of reinforcements is also noted and the investigators suggest that the children were becoming more functional and able to use their own feedback as reinforcers.

Bonvillian and Nelson 1978 discuss therapy they carried out with a non-verbal boy, Ted, beginning at the age of nine. Between the ages of seven, when he entered the treatment center, and nine, he received operant speech training, in which he was rewarded for any vocalization and to which he did not respond positively.

In the six months after the initiation of sign language teaching, Ted made continual additions to his lexicon, learning at the rate of approximately two signs a week. Although he failed to learn 30 per cent of the signs presented to him within this period, his language abilities were significantly improved over the previous oral training period. The signs which he failed to learn or which were more difficult included those which involved more complex finger configurations and those two handed-signs which required a different hand configuration or motion with each hand.

Ted made spontaneous combinations of signs after only three months of training and began having conversations ranging from a few utterances to fifteen minutes in length with signers at home and at the training center.

Work has continued on Ted's speech skills, and has focused on

improving his tongue mobility and control, since Ted has difficulties in controlling his oral movements. The investigators report that these sessions are very stressful for Ted and usually result in the return of many of the bizarre repetitive gestures of an earlier period which otherwise rarely occur.

Fulweiler and Fouts 1976 report on a five year old child diagnosed as autistic who acquired signs after 20 hours of training using the total communication method. The investigator spoke the word while demonstrating, modeling or prompting the sign. As the use of signed speech increased, the use of vocal speech increased in both amount and appropriateness. Phrases were first used in the eleventh hour of training. The use of signs transferred to situations outside the training sessions.

The fact that autistic children can communicate given a language model in a modality that they can initially process led Fulweiler and Fouts to conclude that "one of the main factors in autism may not be a cognitive malfunction, but a perceptual non-functioning in the cross-modal array" (p. 50). Being drawn to gestures and facial expressions rather than voices and finding them an erratic and limited system, autistic children become frustrated. When these gestures are presented systematically and meaningfully, the children can begin to develop their language abilities.

However, as noted by Miller and Miller 1973, not all autistic children respond so positively to sign language training. Some progress is made in all cases, but the amount varies widely from child to child. This fact suggests that the nature or degree of the disorder may vary from child to child. Thus the conclusions drawn by Churchill 1978, that the language disorder is central, or by Fulweiler and Fouts 1976, that

the perceptual disorder is central, may pertain only to a sub-set of autistic children. When EIA is confounded with other disorders such as mental retardation, such hypotheses are even harder to confirm.

2.3. Summary

The context, meaning, and function of language learned by autistic children has been carefully investigated. However, little has been said about the form beyond counting the number of ungrammatical sentences, echoes, nouns, verbs, and adjectives. It is the purpose of this project to examine errors made by autistic children learning signs in terms of the structure of signs.

Research on normal children learning sign language as a native language indicates that they are not only using a strategy that involves transparency as discussed above, but a strategy based on formational parameters discussed by Stokoe 1960 (see Wilbur and Jones 1974 discussed in Chapter IV Section 2.4 below). The form of signs may give another answer to the question posed at the beginning of this section: why autistic children, who failed to learn spoken language, learn sign language. Eisenson 1966 discusses the difficulties many non-verbal children with autistic characteristics have receiving, processing, and remembering stimuli that are produced in a sequential manner. (See also Hermelin 1976, Tanguay 1976 and Levy et al. 1977 discussed in Chapter II Section 1.3.2.4. above.)

The ability to deal with sequential stimuli is a prerequisite to learning spoken languages. In a spoken language, a word consists of a sequence of units. Order is essential, since changing it changes the word: cat, tack, act. In sign language, on the other hand, a word consists primarily of a bundle of simultaneous properties. To be sure,

signs do take place in time and must, therefore, have a sequential order. Indeed, the children in this study tend to have great difficulties with two part signs, usually doing either the first or second half only. However, since the sign normally presents itself more or less as a whole rather than as a string of units, it may not tax a deficient sequencing faculty as much as speech and may be easier for non-verbal autistic children to learn.

It is the purpose of the following chapter to make clear the simultaneous and sequential form of sign languages, focusing on American Sign Language, and to present research in support of the framework adopted for this study.

CHAPTER IV

SIGN LANGUAGE STRUCTURE

Sign languages differ significantly from spoken languages because of the modalities of production and perception. The previous chapter hypothesizes that the structure of American Sign Language provides an explanation for the success of sign language programs with autistic children. An understanding of that structure is a necessary preliminary to understanding how this hypothesis can be true.

1. Sign Language Phonology

There is a level of sign language structure consisting of recurring elements of form smaller than the composite signs in which these elements occur. The elements serve to signal differences in meaning but are not associated with a specific meaning independent of the composites of which they are a part. In this way, they constitute a level of linguistic structure parallel to the phonology of spoken languages. For this reason, recent research in this area of sign language study has used the terms phoneme and phonology to describe the phenomena associated with this level of structure. This study follows these conventions.

1.1. The Parameter Analysis of Sign Language Phonology

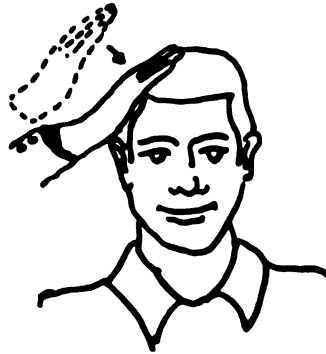
The phonological level is regarded as "consisting of a limited number of values of a limited number of formational parameters occurring simultaneously to constitute the individual sign" (Bellugi et al. 1975: 97). These parameters are similar to phonological features that are specified for presence or absence, but the parameters differ in that

they are multi-valued and relatively open-ended, rather than binary. There is no logical limit to the number of values of a parameter as there is with the binary feature analysis of phonemes in spoken languages.

The first linguistic analysis of American Sign Language was made by Stokoe 1960. The majority of this work is devoted to the analysis of minimally distinctive pre-lexical units. In Stokoe's system, the units are organized into three classes or parameters: (1) what acts (labelled designator, or dez for short), (2) its action (signation, or sig), and (3) its action's location (tabula, or tab). "The dez... is recognized both by its configuration and by its attitude, the sig as significant motion in space, as a change in configuration, or as a change in attitude" and the tab simply as the place or places where all this occurs (p. 40). For example, the sign for HAT is the flat palm touching the top of the head. Tab is the whole head, ☺. Dez is the B hand shape of the manual alphabet and sig is touching, x. The sign would be transcribed as follows ☺ B^x. (See Figure 4.)

Other investigators (Battison 1974, Friedman 1975 and Frishberg 1975) have deemed it necessary to distinguish a fourth aspect, orientation, as a basic parameter in order to differentiate between certain minimal pairs. For example, TRAIN and SHORT are both made with two extended fingers on both hands, one pair brushing the other; they differ only in the fact that in TRAIN the palm of the base hand points downward, while in SHORT, the palm points to the right (see Figure 4).

Stokoe 1978 gives several arguments against a four parameter analysis of signs. First, such an analysis is more complex since it is necessary to "specify whether the hand shape begins its movement with



HAT



TRAIN



SHORT

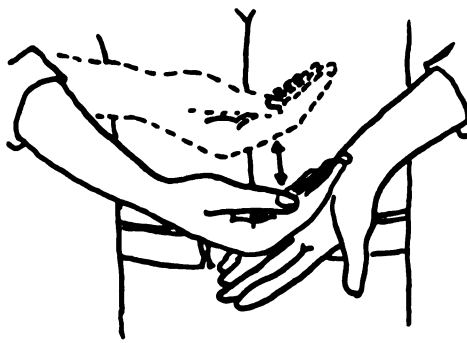
Figure 4: The Signs HAT, TRAIN, and SHORT

the orientation throughout the movement," and thus robs the description of its phonemicity by adding extraneous phonetic detail (p. 83).

Whether this detail is phonetic, or rather phonemic, i.e. necessary to unambiguously described a sign, is a fact not in evidence. Stokoe himself includes a set of subscripts to show "how the dez is held" (p. 68). When such subscripts must be used, when the are extraneous and upon what grounds this decision is based, are not made clear.

A second argument is that "hand shape and attitude (miscalled orientation) are both ways in which what acts can vary and distinctive features of both result from differential muscle action but they are not variable independently from one another, except in a few special circumstances" (p. 83, second emphasis mine). Stokoe lists one such exception, SCHOOL/MONEY; Bellugi and Klimia 1975 list another, STAR/SOCKS (see Figure 5). Bellugi, Klima and Siple 1975 state there are some signs that differ only in respect to orientation, but do not list these. However, it does seem that there are several "exceptions." In structural linguistic studies of spoken languages, one minimal pair is usually considered enough to establish a phonemic contrast. Whether this should result in a whole new category of primes is not clear, but such a minimal contrast must somehow be included in the phonemic inventory.

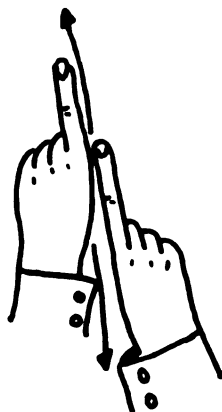
A corollary to Stokoe's objection is that with certain hand configurations only certain orientations are physically possible, and in some cases certain orientations are more "natural." Stating such information is therefore redundant. However, with some orientations, for example, palm up and palm down, one does not seem more or less awkward than the other. They are distinctive, unpredictable aspects of a sign.



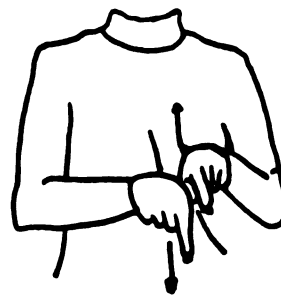
MONEY



SCHOOL



STARS



SOCKS

Figure 5: The Signs MONEY, SCHOOL, STARS, and SOCKS

When orientation is distinctive, Stokoe notes it with subscripts to the hand shapes. As previously stated, Stokoe considers *dez* to be both the hand shape and the orientation. Therefore, a B hand, palm up, palm down, to the left, to the right, or fingers pointing up, is actually five different, distinct hand shape phonemes. Multiplying the entire inventory of handshape phonemes by five increases the phonemic inventory dramatically, whereas adding five orientations increases it relatively little. Stating that orientation is predictable in certain environments is parallel to stating that voicing is predictable for German obstruents in word final position. The contrast is maintained word medially. For example, [bunde] 'unions' and [bunte] 'colorful with adjective ending' are contrasting, but [bunt] 'union' and [bunt] 'colorful' are not.

Thirdly, Stokoe argues from signer's intuitions. In signs that make contact, "the signer is not concerned with where the palm of the hand is facing but kinasthetically senses the pull or lack of it of the forearm rotating muscles as well as the touch of the contacting surfaces of *tab* and *dez*. In non-contact signs, the feel of the rotating musculature is as likely to be a part of the psychological "reality" of signing as is how a sign act looks" (p. 85). Of course, from the point of view of the signer this may be true, although Stokoe cites no experimental evidence in support of this statement. From the addressee's point of view, it may not be an imagined tension in the muscles in sympathy with the signer, but the visual impact a sign makes on the retina which provides information for decoding. Experimental work by Bellugi, Klima and Siple 1975, discussed below in Section 2., gives evidence for strategies of decoding signs using the four parameter schema.

Finally, Stokoe argues that the orientation parameter is not

clearly defined. He states "there is no theory to specify whether its [orientation's] initial or final state is to be regarded as significant" (p. 85). A similar ambiguity arises with the movement and point of articulation parameters. When movement occurs, is it the beginning of the movement or the end point of the movement that constitutes the significant point of articulation? Should both points be specified or not? For example, GIRL, made with a clenched hand, with the thumb extended, moves from a point at the side of the face, 3, to the lower face, 5. If a sign is to be described as having two points of articulation, can the motion between the two be simply inferred or must it be explicitly stated? For example, CEREAL is made by touching the back of a cupped hand to the palm of the other hand and moving it to the mouth as if scooping cereal from a bowl (see Figure 6). If movement is to be inferred from the two points specified, then it too can be predicted, and hence redundant. Yet, this does not lead Stokoe to decide that movement is not phonemic.

Since Stokoe does not present a convincing case against the parameter of orientation, and since there is evidence for its psychological reality (see Section 2. below), a four parameter analysis is assumed here as necessary for the description of a sign.

1.2. Simultaneity and Sequentiality

A sign is described as a simultaneous bundle of phonemes (values for the parameters) and differs from words in that words consist of a sequence of phonemes which are simultaneous bundles of phonological features. Of course, acoustically it can be shown that there is considerable overlap of these features. Onset times of the realizations of the features may not occur simultaneously, but perceptually such



Figure 6: The Sign CEREAL

sequencing is eliminated and discrete units are processed.

Signs, on the other hand, do not consist of elements which can be perceived as discrete units. Rather, most of the units occur simultaneously. Overlap in this case is quite extensive, the form of one unit modifying the others and vice versa. The units fall naturally into the parameter categories established above since, for example, a hand shape unit on one hand cannot combined simultaneously with another hand shape unit on the same hand. Thus the parameters are defined by the fact that units from each can combine together simultaneously. Sequences of these packages within a sign are also possible and are indicated in the notation by a double slash, ||, separating the first half from the second. This is equivalent to compounds in spoken languages. BATHTUB is a sequence of the sign WASH followed by the sign TUB: hands rub the chest, then touch in front of the signer in the T hand shape, separate and move upward tracing a semi-circle: $[]BB_N^X || \emptyset T_{>} T_{<}^{X+} . []$ is the trunk, $_N$ indicates up and down motion, * indicates repetition, $>$ indicates orientation to the right, $<$, to the left, $+$ indicates separation and $\emptyset$ indicates moving to a palm downward orientation (see Figure 7).

In the literature on ASL, it has often been stressed, and appropriately so, that the elements of a sign occur simultaneously and not sequentially. This has led to an ignoring of the fact that signs take place in real time, that they do not have sequential structure (see Ellenberger 1977). One element (such as movement or hand shape), or two, three or all four parameters can change simultaneously. Of course, a change in point of articulation or orientation must involve movement of some type. However, the aspects or phonemic elements of a sign

cannot be performed discretely so that one can observe each in isolation; rather, they must be executed in concert. Thus the study of sign language phonology is quite a different task than that of spoken languages.

1.3. Values of the Parameters

Each parameter or category consists of a group of primes (or phonemes) which are mutually exclusive within a package and which are minimally contrastive. Stokoe lists 22 sigs or motions primes which can be modified by two diacritics indicating sharpness or repetition of the movement. The symbols are somewhat mnemonic. Twelve tabs or points of articulation are distinctive, one of which (neutral signing space in front of the signer) is often not written in transcriptions. The signing space in ASL extends from the base of the trunk to the top of the head and sideways to the greatest extension of the arms. Twenty dez or hand shapes are distinctive. These are generally indicated by the letter of the manual alphabet to which they correspond. Diacritics are used to indicate variations of these. Thus, B (flat palm fingers extended and touching), B (bent B, fingers bent at the first knuckle), and B (B hand shape with thumb extended) are contrasting hand shapes. B and B do not occur at all in finger spelling. A minimal utterance in ASL consists of a hand shape in neutral signing space. For example, ONE is signed with the extended index finger, G hand shape (see Figure 10). Two special subscripts, one tab symbol, and six of the motion symbols used as subscripts of the dez indicate the attitude of the palm, the forearm, and the direction of pointing of the salient finger(s), respectively. (See Appendix D for a complete list of symbols.)

The symbols are arranged in the following order: 1) tab, 2) dez, optionally with attitude subscripts, 3) sig as a superscript to the entire package, and more than one may occur. Certain conventions add more details concerning the primes: a bar on top of or below a hand shape in a two-handed sign indicates its position relative to the other hand, an apostrophe between two hand shapes indicates they are made near or next to each other. Motion symbols are arranged vertically to indicate simultaneity of the motion, e.g. $\overset{x}{v}$ indicates a downward grazing action, x = touch, v = downward motion. Sequentiality is indicated by writing the symbols horizontally.

Thus, the motion class is an exception to the mutually exclusive condition stated above. Either this class includes extraneous phonetic detail which could be implicitly stated otherwise, or the actual movement primes have not been discovered, that is, grazing may be a prime, and hence should be indicated by a single symbol, or the condition is not a characteristic of these parameters.

Movement can be broken down into two categories, which are not mutually exclusive, and which must occur together: direction and type of motion. In Stokoe's treatment, they are similar to the distinctive features of spoken languages since they are treated as simultaneous properties of one phoneme. Some direction elements, as stated above, are used for orientation or attitude of the hand shape. Making a new category and allowing it to specify the direction of both the hand shape and the movement eliminates six of the nine directions of motion. The other three are alternations of two opposite directions: up and down, right and left, away from and toward the signer. Stokoe has already provided a symbol for alternation, $\sim$, so this duplication can

be eliminated by combining this type of motion with a direction unit. In this way thirteen types of motion units and nine direction/orientation units would be recognized rather than twenty-two motion units, nine subscripts for attitude, and conventions to combine them. Conventions would, of course, be needed to indicate whether a unit was to be interpreted as direction or orientation and a whole new category is necessary but this may be so in any case. An additional problem with this analysis is the fact that movement of the hand and movement of the arm are possible at the same time, although not all combinations are physically possible. For example, KITE is made with two fingers pointing upward, with the thumb between them, the K hand shape (see Figure 8). The arm moves to the right while the hand is twisted at the wrist. This problem could be eliminated by introducing further conventions for allowing movement symbols to specify the movement associated with a hand shape or with the entire sign. This suggestion does not involve a major revision of the symbols, but rather proposes a different interpretation and organization of some of them.

An evaluation of the relative merits of Stokoe's original system and this suggestion must be based on not only a simple count of elements, but also on the adequacy of the description and on the simplicity of the system as a whole.

1.4. An Alternative to Stokoe's System

Another, somewhat different, system of notation was developed by West 1960 to describe the sign language of the North American Northern Plains Indians. West's system is also designed to be phonemic (or kinemic in his terminology); that is, he has tried to capture only those aspects of a sign which are distinctive, and he provides minimal pair

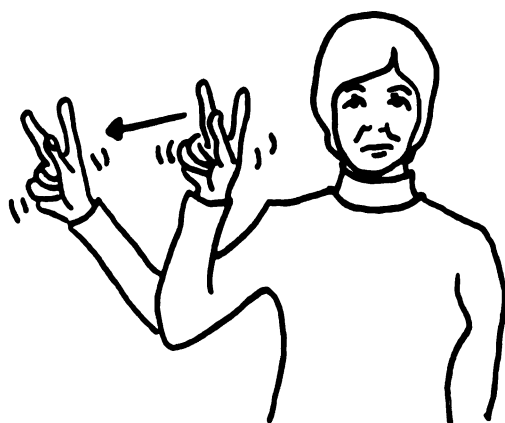


Figure 8: The Sign KITE

pair data to support the analysis.

West divides these aspects into five classes: hand shapes, referents (points of articulation), directions, dynamics (modifications of the other classes), and motion patterns. For the first three classes he utilizes symbols from phonetic alphabets and links them mnemonically according to relatively arbitrary correspondences with a numbering system for articulatory positions. These correspondences are less arbitrary across the three classes as they are based on directions and spatial positions which apply more or less uniformly to the three classes. Voicless consonant symbols are used for hand shapes, voiced consonants with some superscripts for referents, and vowels for directions. For the other two classes, West uses in the former, suprasegmental symbols, in the latter, nasals. Modifications of some of the symbols are also necessary.

Eighteen distinctive hand shapes were established. Nine basic hand forms can be modified by a series generating component, rounding. This rounding component is similar to nasalization, glottalization and voicing in some spoken languages. When added to the basic handshape phonemes it produces a new set of phonemes. In this regard, it is more similar to a distinctive feature in spoken language than to a phoneme.

Forty-one distinctive referents or points of articulation were found: an unmarked point (equivalent to neutral signing space in ASL), 15 hand and arm points, 18 head, body and leg points, and seven external points. If the referent precedes or follows a hand shape phoneme, it indicates position. If it follows a motion pattern phoneme, it indicates the end point of the motion. Thus West utilizes sequential

ordering in transcription to indicate the internal sequential structure of the sign.

In West's third class, directions, eight distinctive phonemes were found, up, down, left, right, away from the signer, toward the signer, touching, parallel to or across. Touching in Stokoe's system is classified as a movement (or lack of movement) phoneme. It is not at all clear as to which is a better solution. If combined with a hand shape, direction phonemes indicate the direction of pointing of the salient part of the hand. If added to a hand shape-direction combination, they indicate the direction of the palm. No marking indicates the most comfortable natural anatomical position. This is comparable to the situation in spoken languages where unmarked sounds are often considered to be easiest to articulate. Combined with a motion pattern phoneme, directions indicate the direction of the motion. This category has a similar function to the orientation/direction category proposed above.

The fourth class, dynamics, or modifying phonemes, is somewhat of a catch-all category. Units of the dynamic class are those which indicate tension, speed, force or extent of the hand shape and motion. The rounding element discussed above in the section on hand shape is also included in this class. This element may be used with two direction phonemes to indicate a direction half-way between them. This first sub-class of dynamics modifies only one phoneme or specifies the relationship between two. A second sub-class consists of those dynamics which modify an entire "package" or a "sub-package," an entire sign or part of a sign, in other words. One group in this category is the hand specifiers, which specify which hand (if that is distinctive for the sign), how many hands and the relationship of the hands to each

other in placement or movement. The second group is repetition elements. A package or sub-package of a sign may be repeated in three ways: exactly, in different directions, and progressively.

Four motion pattern phonemes complete the inventory: circular, curved, straight, oscillating or trembling.

A minimal utterance consists of a hand shape phoneme. Writing conventions put the phonemes in a more or less arbitrary linear order. Hand shape is first, a direction phoneme may follow, referent is third, and movement fourth. Hand specifier dynamics precede the entire package they apply to, repetition follows. Tension, stress, and extent dynamics follow the phonemes they modify; rounding is written beneath. Other conventions which have specific functions have been discussed above.

1.5. Comparison of Stokoe's and West's Systems

Stokoe's system and West's system are quite comparable in terms of organization of minimal elements into classes. They abstract similar components out of the sign as basic elements, i.e., hand shape or dez, referents or tab, and motion or sig. The interpretation of these components or parameters is somewhat different. In West's system, a referent is not only the place where a sign is made or the point of origin of some movement as a tab is, it can also represent the end point of that motion.

1.5.1. Directions and Attitude

By placing directions (orientation) in a separate category, as West does, they can be combined with the other categories which are more discretely specified. In Stokoe's system, on the other hand, neither

orientations nor his equivalents to West's dynamics are placed in a category. They are simply treated as diacritics which combine with other units, such as hand shapes or movements, much as distinctive features do in spoken languages. (See discussion in Section 1.1.) West also differentiates phoneme units, e.g. direction, from feature-like elements, e.g. the dynamic rounding element which he terms an additive component. This element does not seem to be a phoneme when combined with a hand shape, since he separately lists rounded hand shapes as phonemes. With directions, however, it seems to be phonemic since combinations with directions are not listed separately, but derive from the combination of two phonemes much in the same way as suprasegmentals do with vowels.

This conflict between phonemic status and additive component status is not resolved. West's position is similar to the linguist who sets up five long vowels parallel to five short vowels as phonemes rather than five vowels and one suprasegmental phoneme of length. West's rounding component may best be treated as an element of phonemic status since its addition increases the inventory by one, whereas the addition of rounded hand shapes as individual phonemes increases the inventory by nine. Alternatively, it may be best to treat rounding as a phonemic sub-component since it is non-obligatory and must occur in combination with either a hand shape or a direction. However, if it is to be considered the same element in combination with both directions and hand shapes, it should be analyzed uniformly.

1.5.2. Motion

Motion in West's system is simply type of motion, whereas Stokoe combined direction and motion in some symbols and specifies direction

or orientation of others with subscripts. In addition, Stokoe uses the same symbols for "pure" orientation markers and directed motion markers and then includes sub/superscript conventions to differentiate them. This situation can be remedied as is suggested in Section 1.3. above.

Stokoe's treatment of motion is infelicitous in another regard. Certain signs which involve two points of articulation with a movement from one point to another must be written as two part signs with motion implicit between the parts. This views the sign primarily as two static bundles of simultaneous phonemes and leaves the sequential structure implicit. For example, the sign which can be translated as GOAL or OBJECTIVE consists of the extended finger touching the forehead and then moving to touch the tip of the extended finger of the other hand, in Stokoe's notation: 'G' finger (index finger extended) touching (x) at the forehead (☞); 'G' finger touching G finger of the other hand with the arm bent at the elbow (✓) (see Figure 9). A prose explanation as follows in West's system is the best means of comparison, since his system describes a completely different language: the extended index finger touches the forehead and moves in a straight line to touch the extended finger of the other hand. An attempt at the application of the notation to ASL yields: $t\acute{a}d^{\vee}nt\acute{a}d$. t = extended index, clench others, $\acute{a}$ = touch, $d^{\vee}$ = head top, n = straight movement, d = other index, (c.f. p. 42). $t\acute{a}d^{\vee}$ is the first half, $t\acute{a}d$ is the second and the relationship between them is expressed by n . From this concrete example, it can be seen how Stokoe and West deal with the simultaneous and sequential aspects of the sign. Stokoe tends to ignore the sequential aspects, while West integrates them into the description.

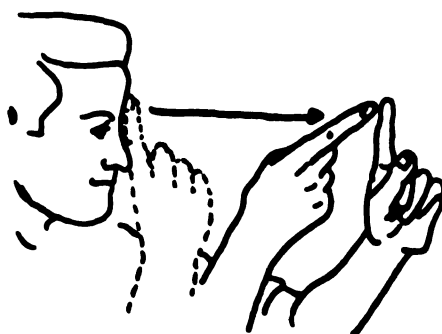


Figure 9. The Sign GOAL/OBJECTIVE

1.5.3. Phonemic Status

Both Stokoe's and West's systems are purportedly phonemic, that is, they ignore visual distinctions which apparently do not make a difference in meaning. Minimal pairs and contrastive evidence are the primary sources of support for both systems. Stokoe 1966 disputes the phonemicity of West's analysis.

West's description and analysis are very fine indeed, but I think his notation is too detailed, symbolizing both contrasts that are significant as phonemes and other differences that may be stylistic or metalinguistic. (p. 244)

Yet, Stokoe cites no examples nor any other evidence to support this statement. West, on the other hand, lists minimal and sub-minimal pairs from his data for as many phonemes as possible. He found 121 of the possible 153 minimal contrasts of hand shapes, 185 of the possible 780 possible contrasts between the referent, 28 minimal and 2 sub-minimal contrasts of the 56 possible direction contrasts, 14 minimal and 8 sub-minimal contrasts of the 42 possible dynamic phonemes, and 10 of the possible 20 minimal contrasts of the motion pattern phonemes.

In addition, West includes lists of possible "allo-kines" (allophones), non-distinctive alternates of phonemes whose occurrence is predictable by distributional information. In English, aspiration is predictable for voiceless stops /p/, /t/, /k/, on the basis of their position in a word, i.e. following /s/, unaspirated voiceless stops occur; initially, aspirated voiceless stops occur; and both sets occur word finally with no distinction in meaning. Thus, aspirated [t^h] and unaspirated [t] are allophones of the phoneme /t/ since they do not signal a difference in meaning.

In sign language, different variants of a phoneme are predictable on the basis of other phonemes occurring simultaneously with it. For example, k, the hand extended, but relaxed, ulnar edge active, when combined with the phonemes eo, pointing up and towards the signer, occurs as the allophone k with the little finger extended and active.

Thus, it is apparent that West has done the appropriate analysis to determine the phonemic status of his units. Stokoe has not examined the analysis carefully enough to provide evidence for or against his objection. Stokoe himself has done little work on the distribution of non-distinctive elements or even on determining what those elements are. Frishberg 1976 and Battison 1974 discuss some well-formedness constraints, but these define the limits of a sign in a general way (see Section 2.3. below). In addition, Stokoe does not make clear cut delineations of the end of one head or face tab and the beginning of another. Top of the head, side of the face, nose, lower face, neck, and entire head are not clearly separated. Specific details about which orientations of the hands are distinctive and which are redundant need to be stated. Perhaps utilizing a phonetic transcription system, such as the Eschkol-Wachmann dance notation system, modified for sign language by Cohen et al. 1977 and applying the technique of phonemic analysis to the results may lead to answer to some of these questions.

For this study an analysis of signs based on the four parameter schema introduced in Section 1. is used, but those aspects discussed in Sections 1.3. and 1.5.2. are included. Stokoe's notation so modified is used where possible to present data in order to avoid cumbersome prose descriptions and to provide for clearer comparisons.

2. Research on the Psychological Reality of the Parameters

Data from perception and production studies, historical analysis and child language acquisition, all indicate that this originally subjective analysis of signs into four convenient parameters actually has psychological reality for native signers of ASL.

2.1. Perception

In short term memory experiments similar to the immediate recall studies of Conrad 1959, 1964 with auditory short term memory for sounds, Bellugi, Klima and Siple 1975 demonstrated that native signers of ASL remember signs in terms of four parameters: movement, location, hand shape and orientation. On the other hand, meaning rather than form seems to be stored in long term memory as with spoken languages.

The experiments were conducted with eight deaf college students of deaf parents who learned ASL as a native language. Signs were presented on a video tape at a rate of one sign per second by a native signer in lists of from three to seven signs. Recall was immediate, ordered and written. This written response consisted of an English word. Thus an extra translation step was involved. The subjects were asked to name one by one the signs previously presented and these names were used to score the recall task. Bellugi and Fischer 1972 reports on research done comparing such recall in the form of signs versus English translation and finds no significant difference between the two tasks.

A parallel group of eight hearing college students with no experience in sign were presented the corresponding words on tape and asked for recall in the same manner.

Signs were chosen on the basis of three criteria:

- 1) occurrence in the vocabulary of young children (18 months to 5 years)
- 2) frequency as judged by native signers,
- 3) ease of translation into English.

Results showed many similarities with previous short term memory research. Average memory span for signs was 4.9 (compared to 5.9 for the hearing group for words). Recency and primacy effects were strong for both groups, that is, the first and last items in a list were remembered more accurately than the items in the middle.

An analysis of the errors was more revealing. Zero overlap between the errors made by deaf subjects and those by hearing subjects occurred. Hearing subjects tended to substitute a word which was highly similar phonologically. Deaf subjects substituted signs that were highly similar visually. The errors tended to preserve the hand arrangement: one handed signs or two handed signs were so remembered. "The majority of errors preserved all but one of the parameters of the original signs" (p. 113-114). Such errors occurred in three of the four parameters. No sign-error pairs differed only in place of articulation. The investigators assumed that in a larger sample such errors would be likely to occur. Movement and hand shape errors seem to be more predominant than orientation errors, but no ranking was made by the investigators as to which parameter was more susceptible to errors.

2.2. Production

The findings of Bellugi, Klima and Siple study are in consonance with the findings of preliminary research with slips of the hand. Bellugi and Klima 1975 report on the characteristics of this type of

error: "sometimes entire signs are switched. Sometimes a prime of one sign is erroneously realized in another sign: hand configurations may be switched, a movement may persevere, or a location may be anticipated" (p. 194). Some of the resulting signs are actual signs of ASL. Others are not actual, but rather are possible signs, i.e., a lexical gap in ASL. Similarly, Fromkin 1971 and 1973 has shown that slips of the tongue usually result in actual or possible sequences of sounds in a spoken language, that is, they do not violate rules governing the ways sound segments may be combined. For example, crib and clip are both actual words in English. Clib is not, but it is a possible word, whereas cvib and dlib would not be.

2.3. Constraints

Certain general constraints have been discovered which govern the well-formedness of signs. Battison 1974 examines two of these, both of which concern two handed signs. The symmetry condition states that in two handed signs where both hands are active, both the hand shape and movement must be identical. Movements may be alternating rather than parallel, but they must be the same type of movement. This constraint reduces the complexity of signs and introduces redundancy by eliminating a large number of possible combinations of hand shapes. The dominance condition states that if the hand shapes differ, only one hand (usually the dominant hand) may be active. Only six hand shapes can serve as the base made by the other non-moving hand. These are the most unmarked maximally distinct handshapes: 1) A, the closed fist, 2) B, the flat palm, 3) 5, palm with fingers spread, 4) G, the fist with index finger extended, 5) C, the hands form a semi-circle, and 6) O, the fingertips meet the thumb, forming a circle (see Figure 10).

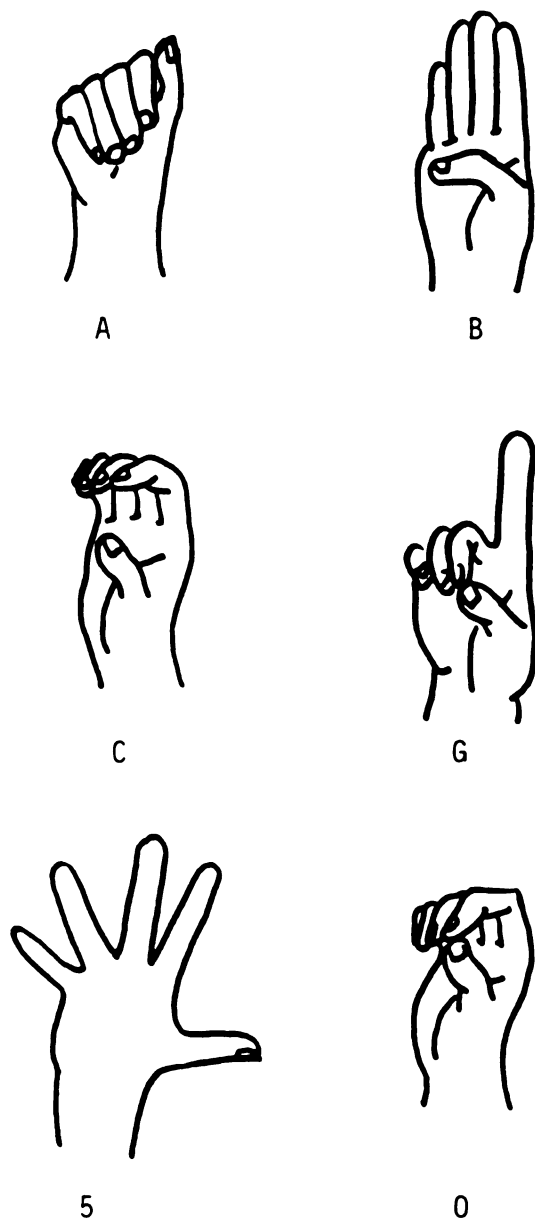
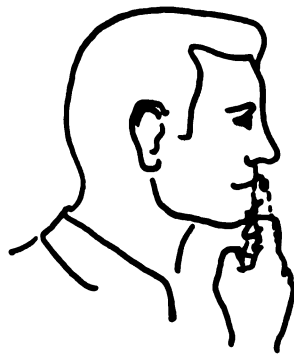


Figure 10: The Hand Shapes A, B, C, G, 5 and 0

Evidence for this assignment of markedness comes from a number of sources. In child language acquisition, these hand shapes are the first to be acquired (Boyes-Braem 1973 and McIntire 1977). These hand shapes occur in all sign languages that have been studied, i.e. Chinese, Russian, French, Iranian, Japanese, and Brazilian (Frishberg 1976).

Frishberg 1976 discusses a third constraint on the permissible sequences of points of articulation in signs with two points. Dividing the signing area into four major areas (head, trunk, arm, hand), only eight of the 16 possible combinations are allowed: Two touches in the same area, a touch in any of the other three areas following a touch on the head, and a touch on the head following a touch on the hand.

Siple 1978 discusses constraints imposed by the visual modality on sign formation. Visual acuity is higher around the point of fixation and decreases toward the periphery. Since signers focus on the eyes during discourse, the area of maximal acuity is centered on the eyes and face. Greater distinctions can and are made in this area. The head and face are divided into six distinct points of articulation. In contrast, the trunk is considered as one point of articulation; that is, no distinctive contrasts are made between different parts of the trunk. Fine distinctions in hand shapes are perceived more readily on the face (e.g., one finger extended touching the lips: RED, two fingers extended touching the lips: SWEET; see Figure 11). Siple expects that only gross distinctions in hand shape and also movement are made in the areas of low acuity. One-handed signs should tend to become two-handed symmetrical signs in these areas, whereas two-handed signs made at the face should tend to become one-handed. Frishberg 1975 gives two examples of the former occurring in the historical development of ASL (ANGRY and



RED



SWEET

Figure 11: The Signs RED and SWEET

TRAVEL, p. 701). CHINESE, on the other hand, a sign originally made with both extended index fingers touching close to the side of the eye and twisting, is now more commonly made with one hand only. Frishberg's work in the field of historical change in ASL provides evidence for these general constraints which indicates a change from more iconic and transparent representations of some objects to a more arbitrary and opaque one.

2.4. Child Language Acquisition

Research on child language acquisition provides further confirmation of the parameter schema. Wilbur and Jones 1974 studied the spontaneous production of three hearing children of deaf parents. They list the following stages of development as further confirmation of the schema (p. 744):

- 1) roughly in the right place, wrong hand configuration, no motion,
- 2) roughly in the right place, wrong hand configuration, wrong motion,
- 3) right place, wrong hand configuration, right motion,
- 4) correct sign.

Point of articulation appears to be the first parameter acquired. Wilbur and Jones point out that since point of articulation requires only the grossest motor control, it is reasonable that it should be first acquired in terms of motor development. This correlates with the Bellugi, Klima and Siple 1975 experiment, where no intrusion errors occurred along the point of articulation parameter. From the Wilbur and Jones data, motion would be acquired before hand configuration.

From Bellugi et al.'s results, no distinction between the two can be made at this point. Orientation is not mentioned in the study, but since it serves to distinguish few signs it is reasonable to conclude that it is most marked and therefore last to be acquired as a formal feature. Bellugi et al.'s work tends to support this conclusion, since few errors were made along this parameter. If there are few minimal pairs where orientation is the distinguishing feature, there would not be as many opportunities for confusion.

3. ASL Syntax

In the preceding sections, discussion centers on the description of the form of individual signs. It is appropriate at this point to say a few words about the way signs can be put together in ASL. Before doing so, it is essential to distinguish ASL from those systems designed to mirror English syntax (Signed Exact English, Seeing Essential English, Manual English) which were primarily devised to teach deaf children English syntax for reading and writing. These systems vary in the ways in which they represent grammatical morphemes. Some use finger spelling. Others invent new holistic signs. ASL, on the other hand, has a syntax all its own, independent from English syntax. Word order is relatively more free in ASL than in English. A fixed subject-verb-object word order occurs only when there may be some ambiguity as to the interpretation of the relationship between actor and recipient. Thus, GIRL EAT CANDY, CANDY EAT GIRL, GIRL CANDY EAT are all acceptable and synonymous, whereas DOG CHASE CAT and CAT CHASE DOG are two different sentences. Word order is not completely free as the first three sentences differ according to which element is the topic and which is the

comment. This situation is parallel to most pairs of active-passive sentences in English. These pairs are synonymous in that they describe the same events but differ with regard to which element is the topic of the sentence.

Signing a sentence in ASL is not simply stringing some signs in some order; rather, ASL utilizes syntactic devices restricted to the visual modality but with some parallels in spoken languages. Incorporation is the collapsing of separate concepts into one sign whose point of articulation is neutral signing space. For example, SHOW is made by pointing with the index finger to the flat palm of the other hand. I SHOW YOU is signed by moving this sign from signer to receiver. YOU SHOW ME involves movement in the opposite direction.

Pronouns are generally indexed, that is, I is pointing toward the signer, YOU is pointing toward the addressee, and third person is pointing off to the left or right (Friedman 1975).

Number can be indicated with the number of fingers extended on the hand. ONE PERSON MEETS ANOTHER: the index finger of both hands approach each other. TWO PEOPLE MEET TWO PEOPLE, the two fingers approach; THREE PEOPLE, three fingers. Four and five fingers represent many people (see Figure 12). Size can be incorporated by changing the extent of the movement. Facial expressions generally accompany this. Person and size may be incorporated together. In I SHOW A SMALL CHILD, the hand moves to the right and down.

Negation may be incorporated by turning the sign away from the signer. In GOOD, the flat hand, palm toward the signer, touches the lips and moves away. In BAD, the wrist rotates so the palm also faces away from the signer. This device can also be incorporated into various

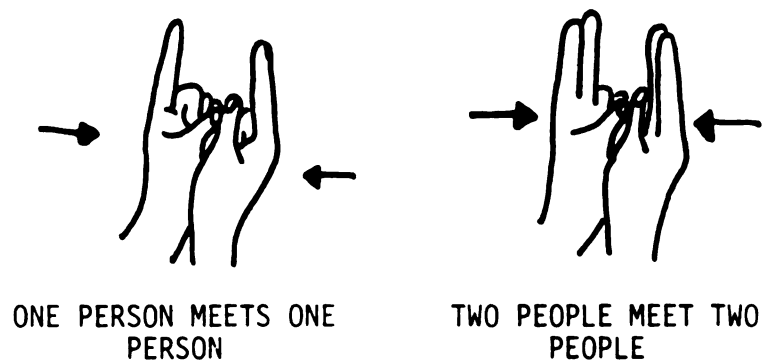
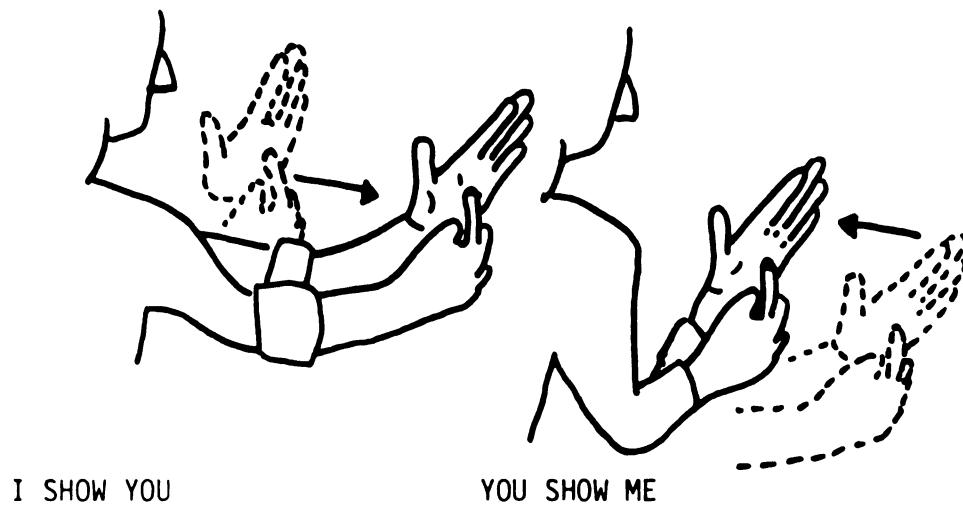


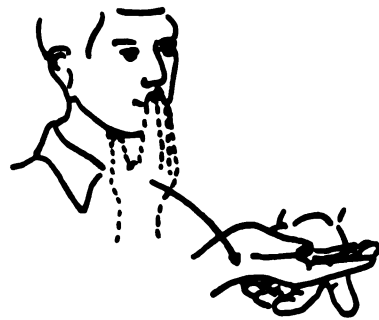
Figure 12: The Signs SHOW and MEET

verbs. LIKE is made by grasping the chest with the thumb and second finger then moving away from the signer with thumb and finger forming a circle, other fingers spread. I-DON'T-LIKE is made by twisting the wrist outwards and releasing the finger sharply (see Figure 13). The negative morpheme NOT may also be used to form this sentence by making a two sign sequence, NOT LIKE. Location and manner may also be incorporated in signs as person and size are (see Fischer and Gough 1978).

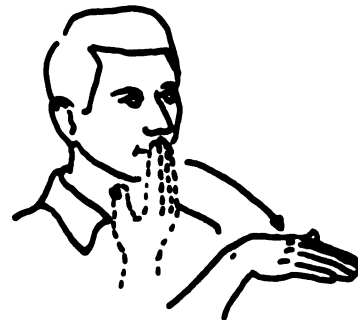
Children have been seen to overgeneralize these devices. For example, a child signed YOU LIKE ME by reversing the movement for I LIKE YOU by bringing the hand from space to touch the chest. This, however, is not an acceptable sign in adult ASL.

Reduplication, a device common in spoken languages, is also used extensively in ASL. Besides functioning morphologically to alter the meaning of lexical items, AGAIN → OFTEN, TREE → FOREST (see Figure 14), reduplication of a sign may signal aspect in a verb and with nouns it can signal plurality. There is a further distinction in ASL between slow and fast reduplication. Slow reduplication of a verb indicates duration; fast reduplication means repetition of the action or habitual action. Slow reduplication combined with a rocking motion indicates excessiveness; fast reduplication combined with horizontal movement indicates many people, things or places (see Fischer 1973).

From this discussion it is clear that ASL syntax is not based on English, but rather is a distinct and complex phenomenon. Since the children in this study have not reached a level of linguistic ability above a one word and occasionally two word level, or more needs to be said concerning ASL syntax. The importance of this section is to distinguish ASL syntax from English syntax.



GOOD



BAD



LIKE



DON'T LIKE

Figure 13: The Signs GOOD, BAD, and LIKE

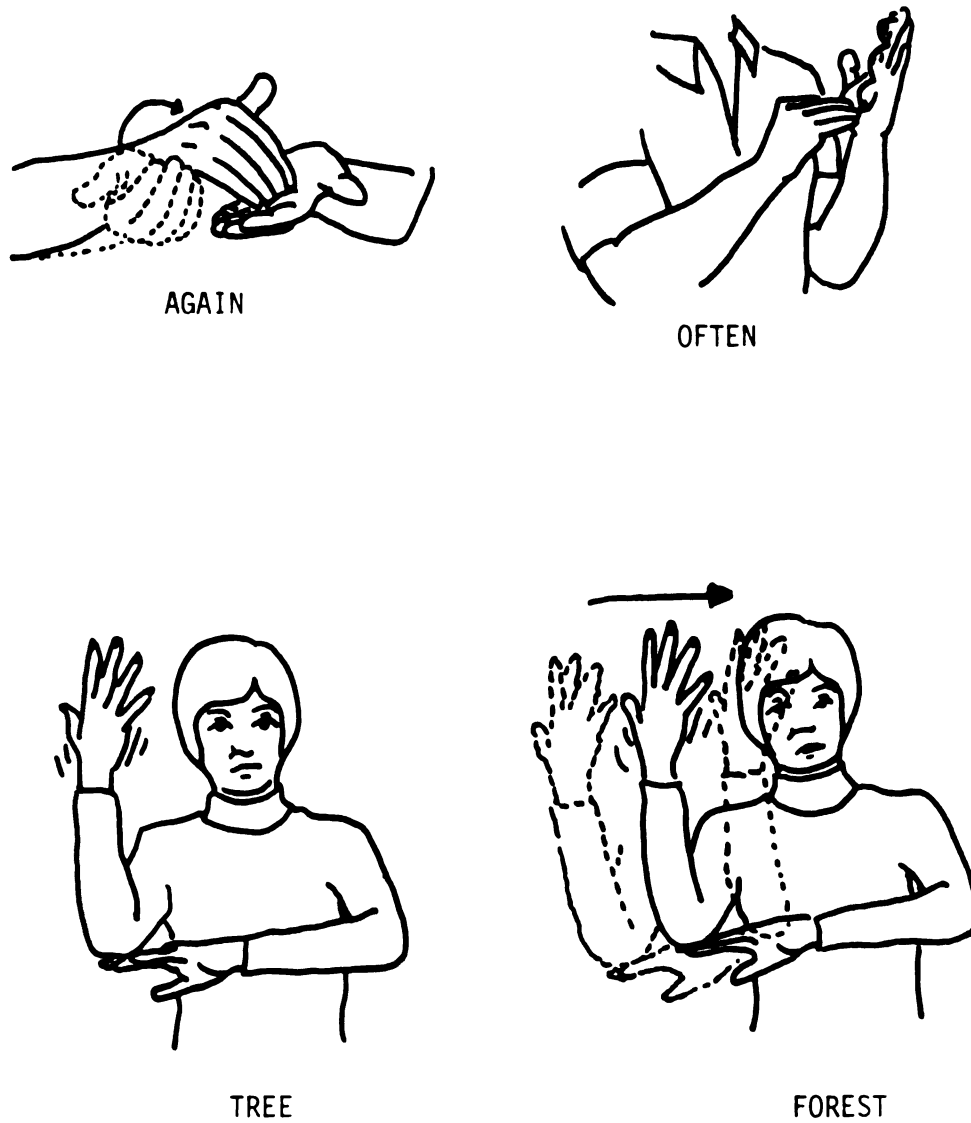


Figure 14. The Signs AGAIN, OFTEN, TREE, and FOREST

4. Conclusion

Sign language shows important structural differences from spoken languages. Besides the obvious fact that signs are produced by the hands and perceived through the eyes rather than by the vocal apparatus and through the ears, they differ from words in another way. Signs consist of simultaneous bundles of phonemic contrasts, which may also be combined into sequences. Words consist of a sequence of phonemic contrasts which are in turn bundles of distinctive and non-distinctive features. It is the purpose of this study to investigate how bundles of phonemic contrasts of signs are learned by autistic children.

CHAPTER V

ERROR ANALYSIS PROJECT

In this study, five non-verbal autistic children were observed during sign language instruction sessions at a daycare school; their errors were recorded and analyzed.

1. The Children

The five children in the project included in this study have been examined by a child psychiatrist and diagnosed autistic. They are all non-verbal. Their psycho-educational profile (PEP) scores for cognitive-verbal skills range from 18 months (untestable) to 30 months. All of the children are male and their ages range from six to 12 years.

1.1. Chris

Chris, age 11, has been in the program for nine months. Chris is the lowest functioning of the children. His PEP motor score is 36 months and his cognitive-performance score is 20 months. Chris rocks frequently, toe-walks, giggles and flaps his hands. When frustrated, Chris bites his wrist often thrusting this in a near-by adult's face. He often waves his arms in other children's and adults' faces.

Chris has a repertoire of six signs, two of which he performs accurately most of the time. The other signs must be molded or modeled by the instructor.

1.2. Jimmy

Jimmy, age nine, has been in the program for three years. He is one of the lower functioning children with a PEP score for motor

control at 54 to 62 months and for cognitive-performance at 20 to 42 months. Jimmy flaps his hands, bounces, and rocks. He constantly uses toys, twigs and sticks in a self-stimulating way by flicking them against his hand. Because of these behaviors, Jimmy appears to be in constant motion. As accompaniments to these behaviors, Jimmy giggles and shrieks.

Jimmy can produce at least 24 signs. Most of these are food and clothing signs. However, when placed in a discrimination task where he must respond to a sign by choosing the appropriate picture, Jimmy reveals a lack of comprehension of the signs he can produce. In addition, Jimmy's signing tends to be performed somewhat carelessly.

1.3. Eric

Eric, age six, has been in the program for 15 months. Eric is one of the higher functioning children with a motor score of 38 to 42 months and a cognitive-performance score of 24 to 34 months.

Eric runs in circles and plays ritualistically and inflexibly. He plays obsessively with circular and cylindrical toys and objects. He constructs towers and scrutinizes them, making minute changes until the structure is perfect. When frustrated, Eric bangs his head against the nearest solid object.

Eric has a repertoire of over 50 signs, which has grown from nothing over a period of 10 months and which is constantly growing. Eric makes two and three word combinations such as WANT COOKIE PLEASE. He signs spontaneously and responds readily to questions posed in signed speech by signing the answer both within and outside the language session environment. Eric also frequently imitates signs made in his environment.

1.4. Herbie

Herbie, age 11, has been in the program for two years and is one of the higher functioning children. Herbie is semi-verbal, that is, he generally articulates an approximation of the first syllable of a word when he signs, e.g. [ga] [gɔ] for coat, [bri] for bread, [kiki] for cookie, [baba] for toilet, [ʃi] [dɛ] [dʒ] for juice, and [tɛ] [dɛ] for chair. Two syllable words generally show reduplication as in [kiki] for cookie. Variation in voicing occurs for the consonants, and simplification of affricates to the corresponding stop was common. There is also variation in Herbie's vowels. However, such variation occurs only along the vertical direction, never from front to back. For example, [dɛ, di, dʒ] may all occur in a sequence as an approximation of juice, but not [di, da]. Of the back vowels, only [a] occurs frequently.

Herbie is the most articulate signer. His PEP scores for motor coordination is at the 60 month level and his cognitive performance score is at the 40 to 49 month level. Herbie's signs are generally very clearly and accurately performed. He has a repertoire of over 80 signs which he can use to name pictures of various objects. When faced with a matching task using written English words and pictures, Herbie signs first and waits for approval before matching the word and picture. He frequently uses signs spontaneously to make requests. These are generally two-sign utterances, e.g. PLEASE PUSH, PLEASE CHIP, TICKLE PLEASE. The order of the elements of such phrases is often reversed. In language session tasks in which he is required to respond to questions with complete sentences, Herbie responds most frequently with two sign utterances. For example, Herbie signs SLEEP BED in response to WHERE DO YOU SLEEP?

Herbie is a generally good natured and co-operative child. He constantly walks on his toes and occasionally flaps his hands. He enjoys bouncing and giggles frequently.

1.5. David

David, age 12, has been in the program for three years. He is one of the higher functioning children. His PEP score for motor control is at 72 months (top of the scale) and for cognitive performance at 42 months. David vocalizes, but not recognizably. His high-pitched giggling seems to be an accompaniment of an internal state rather than a communicative utterance. David frequently rocks and enjoys swinging more than other outside activities. He occasionally flaps his hands. One of David's biggest behavioral problems is his inattentiveness during work activities. His avoidance of tasks is termed gaming by the instructors because of its play-like nature. David often retraces his actions, repeating or re-doing his movements several times before coming to a halt. For example, he has been observed to enter and leave a car several times before finally seating himself.

David's signing is executed less carefully than Herbie's, but his repertoire is as large as Herbie's and he tends to remember less frequently practiced signs over a long period of time. David infrequently signs spontaneously.

2. Instructional Setting

The five children are enrolled in a day school for autistic children which is part of a training center for handicapped individuals. Three other autistic children are also enrolled in the project, but are not included in this study since they do not participate in the sign training program.

The school day is divided into structured activities including language sessions and unstructured play time. Structured activities are designed to improve the children's cognitive skills and are tailored to each individual's abilities, interests and needs. These activities include matching and categorization tasks ranging from simply matching shapes, letters and numbers with the same figure on a separate card, to choosing which objects are the same as a given object regardless of size or angle of presentation. Puzzle construction and tracing pictures with yarn are other activities that the children enjoy and perform well.

Free play is supervised but not organized and varies from outdoor activities on swings to play room activities. Other physical activities include swimming and roller skating. The children also attend films and parties and participate in organized play activities with other children in the training center, although they rarely interact with these children actively.

2.1. Language Sessions

Language sessions are conducted with each child for 10 to 20 minutes a day depending on the child's attention span. Two of the more advanced children, Herbie and David, work together with one instructor. The instructors use signed speech, but only require the children to learn the signs. ASL signs are generally used. If the instructors do not know the ASL sign, a signed English sign is used. A few signs have been invented by the instructors. The manuals Talk With Me (Huffman et al. 1975) and Signing Exact English (Gustason et al. 1972) are used as references.

One instructor's knowledge of signs was acquired from a university course in manual English taught by a signer of ASL. This instructor

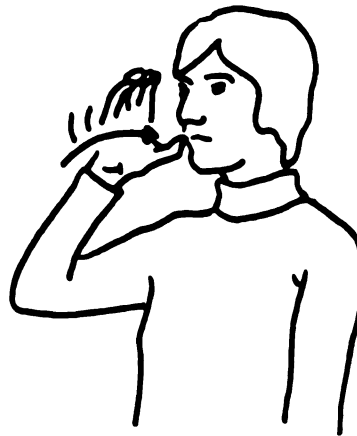
trained the new instructor and aides in basic signs and correspondence to English syntax. The instructors use signed English both with the children and themselves. The aides use signed English only with the children.

Reinforcement techniques are used in the language sessions, but do not constitute the core of the program. Food reinforcements are used when a child is being introduced to language training, but in a very different way from the system used in operant speech training. The first signs a child is taught are generally signs for food, since these are very useful to the child and his caretakers and since food may be more motivating than other objects. In his first language sessions the child is shown a food item, for example, a cookie, and the sign for that item is demonstrated. If, as is usually the case, the child does not imitate the instructor, the instructor molds the child's hands into the sign. The child is then given a piece of cookie and verbal praise, i.e., saying and signing GOOD. This process is repeated until the child is able to perform the sign himself without needing to imitate the instructor's model. When this is accomplished, a new sign is introduced. Often this is the sign for DRINK (see Figure 15). Other food signs are introduced in the same manner.

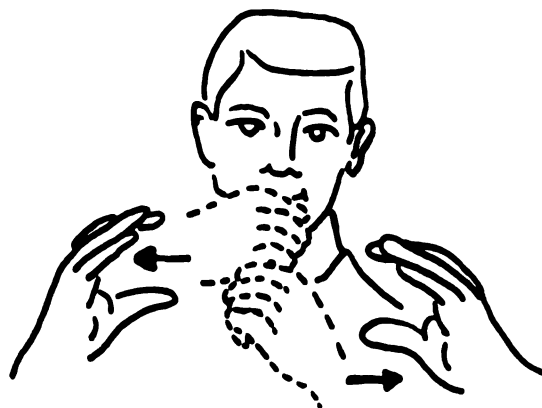
The next step is to introduce names for other objects such as pieces of clothing or toys which are readily available. Reward for correct signing is either being given the object to play with or praise. The order of introduction of signs is based both on needs and on interests of the individual child. For example, Eric, who is fascinated by round objects, was introduced to language sessions with the sign for BALLOON (see Figure 15). Reward for signing consisted of blowing up



COOKIE



DRINK



BALLOON

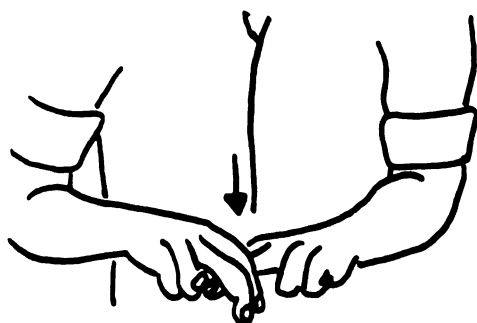
Figure 15. The Signs COOKIE, DRINK, and BALLOON

the balloon and giving it to the child to play with. In this way the child's interests were used to promote enjoyment of and hence attention to the language sessions. In no instance is a sign presented without contextual information, so that from the beginning the child is given a chance to understand one of the functions of signing.

Nouns are the first signs to be trained. Then, useful verbs such as SIT, STAND, and WANT are taught (see Figures 16 and 17). Others, which are of use or interest to the child, such as THROW and SLEEP, are introduced early (see Figure 17). After the child has been taught to sign WANT, rewards become dependent on signing WANT followed by the sign for the desired reward. Such rewards include toys and tickling as well as food.

At some point after the child begins to build a repertoire of signs, the stimulus is shifted from the object itself to a picture of the object. This shift occurs at different times for different children and for different objects, based on the child's ability. Reward at this stage consists of verbal praise. Occasionally it becomes necessary to give food rewards to hold the child's attention, although he must work for them by asking for them. Once the child has grasped the idea behind picture-sign associations with signs he already knows, many new signs may be introduced using pictures. One instructor began teaching the recognition of the sign GONE (i.e., GO + PAST) by presenting the child with four pictures, hiding one while the child shuts his eyes, and requiring the child to make the sign for the missing picture (see Figure 17).

Three of the children are being taught to sign simple sentences, e.g. I WANT _____, I SLEEP IN BED in response of questions as WHAT DO



SIT



STAND

Figure 16: The Signs SIT and STAND



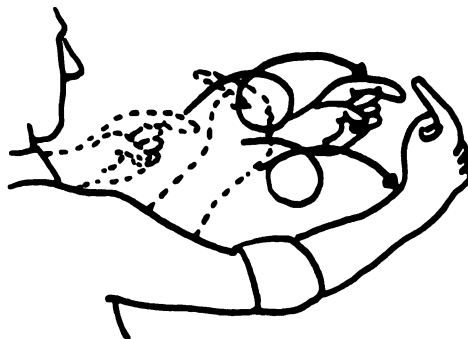
THROW



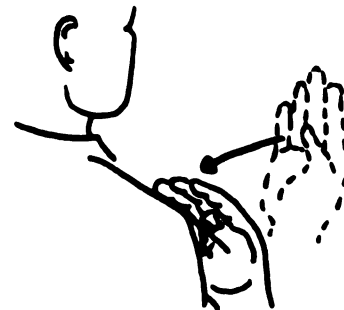
SLEEP



WANT



GO



PAST

Figure 17: The Signs THROW, SLEEP, WANT, GO and PAST

YOU WANT, and WHERE DO YOU SLEEP. Signed English syntax is being used. Such tasks appear difficult for the children and they tend to leave out grammatical morphemes such as I and IN if not forced to use them.

3. Data Collection

Preliminary observation of these language sessions suggested that the children were employing strategies common to normal children acquiring language. For example, several children overgeneralized the use of such words as car or bus to include any vehicle, such as a bike, truck or wagon. Other errors, which could not be explained as overgeneralizations of this type, suggested a structural analysis in terms of the parameters discussed in Chapter IV above.

Thus, a scoring sheet was devised to record errors made along the four parameters. If an error was not classifiable according to that schema, a letter code was used and marked in a column titled unclassifiable (see appendices A and B). M stood for meaningful relationship of the performed sign to the intended sign, P for repetition of the preceding item, X for a gesture unlike signs, such as wild gestures attributable to motor disturbances, and for refusal to perform, and C for correct performance. For one child a new category, M/P, had to be devised at the data classification point, since his language sessions consisted of a sequence of food signs, so that a repetition of a preceding sign was also the substitution of a meaningfully related sign. Nine categories in all were used.

Data were collected by the two regular language instructors over a period of 14 weeks. Multiple observations were made to insure that differences within the subjects did not affect the outcome of the data.

This was especially important with this population, since it is characteristic of autistic children that they vary greatly in attentiveness from day to day. Even from morning to afternoon, their ability to attend to the instructor can diminish or increase drastically. By indicating on the data collection sheets when a sign was introduced for the first time, it was also possible to avoid mixing data on new signs with data on well-practiced signs already in the child's lexicon.

The instructors collected the data in order to control for the effect of experimenter expectations on the design. Data collection could have been biased by prior knowledge of the hypotheses that were being tested. Therefore, data collection procedures were explained to the instructors but the hypotheses were not discussed. Instruction sheets were given to both instructors for referral and the experimenter observed the language sessions weekly to compare her ratings to those of the instructors. Agreement between the experimenter's rating and those of instructor A was 98 percent and of instructor B 90 percent for these sessions.

At these sessions, problems of data collection were discussed and clarified. One problem was the relative imprecision of articulation of the children. Thus, it was sometimes difficult to distinguish between carelessness and error. Other problems occurred with interpreting the categories. For example, the distinction between orientation and point of articulation required clarification. SHOES, made with two closed fists palms downward touching on the index finger edge of the hand ($\emptyset AA^X$), was made in one case by bringing the knuckles of the hands together (see Figure 18). To the instructor, this appeared to constitute a point of articulation error since the point where the hands



Figure 18. The Sign SH0ES

touched was incorrect. For this sign, however, the point of articulation is neutral signing space in front of the signer ($\emptyset$). Therefore, in this case it was the orientation of the palms that was incorrect. To allow the instructors time to familiarize themselves with the collection procedures, only the last 10 weeks of data were subjected to analysis.

Another variable to be controlled is sample size. Since the sample in this study was unavoidably small, it is important to make clear from the outset that this study is of necessity a pilot study. If it were possible to collect data on a large number of non-verbal autistic children, who constitute a very small percentage of the total population of children, the results would be more conclusive and generalizable to the non-verbal autistic population as a whole. It was assumed for this study that the group of children in the project were representative of the target population.

4. Data Analysis

The errors for each child for each sign were counted. If errors were made along more than one parameter on a particular trial, they were counted initially as one error in a multiple-parameter category. After all the data had been so analyzed, multiple-parameter category errors were added into their respective categories to give an overall total for the four parameters. The errors in the other four categories, meaningful relationship, repetition of preceding sign, meaning/preceding, and non-sign/no response, were totaled, as were correct responses.

4.1. Usefulness of Error Analysis

Error analysis is a common, though relatively new, tool in foreign language teaching and is used extensively in studying the competence of and strategies used by children acquiring their native languages and adults learning a second language. Systematic errors, not chance performance mistakes, are considered the best evidence that a child possesses generative rules since correct utterances could be repetitions of utterances from the environment (Brown and Frazer 1964). Corder 1974:25, in applying this principle to second language learning, lists three ways in which errors can be significant:

1. For the teacher, a systematic analysis of learner's errors provides the teacher with a type of internal syllabus for a student, i.e., the errors tell the teacher the weaknesses and strengths of the student and indicate direction for instruction.
2. For the researcher, such an analysis provides evidence for the strategies that the learners employ in their study for the language system underlying the learner's performance.
3. Students themselves can use such an analysis as a learning device.

With regard to language disabled children, error analysis can also be a tool for both teacher and researcher in examining the abilities, strategies and underlying competence of the children.

4.2. Hypotheses

Various hypotheses concerning the strategies that these five autistic children use to produce signs and concerning the structural analysis

of the signs were tested by examining the pattern of errors made by the children when asked to produce signs in the language sessions.

4.2.1. Parameter Hypotheses

On the basis of evidence from child language acquisition, perception and production research as discussed in Chapter IV, Sections 2.1., 2.2., and 2.4. above, it was hypothesized that signs are perceived and produced in terms of four formal parameters and that there is the following hierarchy among them:

1. point of articulation, most primary,
2. movement
3. hand shape
4. orientation, least primary.

The relative ranking of movement and hand shape is somewhat arbitrary in terms of perception research, but is supported by child language acquisition research. Thus it was hypothesized that the difference between the two is not significant. In this study evidence for these hypotheses consisted of the percentage of errors made along each parameter. If autistic children process signs in terms of formal parameters, most of their errors should be accounted for by the four parameters and a small percentage of errors should be made in the categories M, P and X. If the hierarchy is appropriate, a small percentage of errors should be made along the parameter, point of articulation, and a greater percentage along movement and hand shape. Since orientation was considered least primary, the largest number of errors should have been made along this parameter. However, since orientation is contrastive in fewer cases than the other parameters, there are fewer occasions for errors

to occur along orientation that along the other three parameters. Thus, if the hierarchy is correct, there should be more errors per occasion for orientation than for the other three parameters. However, as discussed in Chapter IV, a detailed enough phonemic analysis of ASL is not available and it is beyond the scope of this project to provide such an analysis. Therefore, it is expected that there will be a smaller percentage of errors across signs for the parameter of orientation.

4.2.2. Orientation/Hand Shape Hypothesis

A third hypothesis, that orientation is merely an aspect of hand shapes (Stokoe 1978), was tested. A large percentage of multiple-parameter category errors occurring along hand shape-orientation or a positive correlation between the two categories was considered to be evidence in support of this hypothesis.

4.2.3. Unmarked Versus Marked Hand Shape Hypothesis

In addition, the hypothesis that the hand shapes A, B, C, G, O, and 5 are unmarked while the other hand shapes are marked was examined. Evidence for this distinction comes from various sources. Unmarked hand shapes are first acquired by children, substituted for marked hand shapes by children, are present in all sign languages that have been studied, and are perceptually maximally distinct (Frishberg 1976).

This hypothesis was tested by comparing the error pattern of signs with unmarked hand shapes to that of signs with marked hand shapes. A smaller proportion of hand shape errors for unmarked hand shapes than for marked hand shapes was considered to be evidence in favor of the hypothesis.

4.2.4. Iconicity Hypothesis

Finally, the hypothesis proposed by Konstantareas et al. 1978 that iconic signs are easier for autistic children to learn was tested by comparing the proportion of errors made in producing iconic signs to that made in producing non-iconic signs. Iconicity ratings of 46 of the children's signs chosen at random were formulated following the procedure suggested by Hoemann 1975. Only a subset of the signs were tested due to time limitations. A significantly greater proportion of errors made in non-iconic signs than in iconic signs was considered to be evidence in favor of the hypothesis.

4.2.4.1. Iconicity Ratings

Sixteen students in an introductory linguistics class who had no previous knowledge of ASL or any other manual system were shown the signs and asked to first write the name of the object the sign resembled (i.e., its base) and secondly to write what they thought the meaning of the sign was. The first question was asked to estimate how closely the sign resembled its referent (iconicity). The second was designed to determine the guessability of the meaning (transparency). If 25 percent of the students guessed correctly, the sign was considered iconic and similarly for a transparent rating. These procedures were based on those of Hoemann 1975 (see Chapter III Section 2.1.1. above).

Six examples, TREE, BUTTERFLY, BOY, BLACK, DOG, and CAT (see Figures 1 and 19), were demonstrated before the task was begun. Trial signs were repeated as necessary and subjects were encouraged to write their first impressions and to guess even if they felt they were wrong.

Correct guesses of the meanings were tabulated and nine signs were



Figure 19: The Sign BUTTERFLY

found to be transparent at the 25 percent level. Correct guesses of the base were tabulated and 22 signs were found to be iconic at the 25 percent level. Eight of the nine signs which were transparent were also iconic (see Tables 1 and 2).

An analysis of the errors showed 24 signs to be misleading following Hoemann's method of calculation, i.e., at least 25 percent of the students guessed the same incorrect meaning for the sign. Seven signs were found to be both misleading and iconic. This finding supports the first hypothesis Hoemann proposed to explain the difficulties his subjects had in guessing the meanings of signs (see above Chapter III Section 2.1.1.). His first hypothesis suggests that an understanding of the relationship of the base of a sign to the referent may not be enough information for an individual to understand the sign's meaning as well. Thus the students could guess the sign's base, but could not guess the relationship between the base and the meaning of the sign.

Hoemann's fifth hypothesis, also discussed in Chapter III Section 2.1.1. above, suggests that many signs resemble other referents which do not correspond to the meaning of the sign. The fact that nine of the misleading signs had two different errors guessed by over 25 percent of the students supports this hypothesis. Another result adds further support: four of the transparent signs were also misleading at the 25 percent level. Although this is an interesting result in support of Hoemann's hypothesis, it makes determination of the signs' transparency difficult. Hoemann's procedure has led in this study to a contradictory classification of four signs which suggests that the technique needs some reconsideration. One suggestion for revising the procedure is to raise the criterion level for transparency to 51 or 75 percent to

Table 1: Transparent Signs

Name	% of Correct Guesses	Name	% of Correct Guesses
CUP	27	BANANA	100
BIKE	47	COMB	63
HAT	25	THROW	63
BALLOON	25	MILK	33
DRINK	94		

Table 2: Iconic Signs

Iconic Signs		
Name	Base	% of Correct Guesses
CUP	setting cup on saucer	33
BUS	driving (a bus)	27
BIKE	peddling (a bike)	34
KITE	(a kite) flying	67
BALLOON	blowing up (a balloon)	38
CHEESE	squeezing (curds)	31
CEREAL	eating (cereal)	94
DRINK	drinking = referent	100
SODA	opening (a bottle)	75
BANANA	peeling (a banana)	88
CAR	driving (a car)	38
BALL	shape of a ball	44
COMB	fixing hair (with a comb)	69
STOVE	turning dials	69
HORSE	ears	56
BED	laying head on billow	31
SOUP	eating (soup)	44
SHIRT	place where worn	25
PANTS	place where worn	38
THROW	throwing = referent	94
MILK	milking a cow	60
WANT	pulling something towards the signer	81

eliminate the possibility that any error could also reach criterion. Four signs were transparent at a 51 percent level and two at a 75 percent level. Since it is an arbitrary decision which percent is chosen, Hoemann's decision was followed for this study and the four overlapping signs were coded into both categories (see Table 3).

Seventeen signs were found to be opaque, that is no single meaning, correct or incorrect, was guessed by 25 percent of the students (see Table 4). Non-iconic signs, then, consisted of the two subsets, misleading and opaque signs. The subsets of iconic and transparent signs were each compared with non-iconic signs to determine which rating is a better predictor of the children's success.

4.3. Statistical Analysis

Two-tailed t-tests were used to determine the statistical significance of the evidence for these hypotheses. The t-test is designed to determine whether two means are significantly different or if they are so similar that there is a reasonable probability that the means do not differ in the larger population. A two-tailed t-test simply tests the differences in both directions to determine if a particular mean is significantly greater than or less than another mean.

The t-test was chosen because of the small sample size. A probability level of p less than or equal to .01 was chosen for significance in order to avoid accepting an unfounded hypothesis due to an abnormal sampling distribution. This probability level is not proof of a hypothesis; it merely signifies that the particular difference could have occurred by chance in only one case in a hundred.

Table 3: Misleading Signs

Name	Incorrect Guess A	%	Incorrect Guess B	%
APPLE	twist, turn	26		
ORANGE	call someone	40	drink	26
NUT	teeth	33	denistry	53
COAT	farmer	31		
CHIP	pick something up	25		
KEY	turn	25	screw	25
CHAIR	hang	63		
RECORD PLAYER	circle	44		
TOWEL	wash	50	wash face	31
BUBBLES	talk	25	insects	43
RAISIN	hop, jump	38		
WATER	quiet	38		
BOOTS	doors closing	44		

Misleading and Iconic

KITE	insect	40	bird	26
CEREAL	eat	75		
CAR	drive	31		
HORSE	hear	25		
BALL	cage	25	world	31
BED	sleep	94		
WANT	come	25		

Misleading and Transparent

BIKE	climb	26		
BALLOON	blowing horn	25	music	25
THROW	ball	31		
MILK	cow	26	climb	26

Table 4: Opaque Signs

Name of Sign

BUS	CHEESE	STOVE
ROLLER SKATE	CRACKER	SOUP
CAKE	SODA	MORE
CANDY	SHOES	SHIRT
COOKIE	REFRIGERATOR	PANTS
BATHTUB	SINK	

5. Results

The data for all children for all signs were counted and percentages of the total number of errors for each category were calculated (see Table 5).

5.1. Parameter Hypothesis

The parameter schema accounted for 89.6 percent of the errors that were recorded; 8.7 percent were not accounted for by the parameter schema (two tailed t-test $p < .001$). This supports the hypothesis that signs are describable in terms of this framework. The results also suggest that the children perceived and produce the signs along the formational parameters.

The hierarchy schema is supported by the data. As predicted, hand shape had the largest number of errors. Movement was next, point of articulation, third, and orientation, fourth. There was also a large difference between the number of movement or hand shape errors and point of articulation or orientation errors (movement with orientation and point of articulation: $p = .002$; hand shape with orientation: $p = .001$ and with point of articulation: $p = .002$), but no great difference within those two groups was found (movement with hand shape : $p = .926$, with point of articulation: $p = .487$). Movement and hand shape accounted for 16 percent.

These data are not exactly parallel to Bellugi, Klima and Siple's 1975 results, since they found a few orientation errors, but no point of articulation errors at all. In this study point of articulation errors were greater than orientation errors. This may reflect a difference between language acquisition and use. The children may not have completely acquired orientation as a parameter, that is, they do not know that they can use orientation to make a difference in meaning.

Table 5: Parameter Errors and Non-parameter Errors Across Children

Category	Number of Errors	% of Total Errors	% of Parameter Errors
Parameters			
Point of Art.	246	9.1	10
Movement	822	30.0	34
Hand Shape	1215	45.0	50
Orientation	149	5.5	6
Other Errors			
Meaning	50	1.9	
Preceding	15	.6	
Meaning/Preceding	44	1.6	
Non-Sign/ No Response	168	6.2	

One reason for this may be the fact that they have not learned any pairs of signs for which orientation is minimally or even sub-minimally distinctive. This situation is due, in part, to the fact that there are relatively few instances in ASL as a whole in which orientation is distinctive. In many cases, one orientation is more natural or comfortable. For example, CANDY is made by twisting the extended index finger in the cheek. For this point of articulation and movement, there are few orientations which are even possible and one of those, palm downward, is certainly more natural to perform. Thus, orientation may not be a full parameter in the sense that hand shape is.

This situation is related to the problem of defining what a parameter is. As discussed above in Chapter IV Sections 1.1. and 1.3., it is difficult to formally state a definition which includes all four parameters. For example, Stokoe's motion class is an exception to an exclusion condition. Another problem is the question of distinctiveness. In some cases, point of articulation and motion are interdefinable and orientation is frequently predictable from the values of the other three parameters. It appears that hand shape is the only "full" parameter in the sense of being exclusive and consistently distinctive and the other three parameters provide modifications of it. Such a formulation is not so different from Stokoe's original formulation (Stokoe 1960:40 discussed in Chapter IV, Section 1.1. above).

Another explanation may account for the relatively large number of point of articulation errors. Some of these errors were similar to normal children's developmental errors: in some cases, ORANGE and BALLOON were both made at the forehead rather than at the mouth. This type of point of articulation error is not found in adult errors. Instead, in perception, adults tend to remember a sign as another existing sign

which differs only in point of articulation, and in production, they anticipate the point of articulation by a following sign or merge the points of two signs to a point somewhere inbetween. Adults do not make several different signs at one point of articulation without some meaningful or syntactical basis for the error.

5.2. Orientation/Hand Shape Hypothesis

In 42 of 3299 trials (1.3 percent), simultaneous errors were made in orientation and hand shape. This figure is very close to the number of orientation errors made alone (47 for 1.4 percent of the trials, correlation = .528, two-tailed probability = .000), but differs greatly from that of hand shape alone (752 for 23 percent, $p = .001$). This suggests that while orientation errors may be dependent on hand shape errors, hand shape errors are not dependent on orientation errors. This result may also reflect the slow emergence of orientation as a formal parameter and the rather complete conceptualization of hand shape as a formal parameter for these children. A far greater number of simultaneous errors were made in the movement/hand shape category (345 for 17 percent of the trials, correlation of hand shape with movement and hand shape = .630, $p = .000$) suggesting a greater dependence between movement and hand shape than between orientation and hand shape. These findings do not indicate that the hypothesis should be rejected, nor do they clearly indicate its acceptance is warranted. A careful phonemic analysis of a large number of signs is needed to allow for a more conclusive statement.

5.3. Marked/Unmarked Hand Shape Hypothesis

To examine this hypothesis, the parameter errors made on signs

with unmarked hand shapes (A, B, O, G, C, and 5) were computed and compared to those made on signs with marked hand shapes (see Table 6). In comparing unmarked and marked hand shapes, 940 errors were made along hand shape for signs with unmarked hand shapes. This represents 47.5 percent of the parameter errors made on signs with unmarked hand shapes. 275 errors were made along hand shape for signs with marked hand shapes. This represents 60.6 percent of the parameter errors made on signs with marked hand shapes. In terms of the percentage of parameter errors, hand shape accounted for a greater percentage of errors in marked than in unmarked signs. Although this difference is small (13.1 percent), it is significant at the .05 level (t -value = 1.98 with 236 Degrees of Freedom).

Looking at the errors made in individual signs, of 43 signs containing unmarked hand shapes, errors occurred along hand shape in 31, while in 12, no hand shape errors were made (72 compared to 28 percent). In marked signs, 39 or 43 signs had hand shape errors, while four had none (91 compared to 9 percent). Thus, hand shape was a more pervasive problem in marked hand shape signs. The average number of errors across signs for unmarked signs was 30.32 and 7.05 for marked signs. The least number of errors made on a sign for hand shape for both marked and unmarked signs was one. The greatest number was 202 for unmarked and 58 for marked. Thus a small number of signs contributed most of the errors in the unmarked category.

A consideration of errors across children proved more revealing. Two of the low functioning children made 905 or 96 percent of the hand shape errors for unmarked signs while the other three higher functioning children contributed 35 or four percent of the hand shape errors

Table 6: Parameter Errors for Unmarked and Marked Hand Shapes

Unmarked Hand Shapes		
Parameter	Number of Errors	% of Parameter Errors
Point of Articulation	213	10.8
Movement	707	35.7
Hand Shape	940	47.5
Orientation	118	6.0
Marked Hand Shapes		
Point of Articulation	33	7.3
Movement	115	25.3
Hand Shape	275	60.6
Orientation	31	6.8

for these signs. Since one of the two low functioning children knows only one sign with a marked hand shape and the other knows five, no such unbalanced pattern occurred in hand shape errors for marked signs (81 errors for 34 percent by the low functioning children compared to 155 for 66 percent by the higher functioning children). Table 7 presents the data on unmarked and marked hand shapes for the higher functioning children.

For these higher functioning children, the unmarked/marked hypothesis appears to be valid (16.9 percent in unmarked hand shapes versus 61 percent in marked hand shapes, $p = .02$).

This fact highlights the need for an examination of the errors made by individual children (Section 6 below). Autistic children vary widely from one another and it is important to remember that generalizations that apply to all autistic children are difficult to make.

5.4. Iconicity Hypothesis

To examine the iconicity hypothesis, all errors were added together and percentages were computed using the total number of trials as the denominator. Two three-way comparisons were made, one among transparent, misleading and opaque signs and one among iconic, misleading and opaque signs. Misleading and opaque sign scores were then combined as non-iconic/non-transparent and comparisons were made among iconic, transparent and non-iconic/non-transparent sign scores. Table 8 presents the results of those comparisons. Column A represents the percentage of errors of total trials within a category, column B represents the average number of errors in a category, and column C represents the percentage of the average errors of the total of average errors across

Table 7: Parameter Errors for Unmarked and Marked Hand Shapes for
Eric, David and Herbie

Unmarked Hand Shapes

Parameter	Number of Errors	% of Parameter Errors
Point of Articulation	30	14.5
Movement	94	45.4
Hand Shape	35	16.9
Orientation	48	23.2

Marked Hand Shapes

Point of Articulation	9	3.5
Movement	68	26.8
Hand Shape	155	61.0
Orientation	22	8.7

Table 8: Errors in Iconic, Transparent and Misleading Signs

Category	Number of Signs	Total Trials		A	B	C
		Errors	Correct			
Transparent	9	231	296	43%	25.7	23.9%
Misleading	24	1028	525	68%	42.8	39.8%
Opaque	17	663	461	60%	39.0	36.3%
Iconic	22	718	459	61%	32.6	28.5%
Misleading	24	1028	525	68%	42.8	37.4%
Opaque	17	663	461	60%	39.0	34.1%
Transparent	9	231	296	43%	25.7	38.0%
Non-trans.	41	1691	986	63%	41.2	62.0%
Iconic	22	718	459	61%	32.6	44.0%
Non-Iconic	41	1691	986	63%	41.2	56.0%

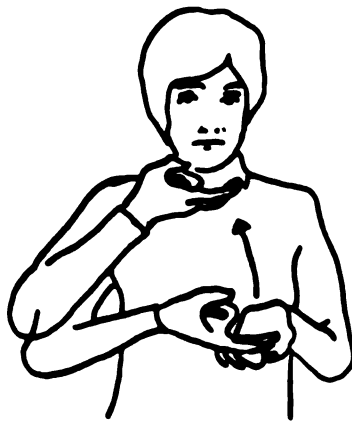
categories. Thus, column A compares errors to correct responses within a category, and column C compares errors across categories.

Little if any difference between iconic and non-iconic error percentages was discovered (1.8 percent of total errors, $p = .07$ and 8 percent of the total of average errors). This finding again supports Hoemann's hypothesis that knowing the base of a sign is not a certain clue to its meaning. Iconicity, a similarity of the sign to its base, was not an indicator of ease of learning (c.f. Konstantareas et al. 1978).

Transparent signs, however, were less subject to errors than were non-transparent signs. A difference of 19.4 percent of the total errors within a category ($p = .007$) and a difference of 24 percent of the across category total of the average errors were discovered. Thus, transparency, the guessability of a sign's meaning, was a better indicator of the children's success than iconicity was.

5.5. Simultaneity and Sequentiality

A subset of signs presented special difficulties for the children. These signs are those which have an internal sequential structure. One sign, BATHTUB, is a compound of two signs: WASH and TUB (see Figure 7). A group of signs, CEREAL, SOUP, and SPOON, involve a change in point of articulation from hand to mouth. Another group, BALLOON, THROW, SODA, and WANT, involved a change in hand shape (A to 5, 0 to 5 and 5 to 5̈) (see Figures 15, 17 and 20). In all cases, the children tended to do only one half of the sign as a static holistic sign, although which half was made varied. This finding reflects the difficulty of autistic children in dealing with temporary sequence and offers support



SOUP



SODA



NUT



EGG

Figure 20: The Signs SOUP, SODA, NUT and EGG

for the theories of etiology which provide an explanation for this difficulty (see Chapter II Section 1.3.2.4. above).

Sequential movement, in general, caused problems for the children, EGG is made with two fingers extended on both hands, crossing and touching along the edges of the fingers and then separating while moving downward (see Figure 20). NUT is made with the closed fist, thumb extended and touching the bottom of the teeth, and then flicking outward (see Figure 20). Typical errors for both signs were to make the sign as a static whole without the following movement. If the movement of a sign did not involve movement away from the body or a change in any other parameter, such as hand shape or point of articulation, and if it involved touching the body and especially if it was also repetitive, no such problem in sequencing occurred. Other movements may have replaced the correct movement (for example, tapping frequently replaced grazing), but such errors seem unrelated to the sequencing problem. Rather, they are most likely due to motor disturbances, such as flicking, rocking, and bouncing, or to a lack of the motor control necessary for the correct movement.

In terms of the parameter schema, an error made because of sequencing problems was scored differently for the four groups: the compound sign was a simultaneous error along all four parameters; point of articulation changes involved a point of articulation error, hand shape changes involved a simultaneous hand shape and movement error, and sequential movement in space such as in EGG and NUT involved simply movement errors. Thus, for what appears to be the result of a single disability, the parameter schema provides no unitary explanation. In linguistics, it is usual to provide a unitary description for phenomena

which have a common explanation. Halle 1959, using this line of reasoning, argues against including a bi-unique phonemic level of description in linguistic analyses. In structural descriptions of Russian obstruents, two rules are needed to describe morphophonemic variation between the phonemes /f/ and /v/ and allophonic variation between [č] and [ǰ] since they are on two different levels. Halle argues that since voicing is involved in both cases, the description can be simplified by postulating one rule for both sets and eliminating the phonemic level.

In addition to this inadequacy, the parameter schema fails in another regard. Movement errors involving lack of movement due to sequencing problems and movement errors where one movement replaces another movement due to motor disturbances must be scored the same way. Thus, two different phenomena received the same description.

Transcriptions which reflect the sequential structure may provide a more adequate description. In Stokoe's system, BATHTUB, CEREAL, and SODA are transcribed as follows (SOUP and SPOON are transcribed as CEREAL except for hand shape which is H for both signs):

Sign	Transcription
BATHTUB	[]B ₄ B ₄ X _N ØT ₄ T ₄ X ₄
CEREAL	ØC _a C _a X ₄ C ₄ X ₄
SODA	ØAF ^Ø AB _Ø ^{vX}

These signs have been transcribed as they are performed by the children and may differ slightly from the transcriptions of Stokoe due to dialectical variation. These signs all consist of two parts. This is indicated by the double bar (||). However, these transcriptions do not provide a clear explanation of the sequencing errors since they do not

explicitly state the sequential structure of these signs, although they imply this structure.

The over five signs from the data gathered here are transcribed as follows:

Sign	Transcription
BALLOON	AA ^{x+} _□
THROW	Ø0 [⊥] _□
WANT	Ø55 [⊥] _{a^o}
EGG	ØHH ⁺⁺ _{xv}
NUT	Å ^x _i

These transcriptions reflect the sequential structure, but in a different way from the first three. Sequence, here, is indicated by a horizontal sequence of movement phonemes. Thus, Stokoe's system does not describe this set of signs in a unitary fashion.

In West's system (with modifications to include the description of forms not found in Northern Plains Sign Language), the signs are transcribed as follows:

Sign	Transcription
BATH	h ₁ æ ₂ ʷneε
TUB	hToæqnoe
CEREAL	æ ₂ ʷnəλ ^v
SODA	Fæ [?] ne ₁ æ ₂ hεə
BALLOON	h [?] əλ ^v no ₁ æ ₂
THROW	æ ₁ æ ₂ no ₁ æ ₂
WANT	h ₁ æ ₂ en ₁ o ₂ æ ₂

EGG

hcəbneɔ

NUT

ʔəλ^vhæ

Explanation of Symbols

Hand Shapes

- ♭ - flat hand-palm active
- ♯ - fingers extended, separated and slightly bent
- 0 - O hand shape
- c - two fingers extended
- ʔ - fist
- T - T hand shape from Stokoe
- F - F hand shape from Stokoe

Movement

- n - straight
- m - curved

Dynamics

- h - both hands active - parallel
- ʘ - both hands active in mirror image
- / - sharp movement
- o - (from Stokoe) thumb extended

Points of Articulation

- ʃ - palm of other hand
- λ^v - mouth
- b - index finger edge
- q - back of fingers
- ʃ^w - chest

Orientation/Direction

- o - to the side
- æ - forward
- e - upward
- ɔ - towards
- ε - downwards
- ə - touch

West's description reflects the changes taking place between the two halves: in CEREAL, nəλ^v represents a movement ending in a touch at the mouth; in BALLOON, THROW and WANT, no♯, nə♯, and nɔ♯ reflect movement to the side, forward and toward the signer respectively, ending in a new hand shape. EGG, SODA, and NUT are also related to BALLOON and CEREAL, since all four involve touching, ə, following by movement, n.

BATHTUB is a compound sign and treated differently from the other signs in West's system, although the sequential structure is implicit in the fact that it is a compound sign.

West's system explicitly states the sequential structure of the signs and provides a more unitary description than Stokoe's system. Therefore, West's system provides a clearer basis than Stokoe's system for predicting the particular difficulties these signs posed.

6. Individual Variation

Autistic children's abilities vary widely from child to child. Such a fact is not entirely surprising since it is also true of normal children. In the area of language acquisition, normal children vary greatly in the ages at which they enter various stages in development (necessitating the use of mean length of utterance to compare children at the same stage in development), in the rate of acquisition of morphemes and syntactic structures and in the types of strategies they use (Brown 1973, C. Chomsky 1969, and Ferguson and Farwell 1975). By presenting only group means rather than individual means, much valuable information has been lost from many child language acquisition studies. It is, therefore, important to examine the data more closely in terms of each autistic child.

6.1. Parameter Errors

Variation in the pattern of parameter errors among the five children occurred which appeared to be related to differences in the children's disorders. Table 9 presents the parameter errors for each child.

Table 9: Parameter Errors for Each Child

Child	Points of Art.		Movement		Hand Shape		Orientation	
	Number of Errors	%	Number of Errors	%	Number of Errors	%	Number of Errors	%
Chris	46	4.2	325	29.5	679	61.5	53	4.8
Jimmy	149	17.6	328	38.8	307	36.4	61	7.2
Eric	31	15.1	70	34.2	91	44.4	13	6.3
David	11	6.1	68	37.4	91	50.0	12	6.5
Herbie	9	9.2	31	3.20	47	48.5	10	10.3

6.1.1. Point of Articulation

Of the five children, Jimmy and Eric had over twice as many point of articulation errors as orientation errors. The other three children had approximately the same number of errors in the two categories. Eric made typical errors, such as making some signs at the forehead which are not normally made there (for example, ORANGE and BALLOON).

6.1.2. Movement

Movement errors were the second most common error in all but one of the children. Jimmy made more movement errors than any other error although the difference between movement and hand shape was rather small ($p = .019$). Jimmy has several motor disturbances which include flicking, rocking and bouncing. He will flick any object against his fingers, hands, or arms, sometimes for hours if not stopped. Many of his movement errors were caused by moving when the sign was static. For example, when making the sign for BALL, Jimmy taps his fingers together rather than simply touching the fingertips and holding them briefly. HAT, made by touching the flat hand to the head, was made by patting the head. In other signs which involve repeated contact, contact was repeated excessively. RAISIN is made by tapping the R hand shape (crossed index and second fingers) against the back of the other hand twice. Jimmy tapped his fingers several times. Tapping often replaced other types of movement. PLEASE is made by rubbing the flat (B) hand in a circle on the chest. Jimmy tapped his chest several times. This error was made by all the children although not as pervasively as Jimmy. The difference in Jimmy's pattern of errors seems to reflect his relatively higher level of motor disturbances involving repeated contact of the

body. Figure 21 presents the standard versions of the signs RAISIN and PLEASE.

6.1.3. Hand Shape

Chris made a greater proportion of errors in hand shape than any of the other children which may reflect his low fine motor control (Hand shape with movement: $p = .05$, hand shape with orientation: $p = .003$, hand shape with point of articulation: $p = .005$). His substitutions were similar to those found by McIntire 1974. All the children had difficulty with hand shape to some degree and tended to replace more difficult hand shapes with easier ones.

6.1.3.1. Substitution Errors

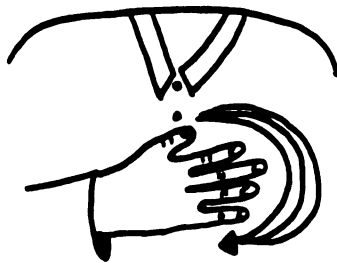
Boyes-Braem 1973 developed an implicational schema to predict which hand shapes would be substituted for others at different stages in language acquisition. Four levels were determined:

1. A S L b0 5 C G
2. B F O
3. I D Y P 3 V H W
4. 8 7 X R T (See Figures 10 and 22)

Substitutions of a less marked hand shape for a more marked one are made downward and rightward. Therefore A should be the first hand shape acquired and should be substituted for all others; that is, no other hand shape should be substituted for A. At stage 3, for example, Y should be substituted 7. If a hand shape falls between two hand shapes, for example, 8 in stage four, either hand shape may be substituted, in this example either I or D.



RAISIN



PLEASE

Figure 21: The Signs RAISIN and PLEASE

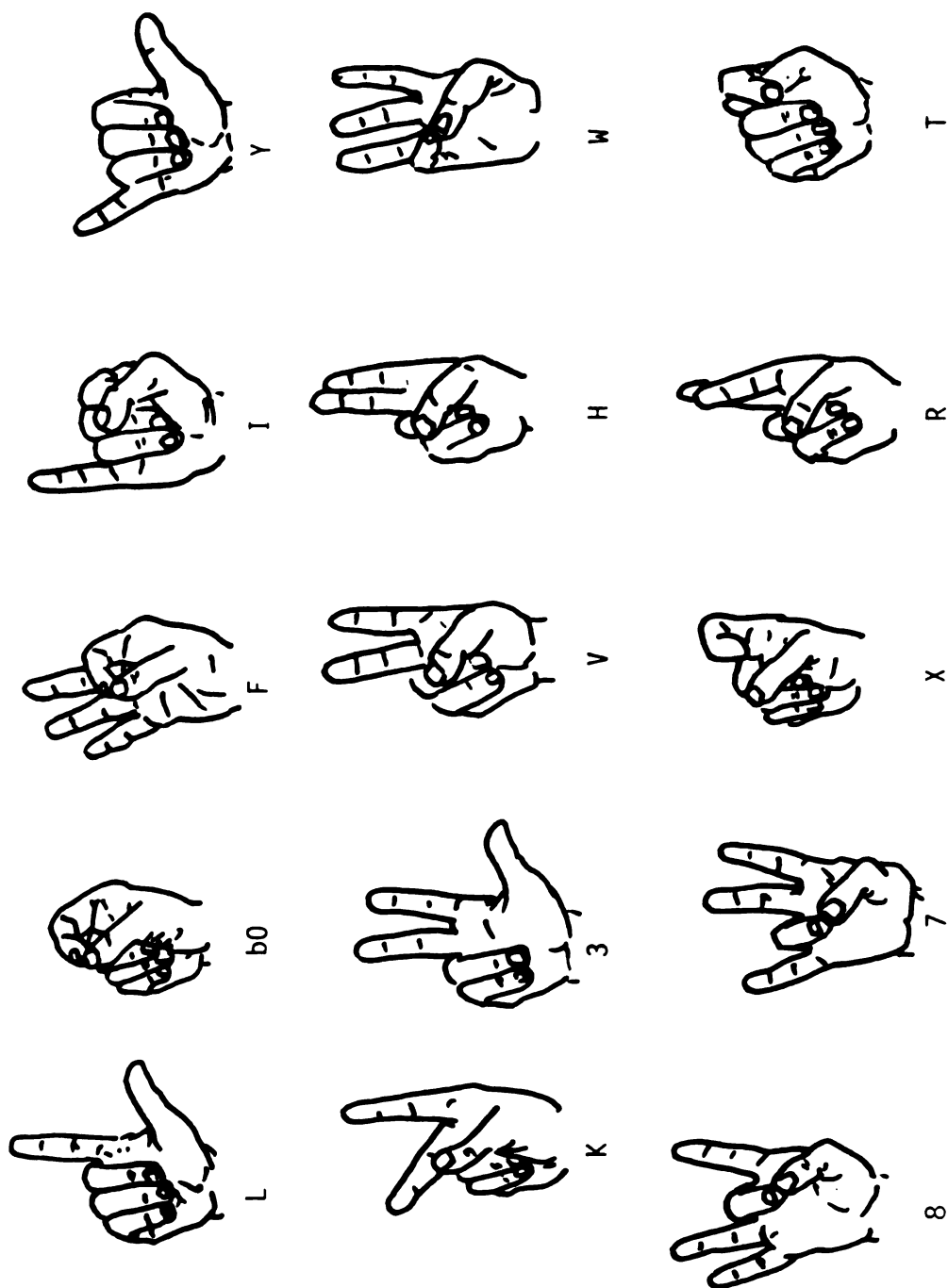


Figure 22: The Hand Shapes L, b0, F, I, Y, K, 3, V, H, W, 8, 7, X, R and T

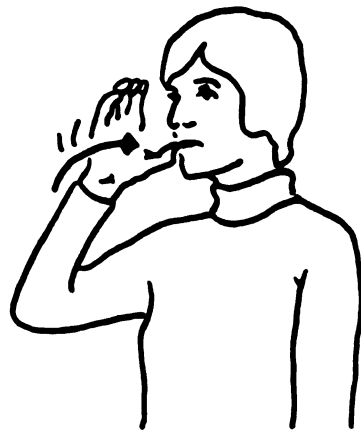
Other researchers have shown this schema to be faulty (see McIntire 1974). The hand shape 5 was often substituted for A in McIntire's study. The findings of this study duplicate in part McIntire's findings, but do not corroborate them, since the behavior of autistic children cannot be equated with that of normal children due to a lack of control of other factors.

6.1.3.1.1. The Hand Shape, 5

Chris substituted 5 for A in DRINK, NUT, and CRACKER. As Chris progressed in his control, he began to substitute C for A. Eric also substituted 5 for NUT and CRACKER at first. Eric, Herbie and David substituted 5 for B in BUS. Chris substituted 5 for G in CANDY. These substitutions may have a developmental explanation, since it requires more control to clench the fist than to leave it relaxed with the fingers extended. Figures 23 and 24 present the standard versions of these signs.

6.1.3.1.2. The Hand Shape, b0

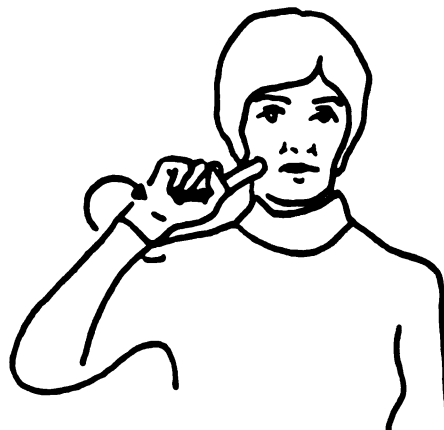
Baby 0 (b0) is a hand shape commonly used by normal children acquiring sign as a native language. It is made with the thumb and forefinger touching to form a circle (see Figure 21). 0 is made by the opposition of all fingers to the thumb in the shape of the letter O. Jimmy consistently replaced 0 with b0 in both MORE and BUBBLES. Eric did so in MORE. Baby 0 was not used as a substitute for any other hand shape by Jimmy or Eric, nor did Herbie or David use it at all. Chris does not know any signs with the hand shape 0, but it would not be surprising if he does substitute b0 for 0 in the future since his fine motor control is at an early stage of development.



DRINK



CRACKER



CANDY

Figure 23. The Signs DRINK, CRACKER, and CANDY

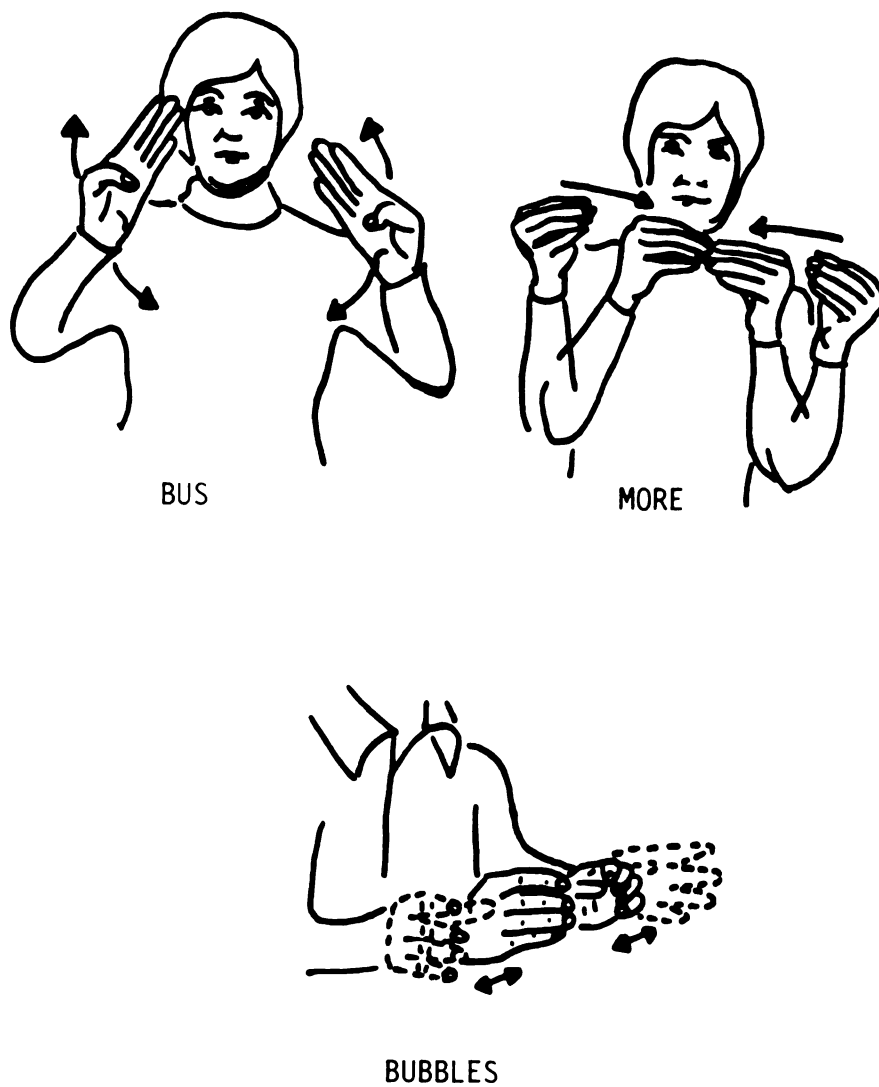


Figure 24. The Signs BUS, MORE, and BUBBLES

6.1.3.1.3. The Hand Shape, A

A was often substituted by all children for more complex hand shapes, e.g. I, X, P and C in the sign for I, APPLE, PANTS, and COAT respectively. G was also substituted for X in APPLE. This does not accord with Boyes-Braem's schema, since it predicts the replacement of X with b0, P with b0 and C with 5. Only the replacement of I by A is correctly predicted.

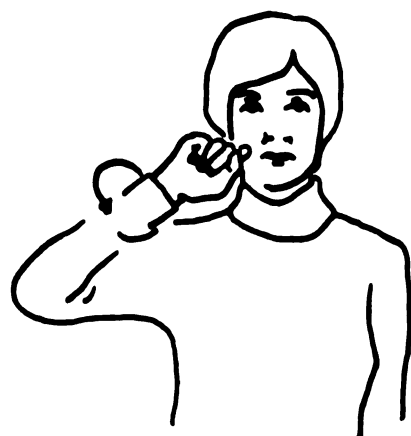
6.1.3.1.4. The Hand Shape, B

Jimmy substituted B for 5 in COMB, perhaps on analogy with HAT which is made with a B hand shape at the same place. All children more or less frequently substituted B for H in CHIPS. H in turn was sometimes substituted for R (e.g. in RAISIN and REFRIGERATOR) which differs from H only in that the two fingers are crossed, a difficult movement to learn. Figure 25 presents the standard versions of these signs.

Chris substituted B for A in CRACKER. This substitution follows the substitution of 5 for A in the same sign in a developmental progression similar to that suggested by McIntire 1974. First the child uses the relaxed extended hand in signing, then he begins to gain control and brings his fingers together and finally he becomes capable of clenching the fingers while signing to make a fist.

6.1.4. Orientation

All the children made similar orientation errors. David often layed his head on the table and therefore made many errors in orientation due to the orientation of his entire body. Several of the children inverted the signs and made them exactly as the instructor made them rather than reversing them. For example, signs for numbers are made



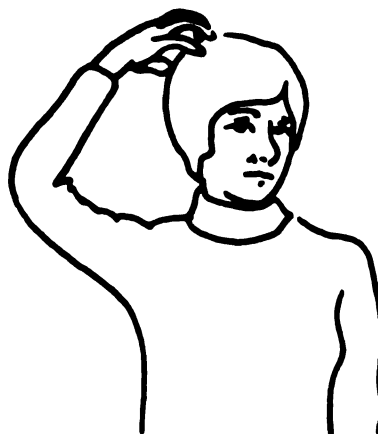
APPLE



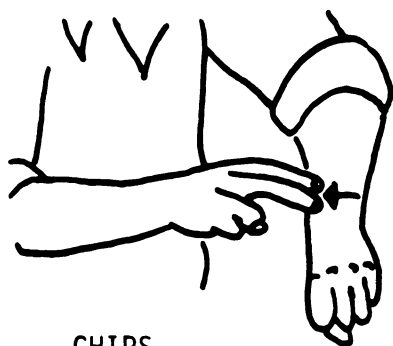
PANTS



COAT



COMB



CHIPS



REFRIGERATOR

Figure 25: The Signs APPLE, PANTS, COAT, COMB, CHIPS and REFRIGERATOR

with the palm facing the receiver. The children often made the signs with their palms facing themselves. Such reversals seem similar to pronoun reversals common in the speech of echolalic autistic children which may be related to autistic children's need for sameness.

6.1.5. Conclusions

Some of the individual variance can be accounted for by variance in the disorders of the children. Jimmy's error pattern seemed to be related to his motor disturbances and Chris's to his low level of motor control. Many of Eric's errors were typical developmental errors which may be due to the fact that he was five years old at the time of the study. Herbie and David had very similar error patterns. David tended to make more errors than Herbie in all categories due mainly to carelessness and inattentiveness.

6.2. Non-Parameter Errors

Although most of the children's errors were accounted for by the parameter schema, additional strategies were revealed by the non-parameter errors (see Table 10).

Only Jimmy appeared to be using overgeneralization as a strategy. The extent to which he used this strategy rather than the strategy of repeating the preceding sign is not clear since 44 of his errors were ambiguously in both categories. As mentioned in Section 3 above, many of Jimmy's language sessions consisted of a series of food signs followed by a series of clothing signs and other types of signs. Thus, the repetition of the preceding sign was also meaningfully related to the intended sign. After the instructor began to intersperse food with other signs, the repetition of preceding signs decreased and the use

Table 10: Nonparameter Errors for Each Child

Child	Meaningful	Preceding	Meaning/Preceding	Non Sign/No Response
Chris	0	7	--	44
Jimmy	47	8	44	34
Eric	2	0	--	42
David	0	0	--	39
Herbie	3	0	--	9

overgeneralizations became more dominant.

Chris is the only other child who used the strategy of repeating the previous sign, but he did not do so to any great extent. All of the children either refused to execute the signs or else gestured unusually in order to express inability to perform or frustration with the task.

CHAPTER VI

CONCLUSIONS

Similarities between the strategies used by autistic children to learn signs and those used by normal children were discovered. Autistic children made developmental errors similar to the errors made by normal children in hand shape and point of articulation. Evidence for the acquisition of formal parameters in autistic children was found which paralleled the acquisition of such parameters by normal children. Such strategies as overgeneralization and repetition were found to a limited extent in this population and these are strategies common to all types of language learning.

Some important differences must also be considered. The specific type of attention, motor and cognitive disabilities associated with autism gave rise to different types of errors from those made by normal children. The category X, which included wild gesturing of an obsessive type, would not have been necessary to describe the acquisition of signs by normal children. The increase in movement errors due to motor disturbances seen in one child in this study would not have occurred in the errors of normal children. As previous research indicates, normal children would not have made errors due to sequencing problems as was common in the autistic population (Wilbur and Jones 1974). However, comparable data from normal children acquiring signs matched according to developmental age should be gathered to permit a more accurate and objective comparison of the two groups in terms of these factors.

Several previously formulated hypotheses about the structure of signs were confirmed. Hand shapes can be classified into marked and unmarked categories on the basis of ease of acquisition and production. The classification of the hand shapes 5, 0, B, G, C, and A as unmarked was supported by the data gathered in this study.

Signs are describable in terms of the four parameters. There appears to be a hierarchy among these four parameters in which point of articulation is most primary. Hand shape and movement are second and third most primary, but no significant distinction between the two can be made at present.

It is difficult to determine the status of orientation since it is distinctive in very few cases. Most of the orientation errors of this population were due to carelessness or to reversing the sign so that it appeared to the child exactly as the instructor's signs appeared to the child. This type of reversal may be related to the inflexibility of the echoes of verbal autistic children which may, in turn, be related to their need for sameness in the environment. It does not appear that orientation has been acquired by the children as a formal parameter and, therefore, orientation appears to be least primary in a hierarchy of parameters.

The parameter schema, however, does not appear to be the optimal framework for analyzing the errors of this population. Many errors which were essentially different could not be differentiated. Hand shape subsumed both errors in the shape of the hands and in the number of hands performing the sign. Substitutions of A for G, for example, were classified as the same error as using one hand to make a two-handed sign. Movement subsumed errors which entailed replacing one

movement for another and adding or deleting movement. These errors seemed to be related to different disorders, but received the same description. On the other hand, errors which appeared to be related to the same basic disorder were described differently. Such a situation provides little insight into the strategies and underlying knowledge involved.

Despite these facts, the parameter analysis does, in part, reflect the severity of different aspects of the syndrome in particular children and the structural analysis revealed parallels between the errors made in processing and producing signs and the difficulties with processing speech that autistic children have. The simultaneous nature of the phonemic elements of a sign permit autistic children to process the sign in a holistic fashion; the sequential nature of some signs tends to be ignored by these children because of the special problems such signs present.

This finding in turn has consequences for the relative success of different syntactic systems with autistic children. If autistic children have difficulties learning unmotivated or arbitrary sequences such as occur in spoken languages, teaching autistic children an English syntax through a form of signed English may be counterproductive. As discussed above in Chapter IV Section 3., ASL syntax is fixed only in those cases where a change in order necessitates a change in meaning. Devices such as incorporation allow sentences to be performed holistically. Such aspects of ASL syntax might prove to be advantageous with autistic children.

An alternate explanation for the effectiveness of sign language with autistic children proposed that the physical similarity of some

signs to their referent enables the children to learn to use symbols. An analysis of the children's errors suggests that iconicity is not as good a predictor of ease of acquisition as transparency is.

Further research should be conducted to explore the formal properties of signs with regard to the specific problems of the autistic population. This study should be expanded to test the generalizability of its conclusions to a larger population. Future research should determine whether there is a correlation between fine motor control and success in learning signs. A formal comparison should be made using this framework with normal children, as well as comparisons with other, disordered populations who are being trained in the use of signs.

Aspects of the signing environment should be studied. Effects of the complexity of instructors' signing should be investigated. In addition, the signing behavior of these children should be examined in other environments beside the language sessions. In particular, the influence of the home use of signs on children in day care situations should be examined. It is probable that motivation is an important factor in language acquisition by autistic children as it is with all language learners. If the children have a use for signs outside of the school environment, it is more likely that they will progress further in the school environment than will children who receive no practice or encouragement in the home. With regard to this issue, a comparison with sign programs in institutional settings would also be valuable.

The framework used in this study could be refined and modified to accomplish many of these suggestions. Although certain deficiencies

were discovered, this framework proved to be a useful and interesting tool for examining the form of signs and the strategies autistic children used in producing signs.

APPENDICES

APPENDIX A

APPENDIX A: Scoring Sheet

Name _____

Date _____

Instructor's initials _____

Name of Sign	New Sign	Movement	Orientation	Hand Configuration	Point of Articulation	Unclassifiable

APPENDIX B

Instructions to the Instructors

Instruction in the use of the sign error scoring sheet.

One sheet should be used per child per session. In the first box, write the equivalent of the sign in English. If the sign is being introduced for the first time, the second box should be checked. The instructor should mark a category in which an error is made with a check mark.

Examples of what is to count as an error in each category:

- 1) Movement: If the child makes the sign for CHIP and either
 - 1) scratches the back of his hand away from himself rather than toward himself, or
 - 2) makes no movement at all. Or
 - 3) if the child makes the sign for BALL and moves his hand in some way.
- 2) Point of articulation: If the child makes the sign for DRINK on his cheek rather than his mouth.
- 3) Hand configuration: If the child makes the sign for APPLE with an extended finger rather than a bent finger.
- 4) Orientation: If the child makes the sign for TOILET with the hand pointing downward rather than upward.

If the child makes an error in more than one category, all should be checked.

If the child makes an error not classifiable in this system one of the following letter codes should be written in the last box:

M - meaningful relationship with the intended sign

P - repetition of preceding sign

X - Non-sign/no response

C - Correct response

If the child is required to repeat the sign, mark the errors made on repetitions on following lines, but there is no need to repeat the English equivalent for such repetitions, unless the sign is repeated after working on other signs.

APPENDIX C

Key to Abbreviations for Appendix C

M - Movement

O - Orientation

HS - Hand Shape

PA - Point of Articulation

A - M/O

B - M/HS

C - M/PA

D - O/HS

E - O/PA

F - HS/PA

G - M/O/HS

H - M/HS/PA

I - M/O/PA

J - O/HS/PA

K - M/O/HS/PA

Me - Meaningful Relationship

P - Repetition of Preceding Sign

X - Non Sign/No Response

C - Correct Response

DATA

Chris

Sign-
name

	M	O	HS	PA	A	B	C	D	E	F	G	H	I	J	K	Me	P	Me/P	X	C
DRINK		7	42	6		2		12									4		7	176
CRACKER	25		141	2		19		10						1			2		19	80
NUT	20		74			112					1						1		3	2
CANDY	7		119	4		70		2		2	2	5								5
CEREAL	11	7	4		6		4					19							4	
CHIPS			22			16					2				3				11	
TOTAL	63	14	402	12	6	219	4	24		2	5	24		1	3		7		44	263

Jimmy (continued)

Sign- name	M	O	HS	PA	A	B	C	D	E	F	G	H	I	J	K	Me	P	Me/P	X	C
WANT	56		35				67			5										11
PLEASE		4																		32
I	5																			1
TICKLE																				35
SCRATCH									1											
CHIP			6			4											1		2	
TOTAL	146	12	175	23	2	65	72	13	1	7	3	16	2	6	22	47	8	44	34	486

M	O	HS	A	B	C	D	E	F	G	H	I	J	K	Me	P	Me/P	X	C
---	---	----	---	---	---	---	---	---	---	---	---	---	---	----	---	------	---	---

[illegible]

Eric (continued)

[illegible]

Herbie (continued)

Sign-
name

	M	O	HS	PA	A	B	C	D	E	F	G	H	I	J	K	Me	P	Me/P	X	C
CHAIR			3			1														13
BED																				11
BIKE																				4
NUT																				11
HORSE			1																	3
GREEN																	1			2
CHOCOLATE			1																1	
MILK																				2
BOOTS																1				
HAMBURGER																	1			1

Herbie (continued)

[illegible]

Herbie (continued)

[illegible]

Herbie (continued)

[illegible]

Herbie (continued)

Sign- name	M	O	HS	PA	A	B	C	D	E	F	G	H	I	J	K	Me	P	Me/P	X	C
NINE																				1
TEN																				1
PAPER																				1
TO																			1	
BATH																				1
THANK YOU																				1
TOTAL	22	5	36	4		5		1		1					4	3			9	260

Herbie (continued)

Sign- name	M	O	HS	PA	A	B	C	D	E	F	G	H	I	J	K	Me	P	Me/P	X	C
NINE																				1
TEN																				1
PAPER																				1
TO																			1	
BATH																				1
THANK YOU																				1
TOTAL	22	5	36	4		5		1		1					4	3			9	260

David (continued)

[illegible]

David (continued)

Sign- name	M	O	HS	PA	A	B	C	D	E	F	G	H	I	J	K	Me	P	Me/P	X	C
THREE																				1
FOUR																				1
FIVE																				1
SIX			1																	
SEVEN			1																	1
EIGHT																				1
NINE																				
TEN			2																	
SOUP		1	2																	4
TOTAL	36	8	67	3	2	22	6								2				39	95

APPENDIX D

APPENDIX D: Notation Symbols for Stokoe's Systems

TAB

- ∅ - in front of signer's body
- ⊂ - face or head region
- ⤿ - forehead or top of head
- △ - mid-face, nose, eyes
- ⤿ - chin, lower face
- 3 - cheek, side of face, ear
- ⋈ - neck, throat
- [] - trunk (shoulders to hips)
- 1 - upper arm
- ✓ - forearm, elbow
- a - back of hand, wrist
- Ⓟ - inside of wrist

DEZ

- A - closed hand
- B - thumb extended hand
- B - flat hand
- 5 - fully spread hand
- C - curved hand
- E - retracted hand
- F - loop and 3/finger hand
- G - index finger hand
- H - double finger hand
- I - little finger hand
- K - angle hand, thumb and index

DEZ (continued)

- 3 - thumb and first two fingers spread
- M - similar to B or O
- R - second finger crosses index
- V - "victor" hand, spread
- W - three fingers spread, thumb on pinkie
- Y - thumb and little finger extended
- 8 - mid-finger in from spread hand

SIG

- ^ - up
- ∨ - down
- N - up and down
- > - rightward
- < - leftward
- z - side to side
- T - toward signer
- ⊥ - away from signer
- I - to and fro
- ⊙ - in a circle
- η - bend
- ⤿ - wiggle
- - open

Notation Symbols for Stokoe's System (continued)

SIG (continued)

- close

)(- approach

X - touch

⌘ - link or grasp

† - cross

0 - enter

÷ - separate

↔ - interchange

~ - alternate

SUBSCRIPTS

_a - supine

_o - pronated

✓ - forearm near vertical

< - salient finger to left

DIACRITICS

· - sharp motion

.. - repeated action

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