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Identifying Important Phonological Features in the Expressive Use of Signs by a Non-oral Mentally Retarded-Emotionally Disturbed Child.

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Identifying Important Phonological Features in the Expressive Use of Signs by a Non-oral Mentally Retarded-Emotionally Disturbed Child

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Abstract

This study investigated the phonology of a sign system when it was used to train expressive vocabulary development in a mentally retarded-emotionally disturbed child. The study specifically dealt with the salience of movement and number of hands involved in the construction of a sign. For the subject in the study, two-handed signs involving movement were the most readily learned. Further comparison among the categories observed indicated that the parameter of movement appeared to be an important factor in expressive learning of signs, while the number of hands involved was less important. Recent studies show that ease of acquisition may be influenced more by the structure of the task than by external reinforcement. Based on this knowledge, it was proposed that the results of the present study could serve as a foundation for building a sign lexicon which would promote learning efficiency as it would be uniquely structured to the individual.

Statement of Problem

Language Delay. The mentally retarded-emotionally disturbed child (henceforth, will be referred to as MR-ED child), is often characterized by severe expressive language delay. It is usually difficult to determine which was the initial problem - the language delay or the cognitive-emotional disorder. It is safe to assume that each plays a particularly important role in the overall functioning of the child. The inability to communicate can cause anxiety and frustration and may lead to increased hostility and impaired academic and social functioning. As this becomes a case of perpetuation of the child's problems, the challenge is to treat the most tangible of the problem areas. Often, this is the language disorder.

Language Remediation. An expressive language delay in a MR-ED child may be severely age inappropriate speech or the complete absence of speech. As it is necessary to afford the child the most efficient and easily acquired means of communication, a variety of methods are employed, one of which is the use of sign language. Although use of sign language, or some form of it, is becoming widespread among teachers of non-oral MR-ED children, such training is not always successful. (For the purpose of the present study, non-oral MR-ED children will be those afflicted by the multiple handicapping conditions of mental retardation, emotional disturbance, and possessing no effective oral

language abilities.) Therefore, the child's frustration with his inability to successfully communicate, paired with his other handicapping conditions, causes him to seek alternative, often inappropriate, methods of expressing his needs and feelings.

Task Characteristics. The question is posed as to why the child's expressive language is not enhanced by the sign language training. One may choose, first, to look at internal factors or those within the learner. One important factor is the degree of motivation which the child brings to the learning situation. As this often is a problem with MR-ED children, many teachers resort to external motivation. Tangible rewards, extrinsic to the task, such as food reinforcers are often used. However, recent research has shown that external reinforcers may eventually lose effectiveness (Stainback & Stainback, 1980) or may, in some cases, actually impede further motivation (Condry, 1977). An alternative is task-intrinsic reinforcement as a stimulant to further motivation (Browning, 1974). The motivation comes from within the task as it is geared to the child's individual interests and/or abilities.

This knowledge of motivation leads us to look at the structure of the task. Perhaps the child is not failing to learn the task, rather the task is failing to teach the child. The child must be viewed as an individual and the task structured to meet his ability to succeed (Kirk, 1972; Swanson & Reinert, 1979). In the field of sign language

research with non-deaf populations, a number of people have begun to investigate this individualized learning at the level of vocabulary (Carlson, 1981; Kriegsmann, Gallaher, & Meyers, 1982).

It may be wise to go beyond looking at the child's sign vocabulary in terms of entire words or groups of words. This is not to say that the interest value a particular sign concept holds for a child is not an important factor. It is necessary to have a solid understanding of each of the components relative to a child's learning of sign language and the degree of its importance to the task as a whole. Yet the trend has been to rely heavily on what is known of language in terms of oral English, with little regard for the unique intrastructure of the sign. Only in recent years has the possibility of sign language having a phonological structure been investigated (Battison, 1980; Klima & Bellugi, 1979; Stokoe, 1978; Woodward & Markowicz, 1980). It is the absence of such an awareness that may have created ineffective sign programs with non-oral MR-ED children. Dennis Cokely (1980) focused on a very major and justified concern surrounding the use and misuse of American Sign Language (ASL), stating, "If Sign Language teachers knew more about how languages work in general and, more specifically, how ASL is structured, then Sign Language instruction would be quite different" (Cokely, 1980, p. 145).

The non-oral MR-ED child does not have the benefit of a homogenous community upon which his sign language training can be based (Bonvillian & Nelson, 1978). Furthermore, those persons involved in training such children may be inadequately educated as to current information regarding the field of sign language and may lack a knowledge of where to begin (Wilbur, 1979). As stated above, two areas which need to be given serious attention are the child and his individual learning abilities and the sign and its phonological structure. A study of the two areas, in combination, could serve as a starting point in the development of a sign language vocabulary for a non-oral MR-ED child.

Research Questions

Phonological Parameters. This study investigated how the complex phonology of a sign system affected expressive vocabulary development in a non-oral mentally retarded-emotionally disturbed child. Phonology refers to the elements which are involved in the formational structure of a sign. The study specifically dealt with the importance of movement and number of hands involved in the construction of a sign. The feature of number of hands involved and the phonological parameter of movement appear to be more easily recognized in the formation of signs by non-oral MR-ED children, while other parameters, such as location or hand configuration, may be more difficult to distinguish (Luetke-Stahlman, Personal Communication, 1982). Furthermore, the variables under consideration are noted as important features in the historical changes that have occured in sign formation (Baker and Cokely, 1980; Wilbur, 1979). Based on the above, the feature of number of hands involved and the parameter of movement were considered to be significant to this study and served as the initial consideration in designing a sign language program for a non-oral MR-ED child.

It was the purpose of this study to discover how the feature of number of hands and the phonological parameter of movement would, in combination, affect the learning of expressive sign vocabulary in a non-oral MR-ED child.

Movement was defined in terms of its presence or absence, mobile versus stationary. These aspects of movement crossed with one-handedness and two-handedness made up the four categories of sign formation. The specific objective was to determine a single subject's response profile over time for each category of signs and draw comparisons among the categories. The study aimed to answer the following questions:

1) Given the categories - 1) one-handed stationary, 2) one-handed mobile, 3) two-handed stationary, and 4) two-handed mobile - and signs representative of each, what will be a single subject's response profile over time for each category?

2) Given the data, is there evidence that the learning that occurs is a result of the procedures employed?

Review of Literature

The use of sign language as a supplement or alternative to spoken English in the language training of non-oral MR-ED children has become widely accepted in recent years. Former concern that use of sign language would inhibit the possibility of future oral language development has been largely discredited (Goodman & Kroc, 1981). Furthermore, there is evidence to support the claim that sign language training may enhance oral language production (Bonvillian, Nelson, & Charrow, 1980; Wilbur, 1979).

This former bias toward sign language may have contributed to the fact that there is an absence of structured sign programs which pertain to MR-ED children. Therefore, many teachers lack sufficient knowledge of sign language and the result is often a nonsystematic, disorganized approach (Daniloff & Shafer, 1981).

It is important to realize that American Sign Language is a language that adheres to certain linguistic universals which must be considered when teaching any segment of the language (Stokoe, 1978). This study acknowledges that it is unrealistic to teach the syntax of American Sign Language in its pure form to a hearing, non-oral MR-ED child whose receptive language is based on oral English. Therefore, some altered form is probable in the sign language education of such a child. Yet, vocabulary selection must be based on the interaction of a variety of factors related not only to

the learner, but to the sign itself. The following is a brief review of several areas commonly regarded as important in vocabulary selection. The phonological aspects of sign language, an area which has been largely ignored in sign language education, will be explored in an effort to substantiate its importance to the field of sign language training.

Task Characteristics. Teachers of MR-ED children are often faced with the difficult task of motivation. Motivation, as it is used here, is defined as a child's desire or interest in performing a task. The use of extrinsic, artificial reinforcement has been used in the past and is currently used in the education of many mentally retarded and emotionally disturbed children. Although behavior modification techniques based upon this type of reinforcement have earned some degree of success, recent studies point to the fact that, due to conditions such as satiation (Stainback & Stainback, 1980), such techniques may not further a person's motivation to continue to succeed and may, in some cases, actually undermine further motivation (Condry, 1977). Therefore, some educators have turned the focus on the internal structure of the task and the effect that such structure has upon the individual's motivational level. This level is measured by the rate of response to the task (Browning, 1974). Due to a host of factors, certain tasks inherently hold more interest for a specific child than others. Consideration of motivational levels in

sign language education is evidenced by the number of high interest vocabularies currently in classroom use. These provide a vocabulary derived from a study of the child's activities and interests (Carlson, 1981; Kreigsmann, et al., 1982). The child has a point of reference for each of the concepts included in his individual vocabulary. Although the motivation to learn these concepts must come from within the child, it is felt that the individualized vocabulary serves as a stimulus for increased motivation.

Attention. Related very closely to the issue of motivation is that of attention. Again, the attention span of the MR-ED child may be lowered to a point where it becomes necessary to modify teaching methods in order for the child to satisfactorily acquire certain concepts (Kirk, 1972). Kriegsmann et al. (1982) proposed certain characteristics which distinguish a strong candidate for signing from a questionable one. In the designated needs areas of imitation and retention of signs, attention to the model was noted as a quality necessary for being a strong candidate for signing. Based upon the fact that sign language is visually oriented, common sense dictates that visual attention is an important prerequisite to the learning of signs. Visual attention, as it is used here, refers, not only to the presence of good eye contact, but to the absence of distracting or off-task behaviors, (e.g., reaching for materials) that may hinder the person's complete attention to the sign model. Although attention is

not a major factor in vocabulary selection, it must be given consideration when one is attempting to reason why a child may be failing to learn the concepts in a given sign vocabulary.

Iconicity. For the person who is unfamiliar with sign language, it is natural to consider the sign in its overall physical form. It has been suggested that a sign viewed as a whole may possess qualities which provide clues as to the meaning of the sign (Konstantareas, Oxman, & Webster, 1978). In early discussions, this focus on the overall physical form of a sign and the resulting image generated, was described as being pictorial, pantomimic, or iconic (Klima & Bellugi, 1979).

Baker & Cokely (1980) define iconicity in a signed language as "a visual resemblance between signs and the things they stand for" (p. 39). There are a variety of ways in which iconicity may be expressed. Several common methods are as follows 1) Direct: The gesture addresses the thing being referred to, as in pointing to body-parts or drawing the outline of a house in the air for the sign HOUSE; 2) Nondirect: The gesture uses part of the object or action to represent the whole, as in using a circular grinding action for the sign COFFEE; 3) Presentation: The gesture utilizes a token of an object or activity either by mime, such as BASEBALL, or by indexing, such as NOSE;

4) Depiction: The gesture may be substitutive as it forms the shape of the object or virtual, as the articulators are used to trace a picture in space (Mandel, 1977).

It is generally agreed that the degree to which a sign resembles its referent, by means of any of the above categories, lies on a continuum between arbitrary and iconic (Klima & Bellugi, 1979). Therefore, a sign which may not be entirely transparent may be translucent. In other words, if the referent cannot be easily guessed by mere visual observation of the sign, perhaps a relationship between the sign and its referent can be determined upon knowing the meaning of the sign (Klima & Bellugi, 1979; Wilbur, 1979). In a study by Klima & Bellugi (1979), in an attempt to measure the degree of transparency or translucency of a certain group of signs for nonsigners, over half the signs were found to be translucent, while tests for transparency found 90% of the signs to be opaque or nonidentifiable.

Griffith, Robinson, and Panagos, (1981) cite Brown (1977) in describing iconicity in ASL as perceived, not universally, but bound by time, culture, age, and experience. Much of the identification of certain signs lies in the associational abilities of the learner (Griffith et al., 1981). The association which the learner makes determines the degree of relationship between a sign and its referent. Based on the above, the assumption can be made that the greater share of signs labeled iconic are translucent rather than transparent and the degree of

translucency does not generalize across populations, but is dependent on the associational abilities of the learner. It is necessary, therefore, to investigate the effects of iconicity in different populations.

Konstantareas et al. (1978) studied the effects of iconicity on sign language acquisition in autistic children functioning at a retarded level. Iconicity was judged, in this case, on the basis of translucency. They found that iconic signs were learned better than noniconic signs and concluded that iconicity facilitates both the decoding and encoding of sign language with this population.

Bellugi, Klima, and Siple (1975), however, found that deaf adults process signs on a level other than iconic. They found that deaf adults rely on the formational structure in the acquisition of a sign.

It is evident that the degree to which iconicity plays a part in sign language is unclear. However, earlier views of sign as being largely pantomimic or pictorial are misconceptions. Recent research has reversed this line of thinking by focusing on the underlying structural form of signs. This is not to say that iconicity may not play a large role in the descriptive process in sign language, especially in an artistic sense (Klima & Bellugi, 1979). Films of deaf signers at Gallaudet in 1913 show signs incorporating more iconic features than they currently possess. This appears to indicate that signs are becoming less iconic over time (Blanton & Brooks, 1978).

Friedman (1977) proposed that a sign system sustains arbitrary or formational elements as well as iconic features. It is based upon this theory that the present study rests. Although the purpose was to investigate certain aspects of the structural code, it was recognized that the preceding variables, i.e., task characteristics, attention, and iconicity, also have an effect on the acquisition or learning of sign language. Therefore, steps were taken to control these variables in order to clearly determine the effects of the structural or phonological properties of sign language.

Phonology. William Stokoe helped to further the development of sign language when he introduced the idea that sign language was, indeed, a language and could be analyzed as such (Battison, 1980). Sign language is based upon fundamental language universals, one of which is its phonological structure (Siple, 1978).

Stokoe pioneered the study of the phonological structure of sign with his Dictionary of American Sign Language on Linguistic Principles in 1965. It based its listing of the signs by their formational units rather than simply glossing an oral language word concept with a pictorially or verbally described sign (Stokoe, 1978).

These original formational units were referred to by Stokoe as "cheremes", a term which has been referred to as "phonemes" since 1974 (Stokoe, 1978). He designated three major parameters that make up each sign. They are (a) hand

configuration, (b) location, and (c) movement (Battison, 1980; Klima & Bellugi, 1972). Unlike oral language systems, in which phonetic information is added sequentially, the phonological parameters of sign language occur simultaneously (Klima & Bellugi, 1979; Evans, 1981). These combinations are governed according to an established set of formational rules (Evans, 1981).

The following is a brief description of each of the phonological parameters. As the present study investigated the movement parameter, particular emphasis has been placed on this aspect. Attention is paid to the importance of the individual features of the phonological structure of a sign as evidenced by error patterns in fluent signers and the rules which influence the construction of signs, both old and new.

Hand configuration. Hand configuration or handshape, as it is sometimes called, refers to the form which the hand assumes while making a sign. American Sign Language has approximately 40-45 different handshapes of which 19 are distinctive. Although many of these handshapes are also familiar to other languages, (e.g., Chinese Sign Language), there are configurational elements which are commonly found in one language and not in another (Frishberg, 1978). This provides support for the idea that there is an underlying structure to sign languages, just as certain sounds are commonly found in some oral languages and not in others.

Location. This parameter designates the area on the body or in space where the sign will occur. Standard signs are made in a delimited area referred to as the signing space. This space is defined by the top of the head, the waist, and span of the arms (with elbows bent) from side to side. The Dictionary of American Sign Language defined the location or place of articulation of a sign in terms of specific loci which relate to the movement of the hands with respect to the body. Therefore, the location may be the area from which, on, near, or toward which the sign moves. Stokoe identified 12 different place of articulation primes or locations. These relate to signs made on the body, signs made with one hand acting on the other, and signs made in the neutral space in front of the body (Klima & Bellugi, 1979).

These highly restrictive rules as to the location of a sign are further proof that sign language goes beyond mere pantomime or pictures drawn with the hands. The only restraints to the use of space in pantomime are the physical restrictions imposed by a person's body (Klima & Bellugi, 1979). This is not the case in sign language which possesses a clear set of rules as to where and how a sign will occur.

Movement. The parameter of movement has been described as the most intriguing, as well as the most difficult to fully understand of the formational properties of sign language. As in the case of handshape and location, the set

of different types of movement is also restricted. For the purposes of the present study, it was felt unnecessary to describe, in detail, each of the movement primes. Rather, a general statement is made listing the component types of movement. The discussion will focus, primarily, on the rules and changes which affect the parameter of movement when it is used with one-handed or two-handed signs.

Klima and Bellugi (1979) identified the following categories of movement with ASL: hand-internal movement, wrist movement, directional (movement along paths in space), circular, interaction of the two hands, simultaneous clusters (two movements are performed simultaneously), sequential clusters (one action is followed by a second), and combination clusters and bisegmental signs. The last category describes those signs which are movement cluster combinations that are both sequential and simultaneous. Bisegmental signs are simple signs that are described as two-sign units. The initial parameter specifications are followed by another specification. The categories above relate to the manner and the location of the movement. There are other analyses of movement which describe distinctive elements such as the direction of the movement and whether one or two hands move and if both hands are articulators (Friedman, 1977).

Number of Hands. Baker and Cokely (1980) listed the number of hands used in the construction of a sign as a minor parameter which they termed hand arrangement. They

further described hand arrangement as (a) signs made with one hand only; (b) signs made with two hands in which both hands move; and (c) signs in which one hand acts upon the other as a base. The Dictionary of American Sign Language lists the greatest percentage of signs from the first category (40%), followed by categories b (35%) and c (25%), respectively (Baker & Cokely, 1980).

The fact that sign language employs two independent articulators appears to present infinite possibilities as to the structure of signs. However, as in the parameters previously discussed, there are constraints imposed upon the relationship of the two articulators. These constraints do not allow an endless variety of simultaneous structural combinations to occur. These constraints are directly related to the movement parameter, as well.

Symmetry. The symmetry constraint applies to signs in which both hands move. It specifies that the handshape and movement must be identical for both hands (Siple, 1978; Wilbur, 1979), and the location of the movement must be identical or a mirror image (Wilbur, 1979).

Dominance. The second constraint, dominance, refers to two-handed signs in which the handshapes differ. In this case, one hand functions as the dominant hand and acts upon the remaining base hand which, generally, does not move (Klima & Bellugi; Siple, 1978; Wilbur, 1979). The base hand is further constrained in that only six handshapes can function in this position (Siple, 1978).

Battison (1980), who was instrumental in describing the symmetry and dominance constraints for two-handed signs, proposed that these constraints are a means of simplifying a relative complexity in one part of a sign by a reduction in complexity elsewhere. That is, in a sign where both hands are moving, the handshapes will be identical and in signs where the handshapes differ, one hand will not move. Klima and Bellugi (1979) view the symmetry constraint as further pressure toward systematizing the symbols and overriding any iconic aspect of the sign. This view tends to support the historical movement of signs from iconic to more arbitrary.

Error Patterns. The purpose of the previous discussion was to further the idea that sign language is composed of distinct formational components which are rule-governed and, in combination, play an important role in the learning of sign language. The remaining discussion is intended to make the point that each parameter is independently important in the encoding process. This supports the purpose of the study, which is not only to observe the parameter of movement and the feature of number of hands involved, in combination, but to draw conclusions as to the relative importance of each of these variables in the expressive learning of the signs.

Poizner, Bellugi, and Tweney (1981) examined the effects of formational similarity unconfounded by semantic similarity in short-term memory recall. (In an earlier study by Bellugi, Klima, & Siple in 1975, there were sign

and error pairs that shared both formational and semantic similarity.) The results of the Poizner et al., (1981) study provided significant evidence that sequences of signs in formationally similar lists are more difficult to recall than sequences of signs in matched random lists. Poizner et al., (1981) note the following from their results:

> The finding that formational similarity has a detrimental effect on recall suggests that despite the simultaneous organization of signs, the visual nature of signs, and the global iconicity of many signs, abstract formational properties are important for coding at this stage of processing. (p. 1152)

Apparently, in short-term memory, intrusion errors are formationally based. This refers to the learner's ability to successfully discriminate among formationally similar signs, i.e., similar aspects of the structure of each sign within a group of signs which may intrude upon one's perception and subsequent learning of the sign. This indicates that, although the phonological parameters are simultaneously produced, they are independently encoded in short-term memory processes (Klima & Bellugi, 1979).

Studies of sign error patterns report that errors are not related to semantics or iconicity (Klima & Bellugi, 1979). These areas are symbolically based and would appear to be directly related to meaning. However, meaning is often distorted by formationally-based sign errors. This is further proof that the phonological structure of sign

language not only plays an important role in the sign as a whole, but each aspect of this formational structure serves as a unit of information in the visual memory and comprehension of the sign.

Summary. The use of sign language with non-deaf populations has become widespread in recent years, however, this has not been accompanied by a parallel increase in knowledge of the language and its structure. Insufficient knowledge has often resulted in a nonsystematic, disorganized approach to teaching sign language.

Teachers of sign language with populations such as non-oral MR-ED children must consider a variety of factors prior to implementing an adequate sign program. This requires knowledge of the child in terms of individual learning abilities as well as knowledge of sign language. Two factors related to the learner which influence learning include motivation and attention. These may be deficit areas in the non-oral MR-ED child. Recent studies show that motivational levels may be influenced more by the structure of the task than by external reinforcement.

Iconicity and phonology are two areas which are externally related to the learner, but directly related to the sign. Iconicity refers to the visual resemblance between the sign and its referent. Early studies which focused on iconicity described signs as being pictorial or a form of pantomime. It is, now, generally agreed that the degree to which a sign resembles its referent lies on a

continuum between arbitrary and iconic. The position of the sign upon this continuum may be described as transparent (i.e., the referent can be easily guessed by mere visual observation of the sign), translucent, (i.e., a relationship between the sign and its referent can be determined if the meaning of the sign is known), or opaque, (i.e., the referent cannot be identified by visual observation of the sign).

The degree to which iconicity plays a part in sign language is unclear. Studies with different populations using sign yield varying results as to the importance of iconicity in the decoding and encoding of sign language. Furthermore, observation of fluent signers indicates that signs are becoming less iconic over time.

In recent years, it has been theorized that signers may rely on the formational structure in the learning of the sign. This is referred to as the phonological structure of the sign and is realized by three major parameters, (i.e., hand configuration, location, and movement), and minor parameters, one of which is the number of hands involved in making the sign.

These distinct formational components are rule-governed and, in combination, play an important role in the learning of sign language. Studies of short-term memory provide evidence, by means of error patterns among signers, that the formational elements of signs are independently encoded, as well.

Research into the phonology of sign language is needed in order to better understand how the language functions. With this improved understanding, teachers of sign language can begin to look at each individual's learning abilities and draw upon the unique component parts of the language in designing a successful sign language program.

Methodology

This study investigated the phonology of a sign system when it was used to train expressive vocabulary development in a non-oral mentally retarded-emotionally disturbed child. The study specifically dealt with the salience of movement and number of hands involved in the construction of a sign. The feature of number of hands involved and the phonological parameter of movement appear to be easily recognized in the formation of signs by non-oral MR-ED children, while other parameters, such as location or hand-configuration may be more difficult to distinguish (Luetke-Stahlman, Personal Communication, 1982).

The categories that were studied included: 1) one-handed stationary, 2) one-handed mobile, 3) two-handed stationary, and 4) two-handed mobile signs. The purpose of the study was to determine the response profile over time for each category within a single subject. Comparisons were then made among the categories.

Subjects

It was originally intended that the study would involve two subjects, a primary and secondary subject. However, two obstacles impeded the involvement of the second subject in the study. They were as follows: 1) Unexpected health problems arose which may have affected the subject's

performance and the resulting data; 2) This subject appeared to be better suited to a more experiential learning situation. Due to the constraints imposed by the methodology of the present study, it was felt that the data did not truly reflect the abilities of the subject. Based on the two factors above, the subject was deleted from involvement in the expressive baseline and training phases of the study. The study, therefore, was limited to a single subject. For these reasons, no description or data pertaining to the second subject is included.

Subject 1. Subject 1 was a five year old white female. According to reports by her mother, she was described as being a normal baby. She was diagnosed as having cerebral palsy at the age of six months. She had four episodes of seizure activity between the ages of five months and three years old and each was associated with fever. Seizuring was initially treated with Phenobarbitol, but the medication was switched to Dilantin in order to decrease a hyperactive condition that was felt to be a side effect of the Phenobarbitol. There was no noticeable decrease in hyperactivity after the medication change. Subject 1 was taking no medication at the time of the study. After a series of infections, tubes were placed in her ears and were reportedly still in place. Results of a recent audiological exam indicated normal hearing sensitivity and middle-ear functioning in both ears. At two years of age, she underwent an adenoidectomy. She had corrective eye surgery

for crossed eyes and a wandering eye. She wore bilateral lower leg braces to remediate problems associated with her gait.

Formal testing, i.e., the Peabody Picture Vocabulary Test, revealed no receptive language score. However, the subject identified pictures of familiar objects by pointing. She made associations (e.g., which child wears which coat). She followed two-stage commands when the directions were given using very simple terms and she did not have to move a great distance. Upon mastery of a sign expressively, she tended to overgeneralize the use of the sign, and often used the same sign to apply to several conditions (e.g., using the sign TOILET when she wanted to move to another activity). She used the following signs expressively: EAT, TOILET, SLEEP, SCISSORS, SIT, SMILE, DOG, SHOES, PLAY, BOOK, WORK, COOKIE, and body parts. She would attempt to imitate an oral model and orally approximated the words eat, bye, please, help, good, and mom. She made eye contact with the trainer for up to five seconds and with the instructional materials for up to ten seconds. She appeared to be motivated by food reinforcers and praise.

Trainer. The trainer in this study was a twenty-seven year old white female. She had worked with MR-ED children for two and one-half years and had been in charge of developing language programming for the subjects in the study for six months prior to the study.

Environment and Apparatus

Environment. The environment was a seven foot by seven foot room. The walls were white and there were no windows in the room. It contained a table which was attached to the south wall, two chairs, and a three-shelf, twelve-inch wide cabinet which was attached to the north wall.

Materials. The materials included a variety of objects. Each object chosen was rated according to its neutrality, judged in terms of how motivating the object would be for each subject. An object was judged to be neutral if a panel of three judges rated it to be moderate in motivation for a subject. The judges rated each object on a scale of one to three, one being low motivation and three being high motivation. Each judge had a minimum of six months experience working with the subjects in the study. Only objects which received an average rating of 1.5 to 2.5 or, in other words, had a medium motivational factor, were used in the study. The results of this rating are provided in Table I.

Signs. The formation of the signs used in the study were based on the dictionaries compiled by Bove (1980) and Riekehof (1978), with the exception of the sign *CUP. *(The convention of capitalization will be used in this paper to denote a signed stimuli). The commonly recognized method for making the sign CUP requires the use of two hands, a dominant hand and a base hand. It was felt, for the purposes of this study, that the two-handed signs utilized

should be symmetrical. As the sign CUP met all other criteria for inclusion in the study, the decision was to substitute the table for the base hand and present CUP as a one-handed stationary sign. This decision was upheld by the fact that it is becoming more common for native signers to drop the nondominant hand in asymmetrical signs and, occasionally, drop one hand in symmetrical signs when it is nonessential for understanding the meaning of the sign (Baker & Cokely, 1980). Friedman (1977) supports this by the following:

> In encumbered signing only the dominant hand moves; often, for signs in which the nondominant hand is the place of articulation [or location] in citation form, the "lost" location is replaced by a convenient surface such as the hip, a tabletop and so on (p. 27).

Efforts were taken to choose signs that were very distinctive from each other in terms of the four categories being studied. Extremely formationally similar signs were not utilized.

Signs were also rated according to each sign's degree of iconicity, judged according to the signs' transparency. Each sign was presented to three separate judges and each judge was asked to identify the sign's referant. Only signs which yielded a high degree of iconicity or those positively identified by two out of three judges were utilized. Each of the judges had no prior experience with

sign language. The results of this rating are provided in Table II.

Procedure

Attention. In order to control for attentional deficits, the subject was required to comply with the following commands prior to beginning each trial in the baseline, training, and probe conditions.

The trainer was seated across the table from the subject.

Trainer: "Sit up straight! Hands in your lap! Look at me!"

If the subject failed to comply, the commands were repeated and physical assistance was provided.

Baseline. It was the purpose of the baseline procedure to determine the subject's receptive and expressive knowledge of each sign concept prior to beginning the training. Objects, corresponding to each sign, and representative of each of the phonological categories, i.e., 1) one-handed stationary, 2) one-handed mobile, 3) two-handed stationary, and 4) two-handed mobile, were used during the baseline procedure.

The subject's receptive vocabulary was tested utilizing objects which corresponded to each of the phonological categories above. These objects were cup, spoon, plate, pants, telephone, key, shirt, bowl, mirror, pencil, coat, and napkin. The object stimuli were presented in a four

choice situation, with one object from each category. The direction was given, "Point to the ____." Five seconds were allowed for a response, at which time the subject was told, "Thank you," and the trainer tested another object. A correct response was scored when the subject pointed to the named object. The entire procedure was repeated four more times, randomizing the order of presentation between trials, for a total of five trials for each object. A trial was defined as a period of time during which the subject was provided a stimulus, given a directive, and allowed five seconds to respond. Data was collected for each trial and the number of correct identifications for each object was divided by the five trials, (i.e., Number Correct/Five Trials). This yielded a percentage of accuracy for receptive knowledge of each object. Eighty percent accuracy had to be achieved by the subject in order that an object be included in the baseline test for expressive vocabulary.

The subject's expressive vocabulary was tested by a procedure whereby each of the objects of which the subject demonstrated receptive knowledge, were presented, one at a time, and the subject was asked to produce the corresponding sign. The objects used in the expressive baseline are as follows: cup, spoon, plate, pants, telephone, key, shirt, bowl, mirror, pencil, coat, and napkin. The following is an example of a typical expressive baseline testing:

The trainer provided a cup.

T: "This is a cup. You sign for cup."

Five seconds were allowed for a response. The subject was told, "Thank you," and the trainer tested another object.

The entire procedure was repeated four more times, randomizing the order of presentation each time, for a total of five trials for each object and its corresponding sign. Data was collected for each trial and the number of correct sign identifications for each object was divided by five trials (i.e., Correct Sign Identifications/Five Trials). This yielded a percentage of accuracy for expressive production of each sign.

The baseline condition for expressive production was continued for a minimum of two sessions. A session was defined as a period of time in which five trials were presented for each sign in the vocabulary. In the event of an ascending baseline, (i.e., the percentage of accuracy for a sign concept increased over two sessions), the baseline condition was continued for a third session. Any concept for which the baseline reached above 20% for the first and/or second sessions and above zero percent for the third session was deleted from the training phase of the study. Twenty percent correct during Sessions 1 and/or 2 was not considered significant due to the possibility of guessing on the part of the subject. The baseline condition was continued until there were two stimuli representative of each of the phonological sign categories stated earlier.

Four of these stimuli were trained and four served in the probe condition. This assignment was conducted randomly.

Training. It was the purpose of the training procedure to allow equal opportunity for the learning and production of each sign selected from the results of the baseline. The signs and objects included in the training were those of which the subject demonstrated sufficient receptive knowledge and no significant expressive production during baseline. One probe concept was chosen from each of the categories studied, i.e., 1) one-handed stationary, 2) one-handed mobile, 3) two-handed stationary, and 4) two-handed mobile signs. This list of training signs included: cup, shirt, spoon, and napkin. The following is an example of a typical training trial:

> (The convention of using small letters paired with capitalization will be used in this paper to denote simultaneous communication.)
>
> The trainer provided a cup.
>
> T: "This is a $\frac{\text{cup}}{\text{CUP}}$." The trainer pointed to and simultaneously spoke and signed for "$\frac{\text{cup}}{\text{CUP}}$".
>
> T: "You sign for $\frac{\text{cup}}{\text{CUP}}$." The trainer directed the subject to sign CUP and simultaneously spoke and signed "$\frac{\text{cup}}{\text{CUP}}$". The trainer waited five seconds for the subject to produce the sign. The trainer reinforced a correct response by the praise, "Good, that is $\frac{\text{cup}}{\text{CUP}}$." If no sign or an incorrect sign was produced, the trainer directed the subject to sign CUP again. Physical

assistance was provided by the trainer to enable the subject to produce the sign.

The trainer taught each of the four signs and the order of presentation was randomized for each subsequent set of training trials. The entire training procedure was implemented four more times for a total of five trials per sign or 20 trials per session. Data was collected on spontaneous, meaning unassisted, sign approximations for each trial. Sign approximations closely resembled the sign model provided by the trainer in terms of handshape, location, and movement. To be acceptable, it was required that the approximation include the movement and the number of hands employed in the model and at least one of the remaining phonological parameters, (i.e., handshape, and location). The number of correct approximations was divided by five trials to yield a percentage of accuracy for each sign (i.e., Correct Approximations/Five Trials = % of Accuracy).

Probe. It was the purpose of the probe condition to ensure that the production of the signs was a result of the training and not due to subject and/or environmental variables. The vocabulary and materials included in the probe condition were those of which the subject demonstrated sufficient receptive knowledge, yet no significant expressive production during baseline. One probe concept was chosen from each of the categories studied, i.e., 1) one-handed stationary, 2) one-handed mobile, 3) two-handed

stationary, and 4) two-handed mobile signs. They are as follows: mirror, plate, pencil, and coat.

The signs in the probe condition were presented in the baseline, during every fifth training session, and at the conclusion of the training format. The following is an example of a typical probe trial:

> The trainer provided a coat.
>
> T: "This is a coat." The trainer pointed to the coat.
>
> T: "You sign for coat." The trainer directed the subject to sign COAT and waited five seconds for a response. The trainer told the subject, "Thank you," and the trainer proceeded to the next sign.

During each training session where the probe condition was presented, the probe signs were intermingled with the training signs (e.g., train, probe, train, etc.). The order of presentation was randomized for each subsequent set of trials and each probe sign was given a total of five trials just as each of the training signs. Data was collected for each trial and the number of correct sign productions was divided by five trials to yield a percentage of accuracy for each sign in the probe condition, (i.e., Correct Sign Production/Five Trials = % of Accuracy).

Data

Collection. Data was collected twice daily for ten days or twenty sessions. The times that the trainer worked with the subject were counter-balanced to control for time

of day effects. Data was collected via a simple tally system. The data sheet included information concerning trainer, date, time, activity, vocabulary, and correct approximations.

Interjudge Agreement. One session was videotaped as a reliability check of the data collected by the trainer. A panel of three judges, each with at least one year of experience working with MR-ED children, rated the tape in terms of the following: 1) consistent teaching style, 2) reliable collection of data, and 3) consistent use of reinforcement. Table III shows the results of that rating.

Experimental Design. The study utilized a single-subject design approach, a valuable tool in applied research. As the purpose was primarily to observe the subject's response profile for the four categories, the study was based on a modified AB design (Birnbrauer, Peterson, & Solnick, 1974). The subject's behavior was recorded (A) during baseline or prior to treatment and (B) collection of data was continued throughout the period of the treatment condition.

In order to ensure internal validity, the above design was slightly modified by the addition of a probe condition. This allowed conclusions to be drawn as to whether changes in the subject's behavior were a result of the treatment or due to other variables. The probe condition was present at baseline and intermittently during the treatment condition. Certain conditions (e.g., motivational level of the learner

and iconicity of the signs), were controlled prior to treatment in order to build confidence in the reliability of the findings (Birnbrauer et al., 1974; Ventry & Schiavetti, 1980).

This type of research has advantages and disadvantages dependent on the goals of the researcher. It should be emphasized that the results of a single-subject study usually do not generalize across subjects. The results are unique only to the subject involved. However, a great deal more can be said about the implications of the results of the study for that particular learner. In this regard, single-subject research is a useful aid in planning and evaluating educational programs for highly diverse populations, such as MR-ED children.

Results

The data collected were compiled and the results of the training and probe conditions were displayed on graphs to allow analysis by means of visual inspection. This allowed, not only observation of each sign category individually, but a graphic comparison of the learning which occurred among the categories.

Receptive Baseline

The subject was tested for receptive knowledge of the following objects: cup, spoon, plate, pants, telephone, key, shirt, bowl, mirror, pencil, coat, and napkin. The testing was conducted during one session in which she was given five trials for each object. She achieved 100% accuracy for receptive knowledge of each of the objects tested.

Expressive Baseline

Following the receptive baseline testing, the subject was tested for expressive knowledge of the same twelve objects used in receptive testing. She was given five trials for each object during each of two sessions. According to the methodology of this study, in the event of an ascending baseline, (i.e., the percentage of accuracy for an object increased over two sessions), the baseline condition would be continued for a third session. Any concept for which the baseline reached above 20% for the

first and/or second sessions and above zero percent for the third session would be deleted from the training phase of the study.

The results were zero percent accuracy for each object except "telephone". The subject's scores for "telephone" acquired during three expressive baseline sessions were as follows: 80%, 100%, and 100%. Due to these scores, "telephone" was deleted from the training phase of the study.

Training and Probe Conditions

Eight objects were chosen from the eleven which remained as a result of the receptive and expressive baseline testing. The objects were divided into four categories, according to the corresponding manual sign. Two objects represented each category. One object from each category was employed in the training condition, while the other served in the probe condition. These categories and their respective training and probe signs were as follows: 1) one-handed stationary (CUP, MIRROR), 2) one-handed mobile (SPOON, PENCIL), 3) two-handed stationary (SHIRT, PLATE), and 4) two-handed mobile (NAPKIN, COAT). In the series of eight graphs, each graph represents an object/sign which was part of the training or probe conditions. These graphs illustrate the subject's response profile over time for each of the objects/signs.

The data collected were analyzed in order to 1) determine the amount of increase and/or decrease in performance within each category, 2) compare the subject's overall response profile among categories, and 3) determine what, if any, significant learning was a result of the training. This was achieved by means of visual inspection, a standard analysis technique in single-subject research. It is based on the assumption that improvement must be visibly apparent in order to be clinically significant (Birnbrauer et al. 1974; Herson & Barlow, 1976; Luetke-Stahlman, 1982). Although statistical procedures have been applied to N=1 studies, statistically reliable differences may have no clinical significance (Birnbauer et al., 1974) and will, therefore, not be utilized in this study.

Data collected on the subject's response during the training condition showed a consistent pattern within each category with the exception of the category of one-handed mobile signs. Below is a description of the results within each category.

One-handed stationary. (See Figure 1) The percentage of accuracy remained at zero percent for the sign CUP for the duration of the study, except during Session 13 when the subject achieved 20%. In view of the nature of the subject's responses prior to and after Session 13, it was felt that her correct response was due to chance rather than demonstrating actual learning.

Two-handed stationary. (See Figure 2) The percentage of accuracy remained at zero percent for the sign SHIRT for the duration of the study. There were occasional trials in which the subject did respond correctly in terms of number of hands, location, and handshape, however, the subject added movement to the stationary sign.

One-handed mobile. (See Figure 3) Unlike the other three categories, which remained at zero percent accuracy for the first three sessions, the one-handed mobile sign SPOON maintained 20% accuracy for the first three sessions and then dropped to zero percent for Sessions 4 and 5. The data fluctuated between zero and twenty percent accuracy through Session 8. The data for Sessions 8 through 20 was variable but showed a general upward trend. One hundred percent (100%) accuracy was achieved for three of the last five sessions.

Two-handed mobile. (See Figure 4) After remaining at zero percent accuracy for Sessions 1 through 3, expressive ability for NAPKIN increased sharply to 80%. It varied between 80% and 100% for the remaining sessions, except during Session 8 when the level of accuracy decreased to 40%. One hundred percent (100%) accuracy was achieved consistently for the last six consecutive sessions.

Comparisons. It is evident from the data that the sign representing the two-handed mobile category (i.e., NAPKIN) was the most readily learned among the four categories. This was followed by the category one-handed mobile. The

categories of one-handed stationary and two-handed stationary exhibited an overall response profile signifying that no learning occurred. Figure 5 is a composite graph which displays the results of this comparison.

Probe. The results of the probe condition for each of the four categories remained at baseline for the duration of the study. These results serve as evidence that the learning that occurred was a result of the procedures employed. The positive effects of the treatment were evidenced by the notable growth in the acquisition of the trained signs in two of the four categories and the lack of improvement in the corresponding probe condition signs. Figures 6 through 9 illustrate the results of the probe condition.

Discussion and Conclusions

It will be recalled that the present study was conducted to investigate how the complex phonology of a sign system affected expressive language development in a non-oral MR-ED child. Two aspects of phonology were observed: the number of hands involved in producing the sign and the presence or absence of movement.

The two variables were crossed to produce four categories of signs, (i.e., one-handed mobile, two-handed mobile, one-handed stationary, and two-handed stationary). Of the four categories observed over twenty sessions, the two-handed mobile category was the most readily learned, followed by the category of one-handed mobile. The categories of one-handed stationary and two-handed stationary showed no significant evidence that learning occurred. Looking at the results in terms of the variables (i.e., movement and number of hands involved), it is evident that the movement parameter appeared to have a powerful effect upon the subject's expressive learning of the signs, however, the feature of number of hands involved was less significant. This is evidenced by the fact that movement was a variable present in both of the categories that had response profiles which indicated the greatest amount of learning. Yet, these two categories differed as to the number of hands employed which serves to weaken that variable as one which is stimulatory to learning. It should

be emphasized that these results are only significant for the subject in this study at her current level of brain development.

This importance of movement is reflected in the literature by the emphasis on movement as it is discussed independently and in combination with other phonological aspects, especially the feature of number of hands involved. Movement plays an important role in the constraints imposed upon the structure of signs as in the symmetry and dominance constraints (Siple, 1978). Although this does not directly support the prominence of movement in expressive learning of signs, it does bring attention to the movement parameter as it functions in the formation of signs. Each of the structural components of sign language is rule-governed, however, the constraints imposed on the movement parameter are more manifest and appear to influence a greater percentage of the total number of possible signs. Based on the results of the present study, it was demonstrated that the movement parameter was not only influential in the formation of several of the signs, (i.e., the symmetry and dominance constraints affected the manner in which the articulators or hands moved and/or interacted), but also had a substantial effect on the subject's expressive learning of signs.

To ensure that the learning which occurred was a result of the procedures employed, a probe condition was presented intermittently. The notable growth in the trained signs in

two of the four categories and the lack of improvement in the corresponding probe condition signs supported the positive effects of the treatment. This information further justifies the conclusion that the presence of movement, in combination with the use of two hands, was highly significant in the subject's expressive learning of signs.

Controls were imposed upon several variables, as to maximize the internal validity of the study. One area, iconicity, presented particular concern as there seems to be disagreement in the field as to the effect that iconicity has on the learning of signs. This confusion appears to generate from the fact that there is no common ground for iconicity. What may be transparent to one learner may not be to another. In the present study, efforts were taken to overcome this by using a panel of three judges to determine the iconicity of a sign as it was not possible to secure this information from the subject. Although the associational abilities of the three individual judges may have differed, the final determination of iconicity was based on the average response of the judges, making the probe condition signs and the training condition signs equal in terms of iconicity. Based on the notable growth in the acquisition of the trained signs in two of the four categories and the lack of improvement in the corresponding probe condition signs, it may be assumed that iconicity did not affect the subject's learning of the signs.

The knowledge gained by a study such as this can be extremely useful in designing sign language programs for non-oral MR-ED children. Recalling the information regarding motivation as being enhanced by intrinsically reinforcing tasks rather than extrinsic reinforcement, one can begin to see a purpose for structuring a task to a child's individual attention and, subsequent, learning abilities. Although this has been attempted with sign language, the majority of studies have focused on areas other than the internal structure of the sign. High interest and functional vocabularies tend to consider only characteristics of the learner, disregarding the formational aspects which may have an impact on the learning of the signs.

A pilot study, such as the one described here, could be run prior to the design and implementation of a sign language program with a non-oral MR-ED child. This would supply useful information concerning the child's perception of the phonological structure of the signs. The present study found movement to be especially important in a single subject's expressive learning of a group of formationally dissimilar signs. Based on research related to error patterns in sign language, additional information could be gained by presenting a subject with several groups of signs in which each group held one formational feature constant for each sign. For example, each of the signs in one group might have identical movement, while another group of signs

might all be one-handed or employ the same handshape. Based on the theory that formationally similar features intrude upon the short-term memory or learning of signs, the conclusion could be drawn that the group of signs which shows the least degree of learning would contain the most salient formational feature.

The results of the present study lend support to the proposal that the phonological features of sign language play an integral part in the expressive learning of sign language with a non-oral MR-ED child. Further research is necessary to fully understand how each of the formational components influences the learning process, both in isolation and in interaction with each other. This information, consolidated with knowledge of the child's interests and activities would serve as a substantial foundation upon which to build a beneficial sign lexicon.

Table I

Neutrality

OBJECTS	RATINGS			
	Judge 1	Judge 2	Judge 3	Average
cup	2	2	2	2
spoon	2	2	1	1.6
plate	2	2	2	2
ball	2	2	2	2
pants	2	2	2	2
telephone	3	2	2	2.3
key	3	2	2	2.3
shirt	3	2	2	2.3
bowl	2	2	2	2
flower	2	3	3	2.7 D
mirror	1	3	2	2
pencil	3	2	2	2.3
coat	2	2	2	2
napkin	2	2	2	2

1 = Low Motivation
2 = Medium Motivation (Neutral)
3 = High Motivation
D = Delete

Table II

Iconicity

OBJECTS	RATINGS			Iconicity Level	
	Judge 1	Judge 2	Judge 3	High	Low
CUP	+	+	+	X	
SPOON	+	+	+	X	
PLATE	+	+	+	X	
BALL	+	-	-		X D
PANTS	+	+	+	X	
TELEPHONE	+	+	+	X	
KEY	+	-	+	X	
SHIRT	+	+	+	X	
BOWL	+	+	+	X	
MIRROR	+	+	+	X	
PENCIL	+	+	+	X	
COAT	+	-	+	X	
NAPKIN	+	+	+	X	

+ = transparent (correct identification)
- = opaque (incorrect identification)

Table III

Interjudge Agreement

CRITERIA	RATINGS		
	Judge 1	Judge 2	Judge 3
Consistent Teaching Style	3	3	3
Reliable Collection of Data	3	3	3
Consistent Use of Reinforcement	3	2	3

The criteria were judged on a continuum of 1 to 3 (3 was the highest rating).

Figure 1
Training
One-handed stationary (cup)

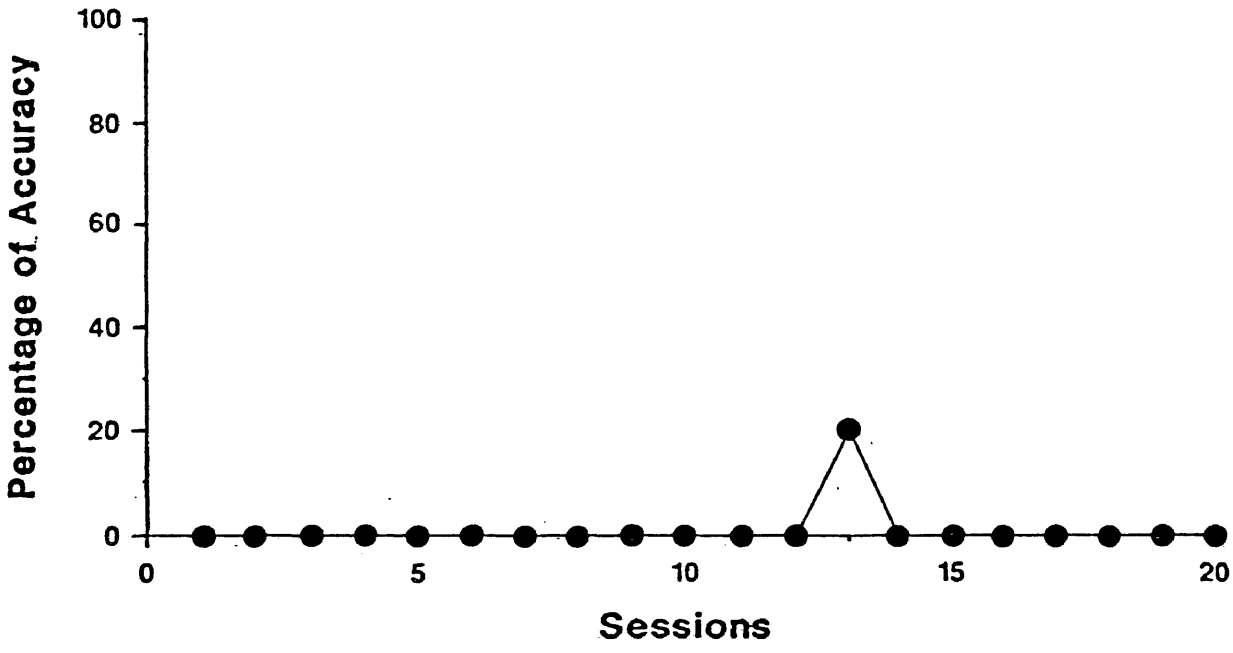


Figure 2
Training
Two-handed stationary (shirt)

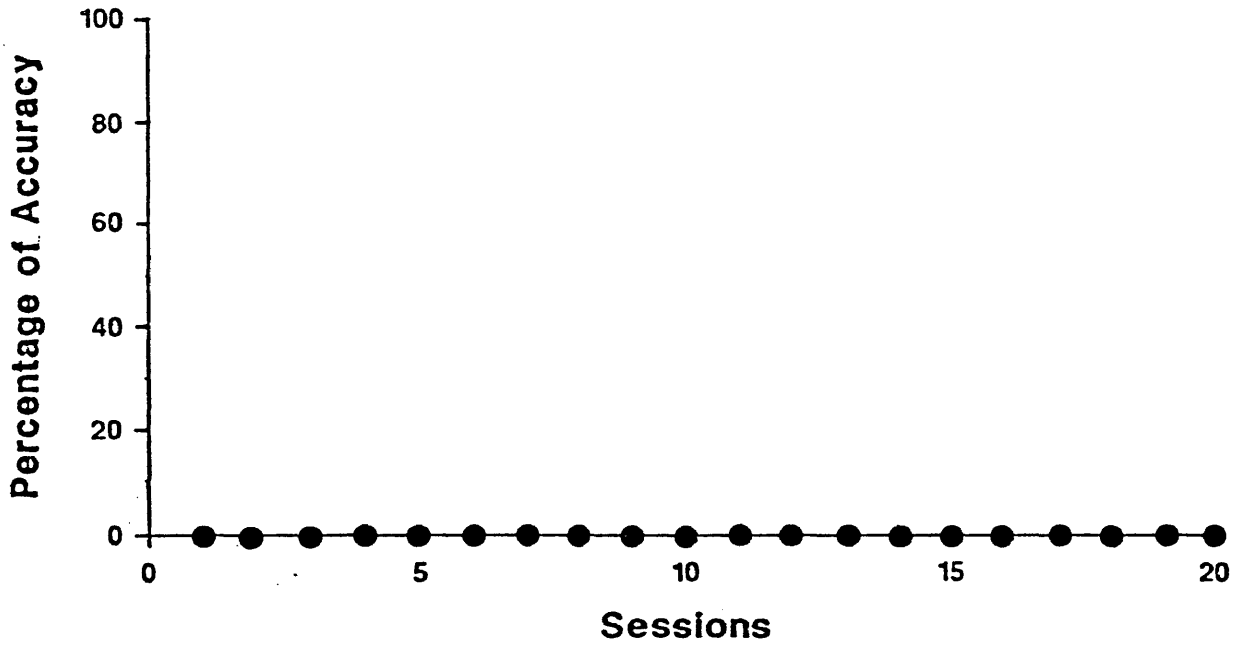


Figure 3
Training
One-handed mobile (spoon)

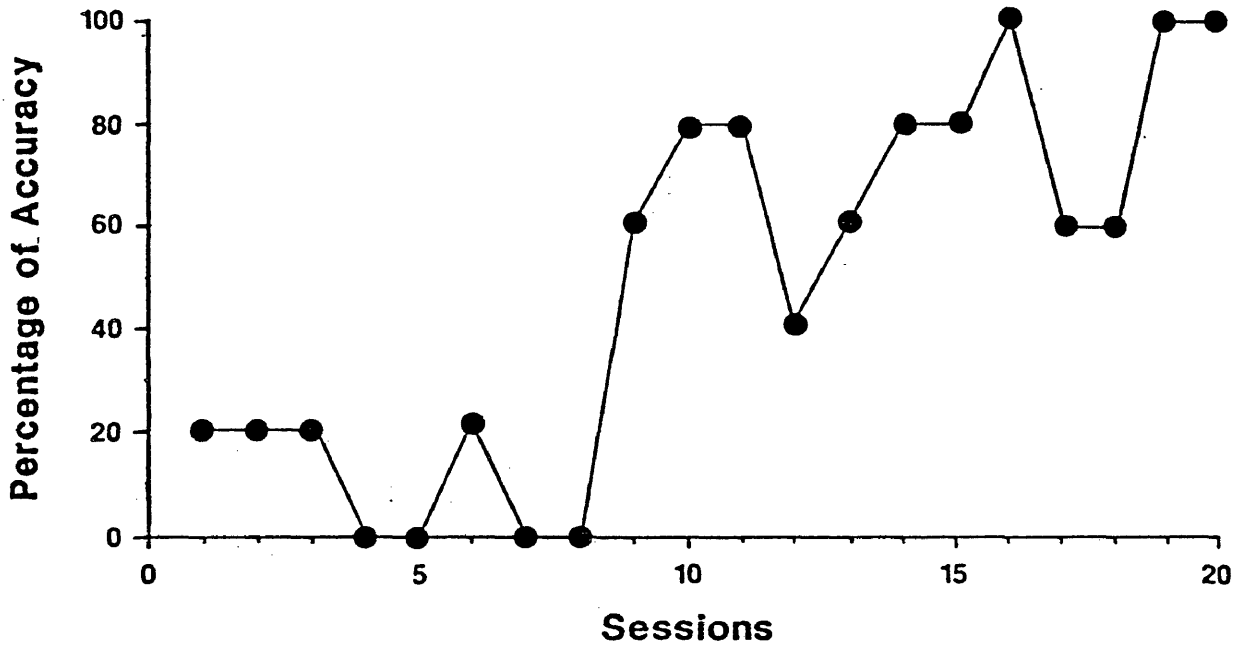


Figure 4
Training
Two-handed mobile (napkin)

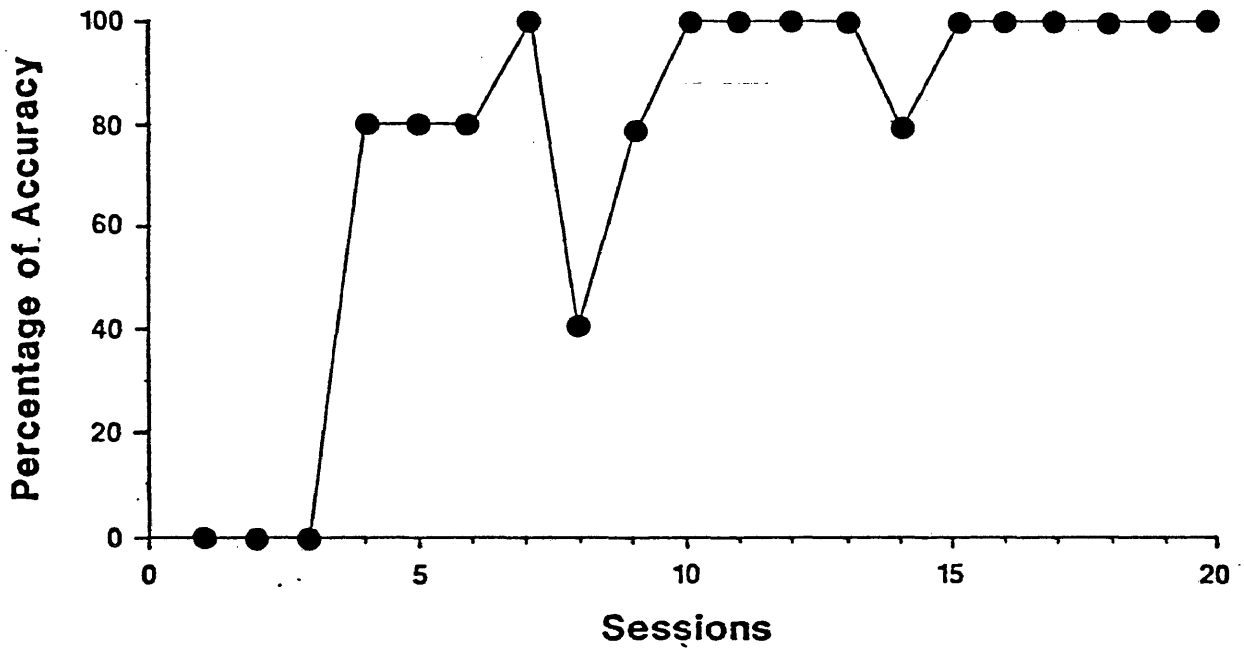


Figure 5
Composite Graph

1 One-handed stationary (cup)
2 Two-handed stationary (shirt)
3 One-handed mobile (spoon)
4 Two-handed mobile (napkin)

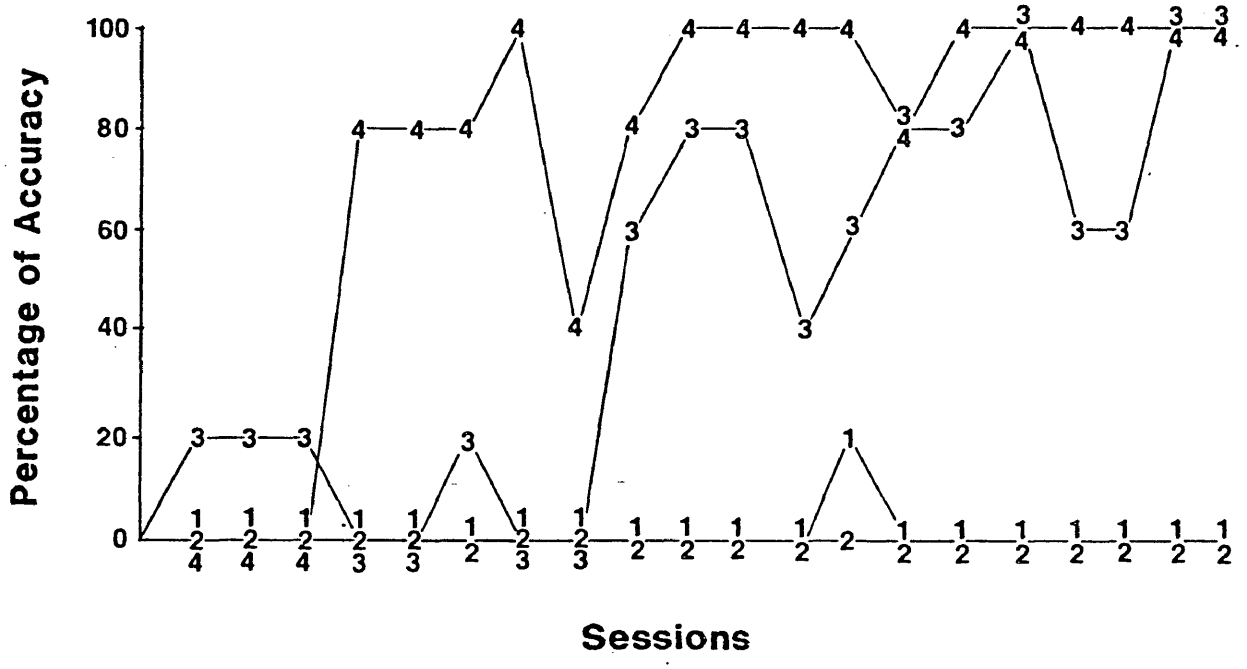


Figure 6
Probe
One-handed stationary (mirror)

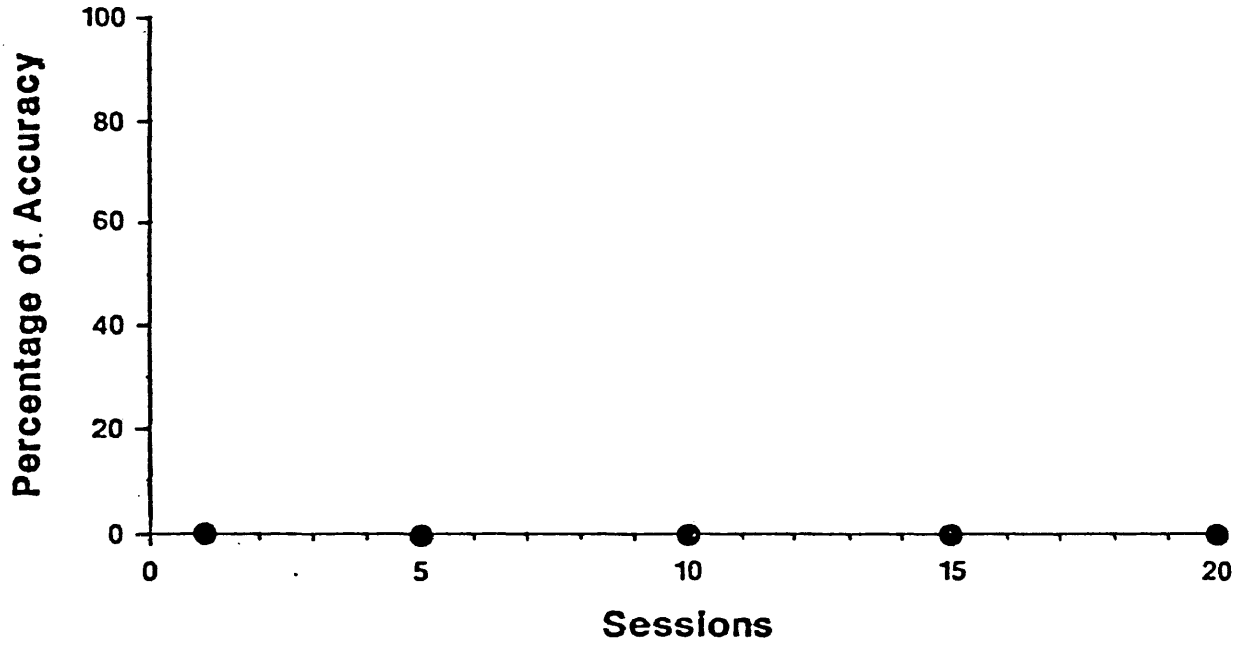


Figure 7
Probe
Two-handed stationary (plate)

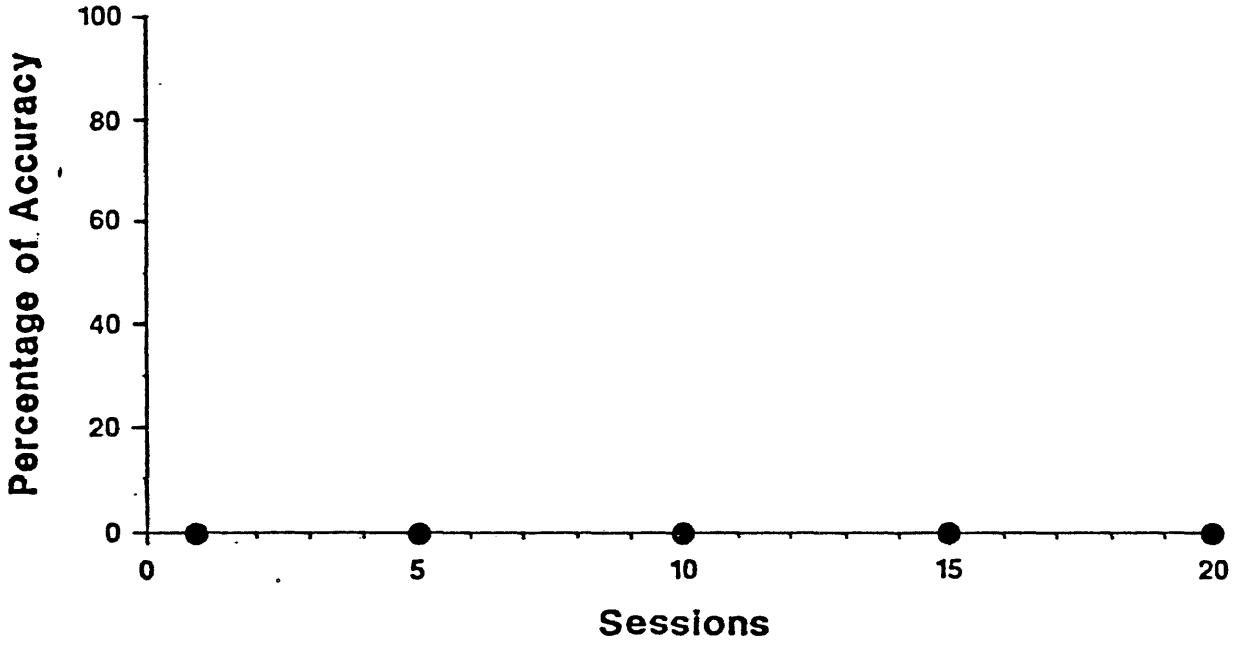


Figure 8
Probe
One-handed mobile (pencil)

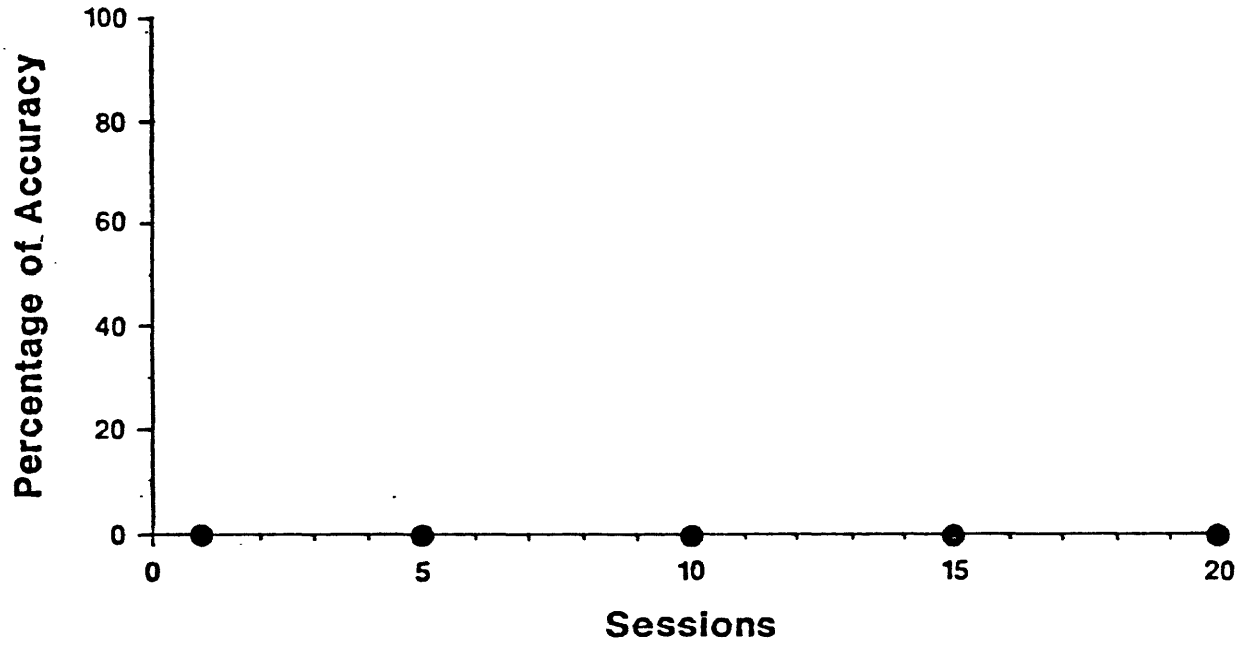
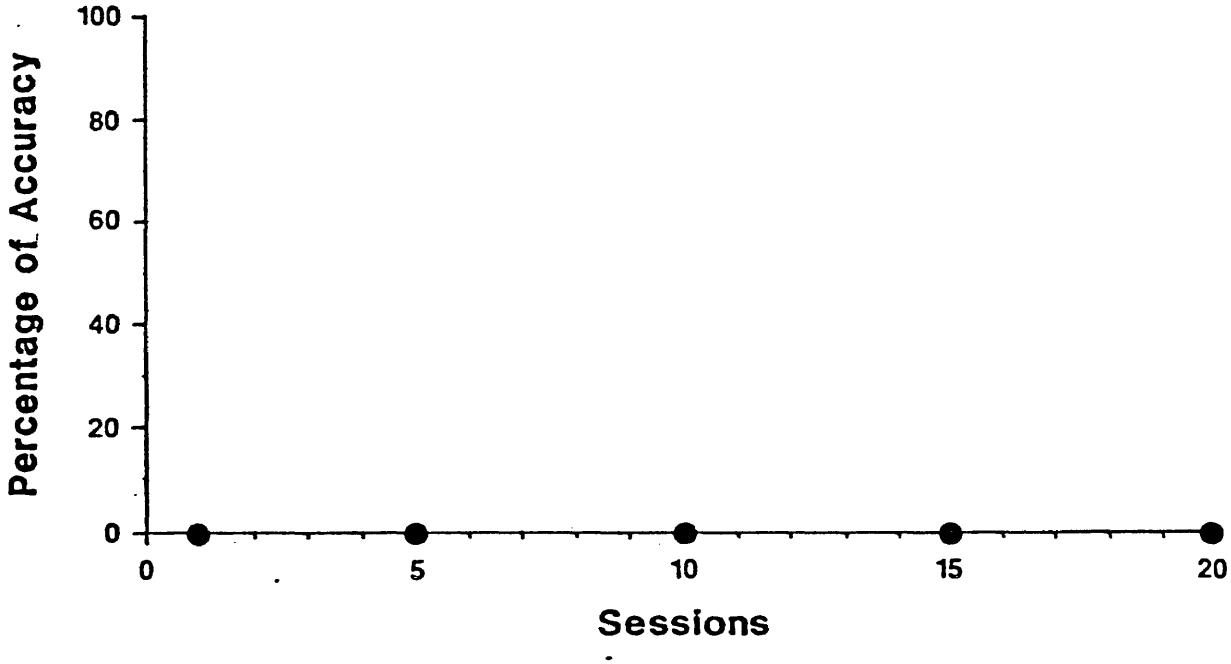


Figure 9
Probe
Two-handed mobile (coat)



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