SYMBOLIC LANGUAGE TRANSFER IN THE AUTISTIC CHILD

DISSERTATION

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The problem of this study is to see if there is more symbolic language transfer by autistic children in an untrained matching situation if there has been previous training on similar matching situations.

The purposes of the study are twofold. The first is to see if subjects will make a motor sign response untrained to an object if the word for the object has been trained to the motor sign response and to see if they will make a motor sign response untrained to a word for an object if they have been trained to make the response to the object named. The second is to see, if transfer occurs, whether the order presentations of object and word are a factor.

The population consists of children diagnosed as childhood autistics. The sample was drawn from children attending school at the Center for Behavioral Studies located in Denton, Texas. A total of six subjects were selected on the basis on their functioning level. Acceptable subjects were those who had no functional or spontaneous speech and no previous experience with sign language. All subjects had been diagnosed autistic by at least three reliable agencies or clinicians.

The general procedure for carrying out the study consisted of pairing a word to an object, and then pairing either the word or object to the motoric sign for that word or object. The tests for transfer trials were between the sign response and either the word or object, depending on which one had not been paired. For example, the word "ball" was paired to the object. Next the sign for "ball" was paired to the object. The transfer trials, therefore, consisted of pairing the sign with the word "ball." This was the basic procedure for all of the four words, objects, and signs employed.

The conditions of the study (Conditions 1, 2, 3, 4) were determined according to the two experimental groups. There were three subjects for each of the experimental conditions. Each ondition consisted of two phases. In Phase I of each condition, a printed word was paired with an object and then with a sign response, and the transfer probe was between the sign response and an object. Phase II of each condition paired the word to the object, then paired the sign response to the object, and testing was for transfer between the sign response and the printed word. Conditions 1 and 3 and Conditions 2 and 4 were the order presentations in each of the two phases, and in the subjects, words, objects, and signs employed. The differences between Conditions 1 and 3 and between 2 and 4 were objects, words, and signs used.

The research design for this study was a factoral experiment with one "between" factor and two "within" factors. Factor A, the "between" factor, was a test of order effects. Factor B, one "within" factor, was the training block. The other "within" factor, Factor C, tested the two phases under each training block.

The number of errors to criterion for the probe tests were analyzed using a three-factor analysis of variance with repeated measures on the last two factors.

The results of the ANOVA showed no significant differences on Factors A, B, and C, or on the interactions of AB or AC. All F scores were tested at the .05 confidence level. The results of the ANOVA, then, indicated that the groups did not differ due to the training procedures, nor did they show differences between the training blocks, or between the probe of the first phase of the Conditions as opposed to the second phase probe.

Even though the ANOVA for errors on the probe tests did not indicate learning by the subjects, the raw data indicated a trend in increased acquisition rate across blocks and phases. Therefore, further analyses were run to see if learning occurred during the training steps. A total of six more analyses were computed. All analyses were factoral designs with one "between" factor and two "within" factors.

The results of all of these additional analyses of variance showed that even though order presentation did not produce differences between the two groups of subjects, the first training block and the first phase of each training block did effect how all subjects performed on the second training block and the second phase of each training block.

Further analyses of the data were done with *t*-tests for correlated means. The results of these tests indicated three-dimensional discriminations were acquired more rapidly and with fewer errors than two-dimensional discriminations, and receptive language tasks were mastered with lesser difficulty than expressive language tasks.

Since it was shown that there were no significant differences resulting from order of presentation, it can be concluded that such procedures as were utilized in the study, while they might be of some benefit in working with autistic children, cannot be expected to contribute to transfer ability of autistics.

In addition, the study was concerned with group centered research, i.e., the parameters of transfer were derived from the means and variances from measures obtained from groups of subjects, and found that there was no significant evidence of transfer either within or between the groups. However, the raw data indicated that individual subjects did demonstrate varying degrees of transfer. This evidence, coupled with the recurring statements in the literature of variability of differences within the autistic population, leads to the conclusion that in studying transfer in this population, individual-centered research would be more profitable in finding relationships between the changing events of transfer.

Although this study did not establish a procedure for the remediation of conceptual malfunctions, it did provide a basis for an outgrowth of future research. A future study employing the same design as in this one could make the training steps comparable, thus allowing for comparisons between acquisition of receptive and expressive language tasks. In addition, an attempt to establish error-less learning discriminations on all four training steps instead of just the first two might result in positive transfer effects.

Since learning increased across training blocks, extention of training blocks might produce changes on probe tests. Another possibility would be training probe tests which were unsuccessful in demonstrating transfer. In other words, if subjects did not indicate transfer on a test step, treat the test step as a training step and see what occurs on the next test step. This procedure would reinforce subjects for making associations, something that was lacking in this study.

Additional procedural changes of this study could involve a receptive language rather than an expressive language probe test, or a series of reptitions of training steps prior to the probe test.

Other research could be in investigating the amount of stimulus control exerted by the components of the experimental conditions. Moreover, temporal and spatial decoding functions of autistic subjects could be assessed to determine the possibility of being confounding variables.

At this time the mechanisms involved in transfer in all populations are not understood, so perhaps when they are studied in autistic children, simpler tasks than symbolic language should be used.

The materials contained in Chapter I consist of an introduction to the study; the statement of the problem; purposes of the study; research hypotheses; background and significance of the study; a glossary of terms; and condensed descriptions of data collection procedures, research design, and analysis of data procedures. In Chapter II the review of the literature is divided into four major sections: (1) characteristics of autistic children; (2) behavior modification and autistic children; (3) conceptual behavior in autistic children; and (4) learning model studies involving transfer of learning. The methods and procedures chapter, Chapter III, deals with a description of the materials and equipment, a description of the population and sample, the procedures for the collection of the data, and the results of the procedure on two normal subjects. An analysis of the results of the study, including analysis of variance and *t*-test statistical designs, a short summary of these results, and conclusions derived from these findings are reported in Chapter IV. And the last chapter, Chapter V, deals with the discussion of the results and implication for future research.

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CHAPTER I

INTRODUCTION

A very important characteristic of human behavior is transfer of learning: the propensity to respond appropriately to new situations on the basis of what has been learned in prior circumstances. This is especially true of such complex behavior as language, reading, and reasoning (Spradlin, Cotter, and Baxley, 1973). Discussions of transfer in these areas generally include the term "concept." For example, in studies involving grammatical and lexical phenomena (Carroll, 1967), thinking (Bruner, Goodnow, and Austin, 1956), and language systems in the chimpanzee (Premack, 1970), this term is used. The definition of "concept" is very similar to that of "stimulus class" (Kendler, 1961; Osgood, 1956; and Goldiamond, 1962), and the two are often used interchangeably (Spradlin, Cotter, and Baxley, 1973; Whaley and Malott, 1971). Current studies indicate that if one member of a stimulus class (concept) is conditioned to control a new response, other members of that stimulus class may also control the new response (Shipley, 1935; Grove, Harton, and Cunningham, 1967; Arnold, 1970; Spradlin, Cotter, and Baxley, 1973). Because transfer appears to be prevalent in populations of varying capacity, it would be of interest to see if it occurs readily in an extremely aberrant population. Childhood autistics are one such population.

Childhood autism is one syndrome subsumed under the label "exceptional children." Rutter and Bartak (1971) characterize these children as having delays in speech development, ritualistic and compulsive behaviors, and abnormal responses to people. Among their interpersonal deficiencies are complete lack of emotion, aloofness from people and indifference toward them, and an inability to communicate. These social deficits are what interested clinicians in the early studies of autistic children (Kanner, 1943; Kanner and Eisenberg, 1956).

Recently, however, investigators in the field of childhood autism have changed their focus to an analysis of the autistic child's perceptual functioning (Wing, 1966; Rutter, 1966; Wing, 1969; Lovaas, Schreibman, Kolgel, and Rehm, 1971; Lovass, Litrownik, and Mann, 1971). In the last two decades, researchers in the field of language and learning disabilities have come to the conclusion that developmental lags and deviant behaviors may occur as the result of perceptual deficits (Strauss and Lehtenen, 1947; Myklebust, 1954; Kephart, 1960; Cruikshank, 1967; Kirk and Kirk, 1971). Most important to normal child development are the visual and auditory perceptual systems. Certain auditory and auditory-visual perceptual skills are necessary precursors to the development of more complex human behavior, such as concept formation. Studies have indicated large deficits in the autistic's auditory (Hoberman and Goldfarb, 1963; Wing, 1966; Rutter, 1966a; Davis, 1967; Wing, 1969) as well as visual modes (Hermelin and O'Connor and Hermelin, 1967; Wing, 1969). Also, there is evidence that, when confronted with a discrimination involving a multidimensional stimulus, the autistic child will selectively respond to only one dimension of the stimulus (Lovaas, Litrownik, and Mann, 1971).

If these perceptual deficits effect concept formation, then the lack of transfer may be a critical aspect of childhood autism. We know that autistic children can learn simple discrimination tasks and motor imitation responses, as well as various social and verbal skills, but somehow these learned abilities do not transfer to the environment in which they live. Obviously, we need to know more about the properties of transfer in this population.

Statement of the Problem

The problem of this study was to see if there is more symbolic language transfer by autistic children in an untrained matching situation if there has been previous training on similar matching situations.

Purposes of the Study

The purposes of this study were

1. to test for the presence of symbolic transfer under

two sets of experimental procedures designated as Condition 1 and Condition 3. Each condition consisted of two training and testing hases. The conditions were identical except for words, objects, and signs employed. Each condition had two phases:

a. Phase I of each of the experimental conditions consisted of training the sign response to the symbolic representation (word) of the object, and testing for transfer between the sign response and the concrete object (object probe).

b. Phase II of each of the experimental conditions consisted of training the sign response to the concrete object and testing for transfer between the sign response and the symbolic representation (word) for the object (word probe).

2. to test for the presence of symbolic transfer under two sets of experimental procedures designated as Condition 2 and Condition 4. Each condition consisted of two training and testing hases. The conditions were identical except for words, objects and signs employed. Each condition had two phases:

a. Phase I of each of the conditions consisted of training between the sign response and the symbolic representation (word) for the concrete object and testing for transfer between the sign response and the concrete object (object probe).

b. Phase II of each of the experimental conditions consisted of training the sign response to the concrete object and testing for transfer between the sign response and the symbolic representation (word) for the concrete object (word probe).

3. to see, if transfer occurred, whether the order presentations of concrete object and symbolic representation were a factor.

Hypotheses

1. Subjects receiving the object probe first would demonstrate transfer as seen in significant differences in number of errors to criterion.

2. Subjects receiving the word probe second would demonstrate transfer as seen in significant differences in number of errors to criterion.

3. Subjects receiving the word probe first would not demonstrate transfer as seen in significant differences in number of errors to criterion.

Background and Significance

Childhood autism has only recently been recognized as a diagnostic category. Evidence of it in the literature has been within the last thirty years. It was at this time that autism was recognized as a syndrome distinct from mental retardation (Copel, 1967). Kanner (1943), in his article "Autistic Disturbances of Affective Contact," made the first identification of childhood autism. He believed the behavior of the eleven children he described to be significantly different from that of retarded individuals and, thus, that it should have a separate classification. Other researchers are in agreement with this conclusion (Ritvo and Provence, 1953; Pronovost, 1961; Rimland, 1964; Copel, 1967).

A diagnosis of autism is based on a unique profile of behaviors. One of the major distinguishing characteristics of the autistic child is some type of speech disorder (Rimland, 1964; Wing, 1966; Pronovost, Wakstein, and Wakstein, 1966). One common deviant speech pattern is echolalia (Wing, 1966; Rutter, 1965; Rutter, 1966a; Pronovost, Wakstein, and Wakstein, 1966). When spontaneous speech does occur in these children, it usually is disordered in some manner (Rimland, 1964; Rutter, 1965; Wing, 1966; Pronovost, Wakstein, and Wakstein, 1966). And it often has a strange, mechanical sound (Kanner and Eisenberg, 1955; Kessler, 1966; Rutter, 1966a; Rutter, 1966b).

Understanding speech often is as difficult as is producing it for these children (Wing, 1966). Autistic children appear to be unresponsive to the spoken word (Hermelin and O'Connor, 1963; Pronovost, Wakstein and Wakstein, 1966; Rutter, 1966a; Wing, 1966). These children's responses to commands are inconsistent; and, when they do respond to commands, ancillary cues are present (Wolf and Ruttenberg, 1968).

Visual perceptual skills are believed to be disordered according to some researchers (Hermelin and O'Connor, 1964; Hermelin and O'Connor; 1965; Wing, 1966; O'Connor and Hermelin, 1967; Wing, 1969). Wing (1966; 1969) found that autistic children have a preference for peripheral vision. Therefore, they tend to look past people and objects, twist their fingers to the side of their face, and more readily recognize moving objects as opposed to stationary ones. These types of responses are indicators of visual perceptual disorders (Wing, 1966; Wing, 1969).

Related to these perceptual abnormalities are the temper tantrums, overactivity, and short attention span which occur in early and middle childhood (Rutter, 1966a; Wing, 1966). A high occurrence of head-banging, biting oneself, or clawing oneself, and other self-injurious behaviors are also prevalent in this population (Rutter, 1966a).

As the development of conceptual behavior is dependent upon sensory input through the auditory and visual channels, deficiencies in these modalities, coupled with maladaptive, injurious responses, interfere with normal decoding of the environment. Perhaps a more formidable deficiency becomes apparent through casual observation of normal children. The normal child acquires conceptual formations, not by environmental shaping of each instance, but by seeing others behave; he learns conceptual behavior through imitation. While Rutter (1966a) and Wing (1966) found self-stimulatory, stereotyped, repetitive movements, such as rocking and finger movements to be very common, while imitation of other people's movements occurred very rarely (Ritvo and Provence, 1953; Kessler, 1966; Lovaas, 1967).

According to Bruner and his associates (1956), concepts serve the essential function of partitioning sensory inputs into manageable proportions, thus reducing their complexity. "Categorization serves to cut down the diversity of objects and events that must be dealt with uniquely by an organism of limited capacities" (p. 245). This simplification function allows for a viable economy of time and effort in dealing with the environment. Perhaps even more important, however, is that knowing a perceived object is an instance of a stimulus class provides a great deal of information concerning that object which is not immediately perceptible. What is known by information of its class membership is virtually all that it can do to an organism as well as what can be done to it (Flavell, 1970). If autistic children do not partition their sensory inputs into manageable stimulus classes, this is important information concerning their reasoning abilities. For reasoning ability, according to Berlyne (1970), involves the establishment of a new stimulus response association based on previously learned associations that differ from the new association in their response terms, their stimulus terms, or both.

Although the literature indicates some of the functional relationships involved in transfer, or concept formation, in the retarded population, little has been done in this area in the field of childhood autism. The traditional approach to the study of conceptualization in autistic children places "severe limitations on the possibility of statements pertaining to (a) the precise aspects of the treatment situation that are affecting the patient's behavior, (b) the function of those aspects, and (c) the quantification of the relationship between treatment and change in behavior" (Lovaas, 1967). The present study is significant in that it attempted to add to the literature some information concerning the functional relationships involved in the conceptual behavior of autistic children.

In the present study, matching printed words to objects and objects to printed words might be regarded as simple reading comprehension; matching objects to sign responses could be simple visual comprehension; matching printed words to sign responses may be considered as visual receptive reading; and matching sign responses to printed words may be called visual expressive reading. Thus, the study could have some relevance both to the principles and practicalities of teaching elementary reading. However, this study was concerned with finding out if there was transfer under specified conditions. An attempt was made to determine if new matching-to-sample performances, not directly taught, could be generated out of a process involving receptive acquisition on the part of the subject.

Definition of Terms

The following terms will have restricted meaning and are thus defined for this study:

Stimulus class--A set of stimuli which control similar responses. For this study, a stimulus class consisted of an object, a printed word name of the object, and signed response for the object.

Concept--The stimulus class which controls behavior.

Concept formation--Refers to an individual's behavior coming under the differential control of a stimulus class (Millenson, 1967).

Conceptual behavior--When the subject responds the same way to all of the stimuli in a stimulus class, but does not respond in that way to stimuli outside that class. In other words, it consists of transfer within a stimulus class and discrimination between that class and other stimulus classes.

Response class--A grouping of all responses which have at least one common characteristic.

Response equivalence--When responses B and C are controlled by stimulus A, then B will tend to control C just as C will tend to control B (Jenkins and Palermo, 1964).

Transfer--When a subject responds to different stimuli in a manner similar to those previously trained.

Generalization--Used interchangeably as transfer.

Discriminative stimulus (S^D)--The stimulus with which reinforcement is associated during discrimination training. If a response which has been associated with a discriminative stimulus is emitted in the presence of that discriminative stimulus, it will be reinforced.

S^{delta} (S^{Δ})--The stimulus which is not associated with reinforcement during discrimination training. During training if a subject makes a response in the presence of S^{delta} which has been trained in the presence of S^D, the response goes unreinforced and will decrease in strength.

Discrimination training--A subject learns to respond in the presence of a discriminative stimulus and not in the presence of S^{delta}.

Stimulus control--Established if a change in some aspect of the antecedent stimulus results in a change in some manner of responding (Terrace, 1966).

Sign response--Visual language involving motor representation of a thought rather than finger spelling. For instance, the idea "hat" is signed by placing the palm of the right hand on the top of the head.

Baseline--A norm of untrained responses, enabling assessment of the change which occurs following the experimental conditions. The norm is established in an observation period prior to the introduction of the experimental procedures.

Trials-to-criterion--Number of trials it takes to master the designated task including no response trials, terminated trials, incorrect trials, and correct trials.

Errors-to-criterion--Number of incorrect and no responses until mastery of designated task.

Termination of a trial--The ending of a trial which is signalled by turning off the red and the white lights and removing the stimulus array from the table for three seconds.

Transfer probe/probe test/probe test step--The fifth step in each phase which tests if the sign response will be made to a previously untrained stimulus.

Word probe--The transfer probe employing a printed word as the previously untrained stimulus.

Object probe--The transfer probe employing an object as the previously untrained stimulus.

Phase I--The experimental procedure which consists of training a printed word to an object and then to a sign response, and testing to see if the sign response will be made to a previously untrained object.

Phase II--The experimental procedure which consists of training an object to a printed word and then to a sign response, and testing to see if the sign response will be made to a previously untrained printed word.

Procedure for Collection of Data

The population for this study consisted of children classified according to Kanner's (1943) diagnosis of early infantile autism. The sample consisted of six autistic children attending the Center for Behavioral Studies, in Denton, Texas.

The general procedure for carrying out the study consisted of training a word to an object, and then training either the word or object to the motoric sign for that word or object. The test for transfer trials were between the sign response and either the word or object, depending on which one had not been trained. For example, the word "ball" was trained to the object. Next the sign for "ball" was trained to the object. The transfer trials, therefore, consisted of pairing the sign with the word "ball." This was the basic procedure for all four words, objects, and signs employed.

The conditions of the study were determined according to the two experimental groups. There were three subjects for each of the experimental conditions. Each condition consisted of two phases. In Phase I of each condition, a printed word was paired with an object and then with a sign response, and the transfer probe was between the sign response and an object. Phase II of each condition paired the word to the object, then paired the sign response to the object, and testing was for transfer between the sign response and the printed word. The differences between Conditions 1 and 3 and Conditions 2 and 4 were the order presentations in each of the two phases, and in the subjects, words, objects, and signs employed. The differences between Conditions 1 and 3 and between 2 and 4 were objects, words, and signs used. A complete delineation of training and testing procedures follows in a subsequent chapter.

Research Design

The research design for this study was a factoral experiment with one "between" and two "within" factors; an AxBxC design with repeated measures on the last two factors (Winer, 1971). Factor A, the "between" factor, was the assignment of subjects to Conditions 1 and 3 or Conditions 2 and 4. Factor B, one "within" factor, was the training blocks--Conditions 1 and 2=B_1; Conditions 3 and 4=B_2. The other "within" factor, Factor C, consisted of the two phases in each condition.

Procedure for Analysis of Data

Errors to criterion for the probe tests were analyzed using a three-factor analysis of variance with repeated measures on the last two factors. The critical comparisons were between B_1 and B_2 on Conditions 1 and 3 and Conditions 2 and 4, as illustrated by the following diagram:

Conditions 1 and 3	A_1	B_1	A_2	B_2
Conditions 2 and 4	B_1	A_1	B_2	A_2

CHAPTER II

REVIEW OF THE LITERATURE

The review of the literature was divided into four major sections: (1) characteristics of autistic children; (2) behavior modification and autistic children; (c) conceptual behavior in autistic children; and (4) learning model studies involving transfer of learning.

Characteristics of Autistic Children

Psychotic or "schizophrenic"disorders in children became of interest to investigators during the 1930's (Potter, 1933; Bradley, 1941; Bender, 1947). However, it was not until the classic paper on autism by Leo Kanner in 1943 that an attempt was made to differentiate character disorders within the group of children with so-called "childhood schizophrenia" (Rutter, 1968). The characteristics of the autistic syndrome, as Kanner described it, were an inability of these children to relate themselves to other people, mutism, or a kind of language that did not seem intended to serve interpersonal communication, an exceptional rote memory, and an obsessive desire for the preservation of sameness. He emphasized the very early onset of the condition which makes it different from other cases of childhood schizophrenia. His major premise, at the time of his article, was that autism represented an innate disturbance of affective contact (Rutter, 1968).

The terms "childhood psychosis" and "childhood autism" are often used synonymously. But autism is generally considered to be a syndrome subsumed under the more general term "childhood psychosis." It has been suggested that the two terms have been used interchangeably because autism is the most important type of childhood psychosis.

Most authors do agree, however, that autism is not the only type of childhood psychosis (Kessler, 1966). There appear to be three main groups of psychotic disorders which develop in childhood, and these are most easily defined according to age of onset (Eisenberg, 1967; Rutter, 1967a). The first variety begins a year or so before puberty and is similar to schizophrenia as seen in adults. The second type of psychosis begins about the age of four or five. Here the child develops normally, and then, sometimes following a rather vague illness, he loses his speech, becomes overactive, and generally regresses. A similar clinical picture sometimes develops after brain disease such as encephalitis, but even in the cases where no overt brain disease is evident, the subsequent course of regression provides evidence of a degenerative brain condition (Kanner, 1949; Benda, 1952; Anthony, 1958; Creak, 1963). Occasionally a differential diagnosis from autism is difficult, if not impossible, to obtain. But it seems that these disorders are basically a type of chronic brain disease and different from autism as Kanner described it (Rutter, 1968). The third type of disorder follows Kanner's description and develops in early infancy but occasionally in the second or rarely in the third year (Eisenberg and Kanner, 1965; Kanner and Lesser, 1958).

As noted earlier, Kanner first believed autism to be an inborn disturbance of affective contact, but later he placed greater emphasis on the obsessive qualities and emotional distance of the children's parents (Kanner and Eisenberg, 1955; Eisenberg and Kanner, 1956). Recognizing an inborn problem, he went on to say that part of the disorder was due to a lack of affection and caring from the parents. Since that time other writers have gone on to suggest that autism is mainly, if not solely, due to psychogenic factors (Despert, 1951; Goldfarb, 1961; Meyers and Goldfarb, 1961; Bettelheim, 1967).

The antithesis to the psychogenic basis for autism is the behavioral viewpoint that autism is environmentally determined. Krasner and Ullman (1965) state that the aberrant behavior patterns of these children are due to differential reinforcement. Or, as Ferster (1961) states it, "the children have not been properly conditioned."

Many writers claim that the disorder is due to organic brain disease (Bender, 1947) which may have originated in difficulties during pregnancy or birth (Knobloch and Grant, 1961).

The reticular system has been implicated as being the problem according to some writers. Rimland (1964) believes the problem is due to the underactivity of the reticular system, while Hutt and his associates (1965a, 1965b) attribute autism to over-arousal of the system.

Other writers note the autistic child's abnormal responses to sounds, smells, and sights and have suggested that there is a basic defect in perception (Stroh and Buick, 1961).

The autistic child's lack of response to sound has received the most notice (Anthony, 1958; Goldfarb, 1961; Rutter, 1966a), leading some writers (Rutter, 1966a; Wing, 1966) to hypothesize that the main defect is an inability to comprehend sounds.

There are a wide variety of other views of autism. Van Krevelan (1952) considers autism a variety of mental retardation, while Goldfarb (1961) suggests it should be sub-divided into organic and psychogenic varieties. Most writers talk about autism as an interaction between innate defects and influences in the environment. But O'Gorman (1967) has taken the idea of multifactorial causes to its most ridiculous limit by attributing autism to schizophrenia, a psychosomatic disorder, genetic over-breeding, emotional disturbances, and possibly a consequence of a defect in lead metabolism.

Prior to Kanner's article, most children currently classified as autistic were diagnosed as mentally retarded (Rutter, 1968). Even though seventy to eighty per cent of autistic children are functionally retarded, that is, on standard intelligence tests and social behavior inventories, they function at the retarded level (Rutter, 1965; Lockyer and Rutter, 1970), they cannot be considered as merely another variety of mental retardation (Rutter, 1968). Normal intelligence is found in one-fourth to one-third of these children. The behavioral characteristics of the functionally retarded children are very similar to those of children functioning in the normal range, making the idea of mental retardation insufficient in accounting for autism (Rutter, 1965; Rutter and Lockyer, 1967).

In addition, autistic children do not have the flat profile on an intelligence test that is characteristic of retarded children. Characteristically autistic children were found to do poorly on those parts of the intelligence test that required the use of language and abstract thinking, but relatively well on puzzle-type subtests (Gilles, 1965; Rutter, 1968; Lockyer and Rutter, 1970). This pattern of scores was found to be related to language development, and it was concluded that the autistic child's poor functioning level could to some extent be related to specific language defects rather than over-all intellectual deficiency (Rutter, 1966a).

Wing (1966) found that the severe interpersonal deficiencies of the autistic, such as lack of eye contact, isolated play, and no bonds of friendship occurred less frequently and far less intensely in the retarded population. Motorically, autistic children show no developmental delays; they are graceful, agile, and, furthermore, do not look retarded (Rimland, 1964).

Until very recently, autism was considered a very early manifestation of schizophrenia (Creak, 1963). This view is based on the severe difficulties in interpersonal relationships evident in both autism and schizophrenia (O'Gorman, 1967). There are major differences between the two, however. Autism is found three to four times as often in males (Rutter, 1966a), whereas schizophrenia occurs equally in the two sexes (Mayer-Gross, Slater, and Roth, 1955). Parents of autistic children were found to be above average and in higher socioeconomic classes in a study by Lotter (1967), while schizophrenics have the same social background as the general population. Schizophrenia appears to run in families (Shields, 1967), but it is not found in families of autistics (Rutter, 1967a). Schizophrenics do not have the wide scatter pattern on intelligence tests that is found in the autistic population (Rutter, 1966a). Delusions and hallucinations, very common symptoms in schizophrenia, are rarely if ever found in autistics, even in adolescence and later life (Rutter, 1966b). And finally, the course of autism appears steady as compared to the history of remissions and relapses found in schizophrenia (Rutter, Greenfeld, and Lockyer, 1967).

The diagnosis of autism is based on a unique profile of behaviors (Rimland, 1964; Wing, 1966, 1976). The characteristics of those children with severe behavioral disorders which begin in very early life are "autism," language development abnormalities, compulsive and ritualistic behaviors, and stereotyped movements (Norman, 1955; O'Gorman, 1967; Rutter, 1966a; Rutter and Lockyer, 1967; Wing, 1966; Rimland, 1964). "Autism" is a term which describes the abberrant interpersonal behaviors of aloofness and distance from people, inability to form lasting relationships, lack of eye-contact, disinterest in other people, especially other children, no feelings of empathy or compassion for others, no appreciation of the subtleties of humor, and little change in facial expression (Rutter, Greenfield, and Lockyer, 1967; Rutter, 1968; Wing, 1966, 1976). These aberrant responses to people were the primary interest of the first clinicians involved in the study of autistic children (Kanner, 1943; Kanner and Eisenberg, 1955).

Kanner felt that the behavior patterns of autistic children could be explained by their lack of affective contact and their insistence on sameness. However, developments in the study of autistic children, combined with studies of language development in normal and handicapped children have changed the focus of most investigators to the perceptual dysfunctions of these children (Wing, 1966; Rutter, 1966a; Lovaas, Schreibmann, Koegel and Rehn, 1971; Lovaas, Litrwik and Mann, 1971; Wing, 1976. More authorities have come to accept the premise that developmental lags and aberrant behaviors may occur as a result of perceptual defects (Strauss and Lehtinen, 1947; Myklebust, 1954; Kephart, 1960; Cruikshank, 1967; Kirk and Kirk, 1971). It has been found that visual and auditory perceptual systems are particularly important to normal child development (Wing, 1976). Some clinicians involved in the study of autistic children have begun to consider the idea that the behavioral defects and aberrant behavior of these children may be by-products of certain perceptual disorders, particularly auditory or visual. The new formulations emphasize underlying organic impairments, especially cognitive problems, affecting the comprehension and use of linguistic symbols and interpretation of sensory experiences (Wing, 1976).

The autistic child's lack of response to sound has probably received the most interest (Anthony, 1958; Goldfarb, 1961; Rutter, 1966a). According to Hoberman and Goldfarb (1963) and Wolf and Ruttenberg (1968), aberrant responses to sound are parents' first indicators that something is wrong with their children.

In a study by Hermelin and O'Connor (1963) the responses of autistic children to simple commands or questions were much lower than those in a subnormal group. Rutter (1966a) found that the children in his study were unresponsive to the spoken word. Other investigators report that not only is response to the spoken word minimal, but also that when these children did respond to auditory commands, their responses were controlled by situational cues or gestures rather than by specific words (Pronovost, Wakstein and Wakstein, 1966; Wolf and Ruttenberg, 1968). Parents of autistic children report noticing difficulties in comprehending speech at some time in the child's development (Wing, 1966).

Strauss and Kephart (1955) report that auditory defects can result in severe behavior disorders such as a lack of both receptive and expressive speech. In Rutter's study (1966a) he found evidence of a marked lack of response to sound. The major difference between the autistic and subnormal populations in his study was the failure of the autistic group to respond to sound. In addition he found the autistic children to be even more unresponsive to the spoken word than to sound in general. Other writers have found responses to both speech and nonspeech sounds in mute autistic children were either completely absent or at least markedly depressed (Pronovost, Wakstein and Wakstein, 1966). In a study by Davis (1967) in a structured auditory environment the most advanced skill that two-thirds of the autistic children had was localization of sound. In her follow-up study (Davis, 1970) she found that once again in a structured environment the children could localize sound, but could not match sounds of simple noise-makers. In an unstructured environment, however, the autistic children did not respond to speech or nonspeech sounds. Autistic childrens' unawareness to sound is so pronounced that a hearing loss is suspected sometime during their development (Hoberman and Goldfarb, 1963). In studies by Rutter (Rutter, 1966a; Rutter and Lockyer, 1967) one-third of the children had been thought to be deaf at one time or another.

Hoberman and Goldfarb (1963) contend that auditory problems of autistic children are not only unawareness of sound, but also over-alertness, fear, and apprehension to sounds. They found that at one time a child may cover his ears at the sound of rustling leaves, and at other times completely ignore loud and shattering noises. This hypo- and hyper-sensitivity to sound is usually found in the same child (Goldfarb, 1963). Other investigators have also found excessive responses to sounds (Rutter, 1966a; Wing, 1966; Goldfarb, 1964; Wolf and Ruttenberg, 1968). According to Wolf and Ruttenberg (1968) one of the major symptoms of childhood autism is abnormal response to sound.

Not only do autistic children have difficulty understanding speech, they also have a great deal of trouble producing it (Wing, 1966, 1976). About fifty per cent of autistic children never acquire functional speech (Kanner and Eisenberg, 1955; Rimland, 1964; Lockyer and Rutter, 1967). The children who are mute are so from birth, or lose speech after early, initial development (Wing, 1966). Those children who do speak have definite abnormalities and retardation in communication (Kanner, 1943; Rimland, 1964; Rutter, 1965; Wing, 1966, 1976; Pronovost, Wakstein and Wakstein, 1966). In those children who do speak, echolalia is the most common deviation (Wing, 1966, 1976; Rutter, 1966, 1966a; Pronovost, Wakstein and Wakstein, 1966). Echolalia is where the child repeats words and/or sentences he hears, but it is not spontaneous speech. Echolalia is parrot-like speech. It can either be immediate--as in the case of asking the child what his name is and his repetition of the question as an answer--or, delayed--as in the repetition of something heard at some prior time, such as a commercial or statement from a parent.

Expressive, spontaneous speech, when found in autistic children is also disordered in some way. The child's speech often has a strange mechanical quality. Other speech problems include a special voice, pronominal reversal, confusion of words, fragmented sentences, over-concrete language, and incorrect word order (Kanner, 1943; Kanner and Eisenberg, 1955; Rutter, 1965, 1966a, 1966b; Rimland, 1964; Kessler, 1966; Pronovost, Wakstein and Wakstein, 1966; Wing, 1966, 1976). In addition other common abnormal speech problems include monotonal speech, with frequent high pitched sounds, lack of inflection (except in echoed speech), unusually extreme variations in intensity, harshness, hypernasality, and hoarseness often interspersed with the normal voice, and usually inappropriateness of the speech to current situations (Rimland, 1964; Pronovost, Wakstein and Wakstein, 1966; Wing, 1976).

Level of speech development appears to be one of the major indicators of future functioning in the autistic child. Kanner and Eisenberg (1955) found in their follow-up study of Kanner's original population that those children who had not developed speech by their fifth birthday had remained at a very low functioning level. Other investigators have found similar results (Brown, 1960; Rutter, 1966).

Visual perceptual skills are also disordered in autistic children (Wing, 1966, 1969; Hermelin and O'Connor, 1964, 1965). It has been reported that some autistic children were suspected of being blind (Wing, 1966; Rutter, 1966), but these findings are rather uncommon. Autistic children have a preference for peripheral vision over central vision. Thus, they tend to look past or through objects and people, engage in twirling objects and fingers to the side of their face, and recognize moving objects more readily than stationary ones (Wing, 1966, 1969, 1976). Hermelin and O'Connor (1964, 1965, 1967) conducted a series of investigations and reported finding that autistic children, when given a choice, selected tactile stimuli over visual ones, and also that speaking autistics could learn a visual discrimination while the mute children could not. In addition they found that autistic children spend less time looking at cards with displays on them than do normal and subnormal children. Instead the autistic children spent their time engaged in non-directional gazing.

There is evidence to suggest, however, that some autistic children do not have visual problems, and in many cases demonstrate superior functioning in form perception (Kessler, 1966). Kanner (1943) reported high performance on the Sequin Formboard in his original population. Other investigators have found advanced form perception as evidenced by exceptional skill in working jig-saw puzzles, often with the picture side down, and in the assembling and dismantling of mechanical or electrical apparatuses (Ritvo and Pronovost, 1953; Mittler, 1966; Kessler, 1966).

Wing (1966) found in many instances autistic children actively seek certain visual stimuli. Fascination with lights and shiny objects occurs as early as infancy. Spinning things have a special attraction for these children. In studies involved with increasing vocalizations, flashing lights were found to be powerful reinforcers (Fineman, 1968a).

Although the olfactory, gustatory, and tactile senses have not received a great deal of experimental study, anecdotal accounts of these senses have been reported. Often these children have unusual tastes and eating peculiarities such as drinking only milk, or only from transparent glasses (Witmer, 1920, Rimland, 1964). Rutter (1966a) and Wing (1966) report that autistics often touch and smell new objects.

Grossly deviant behavior patterns such as ritualistic compulsive behaviors are typical of autistic children. Many of the children become extremely distressed when their routines are interrupted. One common type of this compulsive behavior is an abnormal attachment to a certain object. Another example is the constant shaking or twirling of objects. These compulsions appear to be manifestations of what Kanner (1943) termed "insistence on sameness." So strong is this attachment to a particular structure in their environment they become extremely upset with any change in their lives (Kanner, 1943; Rutter, 1966; Wing, 1966, 1976). Apparently related to this preservation of sameness is the amazing ability of these children to store items in their memory for long periods and recall them exactly as when first experienced (Rimland, 1964; Rutter, 1966; Wing, 1976).

While self-stimulatory, repetitive stereotyped behaviors such as finger movements and rocking occur at a high frequency (Rutter, 1966; Wing, 1966), imitation of other people's movements occurs rarely, if at all (Ritvo and Provence, 1953; Lovaas, 1967). Overactivity and poor attention occurs during early childhood but tends to diminish in later life (Wing, 1966, 1976). Temper tantrums, head banging, and other self-injurious behaviors are prevalent in the autistic population (Rutter, 1966a; Wing, 1966, 1976).

Behavior Modification and Autistic Children

Initial investigations involving behavior modification techniques and autistic children were conducted by Ferster and DeMyer (1961, 1962). These studies demonstrated that autistic children could learn discrimination and match-to-sample tasks through the application of reinforcement principles. Response acquisition was noted as being a very gradual process, however.

The major emphasis of training procedures with autistic children has been in the area of speech development. Success in establishing speech repertoires in formerly mute autistic children has been due to imitation training and differential reinforcement procedures (Mann and Baer, 1971). Teaching speech is a tedious and complicated process. Perhaps the most widely accepted program for teaching speech to mute autistic children was developed by Lovaas and his associates (Lovaas, Berberich, Perloff and Shaeffer, 1966; Lovaas, 1967, 1968). Their procedure consists of four stages: (1) reinforcement of any imitation or approximation to the sound presented by the trainer, (2) reinforcement of imitations of approximations within a six second interval following the sound presentation of the teacher, (3) reinforcement following imitation of the trainer's sound, (4) reinforcement following discrimination between a new sound and the previously learned sound. Lovaas has successfully used this program to teach mute autistic children to imitate sounds and words. When the child can successfully imitate words, he is taught more complex forms of speech (Lovaas, 1967). This procedure consists of initially labelling objects; then, applying these labels to the concepts of time and space; and finally combining the two in spontaneous speech taught in the form of descriptions, questions, and requests.

Hewett (1965) began a speech traning program for a four and one-half year old mute autistic at a more elementary level. First the child was trained to drop a ball in a box in order to receive access to the trainer. Second he was taught to imitate motor movements and to follow commands. And third, he went through a speech program similar to the one described by Lovaas. After six months the child had acquired thirty-two word imitations.

A more elaborate training program was used by Schell, Stark, and Gidden (1967). In the first phase of treatment with a four and one-half year old mute autistic boy, the child was taught to match colors, shapes, pictures of objects, and two letters. The next phase involved the pressing of a lever upon the presentation of an auditory stimulus. The third phase introduced speech training where the boy was initially reinforced for any vocalization, and then only for three sound imitations. The follow-up study (Stark, Gidden, Miesel, 1968) was an extension of the speech training program. When a consonant sound was imitated, it was placed into a vowel-consonant or consonant-vowel combination and then into a consonant-vowel-consonant combination. Concomitantly the child was reinforced for correct sound verbalizations to the letters M, P, and O. When he had learned this task, he was reinforced for correct vocalizations to the MO and PO combinations. He then learned to identify his mother and father through a process of learning to read MO when placed beneath a picture of his mother and PO when under his father's picture. More than a dozen labels were learned this way.

Hingtgen, Coulter and Churchill (1967) taught over two hundred motor imitations and some sound imitations to two institutionalized nonverbal autistic children in a twenty-one day period. In addition, they trained the parents and ward attendents of these children in the utilization of behavior modification techniques. Consequently, a five month follow-up showed the boy could name over two hundred objects and pictures, and spontaneously express simple requests. In addition, he was learning simple descriptive sentences as well as answers to questions. The girl could name some body parts and label some pictures and objects.

Metz (1965) used token reinforcement in teaching imitative responses to two mute autistic children. He found that these children could learn to imitate on specifically trained tasks, and that the learning generalized to similar but new imitative tasks where specific training and specific rewards were not given. In addition, as appropriate learning occurred, inappropriate motor and emotional behaviors spontaneously disappeared. Other investigations have had similar success in establishing verbal repertoires in formerly mute autistic children (Fineman, 1968a, 1968b; Browning, 1971; Sherman, 1965; Pronovost, Wakstein and Wakstein, 1966; Blake and Moss, 1967).

Hewett (1964) taught a mute twelve-year-old autistic boy to communicate through written language. He first was reinforced for picking up objects on command; then for drawing pictures of the objects; then for drawing pictures of the objects on command. The next phase of training consisted of substituting the objects with pictures of the objects. The boy was taught to pick up the pictures on command, and then to match words to the pictures. In this way he learned to label many objects and to express his wants through simple written phrases. Marshall and Hegrenes (1971) used a similar procedure with a seven-year-old nonverbal autistic child. And Villiers and Naughton (1974) were able to establish comprehension and production of simple commands, descriptions, and questions in two autistic children through the use of a "particle language," consisting of English words on magnetic chips.

Functional behavior has also been established in echolalic autistic children through the application of behavior modification techniques (Johnston, 1968). Wolf, Risley, and Mees (1964) treated a four and one-half year old echolalic boy. He was taught to name pictures and objects and to answer simple questions. In addition his severe behavior patterns were eliminated and he was taught to wear his glasses through contingent reinforcement. He attended a nursery school where behavior modification was used by his teachers, and after four years of treatment, he had the language of a normal five year old (Wolf, Risley, Johnston, Harris, and Allen, 1967). Other investigators have established question answering and object and picture naming in echolalic children using behavior modification techniques (Nelson and Evans, 1968; Risley and Wolf, 1967; Marshall and Hegrenes, 1971).

Conceptual Behavior in Autistic Children

"Abnormalities in the handling of symbols and in the development of language and other forms of communication are prominent features in early childhood autism (Ricks and Wing, 1976)" p. 134. Rimland (1964) asserts that the most critical disability of autistic children is their apparent inability to relate new stimuli to past experience. They do not seem to have the ability to relate sensation to memory. Because of this inability to derive meaning from his experiences, the autistic child "cannot understand relationships, nor think in terms of concepts, symbols, analogies or abstractions; and...cannot integrate his sensations into a comprehensible whole (Rimland, 1964) p. 79. It is not that autistic children do not classify on the basis of their concrete experiences, but rather a difficulty in handling symbols (Wing, 1976). Churchill (1972) found that symbolic language processes were deficient in these children even when the mechanics of speech were present.

Scheerer, Rothmann, and Goldstein (1945) were the first to hypothesize that the underlying dysfunction of early infantile autism is an inability to think conceptually. Manifestations of this impairment are such things as pronominal reversal, concrete language, lack of adaptability to environmental changes, unimaginative play, and lack of understanding and use of gestures (Scheerer, Rothmann and Goldstein, 1945; Polan and Spencer, 1959; Goldstein, 1959; Rimland, 1964; Ricks and Wing, 1976). An examination of the abnormalities of language and communication presents the most striking evidence of the autistic child's lack of conceptualization. Echolalia is found in three-fourths of speaking autistic children (Rutter, 1965; Wing, 1971). Meaningless echolalia is the condition where the child repeats words, phrases, sentences, or whole conversations exactly as heard, many times imitating perfectly the inflection as well as the accent of the original speaker without interest in what is being said, and without relevance to the current situation. Children who exhibit meaningless echolalia are able to store words and to reproduce them when an appropriate stimulus occurs, but without understanding. This apparently is not symbolic activity, but more probably an automatic response (Arnold, 1960; Ricks and Wing, 1976). Even when phrases are used appropriately, they are an exact reproduction of the words associated with occasions when needs were satisfied (Kanner, 1943; Scheerer, Rothmann, and Goldstein, 1945; Goldstein, 1959; Bettleheim, 1967; Creak, 1963; Rutter, 1966; Wing, 1976). Examples of this are the boy who always called his grandmother "55" because he once heard her referred to as being 55 years old; and the child who always said "Don't throw the dog off the balcony" when he was about to do something wrong because his mother had used the phrase one time when he had persisted in throwing his toy dog from the balcony of a hotel room (Kanner, 1946).

Concrete use of language refers to the autistic child's limited use and response to words. Words have only one meaning for the autistic child. Ricks and Wing (1976) relate the experiences of an autistic girl, who, while trying on shoes, was instructed to "walk up the aisle." After looking around in desperation, she spotted a step ladder and walked up it; and the little boy, when asked if he had lost his tongue, began anxiously looking for it. Scheerer, Rothmann and Goldstein (1945) attribute pronomial reversal, the uses of "you" for "I," to this concreteness of language. They contend that the inability to comprehend the relational meanings of pronouns is an indication of impaired abstraction.

Non-verbal communication is disordered in these children as well. Although autistic children can smile, laugh, cry, and show fear and anger, they have a tendency to show only the extremes of these emotions. Facial expression is rarely seen or understood (Ricks, 1972; Ricks and Wing, 1976). Gestures are not used as a substitute for speech as it is for deaf children or those with developmental receptive speech disorders. About the most advanced symbolic gesture learned is that of pointing (Ricks and Wing, 1976).

Because of the limited capacity of humans for information processing, structuring and reduction of incoming data is essential to deal effectively with information about the environment (Ricks and Wing, 1976). In a series of studies designed to investigate how autistic children deal with some aspects of spatial organization, Hermelin and O'Connor (1970, 1971, 1976) found that spatial position was more rapidly learned than a visual discrimination task; that autistic children used visual information when it was codable; and that while autistic children have good short-term memory for simple movements and a code which enables them to deal with kinesthetic-spatial cues, they appear unable to refer kinesthetic information to a visually derived spatial framework.

These findings are in accord with the advanced form perception discussed earlier.

In addition to being related in space, objects and events are related in time. Memory for temporal relations of events may be of primary importance for successively presented items of information such as speech (Conrad, 1962; Morton, 1970; Tulving and Madigan, 1970; Ricks and Wing, 1976). O'Connor and Hermelin (1965) compared autistic with normal and retarded children on three tasks designed to test matching, memory, and seriation. In the matching task, subjects were presented with two squares of different size with a cue card and instructions to match. The immediate memory task required subjects to choose between two squares, one of which had been shown three seconds before. For the seriation task, subjects were presented with five squares of decreasing size; the experimenter ordered these according to size; the subjects examined the array; the series was removed, and the subjects required to reproduce it from memory. The results showed all subjects were equal on matching. Autistic and normal children were equal on the memory task, with the retarded children significantly worse. And the normal and retarded children were much better than the autistic children on seriation. Results of this study indicate that visual memory is related to performance intelligence. And in the seriation task where rule extraction, rather than memory, was required, retarded children learned the task but autistic children were unable to abstract the rule, instead they treated the series as a number of unconnected items. Kanner (1943) found that the scenes or parts of stories are never seen as parts of a whole, but only as unrelated fragments. In addition, he found that autistic children do not develop a unified concept of other people as such. The incident of the child who became angry at the foot, not the person, standing on his toy (1944) exemplifies the hypothesis that the child fails to relate his experiences with other people, and therefore no concept of a "person" is developed. Frith (1970a) found the same lack of interrelation of items in a visual task of seriation and color sequence. And on an auditory seriation task (Frith, 1970b) while retarded and normal children were able to extract either one of the two rules present in the input, autistic children applied only one rule regardless of input. When given a task which provided sequential as well as spatial information, autistic children were found to attend to the spatial information only (Frith and Hermelin, 1969).

Based on the assumptions that visual displays tend to induce spatial ordering, and auditory, especially verbal stimuli are temporally organized, a series of experiments were done to investigate whether children with intact language systems differed in strategy from children without intact language systems on ambiguously ordered, visually presented, verbal material (O'Connor and Hermelin, 1972, 1973). In these studies normal, autistic, and deaf children were used to investigate temporal coding and its relation to hearing and language. On the single item selection task which did not require memory, all children ignored temporal succession of the items and selected according to spatial location. This indicated that visual input modality induced a spatial set. The next experiment required memory of the randomly presented numbers and verbal recall. On this task, all the normal children temporally organized their responses, recalling from first to last, while the autistic and deaf children recalled from left to right, a spatial organization. The final experiment consisted of a forced choice recognition procedure. The results obtained for normal children indicated that only temporally ordered digits were recognized correctly. Most of the autistic and deaf children, though, used a spatial rather than temporal organization of the memory code. It therefore was assumed that temporal ordering is in some way related to hearing or listening which is necessary for the adequate use of language as a storage code. In discussing these experiments, Hermelin (1976) concluded,

> The central problem in autistic children appears to involve not stimuli in a particular modality, but stimuli requiring organisation into particular codes which are modality independent. Such codes are used by the normal child to reduce the information load and enable him to integrate stimuli and interpret the environment appropriately through the extraction of rules and redundancies. p. 163.

The inability of autistic children to imitate (Ritvo and Provence, 1953; Goldstein, 1959; Lovaas, 1970) appears closely connected with their lack of temporal organization codes and inability to integrate and derive meaning from their experiences (Rimland, 1964). DeMyer and his associates (1972a) found that autistic children's imitation of body motion is more deficient than imitation of object motion, which in turn is more deficient than their ability to assemble objects that suggest their own solution. DeMyer, et al, conclude: "Body imitation requires that the child should remember a quickly disappearing motion, or perceive, that his body is like that of the demonstrator and transfer the remembered motion to his own motor system" p. 185. In light of the inability of the autistic child to conceptualize a "person" (Kanner, 1944), it seems like an impossible task for him to establish an analogy between himself and another person--a basic requirement for imitation (Rimland, 1964). It is no wonder then that often the only way autistic children learn motor skills is by having their limbs moved through the action that is required (Ricks and Wing, 1976).

Learning Model Studies Involving Transfer of Learning

Prior to Thorndike's (1924) study with high school students, educators and psychologists ascribed to the doctrine of formal discipline (Thomas, 1893; Wormell, 1897;

Roark, 1889). The premise of this doctrine was that training in one skill resulted in improvement of other skills, e.g., ability in language produced ability in mathematics. Thorndike (1924) gave his subjects an intelligence pretest and a posttest at the end of the school year. In analyzing the data, Thorndike found no single course of study resulted in test performance improvement. These results substantiated his earlier findings (Thorndike, 1913) that training on one skill effected performance on another only if the two skills had identical elements. The theory of identical elements was the predecessor of the school of transfer.

The phenomena of transfer became of prominent interest in the Twentieth century (Sandiford, 1928). Out of the acceptance of the theory of identical elements came an investigation of the roles that stimuli and responses played in transfer. Wylie (1919) found that rats pretrained on a specific maze box response to one type of stimulus, learned the same response to a different stimulus much quicker than rats that had not been pretrained. In 1931 Yum, in a series of experiments designed to investigate the function of similarity in stimuli for evoking certain responses, found the amount of recall varied directly with the amount of similarity to the originally trained stimulus.

Although Osgood (1949) was the first to formally discuss retroaction, the effect of an activity on the retention of a previously learned activity, Wylie (1919) had hypothesized that a negative effect might come about through variation in response to a stimulus. The 1920's, 30's, and 40's saw a major interest in how similarity of responses effected learning (Sandiford, 1928; Bruce, 1935, Osgood, 1949; McGeoch, 1942).

In addition to similarity, Miller and Dollard (1941) theorized that generation of a common label to two stimuli established a stimulus common to both stimuli. From this they coined the phrase "cue-producing responses" for responses that provide cues for generalized responding. And they defined "response-mediated generalization" as generalization resulting from cue-producing responses. They also suggested that cue producing responses did not necessarily have to be verbal.

In contrast to Miller and Dollard (1941) is Gibson's (1940) idea of stimulus predifferentiation. Gibson's tenet is that a person's perception of stimuli is altered by associating different responses with the stimuli and there is a consequent reduction of generalization of responding to the stimuli in future discrimination tasks. Gibson believed labels used for stimuli were no longer necessary once the stimuli had become distinct, whereas Miller and Dollard (1941) held that labels must be retained to mediate transfer. Studies designed to affirm the stimulus predifferentiation have not been successful (Gagne and Baker, 1950; Jeffrey, 1953; Spiker and Norcross, 1962). Bialer (1961) in a study designed to relate Miller and Dollard's (1941) work to mentally retarded populations found a definite relationship between measured intelligence and performance on generalization tasks. Subjects were trained to label four objects either bif or mot. He taught subjects to label one cross-like stimulus and one target-like stimulus bif and the other cross-like stimulus and target-like stimulus mot. He then trained subjects to discriminate a cross-like mot and a target-like bif according to their names. Transfer trials were with the cross-like bif and the target-like mot. On the transfer trials subjects could respond either to the spatial (form) or temporal (name) relations of the stimuli. Twenty of the twenty normal subjects transferred according to temporal relations while only eight of twenty mildly retarded subjects transferred temporally, and none of the eight severely retarded subjects transferred temporally.

Baer and Sherman's (1964) study of verbal imitation in young children marked a turning point in the procedures employed in studies of similarity and transfer. In behavioral terms, imitation is defined as a class of behaviors which temporally follow, and therefore are controlled by behaviors of another organism (Baer, Peterson and Sherman, 1967). It is the controlling role of topographical similarity which distinguishes imitative behavior from Miller and Dollard's (1941) "matched-dependent" behavior (Garcia, Baer and Firestone, 1971). In their study, Baer and Sherman

(1964) found that reinforcement of three imitative responses led to the imitation of a fourth, unreinforced response. Through experimental manipulation, they found that it was the reinforcement of the three imitative responses that controlled the imitation of the fourth response. From these findings they proposed that the similarity of children's behavior to a model is often reinforced, thereby making the stimulus of similarity a discriminative stimulus and a secondary reinforcer. A discriminative stimulus is one which has previously been paired with reinforcement (Whaley and Malott, 1971).

Baer, Peterson and Sherman (1967) first trained nonimitative subjects' motor imitations, and then trained verbal imitations. Even after new (untrained) motor responses were being imitated, two subjects failed to imitate a simple vocal response. Further training on vocal imitations produced generalized vocal imitation. Similar results were reported by Clark and Dameron (in press). Subjects in their study were four severely retarded children who demonstrated some motor, but little vocal imitation. Training consisted of interspersing previously unimitated vocal responses with motor and vocal responses which could be imitated. They were successful in extending vocal imitations. Risley (1968) trained topographically different imitations in disadvantaged preschool children. During training, one of the pair of topographically complex responses was intensively trained. Test trials consisted of the model demonstrating the pair of topographically complex responses. The children imitated the complex response to some degree, but were most accurate in imitating the component that had been trained. Bandura and Barab (1971) found more imitation of probe responses which were similar to reinforced responses than to probe trials which were dissimilar to reinforced responses in their study with normal children. And in another study, normal children, who were allowed to imitate either of two demonstrations, reliably displayed imitations which produced reinforcement as opposed to those which did not (Steinman and Boyce, 1971). In the Garcia, Baer and Firestone (1971) study generalized imitation was established in formerly nonimitative retardates. However, they found that generalization was restricted to the topographical type of imitation currently or previously trained.

Studies have also found that generalized imitation procedures can produce correct unreinforced use of nearly any individual part of speech, both receptively or expressively (Baer, 1974). Guess and his associates (1968) taught a severely retarded child to correctly apply singular or plural labels to sets of objects through imitation of a model. Other studies have established generalized use of past and present verb tenses (Schumaker and Sherman, 1971), productive allomorphs (Sailor, 1971), and noun suffixes with novel nouns (Baer and Guess, 1973).

Imitation training is similar to match-to-sample procedures where subjects indicate which of several stimuli matches a sample stimulus (Gewirtz and Stingle, 1968). In imitation training the sample stimulus is a model's demonstration, the matching response, a topographically similar response by the subject. The sample stimulus in a match-to-sample design is displayed before the subject who chooses the matching response from several stimuli. The major difference, then, between these two training procedures appears to be the topography of the required response and the availability of choice stimuli. Regardless of topography, both training procedures involve the subject's responding to a similarity dimension between two sets of stimuli. Therefore, it follows, that the results of generalized imitation studies with motor and vocal responses, will be paralleled in match-to-sample designs (Sherman, Saunders and Brigham, 1970).

In a study investigating transfer in a matching-to-sample design (Sherman, Saunders, and Brigham, 1970), preschool children were trained to match a sample stimulus, while others were trained to mismatch. When a novel sample was introduced, subjects who had been trained to match did so to the novel stimulus, and those trained to mismatch also did so. No responses to the novel sample were reinforced. Following training, a reversal was done in which subjects who were trained to match were trained to mismatch, and those trained to mismatch were trained to match. Transfer once again occurred. These results, then, showed that unreinforced matching and mismatching responses can be controlled through reinforcement operations supplied to other responses. An important concept derived from these generalized imitation studies is that of the functional response class (Baer, Peterson and Sherman, 1967; Peterson, 1968). Risley and Baer (1971) define response class as a descriptive term identifying topographically dissimilar responses that vary together with regard to their probability of occurrence even though only a few of the responses have been reinforced.

Whitehurst's studies (Whitehurst, 1971, 1972; Whitehurst and Novak, 1973) examined generalization of syntax. In order to investigate if distinct grammatical sequences existed as separate response classes, Whitehurst (1971) taught two two-year-old normal children to respond to nine pairs of color-figure combinations with labels specific to each color and each figure. He then trained his subjects on one of the color-figure pairs with a new label that was made up of a combination of the old labels. The form of the response to this one stimulus pair alternated between the two forms. The eight remaining pairs were used as probes. The results of the study indicated that the prompting and reinforcement applied to the one stimulus pair affected the form of the other eight. He interpreted this as an establishment of two response classes--one being the old syntax, and the other the new syntax. In a subsequent study (Whitehurst, 1972), normal children were trained to give one-word labels to colors and one-word labels to form, and two-word labels to color-form combinations. Subjects required fewer trials to reach criterion on previously trained color/new form combinations than on new color/new form combinations. It was also noted that subjects sometimes gave correct two-word labels on first trials with both old color/new form and new color/new form combinations. Whitehurst and Novak (1973) found more use of experimenter sentence structures following reinforced imitation than following modeling procedures.

Researchers in the verbal learning field have also been interested in the effect of prior training on subjects' performance of subsequent tasks. A series of paired-associates paradigms, also referred to as mediational paradigms, which result in positive transfer have been listed by Jenkins and Palermo (1964). The response equivalence paradigm appears closely related to the present study. This paradigm is as follows:

Given that:	A	controls	B
and	A	controls	C
Then :	B will	tend to control	C
and	C will	tend to control	B

According to this response equivalence paradigm, subjects learn a specific B word for every A word in a list. After learning the A-B list, they are taught a new set of C words to the same A word list. Having learned the A-C list, B words are presented as stimuli and the C words are required for the correct response. Typically, subjects learn the B-C list more rapidly following response equivalence training than if training had been with two unrelated lists. It is important to recognize, however that the subjects were not responding to a novel situation without direct training. Rather, subjects are learning a new task more rapidly than they would have without prior training.

Behavioral psychologists attribute transfer to the development of stimulus and response classes (Skinner, 1935). Goldiamond (1962) asserts that stimulus classes do not have to consist of physically similar members, nor do the members of a response class have to be topographically similar. The similarity of the functional properties of the members of the classes, not physical similarities, is what is important. Innate characteristics of organisms, classical conditioning, and setting the occasions for the same responses being reinforced are a few of the possible sources for the establishment of the functional equivalence of stimuli.

Sidman (1971) demonstrated a method for establishing stimulus equivalences, i.e., appropriate responding to novel situations without direct training. His subject was a seventeen-year-old microcephalic boy who could point to pictures when they were named and name pictures. But he could not name printed words, or choose the correct word when a picture was shown to him, or choose the correct picture when a word was given to him, or choose the correct printed word when a word was spoken to him. By teaching him to choose the correct printed word when a word was spoken to him, Sidman found the boy could name printed words, match the word to the picture, and match the picture to the word. All of these latter operations were performed without training. In a replication of this study, Sidman and Cresson (1973) received the same effects with two severely retarded Down's syndrome boys. Sidman, Cresson and Willson-Morris (1974) demonstrated that matching printed words to spoken words would occur without direct training if subjects were first taught to match printed words to pictures and pictures to spoken words. Also, as a result of this training, subjects could name both pictures and printed names of pictures.

In all of Sidman and his associates' studies correct baseline and post-teaching test responses were reinforced. Consequently, a question could be raised as to the effect of baseline reinforcement on post-teaching test performance. The design of the studies lends supporting evidence that training and not reinforcement during test trials effected the dependent variables. In all the studies the choosing responses were taught in blocks rather than all at once. After each block was trained, subjects were tested for non-trained skills both on previously trained responses as well as those yet untrained. Results of these post-training block tests indicated subjects tended to perform better on the previously trained responses as compared to the untrained ones, and that untrained response peformances remained stable.

Spradlin, Cotter, and Baxley (1973) conducted another study in which a new conditional discrimination was established without direct training. In their study with high level retardates, Spradlin and his associates trained their subjects on a two-choice conditional discrimination match-to-sample task where there were two choice stimuli and two sample stimuli. One choice stimuli functioned as a discriminative stimulus for one sample stimuli, while the second choice stimulus functioned as a discriminative stimulus for the other sample stimuli. Then similar training occurred, only this time two new sample stimuli were used. Next, one of the pairs of sample stimuli was trained to control two new choice stimuli. Finally, probe trials, those not employing reinforcement, were introduced to determine if the other sample stimuli would control two new choice stimuli. Results of the study indicated that when two sets of stimuli controlled the same discrimination, training one set to control a new discrimination resulted in control of the new discrimination by the other untrained set. In other words, a stimulus class was established. In a subsequent study, Dixon and Spradlin (in print) demonstrated similar transfer using auditory sample stimuli.

The relation of these matching-to-sample experiments to the familiar mediated-transfer paradigm is evidenced by subjects first learning to match B to A (visual picture to spoken word), and, second, to match C to A (printed word to spoken word); they, then, were able to match B to C (visual picture to printed word) and C to B (printed word to visual picture). These studies not only indicate that the mediated-transfer process occurs in matching-to-sample designs with high level, deviant populations, but also isolates some of the functional relationships involved. It is important to note that the term "mediation" is used in a procedural sense, i.e., it refers to the observation that the B-C association was due to some form of prior learning that involved elements other than B and C (Sidman, Cresson, and Willson-Morris, 1974).

CHAPTER III

METHOD AND PROCEDURES

This chapter deals with a description of the materials and equipment, a description of the population and sample, the procedures for the collection of the data, and the results of the procedure on two normal subjects.

Materials and Equipment

Two sets of word cards for each word, "ball," "flag," "sock," and "pipe," were made. These cards were constructed of standard press-on letters, mounted on 1" x 2", white paper. These cards were then cut out in the shape of the words, mounted on a black background, and laminated. A small flag, a 3" rubber ball, a white sock, and a plastic pipe purchased from a local variety store were the objects. Unrelated motor signs were: table slap (one hand) for ball, tongue out for flag, cover face (both hands) for pipe, and scratch head (one hand) for sock. Unrelated signs were used in order to preclude possible learning prior to the study.

Equipment consisted of a wooden chair with a table attached, a kitchen timer to mark session endings, a 3" x 5" metal box with a vertically moving bar used as an orienting response, a red and a white light, and a tray of consumables.

Population and Sample

The population consisted of children diagnosed as autistic according to Kanner's (1943) diagnosis of early infantile autism. The sample was drawn from children attending school at the Center for Behavioral Studies located in Denton, Texas. A total of six subjects were selected on the basis of their functioning level. Acceptable subjects were those who had no functional or spontaneous speech and no previous experience with sign language. All subjects had been diagnosed autistic by at least three reliable agencies or clinicians. Table I lists the subjects according to age, sex, experimental condition, and length of time in years at the Center for Behavioral Studies.

TABLE I

CHARACTERISTICS OF THE SUBJECTS IN THE TWO EXPERIMENTS

Subject	Condition	Sex	CA	Length of Time at Training School
A	2	f	11	5
B	1	m	12	3.5
C	2	f	9	4
D	1	m	10	5
E	1	m	7	2.5
F	2	m	11	3.5

Procedures for Collection of Data

General Procedures

The experimental room was approximately 12' x 20'. Each subject was seen individually for thirty-minute sessions, four times daily, five times per week. The subject sat in a chair with a table attached. Situated on the table were a lever press, a red and a white light, and a tray of consumables. The experimenter sat directly in front of the subject. Figure 1 illustrates the experimental room arrangement. The sequence for each trial was as follows.

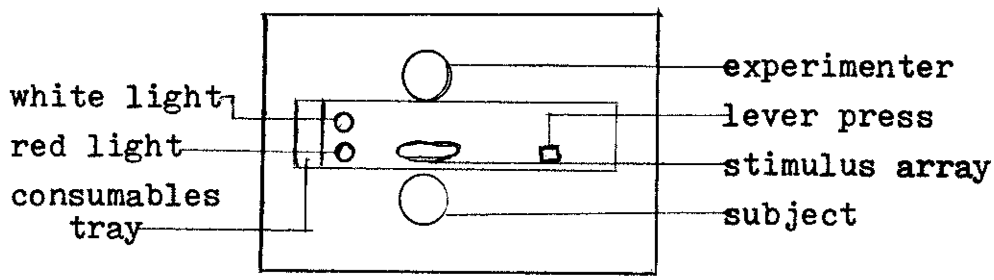

Fig. 1--Experimental room arrangement

After the subject was seated, the experimenter energized the white light. This was a cue to the subject that he was to press the lever. Upon the subject's completion of the lever press, the experimenter presented the stimulus to be matched. He then energized the red light, the cue for the subject to respond; the subject responded, and if the response was correct, he received a consumable. The experimenter then turned off both the white and the red lights.

Prior to introducing experimental procedures, the baseline phase was implemented in order to assess what, if any, entering skills the subjects had in their repertoires which were pertinent to this study, and thus better to assess changes due to experimental procedures. These baseline phases were established through the following matching steps: (1) printed word paired with object, (2) object paired with printed word, (3) object paired with sign, (4) sign paired with object, (5) printed word paired with sign, and (6) sign paired with printed word. Each step was presented in three blocks of five trials each. After each trial, subjects were reinforced with food, regardless of whether the response was correct or incorrect. This insured standard conditions and maintained the subjects' response rates. This series of six baselines was performed for the four objects, signs, and printed words employed in the study.

Following establishment of baseline, subjects were randomly assigned to either Conditions 1 and 3, or Conditions 2 and 4. Randomization was done by placing each subject's name on a piece of paper and placing each slip into a hat. The first three subjects thus selected were assigned to Conditions 1 and 3 and the remaining were assigned to Conditions 2 and 4.

Each condition consisted of two phases. Each phase had five steps--four training steps and one probe test step. Elements of the experimental conditions and phases can best be understood by an examination of Table II. Each phase employed a separate word. In Conditions 1 and 2, "ball" was the word used in Phase I, and "flag" was used in Phase II.

TABLE II

TRAINING STEPS FOR CONDITIONS OF THE EXPERIMENT

Condition 1	Condition 2	Condition 3	Condition 4
Phase I "ball"	Phase II "flag"	Phase I "sock"	Phase II "pipe"
1. word paired with object (w-o)	1. word paired with object (w-o)	1. word paired with object (w-o)	1. word paired with object (w-o)
2. object paired with word (o-w)	2. object paired with word (o-w)	2. object paired with word (o-w)	2. object paired with word (o-w)
3. word paired with sign (w-s)	3. object paired with sign (o-s)	3. word paired with sign (w-s)	3. object paired with sign (o-s)
4. sign paired with word (s-w)	4. sign paired with object (s-o)	4. sign paired with object (s-o)	4. sign paired with object (s-o)
*5. sign paired with object (s-o)	*5. sign paired with word (s-w)	*5. sign paired with object (s-o)	*5. sign paired with word (s-w)
Phase II "flag"	Phase I "ball"	Phase II "pipe"	Phase I "sock"
1. word paired with object (w-o)	1. word paired with object (w-o)	1. word paired with object (w-o)	1. word paired with object (w-o)
2. object paired with word (o-w)	2. object paired with word (o-w)	2. object paired with word (o-w)	2. object paired with word (o-w)
3. object paired with sign (o-w)	3. word paired with sign (w-s)	3. object paired with sign (o-s)	3. word paired with sign (w-s)
4. sign paired with object (s-o)	4. sign paired with word (s-w)	4. sign paired with object (s-o)	4. sign paired with word (s-w)
*5. sign paired with word (s-w)	*5. sign paired with object (s-o)	*5. sign paired with word (s-w)	*5. sign paired with object (s-o)

*Probe trials

In Conditions 3 and 4, the Phase I word was "sock" and the Phase II word, "pipe."

In all components of each phase, excluding the transfer probes, other objects, words, and signs not associated with reinforcement (S^{Δ}), were present in order to establish that the subject was in fact making a discrimination. The training words, objects, and signs associated with reinforcement were referred to as the discriminative stimuli (S^Ds). These designations are used extensively in the following description.

The entire procedure consisted of not only conditions, phases, and steps, but also stages and trial presentations. Table III shows the relationship among these.

The stages were defined as follows:

1. two-word prompt--both objects, S^D as well as S^{Δ}, had printed word names attached.
2. one-word prompt--the S^{Δ} object had its printed word name attached, while the S^D did not.
3. no-word prompt--neither object, S^D or S^{Δ}, had printed word names attached.

It should be noted that since the w-s/s-w and o-s/s-o training steps did not use visual language, the no-word prompt stage was repeated twice.

The S^D and S^{Δ} trial presentations were defined as:

1. 1:1--one S^D presentation then one S^{Δ} presentation
2. 2:2--two S^D presentations then two S^{Δ} presentations
3. 1:1:2:2--one S^D presentation, one S^{Δ} presentation, two S^D presentations, two S^{Δ} presentations

TABLE III

STAGES AND TRIAL PRESENTATIONS ACCORDING TO EXPERIMENTAL PHASES

Phase I	Phase II
1. w-o step	1. w-o step
A. two word prompt stage	A. two word prompt stage
1. 1:1	1. 1:1
2. 2:2	2. 2:2
3. 1:1:2:2	3. 1:1:2:2
B. one word prompt stage	B. one word prompt stage
1. 1:1	1. 1:1
2. 2:2	2. 2:2
3. 1:1:2:2	3. 1:1:2:2
C. no word prompt stage	C. no word prompt stage
1. 1:1	1. 1:1
2. 2:2	2. 2:2
3. 1:1:2:2	3. 1:1:2:2
2. o-w step	2. o-w step
A. two word prompt stage	A. two word prompt stage
1. 1:1	1. 1:1
2. 2:2	2. 2:2
3. 1:1:2:2	3. 1:1:2:2
B. one word prompt stage	B. one word prompt stage
1. 1:1	1. 1:1
2. 2:2	2. 2:2
3. 1:1:2:2	3. 1:1:2:2
C. no word prompt stage	C. no word prompt stage
1. 1:1	1. 1:1
2. 2:2	2. 2:2
3. 1:1:2:2	3. 1:1:2:2
3. w-s step	3. w-s step
A. no word prompt stage	A. no word prompt stage
1. 1:1	1. 1:1
2. 2:2	2. 2:2
3. 1:1:2:2	3. 1:1:2:2
B. no word prompt stage	B. no word prompt stage
1. 1:1	1. 1:1
2. 2:2	2. 2:2
3. 1:1:2:2	3. 1:1:2:2

TABLE III --Continued

Phase I	Phase II
4. s-w step A. no word stage 1. 1:1 2. 2:2 3. 1:1:2:2	4. s-w step A. no word stage 1. 1:1 2. 2:2 3. 1:1:2:2
B. no word stage 1. 1:1 2. 2:2 3. 1:1:2:2	B. no word stage 1. 1:1 2. 2:2 3. 1:1:2:2
*5. s-o step--presentation of ten trials	*5. s-o step--presentation of ten trials

Trial presentations were done in this manner to insure that the subject was attending to the relevant dimensions of the stimulus array rather than some other variable, such as place of the objects of sequence of the word order.

Criteria for mastery for each of the trial presentations were as follows:

1. 1:1--twelve consecutive correct
2. 2:2--twelve consecutive correct
3. 1:1:2:2--twelve consecutive correct on the one-word and two-word prompt stages; thirty consecutive correct on the no-word prompt stage

The above stages, trial presentations, and criteria did not apply to the probe trials which are outlined following the explanation of the training sequences.

Discrimination Training Procedure

Conditions 1 and 2, Phase 1.--

S^D "ball," S^{Δ} "gun"

1. Word paired with object--A ball (S^D) and a small, plastic water gun (S^{Δ}) with their names attached were placed on the table in front of the subject. This was designated as the two-word prompt phase of training because names were attached to both objects. The matching word stimulus "ball" was given to the subject with the instruction "match." At this point, the subject was required to place the word on the correct object. Upon correct matching, the subject received a small quantity of cracker or liquid of some kind. The experimenter then removed the matching word stimulus "ball" from the object, leaving the originally placed word "ball" on the object. The word "gun" was then presented; the subject was required to match as before; reward delivered; and the matching word stimulus removed. This procedure, alternating the presentation of "ball" with that of "gun" (1:1), continued until the completion of twelve consecutive correct responses. The sequence of trials was then the presentation of "ball" "ball," then "gun" "gun" (2:2) for twelve more correct responses. Then the sequence of presentation was "ball" "gun" "ball" "ball" "gun" "gun" (1:1:2:2) for twelve consecutive correct trials.

In the next step, when presenting the matching word stimulus "ball," the word "gun" remained on the object "gun," but the word "ball" was removed from the object "ball." And when the matching word stimulus "gun" was presented, the word "ball" remained on the object "ball" while the word "gun" was removed from the object "gun." This was the one-word prompt stage of training. Once again, the sequence of presentation went from 1:1 to 2:2 to 1:1:2:2. Criterion was as before. Next, both words were removed from the objects--the no-word prompt phase of training. Training continued as above, first with the 1:1 presentation for twelve consecutive correct responses, then with the 2:2 presentation for twelve correct, and finally the 1:1:2:2 pattern for thirty consecutive correct responses.

2. Object paired with word--In this step, the words "ball" and "gun" were placed on the table in front of the subject. He was handed the object "ball" with its name attached, and instructed to "match." He was then required to place the object on the correct word. Then, the object "gun" with its name attached was presented, and the subject was expected to place it on the matching word stimulus "gun" displayed on the table. Presentation of the stimuli was the alternation of "ball" and "gun" (1:1). Criterion was twelve consecutive correct trials. The pattern of presentation then was 2:2 for a total of twelve consecutive correct trials followed by the 1:1:2:2 presentation for twelve consecutive correct responses. The one-word prompt and no-word prompt

stages followed the same presentation sequences with criterion as outlined above.

3. <u>Word paired with sign</u>--The experimenter held the word "ball" in front of the subject's eyes, making sure he attended to the stimulus, made the sign response for the word, and then instructed, "match." The subject underwent passive guidance until he initiated the correct sign response to the word. At this time, the experimenter began gradually placing the word closer to the table in front of the subject, making sure that the subject always attended to the word prior to the "match" instructions. When the subject was responding to the word placed on the table, the experimenter gradually ceased making the sign response prior to saying "match." In this way, the subject began to sign in the presence of the word, rather than imitating the experimenter's motor response. When the subject had completed twenty consecutive correct responses to the word without any ancillary cues from the experimenter, the S^{Δ} phase began. In this phase, when presented with any word other than the S^D "ball," the subject was required to place a small plastic chip into a plastic container. A variety of words were used as S^{Δ}. After ten correct trials of S^{Δ}, random presentations of the S^D, "ball" and the S^{Δ}s began. Criterion of mastery was a total of twenty-four consecutive correct for the 1:1 presentation, twenty-four consecutive correct for the 2:2 presentation, and sixty consecutive correct for the 1:1:2:2

presentation. Once again, a variety of items were used as S^{Δ}.

4. Sign paired with word--The word "ball" was on the table in front of the subject. The experimenter made the sign response for "ball," and the subject was instructed to "match." At this point, the subject was to pick up the word "ball" and hand it to the experimenter. After three correct trials, other words were placed on the table, so the subject had to select in order to make the correct match. After every three trials, the order of words on the table was changed. This insured that the subject was choosing the correct word rather than simply responding to a certain place on the table.

After twenty consecutive correct selections, the S^{Δ} phase began. Here, the experimenter placed the plastic chip in the plastic container, and the subject was to hand the experimenter any word other than "ball." As in training the sign response to the S^D, initially only one word was on the table in front of the subject. However, different words were used for S^{Δ}. When the subject was correctly responding to the experimenter's sign response for ten trials, the S^D "ball" was placed on the table with any S^{Δ}. 1:1, 2:2, 1:1:2:2 presentations of "ball" and S s then began. Mastery once again was a total of twenty-four consecutive correct for 1:1, twenty-four consecutive correct for 2:2, and sixty consecutive correct for 1:1:2:2.

Conditions 1 and 2, Phase II.--

S^D "flag," S^Δ "hat"

1. Word paired with object--As in Phase I.

2. Object paired with word--As in Phase I.

3. Object paired with sign--The experimenter held the object "flag" in front of the subject's eyes, making sure he attended to the stimulus, made the sign response for the object, and instructed "match." The subject underwent passive guidance until he initiated the correct sign response to the object. At this time, the experimenter began gradually placing the object closer to the table in front of the subject, making sure that he always attended to the object prior to the "match" instruction. When the subject was responding to the object placed on the table, the experimenter gradually ceased making the sign response prior to saying "match." In this way, the subject began to sign in the presence of the object rather than imitating the experimenter's motor response. When the subject had completed twenty consecutive correct responses to the object without any ancillary cues from the experimenter, the S^Δ phase began. In this phase, when presented with any object other than the S^D, "flag," the subject was required to place a small plastic chip into a plastic container. A variety of objects were used as S^Δ. Having completed twenty unassisted consecutive correct responses to S^Δ, 1:1, 2:2, 1:1:2:2

presentations of the S^D, "flag," and the S^{Δ}s began. Criterion of mastery was as outlined above.

4. <u>Sign paired with object</u>--The object "flag" was placed on the table in front of the subject. The subject was required to look at the object, then at the experimenter who made the sign response for "flag." The subject once again was instructed to "match." At this point, the subject was required to pick up the flag and hand it to the experimenter. After three correct trials, other objects were placed on the table with the flag. In this way, the subject had to make a selection when instructed to "match." After every three trials, the order of objects on the table was changed. This insured that the subject was matching according to the object rather than to a place on the table. After twenty consecutive correct responses, the S^{Δ} phase began. Here, the experimenter placed the plastic chip in the plastic container, and the subject was required to hand the experimenter any object other than the flag. As in training the sign response to the S^D, only one object was on the table in front of the subject. However, different objects were used for S^{Δ}. When the subject was correctly responding to the experimenter's sign response for ten trials, the S^D "flag" was placed on the table with any S^{Δ}. 1:1, 2:2, 1:1:2:2 presentations of flag and varying S s then began. Mastery was as above.

Conditions 3 and 4, Phase I.--
S^D "sock," S^{Δ} "car"

1. Word paired with object--As in Phase I, Conditions 1 and 2, but using the words and objects "sock" and "car."

2. Object paired with word--As in Phase I, Conditions 1 and 2, but using the words and objects "sock" and "car."

3. Word paired with sign--As in Phase I, Conditions 1 and 2, but using the word "sock."

4. Sign paired with word--As in Phase I, Conditions 1 and 2, but using the word "sock."

Conditions 3 and 4, Phase II.--
S^D "pipe," S^{Δ} "top"

1. Word paired with object--As in Phase II, Conditions 1 and 2, but using the words and objects "pipe" and "top."

2. Object paired with word--As in Phase II, Conditions 1 and 2, but using the words and objects "pipe" and "top."

3. Object paired with sign--As in Phase II, Conditions 1 and 2, but using the word "pipe."

4. Sign paired with object--As in Phase II, Conditions 1 and 2, but using the word "pipe."

Figures 2 and 3 are flow charts of all Phases under all Conditions.

Probe Trials Procedure

1. Subjects receiving training between the word and the sign response.--In order to assess if training the word

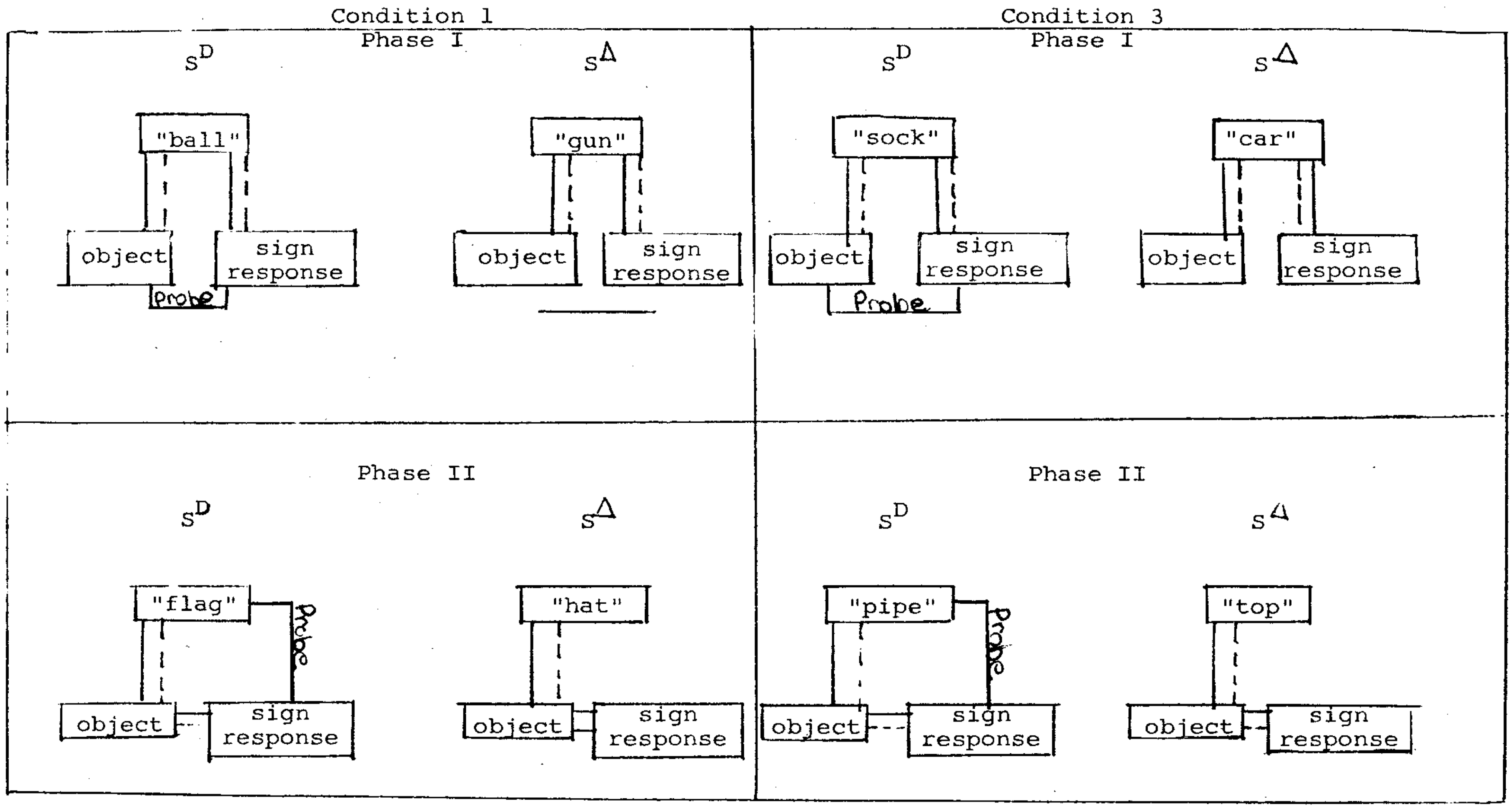

Fig. 2--Experimental training sequences, Conditions 1 and 3

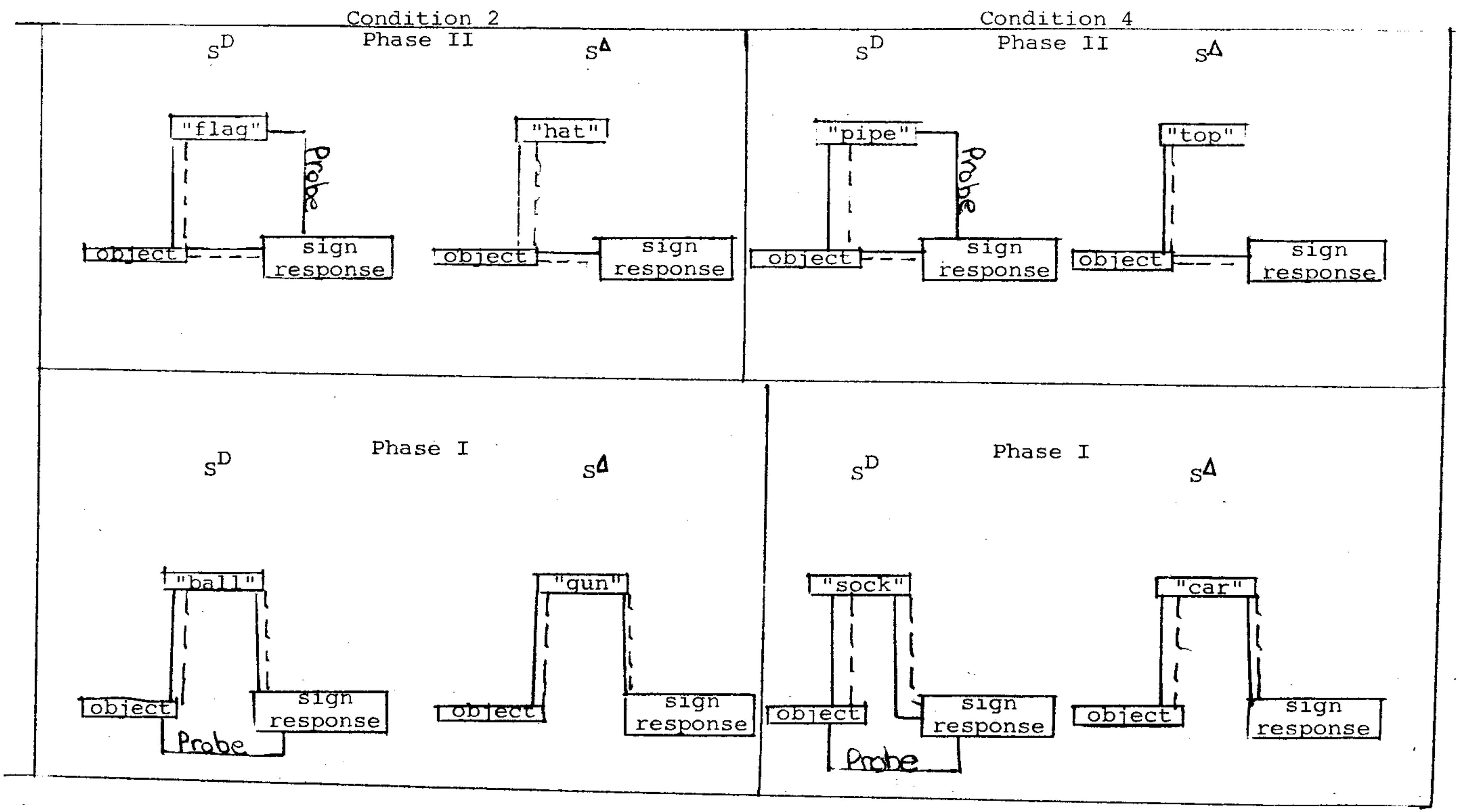

Fig. 3--Experimental training sequences, Conditions 2 and 4

to the object and the word to the sign response effected the acquisition rate of making the sign response to the object, trials to criterion and errors to criterion were recorded. A trial consisted of placing the object on the table in front of the subject and instructing the subject to "match." No prompts were given, and only correct responses were reinforced with direct food. Ten trials with only S^D presentations. Criterion on probe trials was the presentation of ten trials.

2. Subjects receiving training between the object and the sign response.--Assessment of the effect of training the sign response to the word was done as above. The subject was instructed to "match" when the word was placed on the table in front of him. Once again ten trials was criterion.

Correction Procedure

If the subject made an incorrect response, the trial was terminated. The stimulus responded to incorrectly was presented on each successive trial until either the subject matched correctly or responded incorrectly twice. If the latter occurred the subject was prompted via passive guidance until he initiated and successfully executed a correct response. He was then required to make two such correct responses before being presented with a new stimulus.

Design with Normal Subjects

Prior to implementing the study on the autistic children, the design was tested on two normal children--a female age five, and a male, age six. Both children learned the task and demonstrated transfer with no difficulty. Table IV indicates their total trials to criterion and total errors to criterion for all stages in all phases of all conditions.

TABLE IV

TOTAL TRIALS AND TOTAL ERRORS FOR CONDITIONS WITH NORMALS

		Condition 1										Condition 2									
		Phase I					Phase II					Phase II					Phase I				
		W-O	O-W	W-S	S-W	S-O*	W-O	O-W	O-S	S-O	S-W*	W-O	O-W	O-S	S-O	S-W*	W-O	O-W	W-S	S-W	S-O*
Subject A (female)	total trials	126	126	108	108	10	126	126	109	108	10	126	126	110	110	10	126	126	109	109	10
	total errors	0	0	0	0	0	0	0	1	0	0	0	0	2	2	0	0	0	1	1	0
Subject B (male)	total trials	126	126	108	108	10	126	126	108	108	10	126	126	109	111	10	126	126	108	109	10
	total errors	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	1	0

*Probe trials

		Condition 3										Condition 4									
		Phase I					Phase II					Phase II					Phase I				
		W-O	O-W	W-S	S-W	S-O*	W-O	O-W	O-S	S-O	S-W*	W-O	O-W	O-S	S-O	S-W*	W-O	O-W	W-S	S-W	S-O*
Subject A (female)	total trials	126	126	108	108	10	126	126	109	108	10	126	126	108	108	10	126	126	108	108	10
	total errors	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

TABLE IV --Continued

		Condition 3										Condition 4									
		Phase I					Phase II					Phase II					Phase I				
		w-o	o-w	w-s	s-w	s-o*	w-o	o-w	e-s	s-o	s-w*	w-o	o-w	o-s	s-o	s-w*	w-o	o-w	w-s	s-w	s-o*
Subject B (male)	total trials	126	126	108	108	10	126	126	108	108	10	126	126	108	108	10	126	126	108	108	10
	total errors	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Probe trials

CHAPTER IV

RESULTS AND CONCLUSIONS

The following chapter presents an analysis of the results of the study, including analysis of variance and *t*-test statistical designs, a short summary of these results, and conclusions derived from these findings.

Results

Analysis of the Data with ANOVA Designs

The probe tests errors of the subjects in Groups I and II were compared using a factoral design with one between and two within factors. Table V presents the analysis of variance (ANOVA) summary table for the factoral design.

This is an AxBxC design. Factor A, the "between" factor, compared the training procedure--the (s-o)/(s-w) probes compared with the (s-w)/(s-o) probes. Factor B compared training blocks--Conditions 1 and 2 compared to Conditions 3 and 4. Factor C compared the phases under Factor B. Factors B and C were the "within" factors of the design.

The first research hypothesis tested by the ANOVA was:

Ho_1: Subjects receiving the object probe first would demonstrate transfer as seen in significant differences in number of errors to criterion.

TABLE V

SUMMARY OF ANALYSIS OF VARIANCE OF ERRORS ON TRANSFER PROBES

Source	SS	df	MS	F
Between Subjects	206.87	5		
A	117.04	1	117.04	2.57
Subjects within groups [error a]	181.83	4	45.46	
Within Subjects	137.75	18		
B	40.04	1	40.04	2.36
AB	9.37	1	9.37	.55
B x subjects within groups [error b]	67.84	4	16.96	
C	.37	1	.37	.25
AC	3.38	1	3.38	2.07
C x subjects within groups [error c]	6.50	4	1.63	
BC	1.04	1	1.04	.58
ABC	2.05	1	2.05	1.15
BC x subjects within groups [error bc]	7.16	4	1.79	

In order for this hypothesis to be retained, Factor A, the "between" factor, would have to be significant at the .05 confidence level. The results of the ANOVA, however, indicate that Factor A was not significant. Therefore, Ho_1 was rejected.

The second research hypothesis was:

Ho_2: Subjects receiving the word probe second would demonstrate transfer as seen in significant differences in number of errors to criterion.

This hypothesis was rejected, also, as Factor A was not significant.

The third research hypothesis to be tested was:

Ho_3: Subjects receiving the word probe first would demonstrate transfer as seen in significant differences in number of errors to criterion.

As this was also a test of differences between training procedures, Factor A, it was also rejected. The training procedure had no effect on the amount of transfer demonstrated by the subjects on the probe trials.

The ANOVA also showed there were no significant differences on the "within" factors, Factors B and C, or on the interactions of AB or AC. All F scores were tested at the .05 confidence level. The results of the ANOVA, then, indicated that the groups did not differ due to the training procedures, nor did they show differences between the training blocks, or between the probe of the first phase of the Conditions as opposed to the second phase probe.

An examination of the raw data in Appendices A and B provide additional information as to the amount of transfer demonstrated by each subject on the probe tests. As the data indicates, only one subject exhibited transfer on all four probe tests. This subject, receiving the object probe first and the word probe second, was in Group I. Another subject in Group I demonstrated transfer on both phases of the second block of training. In Group II only one child demonstrated transfer, and that was on the second phase of the second training block, i.e., only after the subject had completed all four training phases. The definition of transfer for the purpose of this assessment was three or more correct responses on the ten probe test trials.

The ANOVA for errors on the probe tests did not indicate learning by the subjects. However the raw data indicated a trend in increased acquisition rate across blocks and phases. Therefore, further analyses were run to see if learning occurred during the training steps. A total of six more analyses were computed. All analyses were factoral designs with one "between" factor and two "within" factors. In order to discuss the analyses with the least amount of confusion, Figure 4 is provided to present the subjects, Conditions, Phases, training steps, and probe steps as they were compiled in the ANOVA summary tables as a reference chart.

The assessment of learning for all subjects across all training steps was done by comparison of the d_1 through d_4 number of trials to criterion on b_1 and b_2 for all subjects. Table VI presents the ANOVA summary table for these comparisons. The first statistical test in the ANOVA involved the effects of Factor A, the order presentation effects. As

B

A	subjects	b_1										b_2									
		c_1					c_2					c_1					c_2				
		d_1	d_2	d_3	d_4	d_5	d_1	d_2	d_3	d_4	d_5	d_1	d_2	d_3	d_4	d_5	d_1	d_2	d_3	d_4	d_5
a_1	1	w-o	o-w	w-s	s-w	s-o*	w-o	o-w	o-s	s-o	s-w*	w-o	o-w	w-s	s-w	s-o*	w-o	o-w	o-s	s-o	s-w*
	2																				
	3																				
		b_1										b_2									
		c_1					c_2					c_1					c_2				
		d_1	d_2	d_3	d_4	d_5	d_1	d_2	d_3	d_4	d_5	d_1	d_2	d_3	d_4	d_5	d_1	d_2	d_3	d_4	d_5
a_2	4	w-o	o-w	o-s	s-o	s-w*	w-o	o-w	w-s	s-w	s-o*	w-o	o-w	o-s	s-o	s-w*	w-o	o-w	w-s	s-w	s-o*
	5																				
	6																				

a's = training procedures
b's = conditions
c's = phases
d's = training steps (d_1 - d_4); d_5 = probes

Fig. 4--Factors compiled in the ANOVA summary tables

TABLE VI

SUMMARY OF VARIANCE FOR TOTAL TRAINING TRIALS

Source	SS	df	MS	F
Between Subjects	126744.33	5		
A	31104	1	31104	1.3
Subjects within groups [error a]	95640.33	4	23910.25	
Within Subjects	20765	18		
B	13537.5	1	13537.5	52.15*
AB	20.2	1	20.2	.08
B x subjects within groups [error b]	1038.3	4	259.58	
C	3850.7	1	3850.7	20.47*
AC	522.7	1	522.7	2.79
C x subjects within groups [error c]	752.6	4	188.15	
BC	1.5	1	1.5	.008
ABC	307.8	1	307.8	1.68
BC x subjects within groups [error bc]	733.4	4	183.35	

$p > .05$

there was no significant difference in total number of trials to criterion between the two groups, it can be concluded that the order of training steps had no effect on acquisition. Factor B compared b_1 and b_2 for all subjects and was found to be highly significant (F=52.15). This indicates that all subjects were reaching criteria with fewer trials in b_2 than in b_1. In other words, subjects were learning faster in b_2.

Factor C was also highly significant (F=20.47). This factor compared c_1 to c_2 for all subjects. The significant F means that all subjects required fewer trials to reach criterion on c_2 than on c_1 in both b_1 and b_2.

In addition to the analysis of total training steps trials to criterion, errors to criterion were also analyzed across training steps. The results of this analysis are reported in Table VII. Factor A, the between factor, was highly significant (F=11.89). This means that subjects in a_1 (Group I) required fewer errors than a_2 (Group II) in reaching criterion. Even though the order presentation did not effect total number of trials needed to reach criterion, it did influence the error rate of the subjects in the two groups. These findings do not clearly indicate that the training order of a_1 reduced the number of errors, but the findings do lend credence to this tenet. Factor B's highly significant F (21.16) indicated that all subjects required fewer errors in reaching criterion on b_2 than on b_1. Factor C, F=20, was also highly significant. All subjects, then, had fewer errors in reaching criterion on c_2 than on c_1 on both b_1 and b_2.

The results of these two analyses indicate a definite trend in the subjects' acquisition rates on the training steps, even though transfer on probe tests was not demonstrated.

TABLE VII

SUMMARY OF VARIANCE FOR ERRORS OF TRAINING TRIALS

Source	SS	df	MS	F
<u>Between</u> <u>Subjects</u>	29870.33	5		
A	22352.66	1	22352.66	11.89*
Subjects within groups [error a]	7517.67	4	1879.42	
<u>Within</u> <u>Subjects</u>	2717.5	18		
B	1535.99	1	153.99	21.1*
AB	4.17	1	4.17	.06
B x subjects within groups [error b]	291.33	4	72.83	
C	416.66	1	416.66	20*
AC	13.51	1	13.51	.65
C x subjects within groups [error c]	83.33	4	20.83	
BC	181.56	1	181.5	4.35
ABC	24.00	1	24	.57
BC x subjects within groups [error bc]	167.00	4	41.75	

$p > .05$

In view of the finding that the number of errors to criterion on the total training steps were significantly different between the two groups of subjects, the question of comparability of the two groups was raised. The possibility that the two groups differed significantly with regard to their functioning abilities was examined through an analysis run on d_1 and d_2 (refer to Figure 4) for all subjects. These training steps were chosen because they were the same for all subjects, thus, the least contaminated variables. The summary of the ANOVA for number of trials for these steps is reported in Table VIII, and the ANOVA for number of errors, in Table IX.

These results show that there were no significant differences on Factors A, B, or C for either total trials or number of errors. This indicates that subjects were comparable in functioning skills as demonstrated by no differences in performance on the same tasks. This also lends credence to the tenet that order presentation produced the significantly fewer number of errors in a_1 as compared with a_2 in the ANOVA for total training steps reported in Table VI.

According to the literature reviewed, autistic children learn more readily with three-dimensional stimuli as opposed to two-dimensional stimuli. In order to see if the current study substantiated this premise, an ANOVA comparing d_3 and d_4 for all subjects was run. Table X is a summary of the ANOVA for trials to criterion on d_3 and d_4.

Factor A was found to be not significant. This indicates that order of training had no effect on subjects' task performances on the three-dimensional stimuli as compared

TABLE VIII

SUMMARY OF VARIANCE FOR TRAINING TRIALS (o-w)/(w-o)

Source	SS	df	MS	F
<u>Between Subjects</u>	11850.5	5		
A	1320.1	1	1320.1	.5
Subjects within groups [error a]	10530.4	4	2632.6	
<u>Within Subjects</u>	2866	18		
B	816.6	1	816.6	5.65
AB	24.1	1	24.1	.17
B x subjects within groups [error b]	578.3	4	144.58	
C	416.6	1	416.6	4.58
AC	170.8	1	170.8	1.89
C x subjects within groups [error c]	363.6	4	90.9	
BC	8.3	1	8.3	.07
ABC	4.0	1	4.0	.03
BC x subjects within groups [error bc]	483.7	4	120.93	

to the two-dimensional stimuli used in the current study.

However, Factor B ($F=126.39$) and Factor C ($F=63.44$) were both highly significant. Once again this indicates that the subjects required fewer trials on b_2 than on b_1,

TABLE IX

SUMMARY OF VARIANCE FOR TRAINING TRIALS ERRORS (o-w)/(w-o)

Source	SS	df	MS	F
<u>Between Subjects</u>	531.71	5		
A	70.04	1	70.04	.61
Subjects within groups [error a]	461.67	4	115.42	
<u>Within Subjects</u>	281.25	18		
B	92.04	1	92.04	6.5
AB	1.05	1	1.05	.07
B x subjects within groups [error b]	56.66	4	14.17	
C	35.04	1	35.04	4.72
AC	2.05	1	2.05	.28
C x subjects within groups [error c]	29.66	4	7.42	
BC	18.38	1	18.38	1.62
ABC	1.03	1	1.03	1
BC x subjects within groups [error bc]	45.34	4	11.34	

and further, that c_2 had fewer trials than c_1 on both b_1 and b_2 for all subjects.

Errors on d_3 and d_4 were also analyzed, and results are reported in Table XI.

TABLE X

SUMMARY OF VARIANCE FOR TRAINING TRIALS (w-s)-(s-w)/(o-s)-(s-o)

Source	SS	df	MS	F
<u>Between Subjects</u>	65192.7	5		
A	20126	1	20126	1.79
Subjects within groups [error a]	45066.7	4	11266.68	
<u>Within Subjects</u>	11170.3	18		
B	7385	1	7385	126.39*
AB	2.1	1	2.1	1
B x subjects within groups [error b]	233.7	4	58.43	
C	2882	1	2882	63.44*
AC	5.1	1	5.1	
C x subjects within groups [error c]	181.7	4	45.43	
BC	187.1	1	187.1	3.16
ABC	57	1	57	1
BC x subjects within groups [error bc]	236.6	4	59.15	

$p > .05$

As in the analysis of trials on d_3 and d_4, there were no differences in number of errors due to order presentation. This was concluded because Factor A was not significant. Factor B was highly significant (F=54.58), indicating that

TABLE XI

SUMMARY OF VARIANCE FOR TRAINING TRIALS
ERRORS (w-s)-(s-w)/(o-s)-(s-o)

Source	SS	df	MS	F
Between Subjects	4879.33	5		
A	112.66	1	112.66	1
Subjects within groups [error a]	4766.67	4	1191.67	
Within Subjects	1640.5	18		
B	864	1	864	54.58*
AB	48.17	1	48.17	3.04
B x subjects within groups [error b]	63.33	4	15.83	
C	216	1	216	7.62
AC	4.17	1	4.17	1
C x subjects within groups [error c]	113.33	4	28.33	
BC	181.50	1	181.50	5.44
ABC	16.66	1	16.66	1
BC x subjects within groups [error bc]	133.34	4	33.34	

$p > .05$

subjects made more errors on b_1 than on b_2. Factor C, though not significant at the .05 confidence level, was significant at the .10 level. This indicates there was a slight trend in more errors on c_1 than on c_2 for all subjects.

All analyses of variance, then, showed that even though order presentation did not produce differences between the two groups of subjects, b_1 and c_1 did effect how all subjects performed on b_2 and c_2. This is strong evidence that even though learning was not demonstrated on the probe tests, learning was occurring on the training steps.

Analysis of the Data with t-test Designs

According to evidence presented by Lawrence (1952), an empirical law of discrimination learning is that the second of two discrimination problems may be learned more quickly if the easier discrimination is trained first. It has been found for retardates that a difficult problem is one where the stimuli are patterns on a background. An easier problem is one which involves the presentation of three-dimensional objects. Object discrimination is learned more quickly than a pattern discrimination even when the relevant cues are the same (House, Zeaman, Orlando, Fischer, 1957; House and Zeaman, 1960). From these findings, it would appear that the training steps in the present study involving pairing printed words to sign responses would be a more difficult discrimination than pairing objects and signs. For this reason, a *t* test for correlated means was run for the word-to-sign and object-to-sign training steps for all subjects.

One *t* test was for number of trials and the other for number of errors for each of the two training steps. The *t* score for total trials was not significant (t=.68), nor was the t for errors (t=.61). So, apparently in the current study, the degree of difficulty on the two steps was the same when all subjects' scores were analyzed together. However, when the two groups were analyzed separately all t's were significant at the .05 confidence level. Group I had t=2.79 for trials and t=3.33 for errors. Group II had t=3.4 for trials and for errors, t=3.33. These t tests, then were in accord with earlier investigator findings. In light of these results, it would have seemed that the b_1 for the Group II subjects would have demonstrated transfer on c_1 because they had been trained on an easier discrimination (object-to-sign) first. However, this was not the case, so further comparisons were made to isolate other possible explanations for the lack of transfer on probe tests.

An examination of the training steps indicates that d_3 for all subjects is a receptive language discrimination while d_4 is an expressive language discrimination. "Receptive language" refers to the listening to and/or understanding of language, and "expressive language" to the production of language.

The d_3 training step in the current study required matching either a printed word or an object to a sign response. The procedure involved the trainer making a sign response and the subject choosing either the correct printed word or object from an array of words or objects displayed before him. This is considered a receptive language task in that all that is required is the recognition of a stimulus and not the production of one. The d_4 training step, however, involved the trainer presenting the subject with either a printed word stimulus or an object stimulus and the subject producing the correct sign response. In d_4, then, the subject had to recognize the stimulus, associate it with making a sign response, and connect a sign response to the stimulus. Correlation of the muscular movements involved in producing the sign response and proper execution of the movements were prerequisite task skills, as well.

In order to assess the differences between d_3 and d_4, t tests for correlated means were run first on number of trials, and second on number of errors. The t for trials was highly significant (t=4.84), as was the one for errors (t=6.32). These t tests were done using all subjects' scores added together. Since the t for all scores was significant, an examination of differences between the two training steps for each group analyzed seperately was not warranted. The results of the t tests indicated that the receptive (d_3) discrimination was much easier to learn than the expressive (d_4) discrimination.

Summary

The research hypotheses of the current study were all rejected. Thus, the major tenet of the study, that the procedures used in training would have a positive effect on the learning acquisition of an untrained response, was not substantiated. However, further analysis of the training steps showed that subjects consistently performed better as training continued. In addition, three-dimensional discriminations were acquired more rapidly and with fewer errors than two-dimensional discriminations. And receptive language tasks were mastered with lesser difficulty than expressive language tasks.

Conclusions

Since it was shown that there were no significant differences resulting from order of presentation, it can be concluded that such procedures as were utilized in the study, while they might be of some benefit in working with autistic children, cannot be expected to contribute to transfer ability of autistics.

In addition, the study was concerned with group-centered research, i.e., the parameters of transfer were derived from the means and variances from measures obtained from groups of subjects, and found that there was no significant evidence of transfer either within or between the groups. However, the raw data indicated that individual subjects did demonstrate varying degrees of transfer. This evidence, coupled with the recurring statements in the literature of variability of differences within the autistic population, leads to the conclusion that in studying transfer in this population, individual-centered research would be more profitable in finding relationships between the changing events of transfer.

CHAPTER V

DISCUSSION AND FURTHER RESEARCH

This chapter deals with the discussion of the results and implication for future research.

Discussion

The analysis of the data clearly substantiates that training in one block resulted in more rapid learning in the second block. In the words of Harlow (1949), then, the subjects were "learning how to learn efficiently." In other words, subjects were in the process of forming learning sets. According to Harlow, the establishment of learning sets changes an organism from trial and error adaptation to the environment to adaptation through hypothesis and insight. He seems to be saying that learning sets result in conceptual behavior, or in behavioral terms, in the establishment of stimulus classes. However, in the present study, the subjects were "learning how to learn" specifically in the training steps. They were not learning that the probe test items were in any way connected to the training step items. A question thus arises of why the subjects were unable to establish untrained connections as members of the same stimulus class as the trained connections. The conceptual behaviors, or lack of behaviors, of the autistic child, as earlier reviewed, offer some possible explanations.

As was stated previously, a common characteristic of these children is concreteness of language, i.e., words have very limited meaning. Training a sign response to either one word or one object could very well have made the sign response specific only to that word or object. In addition, the studies by Hermelin and O'Connor (1970, 1971, 1976) repeatedly demonstrated an inability in these children for remembering items which were temporally related. The children in the present study appear to have treated the series of training steps and the tests as unconnected items, learned by rote memory, with no rule extraction evidenced.

Another possible explanation is that in the design of the present study, subjects were never trained to make associations between the training steps and the probe tests. They were tested only to see if they could make the connection without prior training on that particular task. Since prior training (b_1 is here considered as prior training to b_2) effected acquisition rate on the training steps, transfer on b_2 might have also been effected by training the probe test steps on b_1.

The studies by Sidman and his associates lend credence to another possible explanation as to the poor performance on the probe tests. In the present study perhaps not enough words, signs, and objects were trained. In the Sidman studies, subjects did not demonstrate transfer until fourteen to twenty words were trained. The data of the current study also supports this conjecture as the raw data indicates that two of the three children who demonstrated transfer did so in b_2; and one of these two subjects did not demonstrate transfer until c_2 of b_2. One is tempted to think that if further blocks of training were instituted, the subjects would begin to consistently demonstrate transfer.

Two final explanations could come from an examination of the paired-associates paradigm discussed earlier. An illustration of the paradigm as it applies to the current study is:

Stimulus		Response
A word	controls	B object
A word	controls	C sign
B object	will tend to control	C sign
C sign	will tend to control	B object

It could be that when the A-C associations were trained, the A-B associations were extinguished, i.e., the A-B associations were negated by the A-C associations training. That would make B-C associations impossible without some training.

And finally, the probe tests took the form of C-B associations which are backwards to begin with and therefore have considerably reduced strength (Jenkins, 1963).

"The cognitive problems which affect the comprehension and use of language in whatever form...are of major importance in the syndrome of early childhood autism and may eventually be proved to be the primary impairments which explain the whole behavior pattern (Wing, 1976, p. 26)." Wing uses the term "language" as defined by Sheridan (1972) to mean codification or symbolization of concepts for self-communication with regard to past, present, and future events, and for both receptive and expressive interpersonal communication (Wing, 1976). As previously stated, receptive language involves the recognition that sounds and/or letters are words. Expressive language goes on to link these words to symbolically stored associations, a necessary component for understanding the meaning of what is heard.

Even though laymen often consider these two modes of language to be perfectly correlated processes, Spradlin (1963) found a much higher degree of receptive than expressive language in retarded and aphasic populations. Moreover, Lenneberg (1962) proposed that receptive language is a prerequisite for expressive language development.

Examination of the processes involved in the two modes of language substantiates the logic of Lenneberg's hypothesis. Receptive language requires the recognition that sounds or letters are words. Expressive language involves at least four steps: (1) recognizing that sounds or letters are words, (2) linking the words to appropriate associations, i.e., meanings of what is heard, (3) bringing to mind the reply in preparation for expression, and (4) muscular ability for producing the reply. Expressive language, then, requires complex discriminations and associations for its proper effectuation.

Since the probe trials were in the expressive format, perhaps the lack of transfer demonstrated on these trials was due to some break-down in the requirements for the execution of expressive language. The probe trials, then, required not only the recognition of the relationship between the d_1 and d_2 training and d_3 and d_4 training, but also the recall, attachment, and correct motor production of the sign response in relation to the probe stimulus. Given the difficulties autistic children have with temporal relations and their consequent deficiencies in rule extraction, the present study may have been too advanced for their current functioning abilities.

A direct comparison of d_4 and d_5 could have replaced some of this conjecture with empirical data. Unfortunately, the procedures for the steps were so different that any comparison between the two would have yielded results contaminated to the extent of risking results uninterpretable.

When discussing language acquisition in normal children, Ricks (1975) postulated that the growing normal brain is innately organized to constantly scan, check and look for similarities, and also labels the concepts derived from the process. He further hypothesized that the mechanism for scanning, classifying and reclassifying may be the basis for the ability to organize verbal symbols. These formulations appear to be closely connected with the concept of "inner language." According to Sheridan (1972), decoding incoming stimuli and encoding outgoing communication is dependent on a coded storage of concepts. He calls this store of concepts inner language. The acquisition of this store of symbols allows the individual to form new concepts from concrete experiences and from recombining and reshaping ideas already symbolically stored. This enables the individual to produce series of new abstractions based on stored abstractions limited only by the capacity of the person to marshal and handle coded material.

Although they can form simple concepts of size, color, shape, and number, autistic children do not appear able to use their store of concepts in order to form complicated abstractions. When concept formation depends on the ability to manipulate symbols instead of just storing them, the problems of even the most advanced autistic children become evident.

So perplexing are the problems of conceptual behaviors in these children that some authors have noted that the children appear to have done all that they could with language--repeat it rather than understand it (Scheerer, Rothmann and Goldstein, 1945; Goldstein, 1959). However, to leave the analysis at that does not contribute to the alleviation of the learning difficulties of these children. Rather what is needed is systematic analyses of possible controlling variables responsible for the phenomena of the autistic syndrome.

Further Research

Although the current study did not establish a procedure for the remediation of conceptual malfunctions, it did provide a basis for an outgrowth of future research. A future study employing the same design as in the present one could make the training steps comparable, thus allowing for comparisons between acquisition of receptive and expressive language tasks. In addition, an attempt to establish errorless learning discriminations on all four training steps instead of just the first two, might result in positive transfer effects.

Perhaps, since learning increased across training blocks, extention of training blocks might produce changes on probe tests. Another possibility would be training probe tests which were unsuccessful in demonstrating transfer. In other words, if subjects did not indicate transfer on a test step, treat the test step as a training step and see what occurs on the next test step. This procedure would reinforce subjects for making associations, something that was lacking in the current study. In addition, if the subjects did not have an idea of what was expected of them on the probe tests, training eliminates their confusion. Spradlin (personal communication) found this an effective means of acquiring stimulus equivalence in retarded subjects. Whitehurst (1970) also found correction procedures on probes effective in establishing better performance on subsequent probes.

Additional procedural changes of the current study could involve a receptive language rather than an expressive language probe test, or a series of repetitions of training steps d_1 d_2 and d_3 d_4 prior to the probe test. This latter would involve a series of experiments determining the necessary number of repetitions prior to the demonstration of transfer.

These suggestions for possible changes of the current study certainly warrant investigation. However, if none of these procedures effected transfer, it would be necessary to investigate the problem from different angles. Rincover and Koegel (1975) found that when the autistic children in their study did not transfer, it was a result of the lack of control of the relevant stimuli over the children's responses. For example, when the child was given the instruction "Touch your nose," and the child did, it was assumed that the instructions controlled the child's behavior. However, the assessment of stimulus control showed the instructions had nothing to do with the child's response. In addition, the children who did not transfer showed no similarity in the cues to which they were responding. Possible future studies of transfer then could begin by assessing the amount of stimulus control exerted by the considered relevant stimuli of the design. Moreover, temporal and spatial decoding functions of autistic subjects could be assessed to determine the possibility of being confounding variables.

At this time the mechanisms involved in transfer in all populations are not understood, so perhaps when they are studied in autistic children, simpler tasks than symbolic language should be used.

APPENDIX A

RAW DATA SCORES OF TOTAL TRIALS AND TOTAL ERRORS FOR SUBJECTS IN CONDITIONS 1 AND 3

		Condition 1										Condition 3									
		Phase I					Phase II					Phase I					Phase II				
		W-O	O-W	W-S	S-W	S-O*	W-O	O-W	O-S	S-O	S-W*	W-O	O-W	W-S	S-W	S-O*	W-O	O-W	O-S	S-O	S-W*
E	total trials	126	126	138	141	10	126	126	121	126	10	126	126	112	120	10	126	126	110	108	10
	total errors	0	0	7	10	0	0	0	4	6	1	0	0	2	2	0	0	0	1	0	0
B	total trials	127	126	139	161	10	128	126	138	143	10	126	126	125	151	10	126	126	116	129	10
	total errors	1	0	13	36	10	2	0	12	11	10	0	0	7	15	8	0	0	2	21	10
D	total trials	158	144	160	173	10	152	141	148	160	10	139	136	156	137	10	130	135	128	149	10
	total errors	14	7	24	29	10	3	5	5	40	10	3	2	16	11	0	2	4	12	18	0

*Probe trials

APPENDIX B

RAW DATA SCORES OF TOTAL TRIALS AND TOTAL ERRORS FOR SUBJECTS IN CONDITIONS 2 AND 4

		Condition 2										Condition 4									
		Phase II					Phase I					Phase II					Phase I				
		W-O	O-W	O-S	S-O	S-W*	W-O	O-W	W-S	S-W	S-O*	W-O	O-W	O-S	S-O	S-W*	W-O	O-W	W-S	S-W	S-O*
F	total trials	147	139	145	151	10	132	129	135	147	10	129	128	125	142	10	128	127	129	131	10
	total errors	9	4	10	12	10	3	3	6	11	10	2	1	7	9	10	2	1	4	6	10
C	total trials	167	159	199	254	10	164	155	193	218	10	162	165	187	203	10	143	139	186	197	10
	total errors	7	8	29	32	10	8	4	22	29	10	5	9	15	25	10	4	5	19	22	10
A	total trials	130	129	168	177	10	129	127	149	163	10	126	126	146	158	10	126	126	139	142	10
	total errors	4	2	15	18	10	2	1	11	10	10	0	0	9	12	9	0	0	5	7	3

*Probe trials

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