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The Effects of Language on the Mediation of Temporally Based Concepts with Deaf and Blind Children

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THE EFFECTS OF LANGUAGE ON THE MEDIATION OF
TEMPORALLY BASED CONCEPTS WITH
DEAF AND BLIND CHILDREN

by
Gregory W. Doyle

A Thesis Submitted to the Faculty of the Graduate School
of Loyola University of Chicago in Partial Fulfillment
of the Requirements for the Degree of
Master of Arts

September

1975
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VITA

The author, Gregory W. Doyle, is the son of Raymond C. Doyle and Joan (Lundy) Doyle. He was born August 16, 1951 in Chicago, Illinois.

His elementary education was obtained in the parochial schools of Arlington Heights, Illinois and his secondary education at St. Viator High School, Arlington Heights, Illinois, where he graduated in 1969.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Philosophers and scientists have long been fascinated by the development of the human mind. It has only been within the last sixty years that the systematic accumulation of data concerning cognitive development has been initiated.

Commensurate with this accumulation of data has come a great deal of interest and research into the way in which children think and the course of cognitive development from birth through adulthood. Two theories of cognitive development are often cited for the student of psychology: the developmental theory of Jean Piaget, and the modes of cognitive representation of Jerome Bruner.

In the study of Piaget's stage independent theory a number of concepts require elaboration. Piaget, the biologist, posits that there are two systems common to all biological organisms. These functional invariants are universal. They are composed of two processes, organization and adaptation. Organization is the ability of an organism to develop cognitive structures and adaptation is composed of two separate processes, assimilation and accommodation. Piaget's organism is motivated by a need to
maintain equilibrium. Once stimuli impinging on the organism do not meet with expectations, a state of cognitive conflict, or disequilibrium, exists. The organism strives to fit the stimuli into already existing schemata (assimilation). This equilibration is dynamic and never absolute. The resulting condition shows Piaget's child bombarded with visual, auditory and tactile stimuli in a constant state of disequilibrium striving to adapt. The one overriding point made here is that Piaget's theory equates adaptation with intelligence. The more capable the organism is in adapting to his environment the greater the intelligence. The more efficiently an organism functions encoding stimuli the greater the organism's adaptability and intelligence.

In the stage dependent model, Piaget's child begins cognitive growth in the sensorimotor stage. The child's knowledge of his environment is learned through sensory and motor incorporations. The next stage, pre-operational, sees a change from direct interaction with the environment to the manipulation of visual symbols. The child at this stage is egocentric in speech and cannot conserve matter. The concrete operations child presents changes in his ability to conserve matter and to focus on more than one aspect of a problem at a time. The child's primary systems of organization are visual and tactile. In the final stage of development, the formal operations period,
the child is capable of internal representation and abstractions. He possesses the ability to deal with hypotheses. The child abstracts via symbolic function, a term Piaget uses to refer to formal cognitive functioning. The symbolic function is composed of a number of attributes of which language plays a minor role.

Bruner views the development of cognitive functioning as following three successive modes of representation. The first, the enactive mode, in which the child defines events and objects in terms of actions he takes toward them. The second, the iconic mode, posits that the child relies on a high incidence of concrete visual imagery. The third and highest form, the symbolic mode, is characterized by the child's ability to transform experience into language and employ language as a tool for cognitive functioning.

Both Piaget's stage dependent theory and Bruner's modes of cognitive representation account for language as an aspect of cognitive functioning. However, even though Bruner's description of his modes of cognitive representation parallels those of Piaget he differs from Piaget in his interpretations of the role of language in the development of abstract thought. Piaget states that thought and language are closely related but different systems. Bruner, however, hypothesizes that thought is nothing more than internalized language and the syntactical rules of
language rather than logic explain cognitive development.

The research supporting Piaget has focused on spatially based concepts (volume, displacement, transitivity). In an attempt to consolidate the role of language in cognitive functioning and resolve certain areas in the Bruner-Piaget debate it was considered of significant importance to focus on the role of language in modality deficient individuals. To study the role of verbal and visual mediation with deaf and blind children a discrimination paradigm was developed to test the role of language in the mediation of temporally based concepts. It was posited that the encoding and mediation of the temporally based concepts may tend to be firmly entrenched in language. If the result of a temporally based discrimination task suggests that the encoding and subsequent mediation of temporally based concepts in children relies on language, then Piaget may have overlooked an area in cognitive functioning in which language plays a crucial role.

The educational implications accompanying these new data focuses on the following: Does a curriculum which stresses early language development achieve maximal cognitive growth in minimal time? How are early language development and second language learning related? Are educators able to accelerate the acquisition of reading skills by stressing early language development? Are
visually or verbally oriented instructional approaches more facilitative to concept acquisition and therefore to cognitive development? And finally, what of the hypothesis of stage dependency in Piaget's theory? In other words, can a child who lacks the modalities to traverse a specific stage still traverse the stages and think abstractly?

Summary of the Problem

An analysis has been presented explaining Jean Piaget's stage dependent and stage independent theories. The modes of cognitive representation of Jerome Bruner were also elaborated. The preceding analysis indicated some of the problems in evaluating the role of language in cognitive functioning. It was suggested that research supporting Piaget's view of language in cognitive functioning has been established primarily with spatially based concepts.

The purpose of the present study was to examine the role of language in mediating temporally based concepts. It was hypothesized that language was a crucial variable in mediating temporally based concepts. In addition, it was hypothesized that in a tactile, visual and auditory discrimination task normal Ss and blind Ss would be capable of mediation due to the presence of language. Language will permit the mediation of temporally based concepts across all three discrimination tasks.
In a comparison between blind and deaf Ss, blind Ss will utilize language to mediate the auditory discrimination task and the tactile discrimination task. In a comparison between normal and deaf Ss, normal Ss will use language to mediate the visual and tactile discrimination task. Since both normal and blind Ss possess language there will not be a significant difference in mediations when both groups are compared with one another.
CHAPTER II

REVIEW OF THE LITERATURE

The Function of Language in Piaget's System

How does language figure in Piaget's theory of cognitive development? Piaget (1951, 1958) has been most explicit in the relationship between language and cognitive functioning. Two recurrent themes are posited in these writings. The first, suggests that the sources of intellectual operations are not found in language, but in the non-verbal sensorimotor period where a system of schemata are developed. This system was structured by classes and relations, and elementary forms of conservation and reversibility. When the child searches for an object which has disappeared he does it by a series of localizations. These localizations later aid in the development of associativity and reversibility.

The second theme was that representational thought was contemporaneous with the acquisition of language. Both representational thought and language are part of a more general process, the symbolic function. This symbolic function has a number of aspects; different aspects of behavior, all appearing in temporal proximity, indicates its beginnings. The first verbal sounds are initially linked to and contemporaneous with, symbolic play, deferred
imitation and mental images as interiorized imitations. Thought and language are closely related but different systems.

Concerning the first theme Piaget (1951, 1954) and Piaget and Inhelder (1953) have shown that intellectual operations are actions that have become interiorized and reversible, but they are still actions. The findings of several authors have supported this relationship (Inhelder and Piaget, 1964; Inhelder, Bovet, Sinclair and Smock, 1966). In the sensorimotor period object permanency was seen as a general acquisition. An operation was always considered part of a structured whole, of a system of operations, but in the same way, object permanency was not to be understood as the permanency of one or two objects but of objects in general. Thought has its roots in action at the end of the sensorimotor period, and before the appearance of language or of the symbolic function. The child has overcome his initial perceptive and motor egocentricities by a series of decentrations and coordinations. With regard to the second theme Piaget has devoted the majority of a book Play, Dreams and Imitations in Childhood (Piaget, 1951) to this theme.

By the end of the sensorimotor period the child’s first decentrations appear in his dealings with his environment. Action schemata appear that allow the child to
attain his practical aims, which are limited to the immediate present and to the manipulation of concrete objects within his reach. With the development of thought these spatial-temporal restrictions will slowly disappear.

Flavell (1963) comments that as the child is directed toward successes personal satisfactions serve as motivators. Immediate success will not satisfy him, but he will reflect on his own actions and search for explanations. The infant will want to tell others about his discoveries, that now become knowledge of objects and events rather than reactions to objects and events. Concerning this ability of the child to communicate some aspect of the mediating concept, Reed (1971) stated that all concepts for which the child is able to give a verbal label may not serve his as a method of mediating concepts, since the verbalization may not be integrated with his model of reality. The child may be able to give a learned definition of the concept, but not apply the concept in mediating his interaction with the environment. Thus, the child may have learned by rote some concepts which do not as yet act as mediating concepts. There may also be some aspects of his model of reality that the child is unable to encode and communicate. Sinclair (1969) saw the symbolic function as the capacity to represent reality through the process of employing signifiers that are distinct from what they signify. Signals are temporally and spatially
restricted but signifiers are free from such restrictions. According to Piaget (1951) this capacity to represent reality by distinct signifiers has its roots in imitation, which starts very early in the sensorimotor period.

Piaget (1951, 1952, 1954) gave several examples of action imitation that announce the interiorization of representational thought. When Piaget's child Lucienne tries to open a box of matches, she first manipulates it, but without result. She stops acting, seems to reflect on the problem and opens and shuts her mouth several times in succession. She uses a motor-signifier to represent the problem and to find a way of solving it. After this period of reflection she pushes her finger into the small opening and pulls the box completely open.

Language is thus seen as a part of a much larger complex of processes, it does not just appear from nowhere. Piaget has stated in several articles that language was not a sufficient condition for the constitution of intellectual operations (Piaget, 1954, 1961, 1963, 1965, 1966). As to the question of whether language is, if not sufficient, all the same a necessary condition for the constitution of operations, Piaget leaves this question open. Piaget notes (1963) that these operations go beyond language in the sense that they cannot even be expressed in ordinary, natural language. As for concrete operations, Piaget considers language not even a necessary
condition for the constitution of operations. Piaget leaves this question open. Piaget notes (1963) that these operations go beyond language in the sense that they cannot even be expressed in ordinary, natural language. As for concrete operations, Piaget considers language not even a necessary condition for their constitution. He states (Piaget, 1965) that the sensorimotor schemata seem to be of fundamental importance from their very first beginnings; these schemata continue to develop and structure thought, even verbal thought.

Research Supporting Piaget's Hypothesis

A very crucial line of research revolves around the role of language in cognitive functioning in studies dealing with deaf children. Deaf children lack verbal language and have a more limited educational experience, they offer a significant control group to the normal developmental sequence proposed by Piaget. If their cognitive development does not significantly differ from that of normal children there exists important evidence for Piaget's emphasis on the primacy of cognitive maturation. The focal point was whether the possession of language was an essential determiner of the stages of cognitive development observed by Piaget and others, or whether language merely provided experiences which help make this development possible. If language merely provides experiences which help make development possible then it was
hypothesized that experiences of living life itself, in the absence of language, would move a child forward in cognitive development. These propositions were tested using deaf children.

Concerning the vocalizations of deaf children, Lenneberg, Rebelsky and Nichols (1965) did not find a significant difference between deaf and hearing infants during the first three months of life. The evidence appears to indicate that deaf children continue to develop normally by developmental patterns of vocalizations (babbling, crying, cooing) until about six to nine months of age.

Furth (1964, 1966, 1971) considered the issue of whether deaf children show a deficit in concept formation once verbal aspects of the task are removed. Furth presented evidence from a number of experiments that there are often not significant differences. However, the crucial issue focuses on the role of language in concept formation. Furth further discussed the issue of logical reasoning and claimed that deaf children exhibit capacities that show only small deficits at most. Additional studies provide support for Furth's first hypothesis. Vernon (1967) surveyed thirty-three research studies and developed the following hypotheses: 1) there is no close relationship between verbal language and cognitive thought processes, 2) verbal language does not serve as a mediating symbolic system of thought and 3) there was no
relationship between concept formation and the level of verbal language development.

Rosenstein (1959) and Kates, Yudin and Tiffany (1962) found that there was no significant difference between deaf and hearing children in their ability to abstract or generalize when the language requirements of the deaf child were within his capacity. Stachyra (1967) found very similar results with one hundred and twenty-three deaf students and a control group of one hundred normal children.

A group of experiments relating directly to the relationship between language and intellectual operations have been carried out by Inhelder and Sinclair-De Zwart (1967). Their aims were two-fold: 1) to see whether the profound modification that occurs in the child's thinking in the concrete operations period was paralleled by a similar linguistic development and 2) to determine whether a child who still lacks certain concepts or operations would show operatory progress after having undergone verbal training aimed at letting him acquire expressions used by children who already possess the concept in question.

The following conclusions were drawn concerning the first series of experiments. A distinction must be made between lexical acquisition and the acquisition of syntactical structures, the latter being more closely linked to operational levels than the former. Operator like words (more, less, as much as, none) form a class apart whose correct
usage was also very closely linked to operational progress. Secondly, it was proposed that operational structuring and linguistic restructuring parallel each other. The lexical items already mentioned, are already being used or at least easily learned at a pre-operational level; the coordinated structures and operator like words are correctly "understood" in simple situations. Moreover, the difficulties encountered by the child in the use of these expressions seem to be the same as those he encounters in the development of the operations themselves, lack of decentering and the inability to coordinate.

Verbal training leads subjects without conservation to direct their attention to pertinent aspects of the problem, but it did not in fact bring about the acquisition of the operation. Thus, these Genevan results, together with the results of the research on deaf and blind children mentioned earlier, basically confirm Piaget's view on the role of language in the constitution of intellectual operations. In other words, language is not the source of logic, but was structured by logic. The work of Piaget (et al.) strongly suggests that language more often reflects than determines cognitive development. Piaget and his co-workers have made careful attempts to train children in problem solving by teaching them new ways of talking about particular tasks and concepts. The general findings have been that special linguistic training will be of no avail to a child unless his level of cognitive
development has already reached a point at which it can embrace the relevant concept represented by the words. The result of concerted linguistic training has led the Genevans to the following conclusion:

Our general systematic conclusions with respect to the effects of language are straightforward. First, language training, among other types of training, operates to direct the child's interactions with the environment and thus to "focus" on relevant dimensions of the task situations. Second, the observed changes in the justification given (by children) for answers in the conservation task suggests that language does aid in the storage and retrieval of relevant information...little, if any support for the contention that language learning per se contributes to the integration and coordination of "informational units" necessary for the achievement of the conservation concepts (Inhelder, et al., 1966, p. 1963).

Another line of research which suggests that language was not a necessary or sufficient condition for the transmission of abstract concepts revolves around infra-human studies. The work of R. Allen and B. Gardner (1969) with Washoe, a primate chimp, suggested that it was possible to use manual communication to transmit an abstract concept. The chimp closely resembles a deaf child, in that he does not possess language or language capabilities. If it can be demonstrated that an animal not possessing language can mediate certain concepts, this evidence would refute Bruner's position. The results of ongoing research at Atlanta's Primate Center further support the contention that it is possible to communicate concepts without the presence of language. In a controlled laboratory situation, a primate chimp was allowed to converse with his
keeper via a visual computer hookup. A series of buttons tied the chimp's panel with the computer and allowed the chimp to perform a number of tasks. Partial support is offered by this data verifying Piaget's position that language plays only a supplementary role in concept formation.

The Importance of Language to Bruner's System

Bruner's third and highest mode of representational thought is the symbolic mode. Bruner hypothesizes that the basis of this mode was the ability to translate experience into language. Language was used as an instrument of thinking, its internalization becomes logic. The very young child employs logic as an extension of pointing. During the early development of language the child usually only verbalizes about objects that are physically present. The ability to use words to stand for objects that are not present comes gradually to the child. It takes even longer for remote referring words to become manipulated by the transformational apparatus of grammar in a manner designed to aid in the solution of mental problems. Bruner comments:

...it is even later when words become the vehicle for dealing in the categories of the possible, the conditional, and in the counterfactual conditional, and in the vast realm of the mind in which words and utterances have no direct referent at all in immediate experience. Yet it is in these realms that powerful representation of the world of possible experience are constructed and used as models in problem solving (p. 32).
Bruner (1964) believes that toward the second year of life the child is master of the single word or holophrase. Looking at the months that follow, there are two classes of words appearing, a pivot class and an open class. The child begins to engage in combinational talking and possibly, thinking. Lexemes, such as, allgone and mommy, and sticky and bye-bye, were used singly. Now they are combined and become allgone mommy and sticky bye-bye. Allgone has become a pivot word. The mother washes jelly off the son's hands and he utters; "allgone sticky."

Braine (1963) found that the child tries out the limits of pivot words and combinations. These combinations are extraordinarily efficient in representing complex sequences of action. "Allgone bye-bye" after a visitor has departed. This is an excellent and succinct way of wording an occurrence.

Language not only provides a means for representing reality, but also for transforming it. Chomsky (1957) and Miller (1962) have discussed the transformational rules of grammar and how they provide a syntactic means of restructuring the "realities" one experiences. Once the child has mastered the internalization of language as a cognitive instrument it becomes possible for him to transform the regularities and experiences of life with greater flexibility and power than he has ever been capable of before. Vygotsky's (1962) work on language and thought and
Luria and Martinovsky's (1961) work have focused on these restructurings by calling attention to the so-called second signal system which replaces classical conditioning with an internalized linguistic system for shaping and transforming experience. Bruner (1966) refers to the difference between words and images as methods of dealing with experience. Bruner hypothesized that what occurs in Piaget's conservation experiments was nothing more than illusion. If the child usually deals with things in terms of their image properties he may be overcome by his perceptions, even though he may have the language necessary to deal with them in a more powerful linguistic way. If the child was allowed to work the problem out "in his head" before ever seeing the displays, thus permitting linguistic or symbolic representation before the iconic mode monopolizes the situation, then these pre-operational thinkers should succeed at conservation. Bruner placed a screen in front of the beakers, covering all except the tops. The children were then asked whether there was the same amount to drink in the hidden glass after the contents of the standard glass were poured into the wider glass. The results indicated most Ss were able to deal with the problem and show conservation. Virtually no 4 or 5 year olds are usually capable of conservation. Bruner found that half the 4 year olds did not maintain conservation once the screens were removed, while older children maintained their more sophisticated linguistic version.
And Bruner noted their reasons. "It looks different but it really isn't," or "It doesn't change when you only pour it." Language provides the means of getting free of immediate appearances as the sole basis of judgment.

Several studies have supported Bruner's thesis (Bruner and Kinney, 1966; Frank, 1966; and Nair, 1963). These studies tend to point to the decline of a preference for perceptual and iconic methods of dealing with objects and events, particularly with their grouping. Closer inspection, however, suggests another factor at work. There appeared to be evidence of hierarchical structures and rules for including objects in superordinate hierarchies. Hierarchical classification is surely one of the most evident properties of the structures of language, that is, hierarchical grouping that goes beyond perceptual inclusion. As language becomes more internalized, more guiding as a set of rules for organizing events, there was a shift from the associative principles that operate in classical perceptual organization to the increasingly abstract rules for grouping events by the principles of inclusion, exclusion and overlap, the most basic characteristic of any hierarchical system.

Bruner (1966) has also shown that intensive training in the acquisition of dimensional language proves quite useful and significant gains in the ability to conserve were noted. Cognitive growth consists in part of the development of systems of representation as means for dealing
with information. The growing child begins with a strong reliance upon hierarchical learned action patterns to represent the world around him. In time, there is added to this technology a means for simultaneously transforming regularities in experiences into images that stand for events in the way pictures do. To this is firmly added a technique of translating experience into a symbol system that can be operated on by the rules of transformation that greatly increase the ways possible and range of problem solving. One of the effects of his development, or possibly one of the causes, is the power for organizing acts of information processing into more integrated and long-range problem solving efforts.

Bruner suggests that between the ages of 4 and 12 language comes to play an increasingly more powerful role as an implement of knowing. Through simple experiments Bruner has tried to show that language shapes, augments and even supercedes the child's earlier less efficient modes of processing information. Translation of experience into symbolic form with its attendant means of achieving remote reference and combinations reveals to the child a new realm of magnitude beyond the most powerful image formation system. Once language becomes a medium for the translation of experience, there is a progressive release from immediacy. For language has the new and powerful features of remoteness and arbitrariness. Language permits productive, combinational operations in the
absence of what is represented. With this achievement the child can delay gratification by representing to himself what lies beyond the clue directly in front of him. The child may be ready for delay of gratification, but he is not able to achieve it.

It was Bruner's belief that language was paramount to developing logic. Logic consists of nothing more than internalized language. The child uses language as an instrument of thinking. The syntactical rules of language rather than logic can be used to explain mastery of Piaget's conservation problem.

Research Supporting Bruner's View

A great deal of research has focused on language training in conservation experiments and how conservation is related to comprehension and use of dimensional language. Frank (1966) attributed an increase in conservation response after the use of a screening device for the presentation of conservation of liquid tasks, to the resulting activation of verbal responses which suppressed lower-order perceptual responses. One author's work has supported this thesis (Greenfield, 1966). Sinclair (1967) found minimal conservation improvement after training in the use of differentiated language. Peisach (1973) in contradiction to her hypothesis found that language facilitates the logical multiplication of classes, which in turn facilitates conservation. Many theories of stimulus
encoding hold that adults tend to encode stimuli, whether verbal or pictorial, in a pictorial manner and are less likely to recode them to a verbal form (Bruner, 1964; Pavio, 1971; Tversky, 1973). Presumably the mediating process observed to develop at about the age when reading is taught are primarily verbal in nature (Kendler and Kendler, 1962; White, 1965) and serve to shape the schemata by which events are encoded, organized and retrieved. Blank and Soloman (1968) developed a specialized program to facilitate abstract thinking in young deprived children by employing a short individual tutoring session on a daily basis. The results indicated a marked gain in I.Q. for the groups who received the specialized tutoring and no significant gains for control groups.

Yussen (1972) employed sixty preschoolers and second graders training them to discriminate between two simultaneously presented forms under conditions of visual and verbal highlighting of dimensions. Results indicated that relevant verbal experiences facilitated learning for preschoolers and that irrelevant verbal experiences did not interfere with learning.

In refutation to the seemingly overwhelming evidence conducted with deaf and blind children, Bruner (1966) hypothesizes that the processes deaf and blind children use to deal with abstract concepts are as yet unclear. Process oriented approaches to cognitive skills seem to argue strongly that some sort of language was used
internally, even if the language was not that of the society in which the child lived. Competence in abstraction by deaf subjects has in many studies been found to be closely linked to verbal functioning. Oleron (1953) found a deaf sample deficit in nonverbal abstract functioning as determined by a sorting test, and he concluded that the source of the deficiency was the result of language retardation. As one can observe from the literature cited here, the controversy is far from settled.

An area which may be directly related to the Bruner-type approach to cognitive functioning is the information processing model. In the area of short-term memory a large number of studies have reported differences in recall as a function of auditory and visual presentation of verbal items. Penney (1975) found that auditory presentation resulted in retention superior to that of visual presentation in every short-term memory task investigated. She also reported that the capacity for the auditory memory store was greater than the verbal store. This was supported for both item and order information.

In the feedback loop model, auditory feedback increases the amount of recall and aides in processing for long-term memory. The relationship that this may have with cognitive development may be as follows. Logically, from a cognitive point of view, memory, information processing and cognitive functioning are intrinsically linked systems. The capacity for recall (memory) is a
function of modality encoding. If one assumes that the intelligence of an organism is measured as his ability to adapt then it follows that with a more efficient and superior form of recall an organism increases his ability to learn and therefore to adapt. This superior form of adaptation may be intrinsically linked to modality encoding. If it can be demonstrated that auditory processing (verbal mediation) is superior to visual processing (visual mediation) in a discrimination task, then the groundwork for assuming language as a focal point in information processing exists.

Synthesis of Research Related to the Resolution of the Bruner-Piaget Debate

Bruner's modes of cognitive representation and Piaget's developmental sequences parallel each other. It is this one point of conflict, the role of language in cognitive development, that produces the major schism. DiVesta and Paiermo (1974) have suggested that three major approaches to the study of language in cognitive development may be assumed: 1) language precedes thought, 2) thought precedes language and 3) language and thought are inseparable. To assume the last to be true would be to confine one to a behaviorist view of language, suggesting that language and thought are only different delineations of behavior (ala Watson, Skinner and Staats). This third approach was not dealt with in this paper as it was felt
to be beyond its scope. However, the existence of a third theoretical position was kept in mind.

**Language precedes thought:** Bruner believed that language was paramount to developing logic and that logic consisted of nothing more than internalized language. The child translates experience into language and employs language as an instrument of thinking. The syntactical rules of language rather than logic were used to explain mastery of conservation. By exposing the child to a wide variety of linguistic experiences and stressing the importance of semantics and syntax, there was sufficient structure provided for the acceleration of intuitive thought and hence intellectual growth.

**Thought precedes language:** Piaget has stated that the formation of representational thought is contemporaneous with the acquisition of language, both belong to a more general process, that of the constitution of the symbolic function. The first verbalizations are intrinsically linked to symbolic play, deferred imitation and mental images as interiorized imitations. Language development parallels cognition but always lags behind it to become mapped onto experience (Furth, 1970).

Currently the application of Piagetian theory to the classroom is extensive. Its effectiveness and usefulness, however, is being questioned. A new paradigm of concept development has been posited, labeled the Wisconsin Model,
which was based on laboratory experiments on concept learning beginning in 1961 that used Bruner-type concept identification tasks (Klausmeir, Harris and Wiersma, 1964; Klausmeir, Harris, Davis, Schwenn and Frayer, 1968). The Wisconsin Model recognizes the role of language and directed learning experiences as of central importance in acquiring concepts at the classificatory and formal levels. Four levels of attainment were specified by the model and ranged from preschool through high school. Language development and instruction have been established as powerful determinants of when a child attains a certain concept, yet it was not known whether either language instruction or instruction itself, pertaining to a particular concept, influenced the hypothesized four-phase sequence of attainment. Klausmeir and Hooper (1974) suggested that a great deal of work must be done with both the Piagetian system and the Wisconsin Model before either can have a significant effect on the curriculum of the school-aged child.

Therefore, it appears that the importance of language to cognitive functioning continues to be an area needing critical research. With recent development and emphasis on language acquisition, transformational grammar and the emergence of language acquisition devices, the field of psycholinguistics seems rich for exploitation. However, certain areas concerning the effects of language on concept development appear to have been overlooked. It is suggested that research in this area will be fruitful.
In order to obtain the information necessary to resolve the Bruner-Piaget debate the following areas of investigation are suggested:

1) **Research to determine the effects of language on temporally based concepts.** Although much research has been conducted to consolidate the area of conservation acquisition, a new approach seems in order. Using traditional discrimination paradigms, Blank (1974) found preschool children capable of distinguishing between one or two circles regardless of whether or not they applied language to the task. These same children, however, could not discriminate between one and two flashes of light if the children did not apply the relevant verbal labels. Blank suggested that the group of stimuli involving temporally based discrimination tasks were dependent on language. Blank also maintained that the Genevan approach has tended to focus on spatially based concepts and have overlooked temporally based concepts. Since many of the young child's abstract concepts contain such components including; speed (fast or slow), duration (a long time, a little while ago) and sequence (first, second, before, after), Blank posited that research into temporally based concepts could prove valuable. Blank assumes it is a matter for further research to determine the precise relationship between verbal coding and temporally based concepts. It appears that devoting almost exclusive attention to spatially organized stimuli (mass, weight,
height), psychology has overlooked at least one area in which language may be crucial to aiding the speaker in comprehending more subtle and complex stimuli. It is suggested that a new paradigm be developed to assess performance in this area, as well as in other spheres that go beyond the traditional visual discrimination paradigm.

As far as methodological problems of this line of research are concerned, they appear minimal. It seems plausible to develop a number of discrimination experiments that test the importance of language to temporally based concepts. It is possible that the acquisition of temporally based concepts may tend to be firmly entrenched in verbal restructuring. If this proves to be true, then the educational implications would point to an approach which stressed early language development.

2) Research to determine how blind and deaf children traverse Bruner's modes of cognitive representation. a) Do the deaf develop internalized speech?, b) Do the blind employ mental imagery and if so in what ways?, c) What provides the mediation between iconic and symbolic modes in deaf children?, d) Are there any compensatory effects, possibly some sort of iconic-symbolic combination present in sensory limited individuals?, e) To what extent can deaf children communicate symbolically (abstract concepts) via sign language?

The methodological problems are dependent on the experimenter's ability to structure tests that are reliable.
These tests must rely on systematic assessment and evaluation of the material and be appropriately modified for application with sensory limited individuals.

Educational implications are numerous. The development of manual communication is in great need of detailing just how effective it can be in the transmission of abstract concepts and the resultant transfer to the use of the written word. Relevant research studies do not exist. A secondary implication would be to consolidate the area of the role of language in cognitive development. Discovering the manner in which the blind and deaf manage to traverse Bruner's system may provide education with the clues necessary to realize the role of language in concept development.

3) A study of optical illusions employing a cognitive mediation model. Experimental psychology has tended to rely on a sensory-perceptual explanation of optical illusions. However, a second approach for the explanation of optical illusions in adults needs elaboration. A cognitive point of view should take into consideration some type of iconic (visual) fixation. It could be posited that Piaget's conservation experiments are nothing more than optical illusions. The tendency of the pre-operational child to fail to conserve stems not from the inability to understand volume, but from a perceptual fixation—an optical illusion. Adults, when presented with various gestalt experiments of illusion are unable to
rectify the illusion even with relevant verbal explanations. The concrete operations child when confronted with a conservation experiment may use a verbal shield to explain this visual distortion. Further research is needed to determine just how an adult deals with an optical illusion (both visually, conceptually and verbally).

The methodological problems involved with designing and evaluating a cognitive mediation model are numerous. Physiological paradigms must be evaluated and kept in mind, as should the present state of knowledge in psychology, and its limitations in dealing with the mediation process. Some type of discriminations task with optical illusions may prove beneficial in supplying adequate data. Since the majority of Piaget's research focuses on the results of the conservation experiments, the consolidation of this problem would do much to rectify the role of language in concept development. If the methodological problems could be adequately dealt with, critical research on this problem could provide some significant data.

Recapitulation

The preceding discussion emphasized research required to consolidate the Bruner-Piaget debate. A discussion of the goals of studying the role of language in cognitive development is needed. What educational implications can such research provide? DiVesta and Palermo suggested that the study of language development can
provide some relevant answers related to the educational process. First, the relationship between language development and second language learning could be resolved. When should a second language be taught as part of the schools' curriculum? Second, how do departures from standard English affect cognitive ability? This issue was elaborated on in the deficit-difference debate. Those advocating the deficit position believe that non-standard English is related to cognitive impairment, those advocating the difference position suggest the role of non-standard English in cognitive development is inconsequential. Third, how are language development and reading skills related? A theory of reading which is based on developmental psycholinguistics should be constructed around reading as a skill in which thought processes and language interact. Most important is the general goal of suggesting to teachers and parents a workable and reliable model of the role of language in cognitive development. As educators we must differentiate between the importance of educational instruction which is visually oriented and instruction which is verbally oriented. Which teaching techniques provide the most efficient results, or must we combine the methods for greatest usefulness?

If language training proves insignificant in the transmission of an instruction of concepts then much of what is called verbal-oriented teaching is diminished in
value. If, however, language provides the means to facilitate concept attainment, then teaching possesses a valuable implement for accelerating concept acquisition. Effective instructional strategies should be included at all levels of education. By determining and evaluating an educational goal, the teacher can decide in what way matching instructional strategies and input preferences (i.e., verbal or visual) seem most appropriate and meaningful in any given situation.

The preceding synthesis emphasized three areas of potential research. The opinion was expressed that the area most exploitable and with the fewest methodological problems was research to determine the effects of language on the mediation of temporally based concepts. Blank (1974) stated that temporally based concepts contained the following components: speed, duration, sequence. In the present investigation it was decided to employ two of these three components, duration and sequence, in the creation of the stimuli.

It was determined that in order to test the role of language in the mediation of temporally based concepts a discrimination paradigm was required. The discrimination paradigm was developed by employing two of the temporally based components, duration and sequence. The temporally based concepts were transformed to light flashes, sound impulses and tactile vibrations. The discrimination to be made was based on "same" or "different" choices.
In general, the null hypothesis stated that language will not aid blind and normal Ss in mediation. The alternative hypothesis stated that in the visual, auditory and tactile discrimination tasks normal and blind Ss will mediate more T.B.C.s than deaf Ss due to the presence of language. Language was defined in the following way: the expression or communication of thoughts and feelings by means of vocal sounds, and combinations of such sounds, to which meaning is attributed; human speech.

The educational implications revolve around the partial resolution of the Bruner-Piaget debate. If it can be shown that language is a necessary and sufficient condition for the mediation of temporally based concepts then educational instruction which is verbally oriented may prove to aid in concept acquisition and retention. A secondary educational implication could be to stress early language development in order to facilitate cognitive growth.
CHAPTER III

METHOD

Hypotheses Tested

The principal purpose of the study was to test the following null hypotheses:

1) There will be no observed difference between the performance of blind Ss and normal Ss on an auditory discrimination task (blind on auditory task with normal on auditory task).

2) There will be no observed difference between the performance of deaf Ss on a visual task and the performance of blind Ss on an auditory task (deaf on visual task with blind on auditory task).

3) There will be no observed difference between the performance of normal Ss and deaf Ss on a visual discrimination task (normal on visual task with deaf on visual task).

4) There will be no observed difference between the performance of blind Ss on an auditory task and a tactile task and the performance of deaf Ss on a visual task and a tactile task (blind on an auditory and tactile task with deaf on a visual and a tactile task).

5) There will be no observed difference between the performance of normal Ss and deaf Ss on a tactile discrimination task (normal on a tactile task with deaf on a
6) There will be no observed difference between the performance of normal Ss and blind Ss on a tactile discrimination task (normal on tactile task with blind on a tactile task).

7) There will be no observed difference between the performance of deaf Ss and blind Ss on a tactile discrimination task (deaf on a tactile task with blind on a tactile task).

8) There will be no observed difference between the performance of normal Ss on a visual discrimination task and a tactile discrimination task and the performance of deaf Ss on a visual and a tactile discrimination task (normal on a visual task and tactile task with deaf on a visual task and a tactile task).

Subjects

Forty subjects were selected from nine schools in eight school districts. Using a table of random numbers, Ss were randomly divided into one of the three discrimination groups: visual, auditory and tactile. In addition, subjects were randomly stratified according to modality deficiency (i.e., blind or deaf). The criteria used for selection of the modality deficient children were as follows: blind children (totally visually deficient-braille readers) and deaf children (deaf from 75 d.b.). Table 1 contains a numerical description of the Ss.
Table 1. Numerical Description of Subjects According to Demographic Variables.

<table>
<thead>
<tr>
<th></th>
<th>normal Ss</th>
<th>normal Ss</th>
<th>normal Ss</th>
<th>deaf Ss</th>
<th>deaf Ss</th>
<th>blind Ss</th>
<th>blind Ss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade level</td>
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<td>2</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Mean age</td>
<td>7.6</td>
<td>7.8</td>
<td>7.71</td>
<td>9.2</td>
<td>8.8</td>
<td>9.1</td>
<td>8.4</td>
</tr>
<tr>
<td>Economic status</td>
<td>M.C.</td>
<td>M.C.</td>
<td>M.C.</td>
<td>M.C.</td>
<td>M.C.</td>
<td>M.C.</td>
<td>M.C.</td>
</tr>
<tr>
<td>Number of Ss partici-</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>pating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>4 male</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
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<tr>
<td></td>
<td>2 female</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Treatment group</td>
<td>visual</td>
<td>auditory</td>
<td>tactile</td>
<td>visual</td>
<td>tactile</td>
<td>auditory</td>
<td>tactile</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean IQ</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>100.2</td>
<td>99.4</td>
<td>100.5</td>
<td>100.28</td>
</tr>
<tr>
<td>Mean db level</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>90.6</td>
<td>93.5</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
according to demographic variables and treatment group. Due to the paucity of blind Ss meeting criteria for selection, it was possible to employ only 10 blind Ss. This created an uneven number of Ss in two cells.

Experiment I

Apparatus: Table 2 lists the temporally based concepts (T.B.C.s) as discrimination pairs. This list was generated by means of permutations of the two temporal components (i.e., duration and sequence). As a result of these pairings 24 distinct T.B.C.s were tabulated. The 24 pairs were then randomly distributed and reproduced by means of an I.B.M. 360 computer and a tone generator. The tones were 850 c.p.s. and were recorded on a Norelco stereo tape recorder. Tones were either one second or two seconds in duration with an error range of ±.10 seconds. The tones activated two five inch air suspension speakers.

Procedure: The Ss were seated at a table across from E. One speaker was placed three feet to the right of S and one speaker placed three feet to the left of S. The procedure was for E to direct S's attention to the two speakers. The test sequence was randomly distributed across to both right and left side speakers in first and second order. After the test sequence S indicated his choice by responding "same" or "different." Figure 1 shows the timing sequence for three treatment programs.
Table 2

Visual, Auditory and Tactile Temporally Based Discrimination Stimuli

<table>
<thead>
<tr>
<th>Pair Number</th>
<th>Left Side*</th>
<th>Right Side*</th>
<th>Correct Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>A</td>
<td>Same</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>C</td>
<td>Different</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>A</td>
<td>Different</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>D</td>
<td>Same</td>
</tr>
<tr>
<td>5</td>
<td>C</td>
<td>A</td>
<td>Different</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>B</td>
<td>Same</td>
</tr>
<tr>
<td>7</td>
<td>A</td>
<td>D</td>
<td>Different</td>
</tr>
<tr>
<td>8</td>
<td>D</td>
<td>B</td>
<td>Different</td>
</tr>
<tr>
<td>9</td>
<td>D</td>
<td>B</td>
<td>Same</td>
</tr>
<tr>
<td>10</td>
<td>C</td>
<td>B</td>
<td>Different</td>
</tr>
<tr>
<td>11</td>
<td>A</td>
<td>A</td>
<td>Same</td>
</tr>
<tr>
<td>12</td>
<td>D</td>
<td>C</td>
<td>Different</td>
</tr>
<tr>
<td>13</td>
<td>C</td>
<td>C</td>
<td>Same</td>
</tr>
<tr>
<td>14</td>
<td>C</td>
<td>D</td>
<td>Different</td>
</tr>
<tr>
<td>15</td>
<td>A</td>
<td>A</td>
<td>Same</td>
</tr>
<tr>
<td>16</td>
<td>B</td>
<td>D</td>
<td>Different</td>
</tr>
<tr>
<td>17</td>
<td>B</td>
<td>A</td>
<td>Different</td>
</tr>
<tr>
<td>18</td>
<td>C</td>
<td>C</td>
<td>Same</td>
</tr>
<tr>
<td>19</td>
<td>B</td>
<td>B</td>
<td>Same</td>
</tr>
<tr>
<td>20</td>
<td>D</td>
<td>A</td>
<td>Different</td>
</tr>
<tr>
<td>21</td>
<td>A</td>
<td>A</td>
<td>Same</td>
</tr>
<tr>
<td>22</td>
<td>A</td>
<td>B</td>
<td>Different</td>
</tr>
<tr>
<td>23</td>
<td>B</td>
<td>B</td>
<td>Same</td>
</tr>
<tr>
<td>24</td>
<td>C</td>
<td>A</td>
<td>Different</td>
</tr>
</tbody>
</table>

* A = one second on, B = two seconds on, C = one second off-one second on-one second off, D = one second on-one second off-one second on-one second off.
Figure 1. Graphic presentation of three treatment programs.
Instructions to the Ss were as follows:

Sit back and relax. There is a speaker to your right and another to your left. The speakers are connected to this tape recorder. The tape recorder will make a tone to one side and then to the other side. What I want you to do is tell me if they are the same or if they are different. We will do a few practice trials first and I will answer if they are the same or if they are different. Then I will give you some practice before we start. Do you have any questions?

There were five practice trials the first of which was mediated by E. After the fifth practice trial E questioned S on procedure and subsequently ran 19 test trials. The S was informed that there was a 10 second delay between new trials. The dependent variable was the response "same" or "different" to each of the discrimination trials. The Ss responses were recorded on a subject response list.

Hypotheses Tested: Experiment I was designed to test the following hypotheses: one (blind on auditory with normal on auditory tasks) and two (deaf on a visual task with blind on an auditory task).

Experiment II

Apparatus: The Norelco stereo tape recorder was employed in this condition. An audio converter was developed to produce light flashes. The audio conversion circuit transferred the tape recorded T.B.C.s into electrical impulses and illuminated each lamp accordingly with an error range of ±.10 seconds. A display board was placed approximately three feet in front of S. Figure 2 shows
Figure 2. Apparatus set-up for experiment II- testing the mediation of T.B.C.s in the visual modality.
the display board and S's arrangement. The board consisted of two five inch diameter circles. Each circle had a one quarter inch hole through which an 18 volt lamp was inserted.

Procedure: The S was seated at a table across from a wooden display board two feet by two feet on which two circles were inscribed. Since the instructional sequence was considered crucial, a speech specialist expert in manual communication was present during the instructional and practice sequences. The speech specialist was given the normal instructional sequence for an S prior to testing any deaf Ss. The specialist was also instructed to add any additional manual communication she felt might aid in the transmission of the discrimination concept. The Ss responded to the practice trials with a manual sign for same and another sign for different. This was the dependent variable during the experiment. Normal and blind Ss were given the regular verbal instructions as in Experiment I.

Instructions to the Ss were as follows:

Sit back and relax. There is a display board in front of you. The board has two lights, one here (indicating left) and one here (indicating right). The tape recorder will make the lights flash in some way. What I want you to do is to tell me if the flashes are the same or if they are different. We will try some practice trials first and I will do the first one. I will say whether they are the same or if they are different. Then it will be your turn. Do you have any questions?

There were five practice trials the first of which was mediated by E. After the fifth trial, E questioned S
on procedure and subsequently ran the 19 test trials. The
S was informed that there was a 10 second delay between
new trials. The responses were recorded on a subject res-
ponse list.

**Hypotheses Tested:** Experiment II was designed to
test the following hypotheses: two (deaf on a visual task
with blind on an auditory task), three (normal on a visual
task with deaf on a visual task), four (blind on an audi-
tory and a tactile task with deaf on a visual and a tact-
tile task) and eight (normal on a visual task and a tact-
ile task with deaf on a visual task and a tactile task).

**Experiment III**

**Apparatus:** The Norelco stereo tape recorder was a-
gain employed. The audio converter transferred the tape
recorded tones into electrical impulses which activated
two 18 volt key vibrators within an error range of ±.10
seconds. During the discrimination trials $S$ placed his
hands inside a sound-proof wooden box which housed the
vibrators. The wooden box was equipped with two five
inch holes through which the $S$s placed their hands.
Figure 3 illustrates the sound-proof box and $S$'s position
during trials.

It was suggested that any inferences about media-
tion of T.B.C.s across the major input modalities for
blind and deaf $S$s could not be made without a control con-
dition. This supposition was based on the point of
Figure 3. Apparatus set-up for experiment III- testing the mediation of T.B.C.s in the tactile modality.
inequality of visual and auditory stimuli. The stimuli could not be equated qualitatively. However, two controls were instituted. First, in order to control quantitatively Corso (1967) has suggested that in information processing the amount of information transmitted in each condition can be calculated.¹

Secondly, since both blind and deaf Ss both possessed tactile sense capabilities a tactile discrimination task would act as a modality control. If the results of the first two experiments were due mainly to modality inequality, then this would become evident in this control situation. Therefore, it was assumed that with relation to Experiment III there was modality equality for all three groups: blind, deaf and normal.

The dependent variable was the response "same" or "different" to each of the discrimination trials. Responses were recorded on a subject response list.

**Procedure:** The Ss were seated at a table next to E. In front of S was the sound-proof wooden box. The S placed his hands inside the box with the index finger of each hand on each of the key vibrators. The instructional sequence for the deaf Ss was identical with the instructions for the visual discrimination task. The speech specialist was again employed to assist in the instructional sequence and practice trials. The instructional sequence for the blind Ss was identical to instructions given normal seeing and hearing children. The test sequence
Footnote

where: \( R_{it} \) = rate of information transmitted, \( n \) = number of stimuli presented per specified unit of time, \( H(s) \) = uncertainty per stimuli presented.
followed the five practice trials. The S responded "same" or "different." There was a 10 second delay between each new discrimination trial. Responses were recorded on a subject response list.

Instructions to the Ss were as follows:

Sit back and relax. There is a wooden box in front of you. Place the index finger (E indicates his index fingers) inside the box on the metal arm. These arms will not hurt you. The tape recorder will make the arms move in some way. You are to tell me if they are the same or if they are different. I will do the first one and tell you whether it was the same or if it was different. Then it will be your turn. Do you have any questions?

The E summarized what had already been said and questioned S on the procedure. Each S was tested on the 19 test discrimination pairs.

Hypotheses Tested: Experiment III was designed to test the following hypotheses: four (blind on an auditory and on a tactile task with deaf on a visual task and on a tactile task), six (normal on a tactile task with blind on a tactile task), seven (deaf on a tactile task with blind on a tactile task), eight (normal on a visual task and on a tactile task with deaf on a visual and on a tactile task), and five (normal on a tactile task with blind on a tactile task).
CHAPTER IV

RESULTS

The means and variances for the seven treatment groups are presented in Table 3. A graph depicting the mean number of correct mediations across the three modalities (i.e., visual, auditory and tactile) for the blind, deaf and normal groups are shown in Figure 4.

Hartley's F-max was computed to test for homogeneity of variance. This revealed an F-max of 30.62. The hypothesis of homogeneity of variance was rejected at the .05 level. It was suggested (Gardner, 1975) that the F-distribution was robust with respect to violation of the assumption of homogeneity of population error variance.

The first analysis performed consisted of the calculation of a one-way analysis of variance. This revealed an F-ratio of 4.07 which was significant at the .05 level. A descriptive interpretation of the data revealed that the mean number of correct mediations for the blind and the normal Ss were greater than the mean number of correct mediations for the deaf Ss at all levels.

To test the eight a priori comparisons, a t-test for multiple comparisons was employed. The rationale for using a t-test for multiple comparisons was as follows. An analysis of variance informs the investigator that
Table 3

Means and Variances for All Treatment Groups

<table>
<thead>
<tr>
<th></th>
<th>Means</th>
<th>Variances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Ss - Visual Task</td>
<td>16.50</td>
<td>.5833</td>
</tr>
<tr>
<td>Normal Ss - Auditory Task</td>
<td>17.33</td>
<td>.2222</td>
</tr>
<tr>
<td>Normal Ss - Tactile Task</td>
<td>15.83</td>
<td>.805</td>
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<tr>
<td>Deaf Ss - Visual Task</td>
<td>14.83</td>
<td>1.13</td>
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<tr>
<td>Deaf Ss - Tactile Task</td>
<td>14.17</td>
<td>6.80</td>
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<tr>
<td>Blind Ss - Auditory Task</td>
<td>17.0</td>
<td>.400</td>
</tr>
<tr>
<td>Blind Ss - Tactile Task</td>
<td>16.0</td>
<td>.400</td>
</tr>
</tbody>
</table>
Figure 4: A Comparison of the Means of the Three Treatment Groups.
variation due to treatment effect has occurred. Just where this variation lies in the data cannot be localized by means of a one-way analysis of variance. Kirk (1968) stated that by employing a multiple $t$-test alpha could be set at .05 and a type I error for the collection of comparisons could be controlled for more precisely.

Since both normal and blind Ss possessed language, comparisons were made between normal and deaf, and between blind and deaf Ss. Comparisons were also made between normal Ss and blind Ss to determine if their respective performance differed significantly. Table 4 lists the a priori comparisons and the resultant $t$-ratios.

A chi-square Goodness of Fit test was utilized to determine whether the deaf Ss observed performance was significantly greater than chance. The Goodness of Fit test revealed a $x^2 = 5.285$. This exceeded $x^2$ critical and the hypothesis that there was no difference between the performance of deaf Ss and chance performance was not rejected.

In order to further evaluate the data an unplanned a posteriori comparison was computed using Dunn's Multiple Comparisons test. Table 5 provides summaries of these obtained results, comparing each treatment group mean with all other means. However, these new data revealed no novel information.

Summarizing the obtained $F$-ratio, $t$-test values, and figural representations of the data, evidence is offered
Table 4.
A Listing of the A Priori Comparisons and Resultant \( t \)-Ratios.

<table>
<thead>
<tr>
<th>A Priori Comparisons</th>
<th>Hypothesis</th>
<th>( t )-ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Blind on auditory with normal on auditory task.</td>
<td>( H_0 : \mu_6 = \mu_2 )</td>
<td>.403</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>( H_1 : \mu_6 \neq \mu_2 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Deaf with visual with blind on auditory task.</td>
<td>( H_0 : \mu_4 \leq \mu_6 )</td>
<td>2.22*</td>
<td>.05 &lt; ( p ) &lt; .025</td>
</tr>
<tr>
<td></td>
<td>( H_1 : \mu_4 &gt; \mu_6 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Normal on visual with deaf on visual task.</td>
<td>( H_0 : \mu_1 \leq \mu_4 )</td>
<td>2.12*</td>
<td>.05 &lt; ( p ) &lt; .025</td>
</tr>
<tr>
<td></td>
<td>( H_1 : \mu_1 &gt; \mu_4 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Blind on auditory and tactile task with deaf on visual and tactile task.</td>
<td>( H_0 : \mu_6 + \mu_7 \leq \mu_4 + \mu_5 )</td>
<td>2.43*</td>
<td>.05 &lt; ( p ) &lt; .01</td>
</tr>
<tr>
<td></td>
<td>( H_1 : \mu_6 + \mu_7 &gt; \mu_4 + \mu_5 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Normal on tactile task with deaf on tactile task.</td>
<td>( H_0 : \mu_3 \leq \mu_5 )</td>
<td>2.12*</td>
<td>.05 &lt; ( p ) &lt; .025</td>
</tr>
<tr>
<td></td>
<td>( H_1 : \mu_3 &gt; \mu_5 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Normal on tactile task with blind on tactile task.</td>
<td>( H_0 : \mu_3 = \mu_7 )</td>
<td>.202</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>( H_1 : \mu_3 \neq \mu_7 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Deaf on tactile task with blind on tactile task.</td>
<td>( H_0 : \mu_7 \leq \mu_5 )</td>
<td>2.23*</td>
<td>.05 &lt; ( p ) &lt; .025</td>
</tr>
<tr>
<td></td>
<td>( H_1 : \mu_7 &gt; \mu_5 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Normal on visual and tactile task with deaf on visual and tactile task.</td>
<td>( H_0 : \mu_1 + \mu_3 \leq \mu_4 + \mu_5 )</td>
<td>2.12*</td>
<td>.05 &lt; ( p ) &lt; .025</td>
</tr>
<tr>
<td></td>
<td>( H_1 : \mu_1 + \mu_3 &gt; \mu_4 + \mu_5 )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5

Differences Between All Means Using a Dunn's Multiple Comparison to Test for Unplanned A Posteriori Comparisons

<table>
<thead>
<tr>
<th></th>
<th>(X_5)</th>
<th>(X_4)</th>
<th>(X_3)</th>
<th>(X_7)</th>
<th>(X_1)</th>
<th>(X_6)</th>
<th>(X_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(X_5)</td>
<td>-</td>
<td>.6667</td>
<td>1.666</td>
<td>1.8334</td>
<td>2.334</td>
<td>2.834*</td>
<td>3.1667*</td>
</tr>
<tr>
<td>(X_4)</td>
<td>-</td>
<td>1.0</td>
<td>1.167</td>
<td>1.167</td>
<td>2.167</td>
<td>2.50</td>
<td></td>
</tr>
<tr>
<td>(X_3)</td>
<td>-</td>
<td>.167</td>
<td>.6667</td>
<td>1.1667</td>
<td>1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(X_7)</td>
<td>-</td>
<td>.50</td>
<td>1.0</td>
<td>1.333</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(X_1)</td>
<td>-</td>
<td>.50</td>
<td>.833</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(X_6)</td>
<td>-</td>
<td>.3333</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(X_2)</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* \(p < .05\)
which supports the hypothesis that blind and deaf Ss performed significantly better than deaf Ss on all three discrimination tasks. Data supporting the hypothesis that there was no significant difference between normal Ss and blind Ss on an auditory and on a tactile discrimination task was also offered.
CHAPTER V

DISCUSSION

The results of this study support Blank's (1974) contention that language is a crucial factor in the mediation of temporally based concepts.

As anticipated there was no difference between the performance of blind Ss on auditory and tactile discrimination tasks and the performance of normal Ss on auditory and tactile discrimination tasks (Comparisons one and six).

There was an observed difference between the performance of deaf Ss on a visual task and the performance of blind Ss on an auditory task. Blind Ss were able to mediate a significantly greater number of times than deaf Ss (Comparison two).

There was an observed difference between the performance of normal Ss and deaf Ss on a visual discrimination task. Normal Ss performed the mediation of the T.B.C.s a greater number of times (Comparison three).

In a comparison of the performance of blind Ss on the auditory and tactile discrimination tasks with the performance of deaf Ss on a visual and tactile discrimination task, the blind Ss mediated a significantly greater number of T.B.C.s than deaf Ss (Comparison four).
On a tactile discrimination task there was an observed difference in the performance of normal Ss and deaf Ss. Normal Ss were able to mediate the T.B.C.s a greater number of times (Comparison five).

In a comparison of deaf and blind Ss on a tactile discrimination task, blind Ss mediated a significantly greater number of T.B.C.s (Comparison seven).

As hypothesized there was an observed difference in the performance between normal Ss on a visual and tactile task and the performance of deaf Ss on the visual and tactile tasks (Comparison eight).

The present study produced results which strongly supported the hypothesis that language aids children in the mediation of T.B.C.s. As suggested in the review of the literature and exemplified in the present investigation, it was posited that the Genevans may have overlooked an area in cognitive functioning where language may be crucial to mediation.

The overall findings supported Penney (1975) who posited that in information processing the auditory stimuli has the least decay and the greatest recall over time.

The results of the present study suggest that with respect to specific concepts educational instruction which is verbally oriented may aid in concept acquisition and retention. Concept attainment, as posited in the Wisconsin Model, may also be critically linked to language
If language development and concept attainment are intrinsically linked then it follows that early language development may facilitate cognitive growth. It was hypothesized that early language development may accelerate concept attainment and thus maximize cognitive growth.

The study also yielded some interesting theoretical findings, regarding which only speculative kinds of inferences can be drawn. The relationship between language development and reading ability remained undetermined. The review of the literature suggested that a theory regarding language development and reading skills must utilize the findings of developmental psycholinguistics in order to be effective and applicable. If language aids in concept attainment and mediation then it seems reasonable to assume that concept mediation may be related to reading comprehension and reading skills acquisition.

A review and reappraisal of the tape recorded T.B.C.s indicated that 90% were sequential in nature and subject to numerical encoding. Of the 19 test items only two were based on durational concepts. Of these two pairs the blind and normal Ss were able to correctly mediate at about a 75% rate. The deaf Ss responded correctly at about only the 25% rate. Although there was not enough data to make any statistical inferences on duration, the results did suggest that the study was incomplete and inconclusive as regards the role of language in mediating
all T.B.C.s.

During the course of the experiment and in post-experimental interviews, it was determined that it was possible for the Ss to cardinally number the flashes of light and number of vibrations. Thus, if a deaf child possessed the ability to count and visually represent the counting (with his fingers) he could make a correct response without resorting to language. What seems of importance is the fact that normal and blind Ss were much more efficient than deaf Ss at processing the mediation. This was supported by the statistically significant number of correct responses given by normal and blind Ss.

However, one result of the present study provides a partial answer to the question of whether language was a necessary and sufficient condition for the mediation of T.B.C.s. Concerning the mediation of abstract concepts it appears that with respect to sequential T.B.C.s, language was a necessary condition for mediation.

In evaluating the utility of the results of the present study two general criteria were considered. The first of these, internal validity, must be met or the research findings are at best meaningless (Campbell and Stanley, 1966). The present study controlled for the following extraneous variables: maturation--the short experimental period minimized the effects of fatigue, biological and psychological maturation, pre-testing--Ss were tested once and only once, instrumentation--the mechanism
used for the presentation of the stimuli were not subject to significant variation, statistical regression—the Ss were not chosen on the basis of extreme scores but because of specific modality deficiencies, experimental mortality—all Ss participating in the experiment were tested at one point in time. Internal validity could not be established with respect to selection, biases resulting from the differential selection of Ss for the comparison groups. An inspection of the sample will reveal that the sample employed was one of convenience. The West Suburban Association has 210 school districts within its jurisdiction. Due to the rigid criteria necessary for the selection of the sample there were only 25 blind Ss and 37 deaf Ss which met the criteria for selection.

In terms of external validity, or generalization, the results of the present investigation were examined via four jeopardizing factors: First, interaction effects of selection and the experimental variable, as was previously mentioned the sample used was one of convenience and therefore biased. Second, reactive effects of pre-testing, it was assumed that the present study could not be faulted on this point. Third, reactive effects of experimental procedures, the effects arising from the experimental setting will not occur in spontaneous, non-experimental situations. It was assumed that the experimental conditions employed in the present study were contrived and a Hawthorne effect was considered a possibility. Fourth,
multiple-treatment interference effects due to multiple treatments applied to the same Ss where prior treatments influence subsequent treatments in the series because their effects are not erasable. The present investigation could not control for prior treatment influences.

With respect to internal validity the experimenter was reasonably confident in stating that the manipulation of the independent variable resulted in the obtained dependent variable. Overall, the results of the analysis of internal and external validity suggest that there was a high degree of internal validity. In terms of external validity, the results are applicable to a specific limited population (i.e., blind, deaf and normal children between six and eleven years old and coming from middle-class suburban homes).

In order to further evaluate the role of language in the mediation of T.B.C.s, this author is currently conducting a systematic replication of the present study using a different sample and durational T.B.C.s. It was hypothesized that a systematic replication will confirm the results obtained in the present investigation.

As mentioned in the review of the literature, the knowledge necessary for the resolution of the Bruner-Piaget debate revolve around two areas: First, research to determine how children mediate optical illusions and second, research evaluating and mapping the way modality deficient individuals traverse Piaget's and Bruner's
stages of cognitive development.

Before a statement on the role of language in the mediation of all T.B.C.s can be made it is necessary to incorporate the results of current on-going research. When the results of this research are complete an empirical statement can be made on the role of language in mediating all T.B.C.s. With these new data a more definitive statement can be made concerning the role of language in verbally oriented instruction, early language development and the role of language in concept attainment.

In conclusion, the present study supports Blank (1974) in her contention that language is crucial in the mediation of T.B.C.s. The hypothesis that language aids children in processing and mediating T.B.C.s was confirmed. It was suggested that Piaget may have overlooked an area in cognitive functioning where language was necessary for cognitive mediation.
CHAPTER VI

SUMMARY

The purpose of this study was to investigate the role of language in the mediation of temporally based concepts. A discrimination paradigm was developed to test this mediation in blind, deaf and normal Ss.

Both Piaget's stage dependent theory and Bruner's modes of cognitive representation account for language as an aspect of cognitive functioning. However, even though Bruner's description of his modes of cognitive representation parallels those of Piaget he differs from Piaget in his interpretation of the role of language in the development of abstract thought. Piaget states that thought and language are closely related but different systems. Bruner, however, hypothesizes that thought is nothing more than internalized language and the syntactical rules of language rather than logic explain cognitive development.

The research supporting Piaget has focused on spatially based concepts (i.e., volume, displacement, transitivity). In an attempt to consolidate the role of language in cognitive functioning and resolve certain areas in the Bruner-Piaget debate it was considered of significant importance to focus on the role of language in modality deficient individuals. To study the role of verbal and visual mediation with deaf and blind children, a
discrimination paradigm was developed to test the role of language in the mediation of temporally based concepts. It was suggested that the encoding and subsequent mediation of the temporally based concept was firmly based in language.

The experimental task involved mediation of the temporally based concept in three different modalities: visual, tactile and auditory. Subjects were required to make same or different responses to the stimuli.

Using a priori comparisons a t-test for multiple comparisons was computed. The results indicated that blind and normal Ss performed significantly greater than deaf Ss on all three discrimination tasks. Evidence indicating there was no significant difference between normal and blind Ss was also offered.

The results of this study offer support for Blank's (1974) contention that language may be a crucial factor in the mediation of temporally based concepts. As suggested in the review of the literature and exemplified in the present investigation, it was posited that the Genevans may have overlooked an area in cognitive functioning where language may be crucial to mediation. The overall findings supported Penney (1975) who hypothesized that in information processing the auditory stimulus has the least decay and the greatest recall over time.

From the results of the study the following conclusions were drawn: Firstly, concerning the mediation of
abstract concepts it appears that with respect to sequential temporally based concepts language was a necessary condition for mediation. Secondly, with respect to certain, specific concepts educational instruction which is verbally oriented may aid in concept acquisition and retention. Concept acquisition and attainment, as posited in the Wisconsin Model, may also be critically linked to language development.

Thirdly, if language development and concept attainment are intrinsically linked then it follows that early language development may facilitate cognitive growth. It was hypothesized that early language development will accelerate concept attainment and thus maximize cognitive growth.

In conclusion, the present study confirms the hypothesis that language is crucial in the mediation of certain T.B.C.s. It was suggested that the Genevans may have overlooked an area where language is crucial to cognitive functioning.
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The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Master of Arts.

1/9/76
Date

[Signature]