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MATERNAL TEACHING STRATEGIES AND THE DEVELOPMENT OF MENTAL IMAGERY IN BLIND CHILDREN

by

MARY ANN LANG

A dissertation submitted to the Graduate Faculty
in Educational Psychology in partial fulfillment of the
requirements for the degree of Doctor of Philosophy,
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Abstract

MATERNAL TEACHING STRATEGIES AND THE
DEVELOPMENT OF MENTAL IMAGERY
IN BLIND CHILDREN

by

Mary Ann Lang

Advisor: Professor David Bearison

Studies of the relationship between imitation and the development of mental imagery have generally focused on imitation of visually-perceived actions. A study was conducted which investigated the development of mental imagery in the absence of vision. The role of the index in imagery development was explored. Piaget defines an index as a mobile sign which is detached from the action taking place. These mobile signs provide the child with a link between an observable body part or action and an unobservable one. It becomes a symbol which the child applies to these non-visible movements. Particular emphasis was placed on exploring the role of maternal index facilitating on the development of imagery in children.

Since there was no previous research on the role of the index in this process, literature was reviewed in five areas which converge on the problem. The five areas were: (1) Imitation in the development of mental imagery; (2) Representation in infancy and early childhood; (3) The role of vision in the development of mental imagery; (4) The early development of the blind child;

and (5) The mother-child dyad in a teaching situation.

The subjects were 40 children from two through seven years of age, 20 of whom were congenitally blind (CB) and 20 sighted (S). Four tasks were administered. Two of these were carried out to determine each subject's level of mental imagery development. The third task was carried out with each subject and the child's mother and was used to determine the index-facilitation level for each mother. The fourth task was administered to determine the child's imitation ability under standardized conditions. Data were analyzed using Multiple Regression Analyses. The child's controlled imitation score obtained from task IV was analyzed as a covariate to partial out the effect of the child's imitation ability on the index-facilitation behavior of the mother.

No relationship was found between mothers' index-facilitation scores and imagery or imitation scores of children. A significant relationship was found between children's imitation and imagery development. Imitation and imagery scores increased with age for all subjects. Imitation scores were significantly higher for sighted subjects than for blind subjects. The difference between the blind and sighted subjects' imagery scores, however, decreased with age.

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Throughout the development of this project, I have been fortunate to have the encouragement, help, and understanding of many people.

I would like to thank my dissertation chairman, Dr. David Bearison, for applying the high standards by which he evaluates his own work to this project as well. His questions and comments provided a continuous restructuring of perspective that facilitated the development of the study at every stage. I would also like to thank Dr. Harry Beilin for his thoughful help and his consistent encouragement. For his constructive criticism and suggestions for dealing with that criticism, I'd like to thank Dr. Geoffrey Saxe. I am also grateful to Dr. Roger Hart and Dr. Lawrence Gardner for serving as members of the examining committee at my dissertation defense.

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I am also indebted to the community of students of the Graduate Center for providing an atmosphere of cooperation, support, and friendship and to my collegues at the New York Association for the Blind for their support and encouragement.

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CHAPTER 1

INTRODUCTION

The present study was designed to investigate the process by which children develop mental imagery. It was based on Piaget's theoretical model in which imitation provides the mechanism for the development of imagery. More specifically, the study focused on the role of the "index" (a mobile sign which is detached from the action taking place) in the imitation process.

In order to isolate the function of the index, it was studied in congenitally blind children, a population that is more highly dependent on indices than the normal population. Congenitally blind children cannot imitate actions which are easily imitated by sighted children unless these unobservable actions are indexed to actions which can be perceived by senses other than vision.

The imagery development of children whose mothers engage in actions that facilitate indexing was compared to the imagery development of those children whose mothers do not. Four tasks were developed. Two of them (Task I: Imagery and Task II: Perspective Taking) were used to obtain dependent measures which could be used to infer imagery development level. The third task (Task III: Index Facilitation) provided an independent measure of mothers' index-facilitation with their own children. By analyzing the relationship between mothers' index-facilitation and the imagery scores obtained on Task I and II, it was possible to describe the role of the index. It was expected that this role should be particularly evident when comparing the scores of blind and sighted subjects.

A fourth task (Task IV: Controlled Imitation) was included to measure children's imitation ability in a standardized training situation. This task was necessary since there was a possibility that Task III as a measure of the mothers' index-facilitation would be confounded by the children's interaction with the mothers and, perhaps, by the children's imitation ability. The fourth task provided a measure of the children's imitation ability in a situation where the trainer's actions were not influenced by the children's behavior. The children's imitation scores obtained from Task IV were analyzed as a covariate to partial out the effect of children's imitation ability on the index-facilitation behavior of the mothers.

A review of the literature is presented which:

outlines the Piagetian theory of imagery development;
discusses representation in infancy and early childhood;
discusses the role of vision in the development of mental imagery;
describes research on the early development of blind children; and
discusses the mother-child dyad in a teaching situation.

Based upon Piaget's description of the mechanism whereby mental imagery develops as a function of imitation, it seemed that the development of mental imagery in blind children would be delayed. However, since mental imagery does develop in blind individuals, a mechanism for compensating for the role of visual perception in imitation must be available. This study was designed to show that this mechanism might be found in the index. The index, as described by Piaget (1962), is a mobile sign which provides the link between those behaviors and objects which the child can observe visually while imitating and those which he cannot perceive visually, but can perceive through his other senses, at the time of imitation. Since the research that will be discussed supports the contention that intermodal and intramodal transfer involving the non-visual senses is more difficult, a delay in the development of mental imagery was expected for those individuals who are dependent upon non-visual modes of perception. It was also expected that children who are aided in developing non-visual indices would show less of a delay than those not receiving such assistance. Assistance in this realm may come from parents or other primary caretakers who actively provide intervention that increases the opportunities for such indices to develop.

In order to address the problem of describing the relationship between index-facilitation and the development of mental imagery, five hypotheses were developed. These hypotheses derived from the Piagetian model of imagery development, information on the role of vision in imitation, and studies of the cognitive development of blind children. The hypotheses tested were:

1. Imagery scores on an imagery task and a perspective-taking

task for children whose mothers have high index-facilitation scores would be higher than those whose mothers have low index-facilitation scores.

2. There would be an interaction of index-facilitation by vision status such that mothers' index-facilitation scores would be more highly correlated to children's imagery scores on an imagery task and a perspective-taking task in the blind group than in the sighted group.
3. Sighted children would have higher imagery scores than congenitally blind children.
4. The imagery scores for sighted and blind children would increase with age.
5. The imagery scores for sighted children would increase more rapidly with age than the imagery scores for blind children.

Imitation and the Development of Mental Imagery: The Function of the Index

Hypotheses 1 and 4 above were designed to explore the development of imagery, whether the child was sighted or blind. According to Piaget (Piaget and Inhelder, 1971), the semiotic (symbolic) function is a differentiated system of signifiers and signifieds enabling subjects to evoke objects and events not actually perceived at the moment. Imitation is the basis for the formation of the symbolic function. "It is, therefore, the development of imitation which ensures the differentiation of signifiers and signifieds ... imitation ensures the transition between the sensori-motor and the representational ... the image itself is internalized imitation" (Piaget & Inhelder, 1971, p... xvi). Thus, the child incorporates into his or her repertoire behaviors which he or she observes in other people and even objects.

Imitation, at first, takes place only at the moment when the action is perceived. Later in development, the child is able to execute acts of delayed imitation. Imitation in the early stages consists of only those actions which the child can perceive directly in the action of the other as well as his own action patterns. For example, a child will imitate an individual who touches his hand to his legs, but not his hand to his ear, since the child cannot see his own ear. At stage four of the sensory-motor period (8-10/12 months), however, the child will begin to imitate actions that involve parts of his body or movements of his body that the child cannot observe directly (Piaget, 1962). An already established conditioned stimulus becomes an index for the child. The index is a mobile sign which is detached from the action taking place. These mobile signs provide the child with a link between an observable body part or action and an unobservable one. It becomes a symbol which the child applies to these non-visible movements. In attempting to imitate new models, the child tests out his available alternatives in an attempt to apply known means to new situations. Piaget describes an example.

> OBS.20. At 0 ; 8 (9) I put out my tongue in front of J., thus resuming the experiment interrupted at 0 ; 8 (3) which up till then had given only negative results (obs.17). At first J. watched me without reacting, but at about the eighth attempt she began to bite her lips as before, and at the ninth and tenth she grew bolder, and thereafter reacted each time in the same way.
>
> The same evening her reaction was immediate: as soon as I put out my tongue she bit her lips.
>
> At 0 ; 8 (12) same reaction. At 0 ; 8 (13) she put out her tongue, biting it as she did so. When I imitated her she seemed to imitate me in return, watching my tongue very carefully. But from the next day onwards until 0 ; 9 (1) she again began to bite only her lips when I put out my tongue at her without her having done so. Biting the lips thus seemed to her the adequate response to every movement of someone else's mouth (as we shall again see in the course of the following observations).
>
> At 0 ; 9 (2), however, J. put out her tongue and said ba . . . ba at the same time. I quickly imitated her, and she began again, laughing. After only three or four repetitions, I put out my tongue without making any sound. J. looked at it attentively, moved her lips and bit them for a moment, then put out her tongue several times in succession without making any sound. After a quarter of an hour I began again, and then about half an hour later. Each time she again began to bite her lips, but a moment later distinctly put out her tongue. (Piaget, 1962, p. 31)

Figure 1 graphically represents the preceding interaction described by Piaget. "Ba" can be simultaneously perceived by the child in the other (father) and in herself. It is a mobile sign which can be detached from the action taking place. It can provide the link between an observable body part (father's tongue) and an unobservable one (own tongue).

FATHER		CHILD
	(Arrow indicates direction of action)	
Tongue out	→	Bites lip
Tongue out	→	Bites tongue
Bites tongue	←	Bites tongue
Bites tongue	→	Bites tongue
Tongue out	→	Bites lip
Tongue out saying "Ba"	←	Tongue out saying "Ba"
Tongue out	→	Tongue out preceded by tentative bite

Index = "Ba" (auditory)

Figure 1. An imitation interaction between Piaget and his daughter.

At stage five (10/12-18 months), the child is capable of systematic imitation of new models including those involving movements invisible to the child (Piaget, 1962). Although this type of imitation is evident at stage four, it shows a qualitative difference at stage five with respect to its precision. It is also more deliberate and active.

> OBS. 43. We saw in obs. 19-27 how J. succeeded, during the preceding stage, in imitating certain familiar movements connected with the mouth, nose, eyes and ears, because she had tactual knowledge of these organs, and was thus able, by means of a system of indices, to make her own movements correspond with those of the model. During the same period, I tried to make her imitate some new models. The simplest movement I attempted, was to make her put her hand on her forehead, either anywhere, or at certain precise spots. This does not seem to be one of the actions the child makes spontaneously. He may have acquired a tactual knowledge of his hair, but he still has to find the relationship of his forehead to his hair, and his forehead is obviously the least interesting part of his face, and therefore the least familiar to him. Up to 0 ; 11 (11) there was no attempt to imitate any movement connected with the hair or the forehead. On that day, however, when I put my hand on my hair, J. raised hers, and seemed to be feeling in the right direction. There was no reaction as far as the forehead was concerned.
>
> At 0 ; 11 (20) she watched me with interest when I touched my forehead with my forefinger. She then put her right forefinger on her left eye, moved it over her eyebrow, then rubbed the left side of her forehead with the back of her hand, but as if she were looking for something else. She reached her ear, but came back towards her eye.
>
> At 0 ; 11 (23) when I touched my forehead she rubbed her right eye doubtfully, watching me carefully as she did so. Once or twice her hand went a little above her eyebrow, but then came back to her eye. Same reaction at 0 ; 11 (24). At 0 ; 11 (26) she three times touched the sides of her forehead above her eyes, but never the centre. The rest of the time she merely rubbed her eye.
>
> At 0 ; 11 (28), J., confronted with the same model, continued merely to rub her eye and eyebrow. But afterwards, when I seized a lock of my hair and moved it

> about on my temple, she succeeded for the first time in imitating me. She suddenly took her hand from her eyebrow, which she was touching, felt above it, found her hair and took hold of it, quite deliberately.
> At 0 ; 11 (30) she at once pulled her hair when I pulled mine. She also touched her head when I did so, but when I rubbed my forehead she gave up. It is noteworthy that when she pulled her hair she sometimes turned her head suddenly in an attempt to see it. This movement is a clear indication of an effort to discover the connection between tactual and visual perceptions. (Piaget, 1962, p.55)

In the previous interaction, the index is the sight of the child's own hair (visual). The only act she successfully imitated was the touching of her hair. She was able to do this because she could simultaneously perceive her father touching his hair and herself touching her own hair by turning her head quickly to see her hair. She could use this as an index which could then be applied to her own non-visible movements.

Within Piaget's theoretical framework, perception plays somewhat of a secondary role. It is action upon the environment that constitutes the mechanism by which an individual comes to know. Perception does not, therefore, ensure understanding. Perception does, however, constitute the minimum condition for imitation and the development of mental imagery.

Representation in Infancy and Early Childhood

Image Development

According to Piaget, the image comes into being as a result of the development of imitation (Flavell, 1963). Near the end of the sensory-motor period, the child imitates internally, covertly, rather than overtly. "The child's muscles perform an abbreviated imitation of ... [the particular external imitative activity]" (Ginsburg and Opper, 1969, p. 76). At this point in the child's development, it is these abbreviated internal movements that are the mental symbols of the child.

In his experimental work Piaget investigated the following types of images:

(a) Reproductory - attempted copies of objects, etc. which have already been perceived.

(b) Anticipatory - models of anticipated transformations in time, place, or form.

(c) Static - reproduction of an object or event which is unchanged in any way.

(d) Kinetic - image of an object's movement in space.

(e) Transformational - image of an object's change in shape or form. (Ginsburg and Opper, 1963)

Static images can only be reproductive, whereas, kinetic and transformational images can be either reproductive or anticipatory.

Although different types of images have been shown to appear at different ages, imagery development does not follow a stage model as does operational development. Once the semiotic function is developed, the 2-year-old child possesses images that are static and reproductive. The child remains limited to this type of image until around the age of 7 or 8 years when the period of concrete operations begins. The formation of accurate kinetic images before this age seems to be hindered by the child's centering on one aspect of the situation rather than on the coordination of movement with the initial and final states of objects. Transformational images are not possible before this age because the child cannot coordinate conservation of the properties of the object observed with the ability to decenter from the states of the transformation. Once the child is able to imagine a series of steps between the beginning and end states of an event, he is capable of both reproductive and anticipatory kinetic and transformational images.

The image is "the consequence of an internalized action, namely, a covert but active accommodation or 'tracing out' by the subject of the object or event imagined" (Flavell, 1963, p. 83). The image constitutes the first signifier. "The significate being here the action, object, or word of which the image is a reduced and schematic replicate" (Flavell, 1963, p. 153). It is through evidence with regard to deferred imitation, which presupposes an internalized image, that the earliest developments of the symbolic function become apparent. Whereas imitation supplies the signifier, play supplies the significate to which the signifier refers. "In other words the subject provides meaning for his signifiers by assimilating them to the events (more accurately, the schemas subtending the events) which the signifiers denote" (Flavell, 1963, p. 153).

It is important to make the point that within Piaget's system, the visual image that develops is not an extension of perception.

The individual does not take in a photographic replica of an object which then becomes the image upon which he can rely at some later time. During the course of perceiving an object, the individual's eyes move around and across the object in order to establish relationships inherent in the object. His perception is derived from this activity. Visual perception involves motor activity and in the act of perceiving an object, the individual "imitates" that object by tracing its form. It is the internal and abbreviated imitative tracing that is the source of the visual image that represents the object when it is no longer present. Thus, the visual image is not an exact copy of the object, but a symbol that represents the object. It is the result of the child's action upon the object and represents only those relationships which the child knows with regard to the object as a result of his actions upon it. His symbols are distorted to fit his mental structures.

The image is in the realm of figurative rather than operative knowledge. Within Piaget's system, operative refers to that aspect of cognition dealing with actions which have as their result a transformation or change of reality. Figurative refers to aspects dealing with copies or states of reality. The three subdivisions of figurative knowledge are perception, imitation, and mental imagery (Ginsburg & Opper, 1969).

The image functions as a mechanism for the retention of data. In this capacity it frees the individual to deal with objects which are displaced in both time and space. The data available in the image can be acted upon by the individual covertly even in the absence of the object. Therefore, even though the image is subservient to operative knowledge and does not influence the development of structures, it provides this system with data that is free of the restrictions of time and place. Figure 2 shows the relative sequence of development of operative and figurative aspects of knowledge.

The differentiated partnership of assimilation and accommodation which is responsible for sensory-motor intelligence is also responsible for acts of representational intelligence. The difference lies in the fact that sensory-motor assimilations and accommodations deal with objects and events in the child's present perceptual field. With the advent of the semiotic function, however, the child becomes capable of assimilating the present data to the nonpresent significate and accommodating to the nonpresent significate through the medium of the evoked imitative image. Figure 3 shows the relationship of play (assimilation) and imitation (accommodation) to adapted intelligence and the semiotic function.

The problem of equilibration is made more difficult as a result of the need to deal with non-present as well as present objects and events. The child's constant vacillation between play, imitation and adapted intelligence are taken as evidence for the difficulty the child experiences in achieving equilibration.

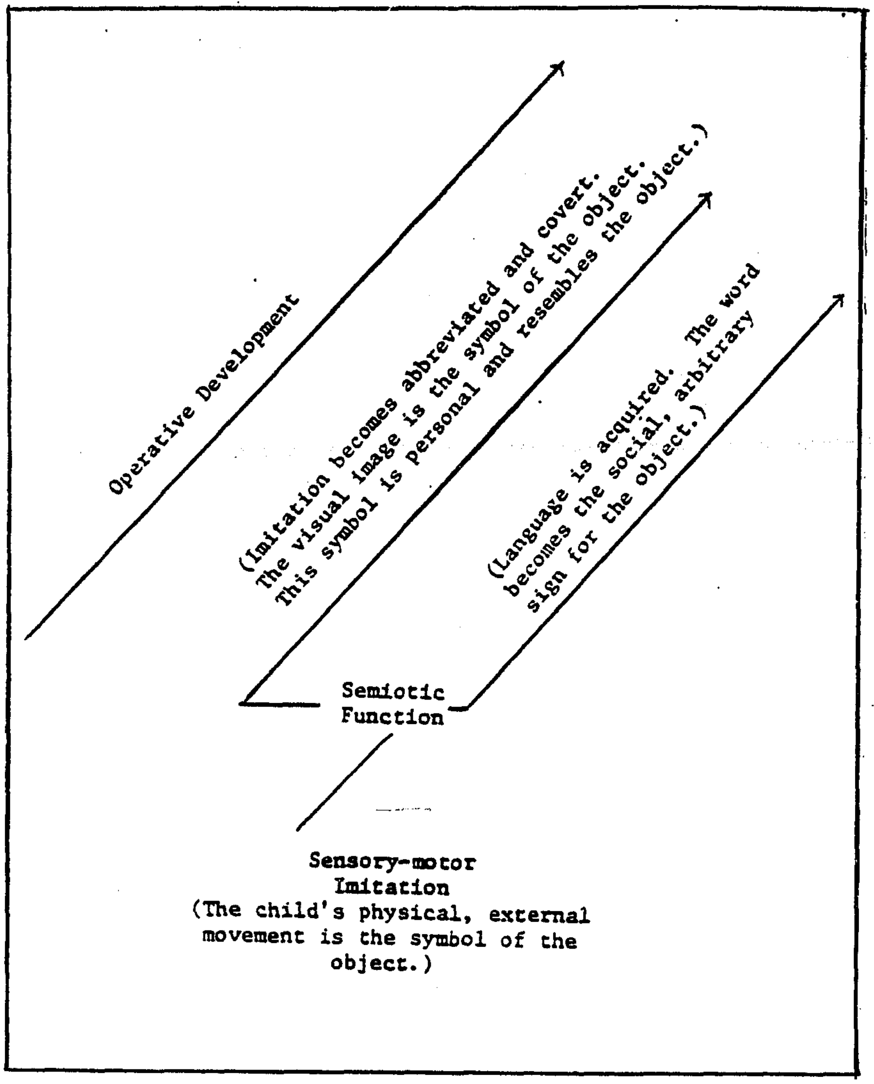

Figure 2. The relative sequence of development of operative and figurative aspects of knowledge according to Piaget.

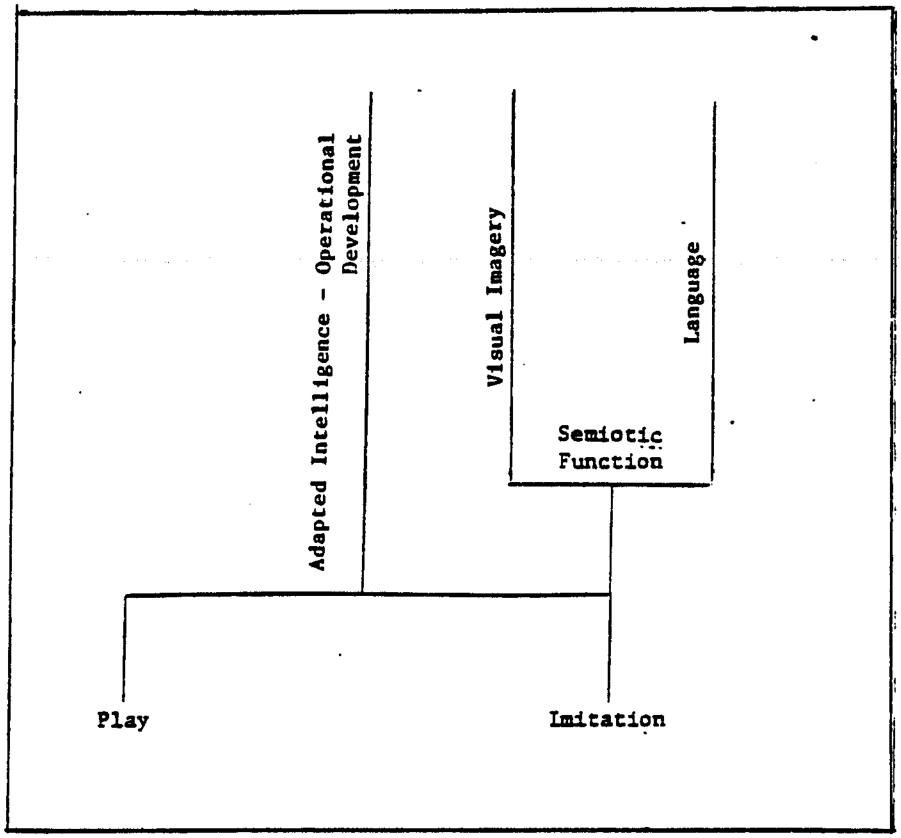

Figure 3. The relationship of play (assimilation) and imitation (accomodation) to adapted intelligence and the semiotic function.

The advent of representational thought comes about as a result of the acquisition of the symbolic (semiotic) function. The semiotic function makes it possible for the child to acquire both private symbols and social signs. It is of particular importance to note that "representational thought does not begin with and result from the incorporation of verbal signs from the social environment" (Flavell, 1963, p. 155). The first signifiers are private symbols which are the product of internalized imitation. Even social signs, words which are acquired by the young child, are assimilated to his own symbolic orientation and are treated very much as his own private symbols.

Piaget's emphasis on cognition-as-action is evident throughout discussions of play, imitation, and the semiotic function. It is by means of the progressive internalization of imitative behavior that the image, the first signifier, develops. It is also the emphasis on cognition-as-action that "provides the connecting link or bridge between the successive developmental forms of intelligence. It is the common element which runs through all intelligent forms, the early and the late, and therefore provides the across-stage continuity in which Piaget believes" (Flavell, 1963, p. 83). For a detailed analysis of the developmental history of the image and the semiotic function in general, the reader is referred to Piaget, J. Play, dreams and imitation in childhood. New York: W. W. Norton and Company, 1962.

Piaget rejects the hypothesis that language is involved in the early symbols of the child (Ginsburg & Opper, 1969). Two reasons for rejecting the position that language plays a necessary role are cited.

> First, certain experiments with animals show that chimpanzees, for instance, have mental symbols which, of course could not be based on language. If non-verbal symbolism is possible in animals then why not in humans too? Second, observation of the child shows that behavior like deferred imitation occurs while language skills are still very primitive. (Ginsburg & Opper, 1963, p. 74)

The observation of Piaget's daughter, Jacqueline throwing a temper tantrum for the first time a day after spending time with a playmate that had a temper tantrum in her presence, is given as evidence of this point. "It is quite unlikely that Jacqueline was at the time capable of a reasonably full verbal description of the boy's temper tantrum. Yet her imitation was quite accurate" (Ginsburg & Opper, 1963, p. 74). Jacqueline's use of deferred imitation, therefore, makes it necessary to infer the use of mental symbols other than language.

A second example of the use of mental symbols before the child is capable of language which would be sufficient to register the event involved, is found at stage six of the sensorimotor period when the child is able to locate an item hidden after a series of invisible displacements. Before language is adequately developed, therefore, both deferred imitation and search behavior are evidence of the child's mental symbols.

Piaget's theory with regard to imagery development has been supported by researchers using a variety of procedures. The experiments of Werner and Kaplan (in Paivio, 1971), which illustrate that subjects can represent abstract dimensions such as time in visual imagery, give support to a model of development in which the visual image plays a continuing role as a form of symbolization.

Image Type

Once the image has appeared, it undergoes further developmental changes. Imagery shows an ontogenesis similar to that of intellectual operations. Initially all images are static. "As the child develops, his imaginal activity becomes more mobile and flexible, capable of anticipating the successive movements of a yet-to-be transformation from one state to another" (Flavell, 1963, p. 358).

Piaget has used three methods to study the development of mental images. He has asked subjects to describe their own images, to draw those images, and to select images from a collection of drawings. Keeping in mind that each of these methods involved certain shortcomings, all of them were generally used in conjunction with extensive clinical interviewing to uncover the dynamics of the behavior being observed. The reader is referred to Piaget, J. and Inhelder, B. (1971) Mental imagery in the child, New York: Basic Books, Inc., for a detailed description of these experimental procedures.

A recent study (Forisha, 1975) of the development of mental imagery and verbal processes using 200 subjects in grades one through five supports the theories of Piaget and Paivio "claiming that verbal and imaginal processes are independent traits whose development parallels each other rather than one (imagery) being the predecessor of the other (verbal) as stated by Bruner" (Forisha, 1975, p. 259).

Gottfried (1976), using first and sixth grade students in a study designed to investigate the effects of instructions and stimulus representation on selective learning in children found that younger and older children showed equivalent patterns of stimulus selection. Since pairs of stimuli that were either conceptually related, perceptually related, or unrelated were used, a developmental pattern, as measured by retention and types of errors, was expected based on Bruner's contention that "representation becomes increasingly conceptual and decreasingly perceptual with development" (Gottfried, 1976, p. 141). Such a pattern was not found. At both age levels, the pattern of stimulus selection was similar, lending support to a Piagetian interpretation.

Mwanalushi (1974) investigated factors in the coding of random patterns in 6- and 9-year-old children. The study attempted to compare imagery and verbal coding systems in a problem demanding spatial coding. Rather than showing a developmental pattern of increased reliance on verbal coding, "the results bear out the hypothesis of differential suitability for information processing of the verbal and imaginal systems. It seems that in problems requiring spatial organization the imaginal mode is a more efficient system for coding information" (Mwanalushi, 1974, p. 207). The pattern of results evidenced in this and the previously mentioned studies lend increasing support to Piaget's model of the figurative aspects of development.

Additional support for the clinical observations of the development of imagery made by Piaget was presented by Overton and Jackson (1973), using a large sample (N = 144) of 3-, 4-, 6-, and 8-year-olds. The major finding of this study supported a developmental sequence in which imitation of the action sequence of an object and actions directed towards the self appear prior to symbolically mediated gestural representations and actions directed toward the external world.

If Piaget's descriptions of the process by which indices facilitate imitation and the development of mental images is accurate, the following hypotheses should be confirmed.

1. Imagery scores on an imagery task and on a perspective-taking task in children whose mothers have high index-facilitation scores should be higher than those whose mothers have low index-facilitation scores.

4. Imagery scores on an imagery task and on a perspective-taking task for sighted and blind children should increase with age.

The Role of Vision in the Development of Mental Imagery

Three other hypotheses tested (2, 3, and 5) are based upon information with regard to the unique characteristics of vision, and research dealing with the development of the symbolic function in the absence of vision. Hypothesis 2 states:

> There should be an interaction of index-facilitation by vision status such that mothers' index-facilitation scores are more highly correlated with children's imagery scores on an imagery task and a perspective-taking task in a blind group than in a sighted group.

Hypothesis 3 states:

> Sighted children should have higher imagery scores than congenitally blind children.

Hypothesis 5 states:

> Imagery scores of sighted children should increase more rapidly with age than the imagery scores for blind children.

These three hypotheses were designed to explore the differences in imagery development between blind and sighted children.

In much of the material describing the development of mental imagery through imitation, imitation of things perceived visually is stressed. Even at the point where imitation of unseen behavior is discussed, it is explained in terms of indices which link the seen with the unseen. <u>If imitation constitutes the mechanism for the development of mental imagery, then an individual who lacks</u>

the opportunity to perceive actions visually will be greatly handicapped in the development of symbols (mental imagery). Opportunities to imitate will be greatly reduced and will be confined to actions which can be perceived through the use of other senses. Since the unique characteristics of vision are not duplicated by any other sense, this would seem to constitute a significant handicap. It is only through vision that the individual can receive large quantities of information at one time in a form that facilitates the apprehension of spatial relationships between the discrete elements. All the other senses require the use of memory to hold sequentially perceived information. This would seem to limit the quality of imitation which would be possible for a child who is at the stage during which imitation of behavior occurring at the moment is the only type of imitation possible. It would also seem to make the establishment of indices more difficult because the information received is limited and the indices, themselves, must stem from sequentially received information.

The development of mental imagery (which according to Piaget, is actually internalized imitation) would be delayed in the blind for any of the following reasons or combinations thereof: simultaneous touch and kinesthetic (haptic) experience is less efficient than visual experience in getting information about the world, and/or vision is not available as a feedback corrective system, and/or vision is absent as the organizer for perceptual experience

(O'Donohue, 1981, p. 6), and/or the intermodal transfer between senses other than vision is more difficult and thus makes development of indices to unseen behaviors required for imitation more difficult. Studies of blind subjects of all ages have shown that aspects of language (part of the symbolic function) are delayed and/or impaired. Bernstein (1978), in her study of 2½- to 4-year-olds, found significant delays in semantic development for blind children. Fraiberg (in Jastrzembska, 1976, pp. 36-153) documented delays in use of the personal pronoun "I". Buchanan (1978, pp. 81-84) cites numerous studies of adolescents and adults which indicate communication problems in blind populations due to a lack of communicative gestures that are usually learned through visually perceived models.

Studies of the relative effects of visual (simultaneous) and tactual (successive) perceptions and its effect on performance levels (Fraisse, in Bernstein, 1978) and intermodal and intramodal transfer (in O'Donohue, 1979, pp. 24-25) seem to support the contention that the development of indices in non-visual areas is much more difficult. Gomulki (in O'Donohue, 1981, p. 16) states that functional strategies develop remarkably slowly in the tactual perceptual system thus delaying haptic pattern formation.

Stephens and Grube (1982) studied the cognitive development of congenitally blind children between the ages of 6 and 18 years of age using Piagetian reasoning assessments. In Phase I of their study, one of the variables studied was mental imagery and spatial relationships. This variable was measured using rotation of beads, rotation of squares, changing perspectives (mobile), and changing perspectives (stationary). They found that the concrete reasoning of their blind subjects improved (somewhat) in most instances, but they continued to be unable to engage in logical thought that involved spatial organization and mental imagery. "Stephens and Simpkins (1974) and Hatwell (1966) posited that because the blind received input primarily through the tactual mode, they lack the required figurative simultaneity that the sighted receive through visual input" (Stephens & Grube, 1982, p. 141).

Stephens and Grube (1982) pointed out that traditionally, terminology used in mental imagery activities has had visual referents. The sensory deficit of blindness makes it necessary for blind children to translate visual information into a scheme that is usable to them. They state that "the accommodation system utilized by congenitally blind children is not readily discernible by a sighted person. Whether the accommodation systems of all blind people are consistent remains to be determined; additional research is needed in this area." (Stephens & Grube, 1982, p. 141).

In phase 2 of the Stephens and Grube (1982) study, a remediation program was administered to blind children. Three 45-minute intervention sessions per week were carried out with each subject during the academic year.

Learning activities were appropriately matched to the

> individual student's indentified cognitive skills as set forth in the profile of his or her performance on measures of reasoning. Teachers who conducted the intervention sessions were trained to use a process-oriented approach that (1) permitted the child to discover knowledge, (2) focused on the child's actions and thoughts, and (3) created ongoing reasoning situations that required the child's interaction with objects and people as thought structures were extended or developed. (Stephens & Grube, 1982, p. 138)

They found that after intervention, the blind children's group performance on the stationary portion of the perspective task was significantly superior to that of the blind control group. Based upon their findings, the authors suggested that the ability to perform spatial orientation and mental imagery tasks probably could be enhanced if blind children were given the opportunity for experiences that circumvent their sensory impairment and draw on their intact functioning.

> Although the activities used in this study promoted some growth on spatial relationships, it is unlikely that more rapid progress can be accomplished without a greater understanding of the congenitally blind child's "compensation system." It is possible that efforts to guide the child's spatial experiences in the early sensory motor period would provide needed information on effective training for deficits in that area. (Stephens & Grube, 1982 p. 141)

Based upon the unique characteristics of vision and research dealing with the development of the symbolic function in the absence of vision, it was anticipated that hypotheses 2, 3, and 5 would be supported.

Early Development of the Blind Child

Research on the early development of blind children provides additional support for hypotheses 2, 3, and 5.

According to Kemp (1980), the early physical and psychological development of blind children is the most extensively studied area of blindness. However, in spite of an extensive literature, there is little reliable evidence (Warren 1977). Kemp (1980) reviewed studies in perceptual-motor, cognitive, language, nonverbal communication, social and personality development, and outlined major problems in working with the information which is available. "Many of the reports are either based on descriptive case-study material of single subjects (e.g., Burlingham, 1961, Fraiberg, 1972) or are methodologically inadequate, for example, in the selection of subjects (totally blind vs. partially sighted, the age of blind subjects and the length of blindness), and in the selection of adequate controls ..." (Kemp, 1980, p. 14).

The literature, in spite of its limitations, does show that there are lags and differences in the development of blind children when compared with sighted children. Warren (1977) has provided a comprehensive review of the early development of blind children which updates Lowenfeld's (1971) review.

Warren (1977), in doing what amounts to the most comprehensive and current review of blindness and early childhood development, reported that much of the work on "blind children" has been done on adolescents. "Furthermore, the work that is available on children of early school age has been concerned primarily with simple discriminative abilities and very little research has been done on the more integrative perceptual functions, such as spatial relations and intermodality organization" (p. 59).

Warren (1977) points out that there is almost no research available on perceptual and motor development of blind children in the age range between infancy and five or six years. He attributes the scarcity of research in this area to the lack of a "captive" population such as the one found during the school years, and the lack of adequate research techniques for this group of children. Researchers who work with older subjects can rely on methods that use verbal instructions, and researchers who work with infants have developed an entirely different set of techniques. The intermediate range between infancy and school age, however, is still without an extensive stock of research methods. This situation has led to a significant gap in knowledge about children.

> In studying questions of perceptual development, it is necessary to keep in mind the importance of the non-visual senses for the blind infant. Vision provides a continuous, rich, consistent, precise and reliable source of information for the sighted child. He depends on this information to help him orient to and identify objects and people, to regulate his own motor behavior, and to provide an overall organization of space. The question for the blind infant is, then, not only how well the nonvisual senses can perform the functions that they serve for the sighted children, but also to what extent the nonvisual senses can substitute for the functions that vision serves for the sighted child. (Warren, 1977, p. 60)

Warren, in discussing the blind child's behavior during each of the stages of the sensory-motor period, indicated that at the third stage, when visual control of manual behavior is important, the developmental patterns of blind and sighted children begin to diverge. The blind child fails to begin to reach for objects.

Fraiberg (1966) studied the reaching behavior of blind children and indicated that it was not until 37 to 48 weeks of age that tactile and auditory schemes begin to unite. Fraiberg (1968) also indicated that the achievement of a mature object concept, which indicates a capacity for mental representation, is delayed in blind infants until 3 to 5 years of age, as opposed to 2 years for children with vision.

Warren (1977) suggested that the divergence in development between blind and sighted children may be attributed to the fact that blindness limits the child because he gets less total information about the world and that he lacks the continuity which is provided by visual experience. In addition, the organizational function of vision is missing for the blind child. "For the sighted child, vision seems to serve as a means of unifying the perceptual experiences gained via other modalities. This function is especially important in the second half of the first year, when the sighted child is actively organizing the world and his experiences with it (Warren, 1977, p. 87).

The Mother-Child Dyad in a Teaching Situation

Research with regard to the mother-child dyad in a teaching situation emphasizes several points which bear on the mother's role in the development of mental imagery in her child. Researchers have pointed out that: (1) development occurs primarily within an interpersonal context (Vygotsky, 1978; Bruner, 1975; Rocissano & Yatchmink, 1982); (2) variables in the interactive relationship between the mother and the child can be related to specific child outcomes (Wood et al, 1976; Wood & Middleton, 1975; Siegel, in press); (3) certain interaction styles are more common in some populations than in others; (McGilicuddy-Delisi & Siegel, 1982; Rocissano & Yatchmink, 1983) and (4) certain strategies seem to facilitate development, particularly in the symbolic area (Rocissano & Yatchmink, 1982).

Since imagery development is a function of imitation, when viewed from the Piagetian theoretical perspective, and imitation activities occur often within the mother-child dyad, this dyadic relationship becomes of great interest when investigating imagery development.

Development occurs primarily within an interpersonal context, and it is often proposed that social partners provide the stimulation and organization necessary for cognitive growth (Vygotsky, 1978). Bruner (1975) maintained that the infant comes to discover the intricacies of his world through an active process of hypothesis formation and hypothesis testing that is guided by the mother's constant interpretations and affirmations of his developing knowledge base. Thus, social interactions provide an important context for the "infant's emerging constructions of his world" (Stern, Beebe, Jaffe, and Bennett, 1977 in Rocissano, L. & Yatchmink, Y. 1982.)

Recent research has focused on the interactive nature of the mother-child encounter rather than on a one-way (mother-to-child) interpretation of the situation. Rocissano and Yatchmink, (1982), for example, studied joint attention in mother toddler interaction. Videotaped interactions between 2-year-olds and their mothers were used to capture similarities and differences across pairs in maintaining joint attention. Their results indicated that mothers and children resembled one another in the extent to which they maintained joint attention. They differed, however, in that mothers more often initiated topics. Based on their observations, they proposed "that a dyadic adaption or 'fit' can be brought about by <u>balanced</u> or <u>counterbalanced</u> sorts of exchanges. In balanced exchanges, partners play similar roles, while in counterbalanced exchanges, they play different roles. In the latter, one partner may be compensating for lack of interactive skill in the other, as has often been shown in research on interaction between care givers and infants or young children" (e.g., Kaye & Charney, 1981; Kaye & Weils, 1980; Stern, 1977 in Rocissano & Yatchmink, 1982). "Interactive skill" referred in this case, to ability to maintain joint attention in a mother-toddler interaction. Rocissano and Yatchmink's (in press a) research "identified various kinds of turns mother-toddler pairs used in interaction, and how these turns functioned to bring about either shared or disparate attention." The turns were analyzed to establish whether they maintained the partner's attention focus, and whether they included social cues. They were interested in the communication function of the turn for the partner.

In relation to the study of index-facilitation in imitation situations, it might be expected that a form of counterbalanced interaction would take place. Mother's would initiate indexing more often in the case where the child lacked imitation skill because of blindness. Mothers would take the initiative for maintaining joint attention to the task and provide cues in the form of indices.

Rocissano and Yatchmink (1982) also studied language skill and interactive patterns in prematurely born toddlers. They found that this group was characterized by a broad range of interactive skills. Their results were discussed in terms of the facilitating effect interaction may have for the acquisition of language. They pointed out that studies of pre-term infants indicated that, in many areas, these infants develop less adequately than full term infants. However, within that group, there are some who seem to show no adverse effects from premature birth. They indicated that the work of Beckwith and Cohen (1978), Cohen and Beckwith (1979), and Sameroff (1980) point to qualities of interaction between infant and care givers as critical in determining developmental outcomes.

Rocissano and Yatchmink (1983) indicated that the preterm infant is more passive and less responsive to the social world than the full-term infant, and that their mothers are in turn more stimulating, intrusive, and controlling than mothers of full terms...(pp. 2-3). It is interesting that the description of the pre-term child could be used to describe the young blind child as well. If the earlier research by Rocissano and Yatchmink with regard to counterbalancing style is considered, it is also a possibility that the description of the pre-term infant's mother's behavior may match the blind infant's mother's behavior in an imitation teaching situation.

Wood, Bruner, and Ross (1976) also studied the dyadic interaction of a child and an adult (in this case, one who is not necessarily the mother). They were interested in "the means whereby an adult or 'expert' helps somebody who is less adult or less expert" (p. 89). They point out that "whether he is learning the procedures that constitute the skills of attending, communicating, manipulating objects, locomoting, or, indeed, a more effective problem solving procedure itself, there are usually others in attendance who help him on his way" (p. 89). With regard to assistance in the realm of imitation, it was pointed out that "observed instances of 'imitation' were all of a kind as to suggest that the only acts that children imitate are those which they can already do fairly well" (p. 99). Among the things the tutor can do to facilitate acquisition of behavior by a child is (a) to maintain direction (this involves keeping the child "in the field"); and (b) to mark critical features that are relevant. "His marking provides information about the discrepancy between what the child had produced and what he would recognize as a correct production" (p. 98). Wood et al. (1976) refer to these two procedures as part of the "scaffolding" process. Scaffolding consists of the adult "controlling" those elements of the task that are initially beyond the learner's capacity. In terms of an imitation teaching task index-facilitation moves by the mother might be seen as an element of scaffolding that allows the child to imitate behaviors which he cannot perceive directly at the time of imitation.

Wood and Middleton (1975) did a study of assisted problem-solving that dealt with the underlying determinants of effective instruction. They found that "mothers who systematically changed their instructions on the basis of the child's responses to earlier interventions...were most likely to see their child perform effectively after instruction" (p. 181). Some mothers will, therefore, be more effective teachers of their own children and should be able to facilitate more accurate performance on the part of their child. Of particular interest, there was no significant correlation between frequency measures and the children's post instruction performances. Thus the sheer quantity of exposure to instruction *per se* has no effect upon the child's task ability.

Wertsch, McNamee, McLane, and Budwig (1980) have also investigated the adult-child dyad as a problem-solving system. They stress the importance of taking the social origins of cognitive processes into account. "The most important reason for analyzing how the young child carries out tasks by participating in a social group (in our case, the adult-child dyad) is that a better understanding of the social processes in this group may provide the key to understanding how the child will later function as an independent cognitive agent" (p. 1215). Wertsch et al. (1980) stress the point made by the researchers cited earlier that:

> If the mature problem solver, acting as an individual, carries out a task through self-regulation, the strategic responsibilities in the adult-child social system are distributed such that the young child carries out the behaviors necessary to complete a task through what we will call "other regulation." In cases where other-regulation is involved, many of the child's overt behaviors may be identical with those carried out through self-regulation, but the adult will have taken over the strategic responsibility for directing these behaviors. (Wertsch et al. 1980, p. 1216)

The results of the Wertsch et al. (1980) study supported "the notion of an ontogenetic transition from other-regulation to self-regulation in connection with a crucial strategic step (looking at the model) in...[their] task setting" (p. 1221). In the area of imitation, many of the episodes of early imitation described by Piaget involve parents imitating their child and then modifying their own behavior slightly in an attempt to get their child to imitate a somewhat new behavior pattern. When the child starts to exhibit behaviors that are not perceived at the moment, the possibility seems to exist that the parent could take on the other-regulatory role in helping the child to develop indices to link actions which are not perceived at the moment to those that are. It may be possible then, for a child receiving such assistance, to function effectively in situations which would ordinarily pose great difficulties. Here again, there seems to be a relationship between the developmental pattern related to the problem-solving system described and the problem encountered by children, particularly those unable to see, in learning an imitation task. The results lend support to the hypothesis that children receiving other-regulation support would be better able to perform.

Sigel (in press) reports a number of studies in which he investigated the relationship between parent's distancing strategies and the child's cognitive behavior. Distancing is "a construct that is used as a metaphor to denote the psychological separation of the person from the immediate ongoing present. The distancing metaphor suggests that the individual can project himself into the past or into the future or can transcend the immediate present. This process of distancing is conceptualized as critical in the development of representational thinking" (p. 5). He indicates that "distancing behaviors are hypothesized to serve as activators of representational thinking since they impose a cognitive demand on the receiver which requires the individual to represent and transform experience into some form of symbol system" (p. 23).

Siegel's assertions about distancing strategies appear to be reasonable, but, as he himself indicates, little can be learned from such a global analysis. He states that it is necessary to define specific strategies used in various psychosocial contexts. The distancing strategies he investigated (demands by parent that the child anticipate future actions or outcomes, reconstruct past events, employ his imagination in dealing with objects, events, and people, and attend to transformations of phenomena) related to child outcome measures and, therefore, supported his hypothesis.

Index-facilitation may prove to be another distancing strategy, one that can be related to child outcome measures in the areas of imitation and/or imagery. Since Sigel (in press) also stressed the point that distancing strategies vary as a function of social and ecological factors, it should be of interest to examine the possible differences in the use of the index-facilitation strategy between groups (blind and sighted) which differ dramatically on their ability to imitate.

McGillicuddy-DeLisi and Sigel (1982) have also discussed distancing strategies specifically in relation to atypical children. They focused on the parents of learning disabled (LD) children and their use of distancing strategies. They choose this group because they felt that it was likely "to benefit most from distancing experiences and yet, by the very nature of their disability, are not likely to be provided with a variety of experiences in the home environment" (p. 204). The blind child seems to fall into the same category with regard to distancing. He is not limited by a learning disability, but often has the same difficulty, because of his sensory impairment, of perceiving, integrating information, and developing symbols for dealing with information and events distanced in time and space. One of their findings was that these parents (particularly the mothers) often used authoritative or authoritarian strategies to get their child to perform. They stated that changes in belief systems with regard to child development could provide "the cognitive readiness on the part of the parents to assimilate new ideas and strategies...for interacting with their...child" (p. 230). For the parent of the blind child, information with regard to the distancing strategy of index-facilitation might prove helpful to them in interacting with their child in a way that could prove to facilitate development.

In summary, the following points with regard to index-facilitation and the development of mental imagery in blind children can be made based upon the research in the area of mother-child dyads in teaching situations.

(1) It may be possible to define one of the variables (index-facilitation) in the interactive relationship between the mother and child and relate it to child outcome measures in the areas of imitation and/or imagery.

(2) Mothers of blind children may demonstrate an interaction style that is different from the interaction style of mothers of sighted children.

(3) Index-facilitation may serve as a distancing strategy which facilitates development in the symbolic area.

Hypotheses

1. Imagery scores on an imagery task and a perspective-taking task for children whose mothers have high index-facilitation scores will be higher than those whose mothers have low index-facilitation scores.

2. There will be an interaction of index-facilitation by vision status such that mothers' index-facilitation scores will be more highly correlated to children's imagery scores on an imagery task and a perspective taking task in the blind group than in the sighted group. Figure 4 illustrates hypothesis 2. It shows the predicted interaction of vision status by mothers' index-facilitation scores in relation to children's imagery scores on both an imagery task and a perspective-taking task. It is expected that the mothers' index-facilitation scores will have a greater influence on the imagery scores of blind children than on the imagery scores of sighted children.

3. Sighted children will have higher imagery scores than

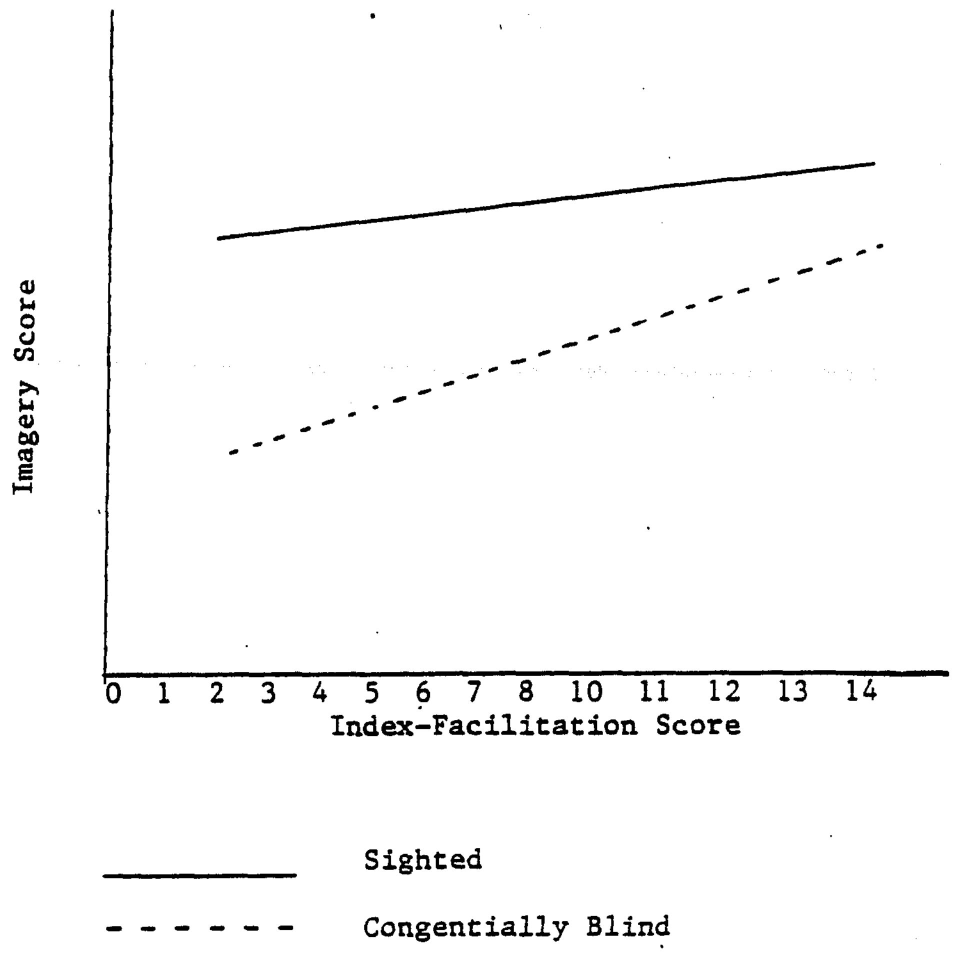

Figure 4. Predicted imagery scores as a function of vision status and mothers' index-facilitation scores.

congentially blind children.

4. The imagery scores for sighted and blind children will increase with age.

5. The imagery scores for sighted children will increase more rapidly with age than the imagery scores for blind children. Figure 5 illustrates hypothesis 5. It shows the predicted interaction of vision status by age in relation to children's imagery scores on both an imagery task and a perspective-taking task. It is expected that imagery scores will be more highly correlated with age for the sighted children than for the blind children.

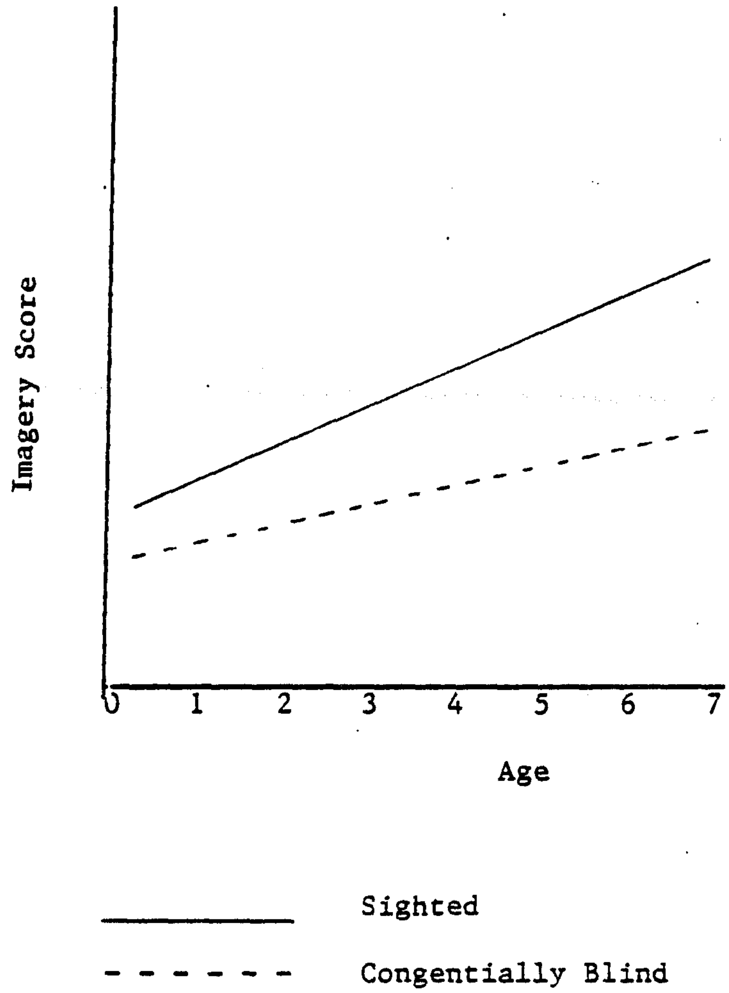

Figure 5. Predicted imagery scores as a function of vision status and age.

CHAPTER 2

METHOD

Subjects

The subjects were 40 children from 2 through 7 years of age, 20 of whom were congenitally blind (CB) and 20 sighted (S). In the blind group, there were 11 boys and 9 girls. In the sighted group, there were 8 boys and 12 girls. There were 5 two-year-olds, 7 three-year-olds, 4 four-year-olds, 7 five-year-olds, 9 six-year-olds, and 8 seven-year-olds. This age range was chosen because it corresponds to the period during which Piaget (1962) documents the development of mental imagery. Beilin (1982) also states that his data indicate that there is a strong relationship between the achievement of superpositioning strategies and relevant transformational imagery at the age of 7.

Both groups of children (CB & S) were of normal intelligence with no other impairments. Teachers' assessments were used to determine whether a child's behavior was within the normal range of intellectual functions. Congenitally blind (totally blind or with light perception only) refers to children blind prior to 6 months of age rather than to those blind prior to 5 years of age (usually set as the upper limit in research) since the development of imagery is based upon imitation during the first 2 years of life.

Procedure

Four tasks were administered to subjects. Two tasks were used to determine subject's mental imagery scores. In task I (the imagery task) subjects had to recognize or reconstruct a geometric transformation of an object and in task II they had to coordinate spatial perspectives. In the third task, mothers' index-facilitation scores were obtained by analyzing how the mothers taught their children an imitation problem. The fourth task provided a measure of subjects' ability to imitate in a standardized situation with the experimenter.

Task I: Imagery

The child was given an opportunity to explore dolls which were then removed or surreptiously transformed in position by sliding, rotating of flipping them. The child was required to select dolls that were the same as the standard or to position dolls so that they were positioned as the standard doll was after the transformation. The child's behavior on this task was used to infer his level of mental imagery development.

Task I is a variation on a task developed by Beilin (1982) to study geometry concepts and processing strategies in young children. The task is also being used by O'Donohue (1982) to study the relationship between strategies which children use to establish geometric concepts and the ability of the child to represent transformations mentally. Beilin (1982) used sighted subjects. The O'Donohue study is using blind and sighted subjects. Both studies made use of geometric figures to investigate the child's use of mental imagery. Beilin classified the transformations made by his subjects as relevant and irrelevant (random). He reported that relevant transformations were made mostly by children 7 years and older. Below that age, 9 of a possible 18 responses were relevant (50%). At 7 years and older, 24 of 30 were relevant (80%) and 18 of the 24 (75%) were complete transformations.

Since the present study was focused on a younger age group, and because it was concerned with the early development of mental imagery in blind children, it used dolls instead of geometric shapes. It was expected that these more familiar objects would present less of an obstacle to performance on the task for these young subjects than relatively unfamiliar geometric shapes.

Materials.

1. A set of dolls was used which was comprised of one doll (A) which served as a standard, a second doll (B) identical to the standard, and four selection dolls. The selection dolls consisted of one doll which was identical to the standard, a second doll which was similar but smaller than the standard, a third doll which was similar but larger than the standard, and a fourth doll which was not similar to the standard. The standard doll and all the selection dolls that were considered the same as or similar to the standard were of the "teen" variety of dolls. These dolls are modeled after the form and proportions of a teenage female. The doll which was not similar to the standard was a "baby" doll which

was modeled after the form and proportions of a female toddler.

2. A square box large enough to contain the largest doll in the array.

3. A tray to hold the selection set of dolls.

4. One cookie cutter in the shape of a gingerbread person.

5. Play-Doh.

Procedure. The interviewer showed the child a cookie cutter in the shape of a ginger-bread person and demonstrated to the child how identical dolls could be made with the appropriate application of the cookie cutter. (This demonstration provided the context for the concept of congruence of "same doll" tested in the experiment.) The interviewer used the cookie cutter to stamp out an identical doll from a flat quantity of Play-Doh, and had the child perform the same action. After the child had cut out several dolls, the interviewer indicated that all of the dolls were the "same" because they were cut out with the same cookie cutter. When the interviewer was confident that the child understood what was meant by "same doll", the child was told that he was going to play a game with some dolls. After the pre-test procedure involving the cookie cutter was completed, the actual testing procedure began. All transformations during the testing procedure were performed by the experimenter and the subject if the subject was blind. If the subject was sighted, the subject watched while the experimenter performed the transformation. The testing procedure was divided into three phases.

Phase 1. Phase one was carried out only once. With the standard doll in front of the subject, the child was asked to choose from the selection set of dolls the one that was identical to the standard. The child's response was recorded as either correct or incorrect. Since both the standard doll and the selection set of dolls were available to the child to see or touch during this trial, a correct response required only the use of a matching, as opposed to an imagery, strategy. This phase was used as a practice trial for the child and since it required only that the child make a congruence judgement with both the standard doll and the selection dolls present, it was not included in the child's score for this task.

Phase 2. The interviewer, who was seated on the child's left, placed identical dolls A (which served as a standard) and B in front of the child. Doll A was on the child's right and doll B, on the left. Each doll was aligned such that its feet were facing towards the child. The interviewer informed the child that dolls A (referred to as the child's doll during this "game") and B (referred to as the experimenter's doll) were the same. The experimenter stated, "Our dolls are the same" and encouraged the child to verify this by touching or looking at the dolls. Then, the interviewer told the child, "Pay attention to what we are going to do." The interviewer and the child (if the child was blind) held doll B steady and placed it in the box such that doll B was completely hidden inside the box without disturbing its position or orientation. Doll B was positioned such that it was in the center of the box (i.e., did not touch any of the sides of the box), the interviewer told the child "Now pay attention," as the interviewer and the child slid the box five inches to the child's right.

The interviewer presented the tray holding four selection dolls to the child, and asked the child to select from the tray the doll that was the same as doll B hidden in the box. If an attempt was made to pick up the box, the child was instructed not to touch the box. The interviewer recorded the child's selection. During this phase, doll A was left in front of the child and could be used as a reference.

The same procedure was repeated again. This time, however, the interviewer and the child rotated the box 90 degrees clockwise with the lower left corner of the box as the center of rotation. After the child selected a doll to match the standard doll in the box, the same procedure was repeated for the third (last) time. This time, the interviewer and the child flipped the box about the right vertical side of the box. The child's selection of a doll to match the standard that was in the box marked the end of phase two of the testing procedure.

During phase two, the child was asked to choose a doll from the selection set after each of the transformations (slide, rotation, flip). In order to perform accurately, the child had to rely on an imaginal strategy, since the doll whose position was transformed remained completely hidden in the box during the transformation and during the time when the child had to make a choice from the selection set of dolls. Each time a correct choice was made the child received one point. His score at this point varied from 0 to 3.

Phase 3. Phase three of the procedure was composed of four transformations (slide, rotation, and two different flips). Identical dolls A (which served as the standard) and B were aligned in their initial phase 2 positions. The interviewer informed the child that dolls A and B were the same. Then the interviewer told the child "Watch what I am (we are) going to do." The interviewer and the child (if the child was blind) held doll B steady and placed doll B in the box such that doll B was completely hidden inside the box without disturbing its position or orientation. Next, the interviewer said to the child, "Watch carefully what I do (we do) to the box," and performed the same slide transformation as specified in phase 2. The interviewer asked the child to demonstrate the transformation performed on doll B by transforming doll A.: "Put your doll (pointing to or putting the child's hands on doll A) so that it will look the way the doll hidden in the box (pointing to or putting the child's hands on the box containing doll B) looks now." The interviewer recorded the child's placement of A. The same procedure was repeated rotating the box 90 degrees clockwise with the lower left corner of the box as the center of rotation. Then it was done again with the standardized doll positioned so that it's feet were pointing toward the child and then flipped about the right vertical side of the box. The last time the procedure was repeated, the standard doll was positioned so that the doll's body was parallel to the side of the table at which the child was seated and then flipped about the right vertical side of the box.

During phase three, the child was asked to position his doll in the same position as the standard doll after each of the four non-visible transformations. In order to perform accurately, the child again had to rely on an imaginal strategy, since the doll whose position was transformed remained completely hidden in the box during the transformation and during the time when the child had to position his doll in the same position as the doll which had been transformed. The subject could make an irrelevant response, a partially correct response, or a completely correct response. An irrelevant response (i.e., handing his doll to the interviewer, making his doll "sit" on the table, etc.) received a score of zero. A partially correct response received a score of 1 through 4 according to the following criteria:

Random movement	=	1 point
(making the doll "walk" on the table)		
Correct type but random	=	2 points
(sliding the doll around on the table)		
Correct type but opposite	=	3 points
(flipping the doll in the opposite direction)		

Correct type but degrees off = 4 points

(rotating the doll in the proper direction but over- or under- estimating the number of degrees of rotation)

A completely correct response received a score of 5. In phase 3, therefore, a subject received a score ranging from 0 to 20. Combining the scores received in phases 2 and 3, the complete range of scores that a subject could receive on task 1 was from 0 to 23. See Appendix A for details on coding, recording, and scoring.

Task II: Perspective-Taking

Each child was trained to find a trinket which was always hidden under the same cup in a set of two cups. After the child found the trinket correctly five times in a row, he was moved to a starting point that was directly opposite the one at which the child had been trained. By noting which cup the child chose on the first trials from this new position, it was possible to infer whether the child was depending on an egocentric system based on the bodily response that had been learned or on a system of coordinated perspectives.

Task II was an adaptation of a task used by Acredolo (1977) to study developmental changes in the ability to coordinate perspectives of large-scale space. The subjects were 3- and 4-year-old children. It was demonstrated that the ability to coordinate perspectives as measured by Acredolo's task underwent developmental change during the preschool years. Almost all of the 5-year-olds, kept track of their movements in space. The 3- and 4-year-olds, however, were significantly less likely to do so unless there were landmarks to aid them.

The procedure used by Acredolo was followed. The apparatus, however, was changed. Since the blind subjects were unable to see the apparatus during testing, the line which defined the quadrants in the Acredolo study was changed to a raised line which could be perceived tactually.

Apparatus. All the testing was conducted using a 2 X 2 foot (.61 X .61m) plywood board divided into four quadrants using raised black tape. Figure 6 illustrates the testing apparatus.

Procedure. Raised black tape was placed on a board to divide it into quadrants and opaque cups were placed upside down on the tapes in the middle of two opposing sides (see Figure 6). Without the child being able to observe, the experimenter hid a trinket under one of the two cups. The trinket was always hidden under the same one. In all conditions, the board was placed on a table. After this trinket had been hidden, the subject was instructed to move his finger along the line to the cup under which the trinket had been hidden. Subjects began the experiment seated in a chair at S1 with the experimenter seated in a chair at S2 (see Figure 6). Since the trinket was always hidden under the same cup, the child was receiving reinforcement for a certain bodily response, namely, either a right turn (for half the children) or a left turn (for the remaining children). When the subject had found it correctly five times in a row, he or she was told, "Okay, before we do it again,

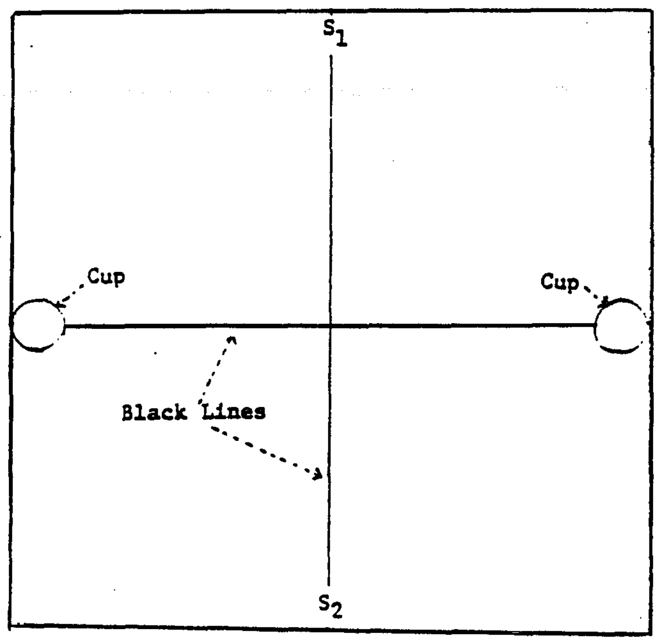

Figure 6. Apparatus for perspective-taking task.

let's switch chairs. You come sit here and I'll sit there." As the child walked from S1 to S2, he was told to touch the edge of the table around which he was walking. He was also reminded, during the time that he was walking, that he was moving from the chair in which he had been sitting to the one in which the experimenter had been sitting. When the experimenter and the child were seated at their new locations, the child was told, "Now, you're sitting in my chair and I'm sitting in your chair." By noting which cup the child chose on the first trials from S2, it was possible to infer whether the child was depending on an egocentric system based on the bodily response that had been learned or on a system of coordinated perspectives, in which he or she proceeded to the same cup that had been chosen all along, despite the fact that a new bodily response was required to reach it. Two test trials from the second position were conducted. The child was not allowed to lift the cup on the first trial from S2 on the pretense that the experimenter had forgotten to put the trinket under either cup and was asked to try again. It was reasoned that if the child really believed the trinket was under the particular cup, he or she would choose the same cup on both trials from S2.

Scoring

Subjects received a score of 0, 1, or 2 for their performance from position S2 according to the following criteria:

0 The subject chose the wrong cup twice indicating that

he was depending on an egocentric system based on the bodily response that had been learned.

1 The subject chose a different cup on each of the two trials indicating lack of certainty.

2 The subject chose the correct cup twice indicating that he was depending on a system of coordinated prospectives.

Task III: Mother's Index-Facilitation

Each mother was asked to teach her child a series of movements which the child was not able to see his mother perform since the child was either blind or, if sighted, wore a blindfold. Since the child could ordinarily learn this series by imitation of the mother's behavior which would be perceived visually, the mother had to devise means whereby she could help the child to perceive her behavior in other ways so that the series could be imitated. The experimenter recorded all index facilitation on the part of the mother. An index was a mobile sign which could be detached from the action taking place. These mobile signs provided the child with a link between an observable body part or action and an unobservable one. For example, the sound of clapping made when bringing the hands together could serve as an index for the action of bringing the hands together. Without seeing another person bringing his hands together, the child could imitate the action if he recognized the clapping sound as an index.

Procedure. The mother was told that she could touch the child if she wanted to during the instruction time (5 minutes), but the goal was to have the child perform the series eventually without being touched. The mother was taught the movement series through visual imitation. No sounds were made and no specific verbal prompts were given. The mother was then asked to teach her child the movement series. Mothers were told that they could tell the child that they were going to show him how to do some movements and that she wanted him to do these things in the same way that she was doing them. They could talk to the child to encourage the child to continue, but they could not tell the child how to do the movements. They had to show the child or direct the child without telling him specifically what to do.

The following actions comprised the movement series that the mother learned and then had to teach to her child.

1. Place the left hand in front of you in a horizontal position with the palm down.
2. Same as #1 with the right hand.
3. Place the left hand in front of you in a cupped position with the fingertips down.
4. Same as #3 with right hand.
5. Bring both hands together at midline with the palms flat against each other.
6. Lift the left foot.
7. Lift the right foot.

Each time the mother completed the series, the experimenter put up her hand indicating that action should stop for a moment so that the series could be recorded.

Materials. The materials that were available were a table, chair, and four matched sets of bells. Each bell was on a circular piece of elastic (bracelet). Mothers were told that they could use these items in any way that they wished to make it easier for the child to do the task. For example, the child could be asked to sit or stand, be placed away from the table or at the table, and/or have bell bracelets placed on him.

Scoring. Two scores were obtained from this task. The first score was the number of different index-facilitation moves a mother made in a session with her child during which her goal was to teach her child to imitate a movement sequence. Possible index-facilitation moves that a mother might make in attempt to get her child to carry out the imitation task are described in Appendix B. An index-facilitation move could be either an action designed to help the child to establish an index or an action which used an index which was known to the child. For example, if a mother wanted her child to place his hand flat on the table in front of him with his palm down, she might take his hand and place it in that position, making a slapping sound with his hand as it came in contact with the table. She would be trying to help him to establish the slapping sound as an index for the action of placing his hand on the table. If, at a later time in the teaching session, she made the slapping sound in order to get him to make the same hand placement action, she would be using an index. These index-facilitation moves were recorded on a form (in Appendix B) which listed the steps in the imitation series, and possible index-facilitation moves. There were 51 different index-facilitation moves listed that might be made to teach the imitation task. Since the number of different index-facilitation moves was of interest, this score was not affected by a mother's repetition of a particular move. Each move was counted only once for the index-facilitation score.

The second score obtained from this task was a measure of the child's performance on the imitation task. The child received one point for each of the seven imitation subtasks which were accurately executed independently. The child could, therefore, receive a score from 0 through 7. The child's score on his last execution of the series within allotted time was recorded.

The first two child-mother subject pairs tested using these tasks were videotaped. The videotape of these sessions was used to train an assistant experimenter to carry out the task, observe the interaction, and code the behavior. After the assistant experimenter was trained, eight child-mother subject pairs were jointly observed and scored by the experimenter and the assistant in order to establish a measure of agreement in the recording of scores on this task.

Task IV: Children's Controlled Imitation

The experimenter taught each child a series of movements which the child was not able to see because the child was either blind or blindfolded. The series was similar to the one used in Task III, but none of the movements was the same as those in that task. As in Task III, however, there were seven steps, including:

> five which required hand movements and positions; two which required foot movements; one which required the use of both hands at once; six which required right--left distinctions.

The experimenter taught the task to each child using a script which did not vary (See Appendix C). By teaching this task in a standardized way, the effect of the child's behavior on the teacher was controlled. The task, therefore, provided a measure of the child's ability to imitate. This measure was used to determine whether or not the child's behavior or ability in this type of task influenced the mother's index-facilitation score.

Procedure. The experimenter taught each child the following movement series.

1. Make a fist with your right hand and place the hand in front of you with the outer edge of your hand facing down.
2. Same as #1 with left hand.
3. Place your right hand in front of you in a horizontal position with the palm up.
4. Same as #3 with left hand.
5. With both hands held flat, touch both thighs at the same time.

6. Move your right foot forward and back.

7. Same as #6 with left foot.

Materials. The materials that were available were a table, chair, and four matched sets of bells. Each bell was on a circular piece of elastic (bracelet).

Scoring. The child's performance was scored based upon the number of component steps which were successfully performed independently after they have been taught to him. The child had a maximum of five minutes in which to learn the task. Since there were seven steps in this series, a child's score could range from 0 to 7 points. The child's score on his last execution of the series within the allotted time was recorded.

CHAPTER 3

RESULTS

Analysis Plan and Variables

The data were analyzed using a series of hierarchical multiple regressions. The dependent variables were children's imagery scores on tasks one and two. These scores were obtained on an imagery task involving the re-construction of a geometric transformation and on a perspective-taking task. There were five independent variables: 1) mothers' index-facilitation scores; 2) vision status (blind or sighted); 3) age (from 2 through 7 years); 4) children's imitation scores on the task administered by mothers; and 5) children's controlled imitation scores.

The children's imitation scores were derived from two tasks. These scores were treated separately. One task was an imitation task administered by the experimenter using a teaching script. By using a script, the children's influence on the individual who was administering the task could be controlled. The scores on this task are referred to as the controlled imitation scores. The other task was the imitation task administered by the mother during the index-facilitation task. This task involved seven movements to be made by the child, as did the one administered by the experimenter. There was no script for this task. Each mother was permitted to go about teaching this imitation task in her usual manner. The scores on this task are referred to simply as imitation scores. The children's controlled imitation score was used as a covariate to partial out the effect that imitation ability may have had on the index-facilitation behavior of the mothers.

Means, standard deviations, Pearson Correlation Coefficients, *t* tests of the differences between the means, slopes, and regression coefficients were computed as needed to illustrate relationships or to test hypotheses. Two types of regression analysis were performed. The first type was a fixed-order step-wise hierarchical regression which involved two steps. On the first step, the children's controlled imitation scores were entered as the covariate. The second step entry was determined by the particular hypothesis being tested. This type of analysis was used to test hypotheses in which the influence of the covariate was of concern. Use of the hierarchical model in this way ensured that any increment in prediction seen upon entry of the second variable would not be due to its relationship to the first variable. The second type of regression analysis that was performed was a random-entry regression which included all variables and interactions without the covariate. This type of analysis was used when the covariate did not have a bearing on the hypothesis being tested. In cases where both types of regression were used to analyze the data, the fixed-order step-wise hierarchical analysis related to the particular hypothesis was done first since it constituted a specific test of a particular hypothesis. In some cases, the random-entry regression was also carried out substituting imitation scores for imagery scores. This was done in cases where the hypothesis with regard to the relationship between specific independent variables and imagery scores was not supported. It was done in an attempt to investigate the possibility that the independent variable was influencing imitation scores rather than directly influencing imagery scores.

Interobserver Agreement

Eight child-mother subject pairs were jointly observed and independently scored by the experimenter and an assistant who had been trained using video-taped mother-child interactions on the index-facilitation task. Two scores were obtained from this task: 1) the number of different index-facilitation moves that the mother made (Range = 0-29); and 2) the imitation score achieved by the child (Range = 0-7). The percentage of agreement between the two observers was computed by dividing the number of subjects on which there was agreement by the total number of subjects scored. On the first score, there was 63% exact agreement and 100% agreement within one scale point. On the second score there was 100% exact agreement.

Descriptive Statistics

Means and standard deviations were computed for age, imagery scores on the geometric transformation task, imagery scores on the perspective-taking task, mothers' index-facilitation scores, children's imitation scores on the task administered by mothers, and children's controlled imitation scores. The means and standard deviations for the total sample and for the blind and sighted subjects separately are presented in Table 1.

The product-moment correlations among all variables were computed. The correlation coefficients and significance levels are presented in Table 2 for the total sample ($N = 40$). Table 3 presents the same material for the blind subjects ($N = 20$), and Table 4 presents it for the sighted subjects ($N = 20$).

Hypothesis 1

The first hypothesis tested was that imagery scores (on an imagery task and a perspective-taking task) for children whose mothers have high index-facilitation scores would be higher than those whose mothers have low index-facilitation scores.

In order to test this hypothesis, a separate hierarchical multiple regression analysis was carried out for each of the two dependent measures of imagery (the imagery task scores and the perspective-taking scores). In each regression analysis, the children's controlled imitation scores were entered as a covariate at the first step of the regression and the mothers' index-facilitation scores were entered at the second step.

The results of the regression analysis predicting children's imagery scores on the imagery task from their controlled imitation scores and mothers' index-facilitation scores are shown in Table 5.

Table 1

Means and Standard Deviations
for all Variables

Variable	Blind (*N* = 20)		Sighted (*N* = 20)		Total Sample (*N* = 40)	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Age (2 - 7 years)	5.15	1.82	5.40	1.82	5.27	1.69
Imagery Scores (Image. Task)	9.25	5.98	16.60	5.21	12.93	6.67
Imagery Scores (Perspec.-Taking)	0.75	0.91	0.80	0.77	0.78	0.83
Mother's Index-Facil. Scores	7.30	7.01	8.95	7.27	8.13	7.10
Imitation Scores	4.70	2.25	5.15	2.25	4.93	2.16
Controlled Imitation Scores	3.95	2.39	5.15	2.08	4.55	2.30

Table 2

Pearson Product-Moment Correlations
Among All Variables for the Total Sample
($\underline{N}$ = 40)

	Vis. Stat.	Age	Image. Tk.	Imag. Persp.- Tk.	Index- Facil.	Imit.	Cont. Imit. Scores
Vis. Stat.	---	.08	.56***	.03	.12	.11	.26*
Age (2 - 7 years)		---	.66***	.05	-.05	.58***	.50***
Image. Tk.			---	.04	.17	.73***	.65***
Image. Persp.-Tk.				---	.07	.15	-.11
Index- Facil.					---	.25	.21
Imit.						---	.66***
Controlled Imit. Scores							---

* $\underline{p} < .05$
*** $\underline{p} < .001$

Table 3

Pearson Product-Moment Correlations
Among All Variables for the Blind
Subjects (N = 20)

	Vis. Stat.	Age	Image. Tk.	Image. Persp.- Tk.	Index-Facil.	Imit.	Cont. Imit. Scores
Vis. Stat.	---	---	---	---	---	---	---
Age (2 - 7 years)		---	.81***	.06	.17	.77***	.56***
Image. Tk.			---	.23	.29	.93***	.70***
Imag. Persp.- Tk.				---	.14	.19	-.22
Index-Facil.					---	.30	.13
Imit.						---	.78***
Controlled Imit. Scores							---

*** $p < .001$

Table 4

Pearson Product-Moment Correlations Among All Variables for the Sighted Subjects (N = 20)

	Vis. Stat.	Age	Image. Tk.	Image. Persp.- Tk.	Index-Facil.	Imit.	Cont. Imit. Scores
Vis. Stat.	---	---	---	---	---	---	---
Age (2 - 7 years)		---	.65***	.02	-.30	.32	.40*
Image. Tk.			---	-.26	-.05	.68***	.55**
Image. Persp.- Tk.				---	-.01	.08	.02
Index-Facil.					---	.19	.25
Imit.						---	.52**
Controlled Imit. Scores							---

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

Table 5

Regression Results Predicting Imagery Scores on the Imagery Task from Mothers' Index-Facilitation Scores With Controlled Imitation Scores as a Covariate

Step	Variable	R^2	df	F	p	R^2 Change	F	p
1	Children's Controlled Imit. Score	.43	1,38	28.35	.001	---	---	---
2	Mothers' Index-Facilitation Scores	.43	2,37	13.85	.001	.0009	.06	n.s.

This analysis indicated that the children's controlled imitation scores made a significant contribution to the prediction of children's imagery scores on the imagery task, $F(1,38) = 28.35$, $p < .001$. Higher imitation scores were predictive of higher imagery scores. The nonsignificant F for the R^2 change when the mothers' index-facilitation scores were added to the regression analysis, however, indicated that mothers' index-facilitation scores did not make a significant contribution to the prediction of children's imagery scores on the imagery task. In addition, the simple correlations, as indicated in Tables 2, 3, and 4 between mothers' index-facilitation scores and children's imagery scores on the imagery task without controlled imitation scores were not significant. Neither the regression analysis nor the product-moment correlations indicated that there was a relationship between mothers' index-facilitation scores and children's imagery scores on the imagery task.

The same regression analysis was carried out for the second dependent measure of imagery (the perspective-taking scores). The results of the regression analysis predicting children's imagery scores on the perspective-taking task from their controlled imitation scores and mothers' index-facilitation scores are shown in Table 6.

This analysis indicated that the children's controlled imitation scores did not make a significant contribution to the prediction of children's imagery scores on the perspective-taking task. The nonsignificant F, for the R^2 change when the mothers' index-facilitation scores were added to the regression analysis indicated that mothers' index-facilitation scores did not make a significant contribution either to the prediction of children's imagery scores on the perspective-taking task.

As with the imagery scores on the imagery task, the simple correlations, as indicated in Tables 2, 3, and 4, between mothers' index-facilitation scores and children's imagery scores on the perspective-taking task without controlled imitation scores being held constant were not significant. Here again, neither the regression analysis nor the product-moment correlations indicated that there was a relationship between mothers' index-facilitation scores and children's imagery scores, this time, on a perspective-taking task.

In summary, neither of the regression analyses showed a significant effect for mothers' index-facilitation. The only variable which significantly predicted imagery scores (and this only on the imagery task) was children's controlled imitation scores. These analyses did not, therefore, support the hypothesis that imagery scores (on an imagery task and a perspective-taking task) for children whose mothers had high index-facilitation scores would be higher than those whose mothers had low index-facilitation scores.

Table 6

Regression Results Predicting Imagery Scores on the Perspective-Taking Task From Mothers' Index-facilitation Scores With Controlled Imitation Scores as a Covariate

Step	Variable	R^2	df	F	p	R^2 Change	F	p
1	Children's Controlled Imit. Score	.01	1,38	0.45	n.s.	---	---	---
2	Mothers' Index-Facilitation Scores	.02	2,37	0.39	n.s.	.009	.34	n.s.

Additional Analyses Carried Out to Investigate the Relationship Between Index-Facilitation Scores and Imagery Scores

In order to examine the relationship between imagery scores (on the imagery task and the perspective-taking task) and the mothers' index-facilitation scores without imitation scores as a covariate, two additional multiple regression analyses were carried out. In these analyses, the independent variables were mothers' index-facilitation scores, vision status, age, the interaction of mothers' index-facilitation scores x vision status, and the interaction of vision status x age. These were random entry regression analyses without imitation scores as a covariate. In fact, imitation scores were eliminated from the analyses. The results of the random-entry regression analysis using the imagery scores on the imagery task are presented in Table 7 and the results using the imagery scores on the perspective-taking task are presented in Table 8.

Inspection of the results in Table 7 in which the imagery scores on the geometric transformation task were the dependent measure revealed that only the interaction of vision status x age proved to be a significant predictor of these imagery scores, $F\ (1,38) = 62.38$, $p < .001$. Greater age and sightedness were predictive of higher imagery scores. The non-significant, F for the R^2 change when the mothers' index-facilitation scores were entered into the regression analysis indicated that even without

Table 7

Random Entry Regression Results Predicting Imagery Scores on the Imagery Task Without the Use of Imitation Scores as a Covariate

Step	Variable	R^2	df	F	p	R^2 Change	F	p
1	Vision x Age	.62	1,38	62.38	.001	---	---	---
2	Mothers' Index-Facilitation Scores	.65	2,37	34.35	.001	.03	3.01	n.s.
3	Age (2-7 yrs.)	.68	3,36	25.35	.001	.03	3.22	n.s.
4	Vision	.71	4,35	21.48	.001	.03	3.85	n.s.
5	Vision x Mothers' Index-Facilitation Scores	.71	5,34	16.70	.001	.00	0.01	n.s.

Table 8

Random Entry Regression Results Predicting Imagery Scores on the Perspective-Taking Task Without the Use of Imitation Scores as a Covariate

Step	Variable	R^2	df	F	p	R^2 Change	F	p
1	Mothers' Index-Facilitation Scores	.00	1,38	.19	n.s.	---	---	---
2	Age (2-7 yrs.)	.01	2,37	.14	n.s.	.00	.10	n.s.
3	Vision x Mothers' Index-Facilitation Scores	.01	3,36	.10	n.s.	.00	.04	n.s.
4	Vision*	.01	4,35	.11	n.s.	.00	.15	n.s.

* After the fourth variable was entered, the F-level or tolerance-level was insufficient for futher computation.

imitation scores being considered, mothers' index-facilitation scores were not significant predictors of these imagery scores.

Inspection of the results in Table 8 in which the imagery scores on the perspective-taking task were the dependent measure revealed that none of the variables tested proved to be a significant predictor of these imagery scores.

Analysis Carried Out to Investigate the Relationship Between Index-Facilitation Scores and Imitation Scores

Since the theoretical model upon which this study was based indicated that it was through imitation that imagery developed, it was decided to "back up," so to speak, and investigate the relationship between the mothers' index-facilitation scores and the children's imitation scores (both on the task administered by the mothers and on the controlled task administered under standardized conditions by the experimenter). Two more random order multiple regression analyses, therefore, were carried out. In the first, the dependent variable was children's imitation scores on the task administered by mothers (referred to simply as imitation scores). In the second regression analysis, the dependent variable was children's controlled imitation scores. In both analyses, the independent variables were the mothers' index-facilitation scores, vision status, age, the interaction of the mothers' index-facilitation scores x vision status, and the interaction of vision status x age.

The results of the random-entry regression analysis using the imitation scores on the task administered by the mother are presented in Table 9. The results of the analysis using the controlled imitation scores are presented in Table 10.

Inspection of the results in Table 9 in which the imitation of mothers' scores were the dependent measure revealed that age, $F\ (1,38) = 18.39$, $p < .001$, and the interaction of vision x mothers' index-facilitation scores, $F\ (2,37) = 4.86$, $p < .05$, were significant predictors of these imitation scores. Greater age was predictive of higher imitation scores. These findings will be brought up again later in relationship to hypotheses pertaining to them. The non-significant F for the R^2 change when the mothers' index-facilitation scores were entered into the regression analysis indicated that the index-facilitation scores were not significant predictors of these imitation scores.

Inspection of the results in Table 10 in which the controlled imitation scores were the dependent measure revealed the same findings as with the previous measure of imitation. Age, $F(1,38) = 12.24$, $p < .01$, and vision x mothers' index-facilitation scores, $F(2,37) = 5.91$, $p < .05$, were significant predictors of controlled imitation scores. Here again, greater age was predictive of higher imitation scores. This finding will be discussed later in relationship to hypotheses pertaining to it.

Analysis of the data in which imitation scores were substituted for imagery scores in order to investigate the role played by mothers' index-facilitation scores did not reveal a significant effect for index-facilitation.

Hypothesis 2

The second hypothesis tested was that there would be an interaction of index-facilitation by vision status such that mothers' index-facilitation scores would be more highly correlated to blind children's imagery scores (on both the imagery task and the perspective-taking task) than to sighted children's scores. In other words, it was expected that a significant effect for index-facilitation x vision status would be found.

This hypothesis differed from the first hypothesis in that the first hypothesis stated that index-facilitation would constitute a significant effect across all subjects. This hypothesis was tested to explore the effect of index-facilitation within the sighted and blind groups. It was anticipated that index-facilitation would prove to be of greater significance in relation to the imagery scores for blind children than for sighted children.

The same statistical procedures were followed to test this hypothesis as were used to test the first hypothesis. A separate hierarchical multiple regression analysis was carried out for each of the two dependent measures of imagery (the imagery task scores and the perspective-taking scores). In each regression analysis, the children's controlled imitation scores were entered as a covariate at the first step of the regression and the interaction of mothers' index-facilitation scores x vision status

Table 9

Random Entry Regression Results Predicting Imitation Scores on the Task Administered by Mothers

Step	Variable	R^2	df	F	p	R^2 Change	F	p
1	Age (2-7 yrs.)	.33	1,38	18.39	.001	---	---	---
2	Vision x Mothers' Index-Facilitation Scores	.40	2,37	12.56	.01	.08	4.86	.05
3	Vision x Age	.42	3,36	8.55	.01	.01	.71	n.s.
4	Vision	.43	4,35	6.56	n.s.	.01	.77	n.s.
5	Mothers' Index-Facilitation Scores	.43	5,34	5.11	n.s.	.00	.03	n.s.

Table 10

Random Entry Regression Results Predicting
Controlled Imitation Scores

Step	Variable	R^2	df	F	p	R^2 Change	F	p
1	Age (2-7 yrs.)	.24	1,38	12.24	.01	---	---	---
2	Vision x Mothers' Index-Facilitation Scores	.35	2,37	9.87	.01	.03	5.91	.05
3	Mothers' Index-Facilitation Scores*	.36	3,36	6.88	.01	.02	.91	n.s.

* After the third variable was entered, the F-level or tolerance-level was insufficient for further computation.

was entered at the second step. This parallels the process used to test the first hypothesis. The only change being the substitution of the multiplication term during the second step for the index-facilitation scores used to test the first hypothesis. The results of the regression analysis predicting children's imagery scores on the imagery task from their controlled imitation scores and mothers' index-facilitation scores x vision status are shown in Table 11.

This analysis indicated (as it did in the regression analyses carried out to test the first hypothesis) that the children's controlled imitation scores made a significant contribution to the prediction of children's imagery scores on the imagery task, $F(1, 38) = 28.35$, $p < .001$. The non-significant F for the R^2 change when mothers' index-facilitation scores x vision status was added to the regression analysis, however, indicated that this interaction term did not make a significant contribution to the prediction of children's imagery scores on the imagery task. In other words, there was no evidence to support the prediction that index-facilitation would have a differential effect on these imagery scores depending upon whether the subjects were blind or sighted.

The same regression analysis was carried out for the second dependent measure of imagery (the perspective-taking scores). The results of the regression analysis predicting children's imagery scores on the perspective-taking task from their controlled imitation scores and mothers' index-facilitation scores x vision status are shown in Table 12.

This analysis indicated that the children's controlled imitation scores did not make a significant contribution to the prediction of children's imagery scores on the perspective-taking task. The non-significant F, for the R^2 change when the interaction of mothers' index-facilitation scores x vision status was entered into the analysis indicated that this term did not make a significant contribution to the prediction of the imagery scores on this task. As in the previous analysis (using the imagery task scores) there was no evidence to support the prediction that index-facilitation would have a differential effect on these imagery scores depending upon whether subjects were blind or sighted.

In summary, neither of the regression analyses showed a significant effect for mothers' index-facilitation scores x vision status. As in the analyses carried out to investigate the first hypothesis, the only variable which significantly predicted imagery scores (and this only on the imagery task) was children's controlled imitation scores. These analyses did not, therefore, provide support for the hypothesis that there would be an effect of index-facilitation x vision status such that mothers' index-facilitation scores would be more highly correlated with blind children's imagery scores than with sighted children's imagery scores (on both the imagery task and the perspective-taking task).

Table 11

Regression Results Predicting Imagery Scores on the Imagery Task from Mothers' Index-Facilitation Scores x Vision Status With Controlled Imitation Scores as a Covariate

Step	Variable	R^2	df	F	p	R^2 Change	F	p
1	Children's Controlled Imit. Scores	.43	1,38	28.35	.001	---	---	---
2	Mothers' Index-Facilitation Scores x Vision Status	.44	2,37	14.46	.001	.01	.76	n.s.

Table 12

Regression Results Predicting Imagery Scores on the Perspective-Taking Task from Mothers' Index-Facilitation Scores x Vision Status With Controlled Imitation as a Covariate

Step	Variable	R^2	df	F	p	R^2 Change	F	p
1	Children's Controlled Imit. Scores	.01	1,38	.45	n.s.	---	---	---
2	Mothers' Index-Facilitation Scores x Vision Status	.02	3,37	.35	n.s.	.01	.76	n.s.

Additional Analyses Bearing on the Relationship Between Index-Facilitation x Vision Status and Imagery Scores

As in the case of the first hypothesis, the relationship between the variables in this hypothesis without the influence of the covariate (controlled imitation scores) was of interest. The two random-entry regression analyses carried out to explore the relationships in the first hypothesis without the covariate provided the information necessary to look at this hypothesis as well. These analyses were now reviewed in order to examine the relationship between imagery scores (on the imagery task) and the interaction of mothers' index-facilitation scores and vision status. In these analyses, it will be recalled, the independent variables were the mothers' index-facilitation scores, vision status, age, the mothers' index-facilitation scores x vision status, and vision status x age. For the results of the regression analysis using the imagery scores on the imagery task, the reader is referred back to Table 7 and for the results using the scores on the perspective-taking task, to Table 8.

Inspection of the results in Tables 7 and 8 indicated that the interaction of mothers' index-facilitation scores x vision status was not a significant predictor of either of these imagery scores.

Additional Analyses Bearing on the Relationship Between Mothers' Index-Facilitation Scores x Vision Status and Imitation Scores

Here again, since the theoretical model upon which the study was based indicated that it is through imitation that imagery develops, it was decided to investigate the relationship between imitation scores (both on the task administered by the mothers and on the controlled imitation task) and mothers' index-facilitation scores x vision status. The two random-entry regression analyses carried out to explore the relationship between the independent variables of interest in the first hypothesis and imitation scores also provided the information necessary to look at the relationship between the terms of interest in this hypothesis. For the results of the regression analyses using imitation scores on the task administered by mothers as the dependent measure, the reader is referred back to Table 9 and for the results using the controlled imitation scores as the dependent measure, to Table 10.

The significant $\underline{F}$ for the $\underline{R}^2$ change shown in both Table 9, $F\ (2, 37) = 4.86$, $\underline{p} < .05$, and 10, $F\ (2, 37) = 5.91$, $\underline{p} < .05$, when vision x mothers' index-facilitation scores was entered into the regression analysis showed that this interaction was significant. This indicated that the slope for the linear relationship for the imitation scores (on both imitation tasks) and mothers' index-facilitation scores was different for the blind and sighted groups. In order to examine this difference, a least-squares linear function was fitted between imitation scores and mothers' index-facilitation scores separately for the blind and sighted groups.

The slopes of the linear functions, the correlations between mothers' index-facilitation scores and imitation scores, and the significance of these correlations were computed for each group on each of the two imitation tasks. For the blind group in the case of the imitation scores on the task administered by mothers, the slope for the linear function was .10 with a correlation of .30 (n.s.). For the blind group in the case of the imitation scores on the controlled task, the slope was .05 with a correlation of .13 (n.s.). For the sighted group in the case of the imitation scores administered by mothers, the slope was .05 with a correlation of .19 (n.s.). For the sighted group in the case of the controlled imitation scores the slope was .07 with a correlation of .25 (n.s.). This analysis indicated that in spite of the fact that, the interaction of vision x mothers' index-facilitation scores was a significant predictor of imitation scores, vision status and mothers' index-facilitation scores were not significant predictors of imitation scores.

This analysis indicated that imitation scores (on both imitation tasks) were not significantly correlated with mothers' index-facilitation scores in either the blind or the sighted group. Therefore, as in the case of the relationship between index-facilitation and imagery scores, index-facilitation scores were not found to be a significant predictor of imitation scores either across both groups of subjects nor specifically for either the blind or sighted group.

Hypothesis 3

The third hypothesis tested was that sighted children would have higher imagery scores (on both the imagery task and the perspective-taking task) than congenitally blind children. In other words, it was expected that there would be a significant difference between the two groups (blind and sighted) on the imagery task scores.

In order to test the hypothesis, a *t* test of the differences between the scores of the blind and sighted children on both imagery tasks was carried out. The results of the *t* tests comparing blind and sighted children's scores on these tasks are shown in Table 13. A significant difference between blind and sighted children's imagery scores was found on the imagery task, $t\ (38) = 4.61$, $p < .001$. The mean for sighted children was 14.20, whereas, for blind children it was 7.55. To clarify the relationship between imagery scores on the imagery task and vision status, a Pearson correlation coefficient was computed between the scores of the two. The reader is referred to Table 2 which presents the correlations for all variables for the total

Table 13

t Tests Comparing Blind and Sighted Children's Scores on Imagery Tasks

Variable	Blind		Sighted				
	Mean	SD	Mean	SD	t	df	p
Task I: Imagery	7.55	4.89	14.20	4.20	4.61	38	.001
Task II: Perspective-Taking	0.75	0.91	0.80	0.77	0.19	38	n.s.

sample. The strength of the relationship between the children's imagery scores on the imagery task and vision status was indicated by the correlation coefficient of .56 which was significant beyond the .001 level.

In contrast to the results found with regard to the blind and sighted children's imagery scores on the imagery task, the results pertaining to the childrens' imagery scores on the perspective-taking task showed no significant differences. As indicated in Table 13, the *t* test indicated that there was no significant difference between the two group's imagery scores on the perspective-taking task. Inspection of the correlation coefficients presented in Table 2 also indicated that vision status and imagery scores on the perspective-taking task were not significantly correlated.

In summary, the analyses related to the relationship between vision status and children's imagery scores (on the imagery task only) provides support for the hypothesis that sighted children will have higher imagery scores than blind children.

Hypothesis 4

The fourth hypothesis tested was that the imagery scores for sighted and blind children would increase with age. In other words, it was expected that age and imagery scores on both the imagery task and the perpective-taking task would be positively correlated with age.

In order to test the hypothesis, Pearson correlation coefficients were computed for the children's imagery scores (on both the imagery task and the perspective-taking task) and age. The reader is referred to Table 2 in which the correlations among all variables for the total sample were reported. The correlation between age and the children's imagery scores on the imagery task was .66 which was significant at the .001 level. The correlation between age and the children's imagery scores on the perspective-taking task was .05 and was not significant.

In summary, the analysis relating to age and children's imagery scores (on the imagery task only) supported the hypothesis that imagery scores for sighted and blind children increase with age.

Hypothesis 5

The fifth hypothesis tested was that the imagery scores for sighted children would increase more rapidly with age than the imagery scores for blind children. In other words, it was expected that there would be an interaction of age x vision status such that the rate of increase in imagery scores for sighted children would be greater than the rate of increase for blind children. This hypothesis differed from the previous one in that it predicted an effect for age across both groups, whereas, this hypothesis focuses on the difference in age-related increases between the groups.

The relationship between children's imagery scores (on the imagery task and the perspective-taking task) and the relationship of vision status and age was first tested by means of two separate multiple regression analyses. These particular regression analyses were mentioned earlier in this section in the context of additional analyses related to hypothesis 1 and their results presented in Tables 7 and 8. They were random-entry analyses in which the independent variables were the mothers' index-facilitation scores, vision status, age, mothers' index-facilitation scores x vision status, and vision status x age.

Inspection of the results in Table 7 in which the imagery scores on the imagery task were the dependent measure revealed that vision status x age proved to be a significant predictor of these imagery scores, $F\ (1,\ 38) = 62.38$, $p < .001$. Inspection of the results in Table 8, in which the imagery scores on the perspective-taking task were the dependent measure, however, revealed that none of the independent variables were significant predictors of these imagery scores.

The significant effect of vision x age in relation to the children's imagery scores on the imagery task indicated that the slope for the linear relationship for the imagery scores on this task and age was different for the blind and sighted groups. In order to examine this difference, a least-squares linear function was fitted between these imagery scores and age separately for the blind and sighted groups. The slopes of the linear functions, the correlations between age and imagery scores, and the significance of these correlations were computed for each group. The slope for the linear function for the blind group was 2.67 with a correlation of .81 ($p < .001$). The slope for the sighted group was 2.12 with a correlation of .65 ($p < .001$). This analysis indicated that greater age was highly correlated with higher imagery scores on the imagery task for both groups. However, the slope (2.67) for the linear function for the blind group was significantly greater, $F(1, 38) = 62.38$, $p < .001$, (as indicated by the significant effect in the regression analysis) than the slope (2.12) for the sighted group. This indicated that the imagery scores on this task increased more rapidly with age for the blind group than for the sighted group.

In summary, as predicted in hypothesis 5 a significant effect was found between vision x age, but the direction of that interaction was opposite to that which was predicted. Therefore, the analysis did not provide support for the hypothesis that imagery scores for sighted children would increase more rapidly with age than the imagery scores of blind children.

Summary of Results

Five hypotheses were tested. The following were supported:

Sighted children would have higher imagery scores than blind children.

Imagery scores for sighted and blind children would increase with age.

The following were not supported:

Imagery scores for children whose mothers have high index-facilitation scores would be higher than those whose mothers have low index-facilitation scores.

Mothers' index-facilitation scores would be more highly correlated to blind children's imagery scores than to sighted children's imagery scores.

Imagery scores for sighted children would increase more rapidly with age than the imagery scores for blind children.

Additional analyses carried out to examine imitation scores as a dependent variable revealed that vision status x mothers' index-facilitation scores proved to be a significant predictor of children's imitation scores on two separate tasks (imitation task administered by mothers and controlled imitation task).

CHAPTER 4

DISCUSSION

The Relationship Between Index-Facilitation and Imagery Development

This study was designed to investigate the process by which children develop mental imagery. It was based on a Piagetian theoretical model in which imitation provides the mechanism for the development of imagery. In particular, it focused on the role of the "index" (a mobile sign which is detached from the action taking place) in the imitation process.

In order to isolate the function of the index, comparisons were made between its use in sighted and congenitally blind children, a population that in theory should be more highly dependent on indices than the normal population. One of the reasons for this is that congenitally blind children cannot imitate actions which are easily imitated by sighted children unless these non-visible actions are indexed to actions which can be perceived by other senses.

It was expected that there would be a significant relationship between mothers' index-facilitation and children's imitation and construction of mental images.

A positive relationship between high index-facilitation on the part of mothers and imagery development in children was not found for either the blind or the sighted subjects. Since imitation scores were available for all of the children in the study, the data were also analyzed to see if mothers' index-facilitation was positively related to imitation performance. Here again evidence was not found to support this relationship. A significant relationship was found, however, between both the blind and sighted children's imitation scores and their imagery scores. This is consistent with the Piagetian model in which imitation is the basis for the formation of the symbolic function. "It is ... the development of imitation which ensures the differentiation of signifiers and signifieds ... imitation ensures the transition between the sensori-motor and representational ... the image itself is internalized imitation" (Piaget & Inhelder, 1971, p. xvi).

Piaget indicated (1962) that the child will imitate actions that involve parts of his body or movements of his body that he cannot observe directly by making use of indices. The index is an already established conditioned stimulus, a mobile sign, which is detached from the action taking place. It becomes a symbol which the child applies to these non-visible movements. Since the activities to be imitated during the index-facilitation task could not be seen by the subjects because they were either blind or blindfolded, it was expected that index-facilitating behavior on the part of the mothers would have a positive effect on the children's performance.

The fact that the present study was unable to find evidence in support of the hypothesized relationship between mothers' index-facilitation and children's imagery or imitation scores may indicate that, although indexing is the means by which a child imitates movements which are not visible to him, the development of these indices may not be related to specific instruction. The development of imagery may be similar to the acquisition of conservation or other logical structures. Piaget (1959) states "In the first place, it is incontestable that a certain amount of learning of logical structures can take place. ... However, in the second place, this learning of logical structures remains very limited" (in Duckworth, 1979, p. 303). Duckworth (1979) adds, "that is, it took a long time and was neither universal nor generalizable" (p 303). As with conservation acquisition, imagery development may be related to the child's structures and determined by the regulatory system related to structures. If this is the case, then it is not possible for the mother to facilitate directly indexing, imitation, or imagery development, but only to provide an environment in which the child has opportunities to imitate and establish his own indices. Just as in the case of conservation, the parent or teacher can only provide an environment in which the child can carry out his own natural experiments which will lead to the acquisition of conservation.

Piaget (1962) distinguished between a signal and an index. He states,

> The "signal" (in the sense in which it is understood in the case of conditioned behaviours) is embodied firmly and finally in a schema and produces its effect more or less automat-

> ically, whereas the "index" is a mobile sign, detached from the action taking place, and making possible both anticipation of an immediate future and reconstruction of a recent past. ... it is just sufficient to enable the child to give meaning to the ... data he perceives in others. ... [it is] a mean term ... . In other words [for example], thanks to the index, the child assimilates the visual and auditory model to the auditory motor schema with which he is familiar in himself, and imitation becomes possible through accommodation to this schema. The sound then becomes unnecessary, whereas, if it were a signal it would have to persist as a stimulus...
> The meaning of the model itself depends on an act of assimilation, and the visual perceptions, far from being mere signals, are indices resulting from the similarity. ... [In the case of actions using indices,] the child's behavior seems to indicate understanding. (pp. 42 - 43)

Piaget's distinction between a signal and an index indicates that the index is related to assimilation. This relationship to assimilation, which is not associated with a signal, indicates that the mechanisms of imagery development may closely parallel those of conservation acquisition and other operative aspects of development.

If indices are, as Piaget states, "intelligent" (1962, p. 42) and are the mechanism for assimilation of schemas, perhaps the establishment of indices is related to the structural development process and is not directly influenced by training. This relates to the present study in that no relationship was found between the mothers' scores on the index-facilitation task and children's imagery or imitation scores, but a significant relationship was found between children's imitation and imagery scores. In addition, children's imitation scores on the task administered by the mothers were more highly correlated with children's scores on the imagery task than children's controlled imitation scores on the task administered by the experimenter were with imagery scores. This may indicate that the mothers were influencing the children's imitation behavior, but this influence was not describable simply in terms of index-facilitation. Although Piaget discusses the assimilative aspects of the index, his emphasis on imitation as a process dominated by accommodation and on the necessity for training in imitation tasks involving movements which the child cannot see himself make leads to an ambiguity in the model that requires further clarification. It is acknowledged that Piaget's description of the development of imitation involving indexing mentions assimilative processes that must be considered in exploring imitation and imagery development. However his emphasis on training and accommodation in the imitation process may require modification.

The data did not provide support for Piaget's explanation of the role of the parent as a facilitator of indexing in imitation activities. Since Piaget stated that "training in imitation is necessary, especially when it is a case of imitation of movements which the child cannot see himself make" (1962, p. 41), the present findings appear disconfirming and suggest a rejection or change in the theory. The findings suggest a change with regard to the role of external facilitation of imitation and the mechanisms involved in imitation. In the case of imitation where the action of the other and the self can be perceived at the time of imitation,

imitation seems to be dominated by accommodation. This is consistent with Piaget's theory in which imitation is accommodation to external reality. During this type of imitation, therefore, the child's behavior is under the control of the environment (physical or social). On the other hand, imitation which involves actions or body parts which cannot be perceived in the other and the self at the time of imitation seems to be dominated by assimilation. Piaget, himself, indicates that an index (which is required in this type of imitation) is "intelligent," meaning that "the child's behavior seems to indicate understanding" (1962, p. 43). Therefore, the development of an index requires assimilation which presupposes the influence of the child's structures. Indexing involves assimilation, not just association as is the case for a signal.

Piaget's strong statement regarding the role of the social environment in imitation interactions led to an expectation that measurement of indexing would provide some insight into techniques which could be used to train children who required help in order to imitate. Duckworth (1979) in discussing application of Piaget's theory to teaching describes two themes which have been pursued in Genevan research related to training: the interplay between the child's attempt at a practical result and his or her efforts to understand, and the interplay among the various access routes to knowledge - perceptions, actions, and words or formulas. She suggests that the research designed to explore these themes indicates,

> that practical situations, which are the ones that correspond most to children's natural activity, are not only sufficient, but are also the best kinds of learning situations. In the course of trying to solve practical problems, children spend time reorganizing their levels of understanding; in real situations, children develop multiple access routes to their knowledge. ... We need only broaden and deepen their scope by opening up parts of the world that children may not, on their own, have thought of thinking about. (p. 311)

Based on Duckworth's (1979) summation of the Genevan findings, perhaps it would be more accurate to state that children need models to imitate, but that the model does not control the development of imitation through index-facilitation. This may be so because the meaning of the index, or whether the index has any meaning at all, is determined by the child's mental structures.

Although imitation of actions which can be perceived in the other and one's self at the time of imitation may be actions which involve only accommodation, this may not be so in the case of imitation of actions which cannot be perceived in the self and the other at the time of imitation. In this case, indexing is required. Indexing, being an intelligent act provides the assimilative mechanism for linking two schemes. Changes in imitative behavior which take place using indices would, therefore, be autonomous and would be under the influence of the regulatory system related to structures.

Since this study dealt with an area, maternal index-facilitating, which has not been explored previously in a systematic way, it seemed appropriate to indicate that the findings did not provide support for certain aspects of the Piagetian model. The findings and interpretations presented, however, must be viewed only as possibilities since the study did not provide evidence to disconfirm the model. It must be acknowledged that the measure of index-facilitation that was used was a quantitative measure of the amount of indexing done by the mothers and that there was an assumption that this amount would be related to imitation and imagery development. It is possible that a Piagetian interpretation of the role of index-facilitation would hold that merely some minimal threshold level is necessary for this cognitive function to develop. It must also be pointed out that there was an assumption underlying the present study that maternal indexing from 2 through 7 years of age was consistent with maternal indexing during the sensorimotor period. It may be that maternal indexing at the later period has a very different character than it does during the earlier period, and that the relationship between this maternal behavior in these two periods is weak.

Based upon observations of the mothers who took part in this study, it was felt that there was qualitative differences between interactions which took place between the mothers and children during the index-facilitation task that was not captured by the scoring system developed for the task. It was noted that mothers seemed to differ in the extent to which they focused on the child's reaction to their teaching strategies and in the extent to which they modified their strategies based upon the child's behavior. Some mothers developed a plan of action which they carried out even though it was not successful in getting the child to perform appropriately. These mothers often repeated their procedure many times before changing it, or, in some cases, never changed it.

Other mothers, however, changed their method of instructing the child rapidly when the child did not perform as they wanted. These mothers tended to show a wide range of alternative strategies for getting their child to imitate and also showed great flexibility in moving among strategies. The behavior of these mothers seemed to be highly influenced by their child's behavior, whereas, the behavior of the mothers described earlier seemed uncoordinated with what their child was doing.

It would be interesting to explore the nature of the interaction that seemed to be taking place in order to evaluate the mothers': 1) awareness of the impact of their behavior on their child; 2) the range of strategies they could generate; and 3) the flexibility they could demonstrate in using strategies. These differences could probably be measured by video taping the interaction between the mothers and children and coding the mothers' responses when the child does not perform appropriately. It would be possible to record the number of strategies a mother used and how many times she repeated an unsuccessful strategy before changing to another one. In order to get additional information about the mothers' awareness of what was occuring and their plan, if they had one, this procedure should probably be combined with an interview of each parent.

The Referential Communication Paradigm as a Method for Investigating Imagery Development

According to Light (in press) studies of parent-child interactions which have attempted to find clear correlations between different styles of parenting and measures of children's performance indicate "that 'something is going on', but [do] not permit any confident identification of critical elements or features of parental behavior." Light indicated that attempts had been made to examine the "characteristics and consequences of parent-child interaction more directly." He discussed a number of studies of referential communication which may provide a framework for interpreting the findings of the present study.

Light pointed out that many of the referential communication studies made use of the Kraus and Glucksberg (1969) paradigm in which two individuals were engaged in a communication task while separated by a screen. One of the individuals (the speaker) had to give the other (the listener) enough discriminative information about a particular object (usually a picture) so that the listener could pick the object from a set of possibilities. Of particular relevance to the present study is the work of Dickson et al (1979), in which mothers were asked to describe one of a set of pictures to their own 4 year-old children.

> Referential communication accuracy for the pair was defined in terms of the listener's choices. This measure was found to be predictive of the child's I.Q. and other cognitive test scores one and two years later. More impressively, this relationship remained significant, even when measures of mother's I.Q., socioeconomic status and child's ability at four were partialled out. These results suggest that the effectiveness of communication between mother and child may represent an important element in what the authors term the 'cognitive socialization' of the child. (Light, in press)

The present study attempted to show that a relationship existed between mothers' teaching behavior and children's imagery scores. The measure of the mothers' teaching behavior was her score on a index-facilitation task. This score was then analyzed in relation to childrens' imagery scores and, later, to their imitation scores. No significant relationships were found between the mothers' scores and these children's score for either the blind or the sighted subjects. The task, in the present study, in which the mothers were engaged, when they were given their index-facilitation scores was conceptually similar to the referential communication task developed by Kraus and Glucksberg (1969) and the one used by Dickson et al (1979). In the present study, however, the mother had to convey sufficient discriminative information so that the child could execute a series of movements accurately in a specific order. As in the Kraus and Glucksberg (1969) study, subjects (children, in this case) were unable to see the persons (mothers, in this study) attempting to convey information upon which the subject was expected to act.

In the present study, children also received an imitation score based upon their performance of the task the mothers were attempting to teach. It was, however, the mothers' scores that were treated as the independent variable. These scores were expected to be predictors of children's imagery scores, but were not. In the Dickson (1979) study, however, the measure of referential communication competence that was used was the accuracy of the listeners' choices. In the present study, this measure would be equivalent to the accuracy of the childrens' performance on the movement imitation series that they were taught by the mothers. When the children's imitation scores were used as measures of the mothers' teaching competence and were analyzed in relation to childrens' imagery scores, the findings of the present study corresponded to previous studies of mother-child interaction in referential communication tasks. Both blind and sighted children's imitation scores on the tasks taught to them by mothers were significantly correlated with their scores on the imagery task. In addition, the children's imitation scores on the task taught by mothers were more highly correlated with children's imagery scores than their imitation scores on the task taught by the experimenter were with scores on that same imagery task. This pattern was consistent whether the scores for the total sample were analyzed or blind and sighted subjects' scores were analyzed separately. Data from the present study cannot be statistically analyzed to determine whether there is a significant difference between these correlations because the imitation tasks taught by the mothers and the experimenter were exactly the same in form, but differed with regard to the particular movements involved. Replication of the present study using these two imitation tasks as alternate forms of the same task and randomly assigning the two forms of the task to mothers and the experimenter would provide the data necessary to determine the significance of the differences observed.

Although the findings of the present study did not provide support for the hypothesis that imagery scores for children whose mothers had high index-facilitation scores would be higher than those whose mothers had low index-facilitation scores, it did provide evidence in support of the hypothesis that imagery scores would be higher for those children whose mothers received high scores (based on children's imitation scores) on a teaching task involving referential communication than those whose mothers received low scores. No evidence was found to show that the index or index-facilitation was related to imagery scores. When, however, the task was analyzed in a way similar to that used by Dickson et al (1979) in a referential communication task in which the children's imitation score obtained during the mother-child interaction was used as the independent variable, the findings were consistent with those of Dickson. In Dickson's study and the present one there was a positive relationship between children's scores on the referential communication task (the imitation task in the present study) and the dependent variable (IQ and other cognitive test scores in the Dickson study and imagery scores in the present study). Light (in press) stated that Dickson's results with regard to maternal teaching strategies are an important element in the 'cognitive socialization' of the child. The present findings suggest that maternal teaching strategies are also important elements in the development of children's symbol systems. Light comments on the development of these symbols.

> It is possible to describe what the child learns through such experiences in terms of signifier - signified relationships. However, it is not at all clear that in such cases, the signified has priority over the signifier. In Piaget's account, signifiers are 'grafted on' (Walkerdine, 1982) to the child's knowledge, and serve as representations of it. Mathematical signifiers serve only to represent schemata whose origin lies elsewhere. Walkerdine and Corran's analysis suggests rather that both signifier and signified are co-constructed in the course of the teacher-pupil dialogues. While such an analysis is speculative, and its empirical foundation slight, it offers a clear reflection of an emergent theme in contemporary research. (in press)

The present study found a relationship between imitation and imagery, but not between index-facilitation and imagery or imitation. These findings may mean that there is no relationship between indexing and imagery, or, more specifically, between mothers' index-facilitating behavior and children's imagery scores. Piaget (1962) does state directly, however, that "training in imitation is necessary when it is a case of imitation of movements which the child cannot see himself make" (p. 41). If that is the case, investigation of the role of instruction in imagery development might be explored more profitably within the context of the broader referential communication paradigm.

In summary, evidence was not found to support the hypothesized relationship between index-facilitation and imagery development. A significant positive relationship was found between children's imitation and imagery scores. It was suggested that the relationship between maternal teaching and imagery development might be explored further by adopting the method used by Dickson (1979).

The Relationship Between Imagery Development and Vision Status and Age

Based upon Piaget's description of the mechanism whereby mental imagery develops as a function of imitation, it was expected that the development of mental imagery in blind children would be delayed when compared to the imagery development of sighted children. It was found that sighted children did significantly better than blind children on the imagery task involving a geometric transformation.

The imagery task was an adaption of a task developed by Beilin (1982). In the original task, the objects which were manipulated were geometric forms. In the present study, the objects to be manipulated were dolls which varied on the same dimensions as the geometric forms. Schultz (1978) reported that "particular figurative features of a transformation such as size of a figure, familiarity with its configuration, and different task directions all affect performance (in Beilin, 1984, p. 18). It was, therefore, expected that the use of familiar objects, such as dolls, would present less of an obstacle to the performance of the task by the young subjects (two through seven years of age) in this study than the relatively unfamiliar geometric shapes used by Beilin (1982) and O'Donohue (1981) with older subjects. In the present study, the imagery task successfully discriminated blind from sighted subjects. In addition, within each of these groups, it revealed a significant positive relationship between imagery development and age. Beilin (1982) indicated that his transformational imagery task appeared "to be neither easier nor more difficult than the traditional Piagetian tasks in that the age at which the task is succeeded in is 7 - 8 years, the age reported for Genevan subjects."

> Seven years appears as the age at which the child is able to imagine the relevant transformation (slide, flip or rotation). Many, however, were not successful at it. Only 13 trials of 46 (28%) resulted in accurate transformations (that is they were relevant transformations that were complete and in the correct direction). None of these were carried out by a child younger than 7 years; the first fully successful child (in all 3 transformation trials) was 8 years old. (Beilin, 1982)

In the present study, however, by substituting familiar items (dolls) for unfamiliar ones (geometric forms) a gradual developmental change in imagery scores with age (2 - 7 years) was shown for both blind and sighted subjects. It would appear that the present task provided less of an obstacle to performance than tasks used by others to assess imagery development.

In addition to expecting sighted subjects to do better than blind subjects on imagery tasks and older subjects to do better than younger subjects, it was expected that the imagery scores of sighted children would show a more rapid increase with age than those of blind children. This third hypothesis was not supported. The scores for the blind group increased more rapidly with age than those for the sighted group. The original hypothesis related to the expected relative magnitude of change in scores for the two groups was based upon previous studies which compared blind and sighted subjects in a variety of areas (Warren, 1977; Stephens & Grube, 1982; Fraiberg et al, 1966). The present finding regarding rate of development was inconsistent with the literature on haptic experience and lack of vision (O'Donohue 1981, p.6), effects of visual (simultaneous) and tactual (successive) perceptions (Fraisse, in Bernstein, 1978), intermodal and intramodal transfer (O'Donohue, 1979, pp 24-25), and haptic pattern formation (Gomulki in O'Donohue, 1981, p.16). The finding of the present study that blind children scored lower than sighted children on the imagery task at all ages, but that their imagery scores were more highly correlated with age than sighted children's imagery scores were is consistent with the Piagetian explanation of development. Piaget emphasized the role of children's active involvement with the environment and of social interaction (Ginsburg & Opper, 1979). In both of these areas blind children experience deprivation. They are less active as infants.

> The blind child will not be attracted to people and objects or even parts of his own body - his hands and feet- nor will he know they exist, unless he can experience them through touch, sound, or taste. In other words, he will not be motivated to explore, unless guided to what he cannot see, unless made to

> feel and hear what is brought to him. By the same token, if there is no awareness of the environment, there is no desire or need to communicate. (Kastein et al, 1980)

With such deprivation it should be expected that the minimum experience necessary for each stage of development might not exist for blind children until they are somewhat older than sighted children who are functioning at each stage level. Blind children do not begin to reach out until they have begun to understand that sounds are related to objects or people and are able to localize these sounds and associate them with events. The minimum conditions for the development of cognitive understanding of space, physical perspectives, and spatial transformations may be available to them only when they can localize sounds. Acquisition of developmental milestones may then proceed rapidly and approximate levels attained by sighted children of the same age. The findings of the present study demonstrated such a pattern.

Preliminary analysis of data from a study designed to investigate blind and sighted children's strategies on a transformational imagery task (O'Donohue, 1981) has provided information that indicates that blind and sighted children used different strategies to deal with the imagery task. Sighted children generally used a place strategy which involves actions which take into consideration the environment in which the object to act upon is embedded. For example, in the O'Donohue study, each child was asked to observe while a slipper which had been enclosed in a square box, was flipped about the right vertical side of the box (as the doll was in the present study). In its original position, the sole of the slipper was in contact with the table, the toe was at the child's left, and the heel at the right. The child was unable to see the slipper in its new position because it was enclosed in the square box. The child was asked to take another slipper which had been placed in front of him in the original position and make it look the way the slipper in the box looked after it had gone through the flip transformation. Children using a place strategy rotated the slipper 180° with the toe of the slipper as the center of rotation. The slipper, therefore, was positioned appropriately with regard to the toe-heel orientation, but remained with the sole in contact with the table. O'Donohue referred to this as a place strategy because the child's behavior indicated that the change in placement of the object in the box in relation to the table surface edges was the element which the child used to make his choice. He was taking into consideration the environment in which the object to act upon was embedded. Blind children, on the other hand, generally used a movement-memory strategy. For example, given the same task to accomplish, children using a movement-memory strategy flipped the slipper about the horizontal axis. The slipper, in this case, was positioned appropriately with regard to the relative positions of its sole and top but remained with the heel at the child's left and the toe at the right. O'Donohue referred to this as a movement-memory strategy because the child's behavior indicated that the movement of the object was the element which the child used to make his choice.

Since young blind children do not have the perceptual information with regard to the larger environment in which objects exist, but do have experience with movement transformations, O'Donohue's findings with regard to strategy use are not surprising. O'Donohue also finds some evidence that younger sighted children used the movement-memory strategy and older sighted children used the place strategy indicating that the movement-memory strategy may be an earlier, less effective one, than the place strategy. The findings that sighted children made more correct judgements on the task than blind children may provide further support for the hypothesis that the place strategy is more effective than the movement-memory strategy. These findings are based upon a small sample and have not been fully analyzed, and therefore, must be supported by studying these factors in a larger sample using a design that will provide information about the sequence of development of the strategies and their relative effectiveness. Future studies which employ a combination of the strategy and error analysis used in the O'Donohue study and the imagery task used in the present study might provide a clearer picture of the factors responsible for changes in children's performance on imagery tasks.

In addition to the possibility that strategies which differ in effectiveness may have been influencing the children's scores on the imagery task, there is the possibility that children's task decisions were governed by the development of concrete operational ability as the children neared 7 years of age. As concrete operational structures began to dominate the process, the influence of the strategy may have been diminished. If this were so, it would be expected that the difference between scores of the blind and sighted groups would begin to decrease. This was what was found in the present study and may indicate that the children were moving from perceptual to cognitive strategies for accomplishing this task. There is not yet enough evidence to offer this explanation with certainty, but it does seem to warrant further investigation.

Since rate of development for the blind group was significantly greater than for the sighted group, but the sighted subjects in this study always scored higher than the blind subjects at comparable ages, statements with regard to this finding should be made with caution. Another possible explanation for these findings is that the particular form of imagery being measured by this task may be beginning to reach its highest level of development in the sighted group and that the rate of development for that group is already slowing down before the eighth birthday. If this is so, the interaction effect found could be a function of the age range investigated in this study. Beilin (1984) indicated that a transformational understanding of congruence begins to emerge around 7 years. In addition, "the knowledge of geometric transformations that develop between 7 and 11 years of age is sensitive to task demands. The nature of the task as well as the cognitive processes involved interact with the particular transformation to yield differential performance" (p. 56). Beilin (1982) also stated that his findings related to the imagery task "are very much in accord with the predictions of Piagetian theory of the achievement of operative structures at this age [7 years] and their influence on performance. Not only do they influence success in problem solving but they appear to be associated with the types of strategies children utilize in solving problems. A replication of the portion of the study designed to illustrate the relationship between imagery development and age which involved children beyond eight years of age could provide the data necessary to explain the finding.

A second task was used to obtain an imagery score for subjects. This was an adaptation of a task used by Acredolo (1977) to study developmental changes in the ability to coordinate perspectives in large-scale space. The subjects were 3- and 4-year-old children. The data in that study demonstrated that the ability to coordinate perspectives (an indication of mental imagery according to Piaget) undergoes developmental changes during the preschool years. The procedure used by Acredolo (1977) was the same in the present study, but the apparatus was changed. A line which was used to define quadrants was changed to a raised line so that it could be preceived tactually (Fig. 6).

The perspective-taking task did not discriminate between vision status groups or within groups according to age. The failure of this task to provide evidence with regard to the development of perspective taking is difficult to explain since it incorporated all of the conditions indicated by Acredolo (1977) to be helpful to the child in accomplishing the task successfully. It was a small-scale space that could be observed as a whole with ease. As a small-scale model it was viewed within a larger space where there were many landmarks which could be used to distinguish the two cups, thereby facilitating an appropriate response. Each child had to move to the opposite side of the table before making the scored responses - a movement that as Acredolo states "would be difficult to ignore (p.6)".

One factor that might account for the failure to replicate Acredolo's findings was a suspiciousness articulated by some of the older subjects. Many of them indicated that they thought they knew where the trinket was located, but didn't believe that the experimenter would be so foolish as to hide the trinket under the same cup so many times and that they thought that eventually, the experimenter would trick them by changing the location. This suspicious behavior continued in spite of repeated assurances that the experimenter was not trying to trick them. For this reason a post test interview of the child with regard to where he really thought the trinket was and why he made his choice should probably be included.

Another factor that might account for the discrepancy between the Acredolo findings and those of the present study was the difference between the two studies in the use of landmarks. Acredolo conducted her experiment under three conditions: with no landmarks, with indirect landmarks, and with direct landmarks.

> In the no-landmark condition, the room contained no landmarks to help the child differentiate the sides of the room. In the indirect landmark condition, a red circle was hung behind S_1, and a black triangle behind S_2, thereby differentiating the starting positions but not the cups. In the direct landmark condition, the cups were placed on tables covered by distinguishably different tablecloths so that a simple association between cup and tablecloth, a topological response, would suffice to code a particular cup. (Acredolo, 1977, p. 3)

The present study, on the other hand, did not attempt to control the landmarks in the large-scale space in which the task was carried out and did not provide specific landmarks to mark S_1 and S_2 or the cup locations. The only consistent assistance the children were given in order to draw their attention to their change in position relative to the cups was: 1) that they were told that they were going to change seats with the experimenter; 2) they were instructed to touch the edge of the table around which they walked when they changed seats; and 3) they were reminded that they were sitting in the experimenter's chair and that the experimenter was sitting in their chair after they changed places. Since no attempt was made, in the present study, to control the large-scale space in which the task took place, it is possible that factors related to that space may have influenced children's performance on the task in ways that masked any developmental trend in ability to perform the task.

In summary, no relationship was found between maternal index-facilitation and children's imagery or imitation scores. The findings suggested a change in the Piagetian theory with regard to the role of external facilitation of imitation and the mechanisms involved in imitation. A significant positive relationship was found between imitation and imagery development. The imagery scores for sighted subjects were significantly higher than for blind subjects and imagery and imitation scores increased with age for all subjects. In addition, the finding that children's imitation scores on a task taught by mothers were more highly correlated with children's imagery scores than children's imitation scores on a task taught by the experimenter were with those same imagery scores indicated that mothers may have been influencing imagery development and that this influence can be measured using childrens' imitations scores.

The task designed to evaluate imagery level by means of an imagery task involving a geometric transformation activity using dolls proved to be a useful tool for examining imagery development in young children (2 - 7 years). The second task used to determine imagery level, by means of a perspective taking task, did not provide information consistent with its previous use and may require the addition of a post test interview.

It was suggested that future investigation of the relationship between mothers' teaching strategies and children's imagery development make use of the referential communication paradigm used by

Dickson (1979), the strategy and error analysis techniques used by O'Donohue (1981), the imagery task using dolls developed for the present study, and alternate forms of the imitation task used in the present study.

Appendix A:

Task I - Coding Explanation and Recording Form

Task I

Coding Explanation

Phase 1	Points
Responses	
Incorrect	
Correct	

Strategies

1. Compares size using superimposition or edge match.
2. Compares internal features.
3. Random - no comparison to standard.

Phase 2	
Responses	
Incorrect	0
Correct	1

Strategies

(Same as Phase 1)

Phase 3	Points
Responses	
Incorrect	0
Partial correct	
Random movement	1
Correct type but random	2
Correct type but opposite	3
Correct type but degrees off (Head to toe/180 rot.)	4
Completely correct	5

Task I		Strategies				Responses			Name
		Compares Size		Compares Int. Features	Random	Incor.	Correct		
Phase I		Superimp.	Edge Match						Total
Phase II						0	1		
	Slide								
	Rotate								
	Flip								

						Incor. 0	Random 1	Correct Type Rand. 2	Correct Type Oppos 3	Correct Type Degrees Off 4	Correct 5
Phase III	Slide										
	Rotate										
	Flip 1										
	Flip 2										

Appendix B:

Task III

Mother Index-Facilitation Behavior Possibilities

and

Recording Form

Task III

I. Put the left hand in front of you in a horizontal position with the palm down.

1. Mother takes child's left hand and puts it into the correct position.
2. Mother places child's left hand on top of hers and moves her hand into the correct position.
3. Mother takes child's left hand and puts it into the correct position having the child slap the table with his palm.
4. Mother places child's left hand on top of hers and moves her hand into the correct position slapping the table with her palm.
5. Mother takes child's left hand and puts it into the correct position while wearing a matching bell bracelet placed on her left wrist and the child's left wrist.
6. Mother places the child's left hand on top of hers and moves her hand into the correct position while wearing a matching bell bracelet placed on her left wrist and the child's left wrist.
7. Mother takes child's left hand and puts it into the correct position having the child slap the table with his palm while wearing matching bell bracelets placed on her left wrist and the child's left wrist.
8. Mother places the child's left hand on top of hers and

moves her hand into the correct position slapping the table with her palm while wearing matching bell bracelets

placed on her left wrist and the child's left wrist.

9. Mother slaps table.

10. Mother jangles bells on her left wrist.

II. Put the right hand in front of you in a horizontal position with the palm down.

1. Mother takes the child's right hand and puts it into the correct position.

2. Mother places the child's right hand on top of hers and moves her hand into the correct position.

3. Mother takes the child's right hand and puts it into the correct position having the child slap the table with his palm.

4. Mother places the child's right hand on top of hers and moves her hand into the correct position slapping the table with her palm.

5. Mother takes the child's right hand and puts it into the correct position while wearing matching bell bracelets placed on her right wrist and the child's right wrist.

6. Mother places the child's hand on top of her's and moves her hand into the correct position while wearing matching bell bracelets placed on her right wrist and the child's right wrist.

7. Mother takes the child's right hand and puts it into the correct position having the child slap the table with his palm while wearing matching bell bracelets placed on her right wrist and the child's right wrist.
8. Mother places the child's right hand on top of hers and moves her right hand into the correct position slapping the table with her palm while wearing matching bell bracelets placed on right wrist and the child's right wrist.
9. Mother slaps table.
10. Mother jangles bells on her right wrist.

III. Place the left hand in front of you in a cupped position with the fingertips down.

1. Mother takes child's left hand and puts it into the correct position.
2. Mother places the child's left hand on top of hers and moves her hand into the correct position.
3. Mother takes the child's left hand and puts it into the correct position having the child click his nails on the table.
4. Mother places the child's left hand on top of hers and moves her hand into the correct position making a clicking sound on the table with her nails.

5. Mother takes the child's left hand and puts it into the correct position while wearing matching bell bracelets placed on her left wrist and the child's left wrist.
6. Mother places the child's hand on top of hers and moves her hand into the correct position while wearing matching bell bracelets placed on her left wrist and the child's left wrist.
7. Mother takes the child's left hand and puts it into the correct position having the child click his nails on the table while wearing matching bell bracelets on her left wrist and the child's left wrist.
8. Mother places the child's left hand on top of hers and moves her hand into the correct position making a clicking sound on the table with her nails while wearing matching bell bracelets on her left wrist and the child's left wrist.
9. Mother clicks her nails on table.
10. Mother jangles bells on her left wrist.

IV. Place the right hand in front of you in a cupped position with the fingertips down.

1. Mother takes the child's right hand and puts it into the correct position.
2. Mother places the child's right hand on top of hers and moves her hand into the correct position.

3. Mother takes the child's right hand and puts it into the correct position having the child click his nails on the table.
4. Mother places the child's right hand on top of hers and moves her hand into the correct position making a clicking sound on the table with her nails.
5. Mother takes the child's right hand and puts it into the correct position wearing matching bell bracelets placed on her right wrist and the child's right wrist.
6. Mother places the child's right hand on top of hers and moves her hand into the correct position while wearing matching bell bracelets on her right wrist and the child's right wrist.
7. Mother takes the child's right hand and puts it into the correct position having the child click his nails on the table while wearing matching bell bracelets on her right wrist and the child's right wrist.
8. Mother places the child's right hand on top of hers and moves her hand into the correct position making a clicking sound on the table with her nails while wearing matching bell bracelets on her right wrist and the child's right wrist.
9. Mother clicks her nails on the table.
10. Mother jangles the bells on her right wrist.

V. Bring both hands together at midline with the palms flat against each other.

1. Mother takes the child's hands and puts them into the correct position.
2. Mother places the child's hand on hers and moves her hands into the correct position.
3. Mother takes the child's hand and puts them into the correct position making a clapping sound as she brings his palms together.
4. Mother places the child's hands on hers and moves her hands into the correct position making a clapping sound as she brings her hands together.
5. Mother claps.

VI. Lift the left foot.

1. Mother takes hold of the child's left leg and lifts his foot off the ground.
2. Mother places her left leg behind the child's left leg and bends her knee lifting the child's leg.
3. Mother takes hold of the child's left leg and lifts his foot off the ground making a stamping sound as she puts it down on the floor.
4. Mother places her left leg behind the child's left leg and bends her knee lifting the child's foot off the ground making a stamping sound as she puts her foot on the floor.

5. Mother takes hold of the child's left leg and lifts his foot off the ground while wearing a matching bell bracelet placed on her left ankle and the child's left ankle.
6. Mother places her left leg behind the child's left leg and bends her knee lifting the child's foot off the ground while wearing a matching bell bracelet placed on her left ankle and the child's left ankle.
7. Mother takes hold of the child's left leg and lifts his foot off the ground making a stamping sound as she puts it down on the floor while wearing a matching bell bracelet placed on her left ankle and the child's left ankle.
8. Mother places her left leg behind the child's left leg and bends her knee lifting the child's foot off the ground making a stamping sound as she put her foot down on the floor while wearing a matching bell bracelet on her left ankle and the child's left ankle.
9. Mother stamps her foot.
10. Mother jangles the bells on her left ankle.

VII. Lift the right foot.

1. Mother takes hold of the child's right leg and lift his foot off the ground.
2. Mother places her right leg behind the child's right leg and bends her knee lifting the child's leg.

3. Mother takes hold of the child's right leg and lifts his foot off the ground making a stamping sound as she puts it down on the floor.
4. Mother places her right leg behind the child's right leg and bends her knee lifting the child's foot off the ground making a stamping sound as she puts her foot down on the floor.
5. Mother takes hold of the child's right leg and lifts his foot off the ground while wearing a matching bell bracelet on her right ankle and the child's right ankle.
6. Mother places her right leg behind the child's right leg and bends her knee lifting the child's foot off the ground while wearing a matching bell bracelet on her right ankle and the child's right ankle.
7. Mother takes hold of the child's right leg and lifts his foot off the ground making a stamping sound as she puts it down on the floor while wearing matching bell bracelets placed on her right ankle and the child's right ankle.
8. Mother places her right leg behind the child's right leg and bends her knee lifting the child's foot off the ground making a stamping sound as she puts her foot down on the floor while wearing a matching bell bracelet on her right ankle and the child's right ankle.
9. Mother stamps her foot.

10. Mother jangles the bells on the right ankle.

Task III

Series Step	Direct manip.	Passive follow		Direct manip. & sound	Passive follow & sound	Direct manip. & bell	Passive follow & bell	Direct manip. & sd. & bell	Passive follow & sd. & bell		Sound	Bell	Notes
1. Left hand horiz.													
2. Right hand horiz.													
3. Left hand cup													
4. Right hand cup													
5. Hands Midline													
6. Left foot up													
7. Right foot up													
	Direct Training			Index-Establishment							Index use		
				Index-Facilitation									

Name		
Index Total	Index Tally	Imit. Total

Appendix C:

Task IV - Teaching Script

Follow this script while sitting next to the child at a table. The child must be seated on a chair that allows his feet to touch the floor.

> I am going to teach you a game. In the game I will do something and then you will do it. I will help you to do each thing, then you will do it by yourself. You and I will wear some bells while we play the game.

Put a matching set of bells on the child's right wrist and your right wrist.

> Shake the bells on your wrist. They sound the same as mine. Listen to mine again. (Shake bells) Shake your bells. They are the same.

Repeat the above sequence for the bell set for left arm.

> Now we can play the game. I'm going to do things and show you how to do them. I want you to do the things by yourself after I show you how. I will do things to help you.

Carry out the following actions with the child. You may talk to the child to encourage him to continue, but you cannot tell the child how to do the movements. You must follow the steps outlined to help the child to make the movements. You cannot <u>tell</u> the child specifically what to do.

I. Outcome behavior: The child will make a fist with his right hand and place the hand in front of him with the outer edge of the hand facing down.

1. Take the child's right hand and put it into the correct position.
2. Place the child's right hand on top of yours and move your hand into the correct position.
3. Take child's right hand and put it into the correct position having the child bang the table with his fist.
4. Place the child's right hand on top of yours and move your hand into the correct position banging the table with your fist.
5. Take child's right hand and put it into the correct position while shaking the matching bell bracelet placed on your right wrist and the child's right wrist.
6. Place the child's right hand on top of yours and move your hand into the correct position while shaking the matching belt bracelet placed on your right wrist and the child's right wrist.
7. Take child's right hand and put it into the correct

position having the child bang the table with his fist while shaking the matching bell bracelet placed on your right wrist and the child's right wrist.

8. Place the child's right hand on top of yours and move your hand into the correct position banging the table with your fist while shaking the matching bell bracelets placed on your right wrist and the child's right wrist.

9. Bang table.

10. Jangle bells on your right wrist.

II. Outcome behavior: The child will make a fist with his left hand and place the hand in front of him with the outer edge of the hand facing down.

1. Take the child's left hand and put it into the correct position.

2. Place the child's left hand on top of yours and move your hand into the correct position.

3. Take the child's left hand and put it into the correct position having the child bang the table with his fist.

4. Place the child's left hand on top of yours then move your hand into the correct position banging the table with your fist.

5. Take the child's left hand and put it into the correct position while shaking the matching bell bracelets placed on your left wrist and the child's left wrist.

6. Place the child's left hand on top of yours and move

your hand into the correct position while shaking the matching bell bracelets placed on your left wrist and the child's left wrist.

7. Take the child's left hand and put it into the correct position having the child bang the table with his fist while shaking the matching bell bracelets placed on your left wrist and the child's left wrist.
8. Place the child's left hand on top of yours and move your left hand into the correct position banging the table with your fist while shaking the matching bell bracelets placed on your left wrist.
9. Bang table.
10. Jangle bells on your left wrist.

III. Outcome behavior: The child will place his right hand in front of him in a horizontal position with his palm up.

1. Take child's right hand and put it into the correct position.
2. Place the child's right hand on top of yours and move your hand into the correct position.
3. Take the child's right hand and put it into the correct position having the child tap his knuckles on the table.
4. Place the child's right hand on top of yours and move your hand into the correct position making a tapping sound on the table with your knuckles.
5. Take the child's right hand and put it into the correct

position while shaking the matching bell bracelets placed on your right wrist and the child's right wrist.

6. Place the child's wrist hand on top of yours and move your hand into the correct position while shaking the matching bell bracelets placed on your right wrist and the child's right wrist.
7. Take the child's right hand and put it into the correct position having the child tap his knuckles on the table while shaking the matching bell bracelets on your right wrist and the child's right wrist.
8. Place the child's right hand on top of yours and move your hand into the correct position making a tapping sound on the table with your knuckles while shaking the matching bell bracelets on your wrist and the child's right wrist.
9. Tap knuckles on table.
10. Jangle bells on your right wrist.

IV. Outcome behavior: The child will place his left hand in front of him in a horizontal position with his palm up.

1. Take the child's left hand and put it into the correct position.
2. Place the child's left hand on top of yours and move your hand into the correct position.
3. Take the child's left hand and put it into the correct position having the child tap his knuckles on the table.

4. Place the child's left hand on top of yours and move your hand into the correct position making a tapping sound on the table with your knuckles.
5. Take the child's left hand and put it into the correct position shaking the matching bell bracelets placed on your left wrist and the child's left wrist.
6. Place your child's left hand on top of yours and move your hand into the correct position while shaking the matching bell bracelets on your left wrist and the child's left wrist.
7. Tap knuckles on the table.
8. Jangle the bells on your left wrist.

V. Outcome behavior: With both hands held flat, the child will touch both thighs at the same time.

1. Take the child's hands and put them into the correct position.
2. Place the child's hands on yours and move your hands into the correct position.
3. Take the child's hands and put them into the correct position making a slapping sound as you bring his palms into contact with his thighs.
4. Place the child's hands on yours and move your hands into the correct position making a slapping sound as you bring your palms into contact with his thighs.
5. Slap thighs.

Before going on, repeat the procedure described on page 1 for placing bells on the child's and your ankles.

VI. Outcome behavior: The child will move his right foot forward and back.

1. Take hold of the child's right leg and move it forward and back.
2. Take hold of the child's right leg and move it forward and back making a sliding sound as you do so.
3. Take hold of the child's right leg and move it forward and back while shaking the matching bell bracelet placed on your right ankle and the child's right ankle.
4. Take hold of the child's right leg and move it forward and back making a sliding sound as you do so while shaking the matching bell bracelet placed on your right ankle and the child's right ankle.
5. Make sliding sound with your foot.
6. Jangle the bells on your right ankle.

VII. Outcome behavior: The child will move his left foot forward and back.

1. Take hold of the child's left leg and move it forward and back.
2. Take hold of the child's left leg and move it forward and back making a sliding sound as you do so.
3. Take hold of the child's left leg and move it forward and back while shaking the matching bell bracelets

placed on your left ankle and the child's left ankle.

4. Take hold of the child's left leg and move it forward and back making a sliding sound as you do so while shaking the matching bell bracelets placed on your left ankle and the child's left ankle.

5. Make sliding sound with your foot.

6. Jangle the bells on your left ankle.

Assessment Phase

(A) Ask the child to listen and then do what you are doing. Ring the bells on the limbs being used and make the other sound associated with each movement. Go through the entire series. (B) If time permits go through the script for any movement that was not correct. (C) If time permits, go through entire series following directions explained above in "A". (D) The child receives one point for each of the seven imitation subtasks which are accurately executed independently. The child's score on the last execution of the series within allotted time is recorded.

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