

THE DEVELOPMENT OF SELF RECOGNITION IN YOUNG CHILDREN

by

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in the Department

of

Psychology

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SIMON FRASER UNIVERSITY

July 1975

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### Abstract

An eight-month longitudinal study was conducted to investigate the importance of the correspondence between self and image movement for the development of visual self recognition. Four 3-minute videotape conditions were presented sequentially to each of 11 children, five boys and six girls, once a month for eight months starting when all were 18 months old. During each session the child was seated in a highchair facing a TV screen and his behavior was videotaped. In a Simultaneous Condition the child was exposed to an immediate videotape playback; thus the image was of himself with movement corresponding to his concurrent movement. In a Discordant Condition the child was exposed to a videotape of himself taken moments before; thus the image was of himself but the movements did not correspond to those he was currently making. In an Other Child Condition the child was exposed to a prerecorded videotape of another child in the same experimental setting; thus the image was different as well as the movements the image was making. In a Parent Condition the child was exposed to a prerecorded videotape of his parent. After the videotape conditions a mirror was placed over the TV screen for 3 minutes (Mirror Condition).

Self recognition was determined by the child's verbal identification of images and/or his responses to a clown face which appeared behind the images in all but the Parent Condition. A felt clown face was lowered from the ceiling to a point slightly above and behind

the child such that it could be seen by the child on the TV or mirror but could not otherwise be seen in the child's visual field. It was assumed that if the child turned around to look for the clown face after having seen it appear on the TV screen or mirror, he had recognized the image as his own. In addition, measures of attention to the TV or mirror and repetitive action with attention to the image movement, which might indicate the child was testing the simultaneity of his own movement with that of the image, were taken.

In a subsidiary Photograph Condition each child was shown two sets of photographs: a set of adults' pictures one of which was of the child's parent and a set of children's pictures one of which was of the child. The child was asked to pick out the pictures of his parent and himself.

All the children recognized themselves first in the Mirror Condition, then in the Simultaneous Condition, and, finally, in the Discordant and Photograph conditions. They recognized their parents in both the videotape and photograph media before they recognized themselves. This sequence of recognition was the same for all children. Self recognition occurred in conditions in which there was a correspondence between self and image movement before it occurred in conditions in which there was no such correspondence. Prior to recognition, repetitive actions with attention to the image, which might indicate the testing of this correspondence, increased in the Simultaneous Condition. These findings suggest that initial self recognition in young children is cued by the

simultaneity between self and image movement. Attention was highest to the self images in the Simultaneous and Discordant conditions throughout the study indicating the children saw the similarity between these images even before they could recognize themselves without the cues of simultaneity. Later recognition in the conditions without a correspondence between self and image movement must have been based on the child's development of a mental representation of what he looked like to which he matched the images he saw.

### Acknowledgments

The author wishes to express her sincere appreciation to Dr. Jean Koepke for her invaluable advice and guidance throughout the course of this investigation, to the children and parents who participated in this study and made it enjoyable, and to Chris Tragakis.

## Table of Contents

List of Tables	ix
List of Figures	viii
Introduction	1
Method	18
Results	34
Discussion	72
References	86
Footnotes	89
Appendix A	93
Appendix B	98
Appendix C	110
Appendix D	112
Appendix E	129



List of Tables

<u>Table</u>	<u>Page</u>
1 Recognition Session, Age at Recognition, and Recognition Criteria for Each Child in the Parent, Mirror, Simultaneous, and Discordant Conditions	35
2 Mean Percentage of Attention Time in Each Condition in Sessions 1 through 8	41
3 Mean Percentage of Attention Time Spent in Movement Testing in Each Condition in Sessions 1 through 8	45
4 Mean Percentage of Attention Time in Each Condition in Sessions Before, During, and After Self Recognition in the Simultaneous Condition	51
5 Mean Percentage of Attention Time Spent in Movement Testing in Each Condition in Sessions Before, During, and After Self Recognition in the Simultaneous Condition	54
6 Mean Percentage of Attention Time in Each Condition in Sessions Before, During, and After Self Recognition in the Discordant Condition	57
7 Self and Parent Recognition Sessions in Photographs and Videotaped Parent, Simultaneous, and Discordant Conditions	58
8 Mean Frequency of Deferred Imitation in the Parent, Discordant, and Other Child Conditions in Sessions 1 through 8	63
9 Exposure to Reflective Surfaces in the Home	65
10 Session of Completion of Object Permanence Tasks and Self Recognition in the Mirror Condition	67
11 Initial Session of Turned-Card or Correct Responses in the Picture Perspective Task and Self Recognition in the Discordant and Photograph Conditions	69
12 Correct Pronoun Usage and Self Recognition in the Discordant and Photograph Conditions	71

<u>Table</u>	<u>Page</u>
A1 Mean Percentage of Attention Time in Each Condition in Sessions Before, During, and After Self Recognition in the Mirror Condition	94
A2 Mean Percentage of Attention Time Spent in Movement Testing in Each Condition in Sessions Before, During, and After Self Recognition in the Mirror Condition	96
A3 Mean Percentage of Attention Time Spent in Movement Testing in Each Condition in Sessions Before, During, and After Self Recognition in the Discordant Condition	97
B1 Use of First and Second Person Pronouns in Reference to Self and Parent	99
B2 Percentage of Egocentric, Turned-Card, and Correct Responses to Questions Using Pronouns and Proper Names	102
B3 Percentage of Answered Trials Scored Egocentric, Turned-Card, or Correct on Each Picture Perspective Task	104
B4 Initial Sessions of Either Turned-Card or Correct Scores and All Correct Scores on Each of the Picture Perspective Tasks	107
B5 Initial Sessions of 1st. and 2nd. Person Pronoun Usage and Perspective Taking on Picture Perspective Task	108
D1 Analysis of Variance of Percentage of Attention Time Over All Eight Sessions	113
D2 Analysis of Variance of Percentage of Attention Time Spent in Movement Testing Over All Eight Sessions	114
D3 Parent Recognition: Analysis of Variance of Percentage of Attention Time	115
D4 Parent Recognition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing	116

<u>Table</u>	<u>Page</u>
D5 Self Recognition in the Mirror Condition: Analysis of Variance of Percentage of Attention Time	117
D6 Self Recognition in the Mirror Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing	118
D7 Self Recognition in the Simultaneous Condition: Analysis of Variance of Percentage of Attention Time	119
D8 Self Recognition in the Simultaneous Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing	120
D9 Self Recognition in the Simultaneous Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing in the Parent Condition	121
D10 Self Recognition in the Simultaneous Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing in the Discordant Condition	122
D11 Self Recognition in the Simultaneous Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing in the Other Child Condition	123
D12 Self Recognition in the Simultaneous Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing in the Simultaneous Condition	124
D13 Self Recognition in the Simultaneous Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing in the Mirror Condition	125
D14 Self Recognition in the Discordant Condition: Analysis of Variance of Percentage of Attention Time	126
D15 Self Recognition in the Discordant Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing	127
D16 Analysis of Variance of Frequency of Deferred Imitation in the Discordant and Other Child Conditions Over All Eight Sessions	128

<u>Table</u>		<u>Page</u>
E1	Recognition Responses	130
E2	Percentage of Attention Time	132
E3	Percentage of Attention Time Spent in Movement Testing	134
E4	Recognition in the Photograph Condition	136
E5	Frequency of Deferred Imitation	137
E6	Frequency of Matching Behavior	138
E7	Number of Correct Trials in the Fourth Object Permanence Task	139
E8	Scores on Each of the Picture Perspective Tasks	140

List of Figures

<u>Figure</u>		<u>Page</u>
1	Diagram of research room	19
2	Mean percentage of attention time in each condition for sessions 1 through 8	40
3	Mean percentage of attention time spent in movement testing in each condition for sessions 1 through 8	44
4	Mean percentage of attention time in each condition before, during, and after self recognition in the Simultaneous Condition	49
5	Mean percentage of attention time spent in movement testing before, during, and after self recognition in the Simultaneous Condition	53
6	Mean frequencies of deferred imitation in the Parent, Discordant, and Other Child conditions in sessions 1 through 8	61

## The Development of Self Recognition in Young Children

The development of self recognition may play a key role in the formation of early self concept which in turn has far reaching implications for personality theories (Lacan, 1968). The development of visual self recognition per se, however, lacks a critical experimental analysis. It is the purpose of this study to investigate the process by which the child comes to recognize his<sup>1</sup> own image. In particular, the study looks at the importance of correspondence between self movement and image movement as a precursor to self recognition.

### Literature Review

A number of subjective accounts of self recognition in infants are reported in baby biographies which were popular around the turn of the century. These biographies were most often written by the child's parent and varied both in the time self recognition was said to occur and the method which determined self recognition. Darwin (1877) judged his son to recognize himself at 9 months when upon hearing his name called he turned to his mirror reflection and exclaimed "Ah". Preyer (1893) was satisfied that his son recognized himself at 14 months because he showed evidence of recognizing his mother at this age. Cooley (1908) implied his daughter showed self recognition at 24 months when she responded to her mirror reflection with "my baby".

In a later baby biography, Zazzo (1948) recorded his son's responses to his self image in three media: mirrors, still photographs, and moving films. The child could name his image in the mirror at 2 years and 3 months, in still photographs at 2 years and 7 months, and in moving films at 2 years and 9 months. Unfortunately Zazzo did not report his son's responses to the three media at simultaneous times or regular intervals so comparisons between the media are difficult to make.

In addition to parental records of self recognition, several infant development tests include mirror items in their scales (Bayley, 1969; Buhler, 1930; Cattell, 1940; Gesell, 1928, 1934; Griffith, 1954). Only the Merrill-Palmer Scale, however, includes a test item for self recognition in mirrors which indicates that most children verbally identify their mirror reflection at 2 years of age (Stutsman, 1931).

The most thorough account of children's reaction to their reflections was carried out by Gesell and associates. Gesell and Ames (1947) gathered a vast body of information concerning normative behavior toward mirrors from 4 to 18 months of age but no reference was made to self recognition. In an earlier investigation Gesell and Thompson (1934) studied over 500 children from birth to 2 years of age and concluded that it was doubtful whether any self recognition occurred in early childhood.

More recent observations were reported by D. Dixon (1952) and J. Dixon (1957). D. Dixon studied the effect of mirror experience on

social behaviors towards the mirror, e.g., smiling, vocalizing. Four times between the ages of 4 and 18 months an infant who received extensive mirror exposure was compared with his twin who received no exposure except on comparison trials. No significant differences in behavior were found. J. Dixon looked at mirror behaviors of additional children during the same age range and noted that behavior toward mirrors differed with age. He described the following sequential pattern: interest in the reflection of significant others (4 to 5 months), interest in the reflection as a playmate (4 to 6 months), interest in the correspondence between self behavior and mirror behavior (6 to 12 months), and self-directed behaviors (12 to 18 months). The self-directed behaviors consisted primarily of shyly avoiding looking at the image and then smiling coyly to it. That is, the children responded self consciously toward the reflection, which might imply self recognition.

The first experimental analysis of self recognition comes from the animal literature. In a study of self recognition in chimpanzees and lower monkeys, Gallup (1970) found the phenomenon to be exclusive to higher primates. After initial exposure to their mirror reflections for several days, the animals were anaesthetized and red dye was applied to their foreheads and ears. When the anaesthetic wore off the animals were again exposed to their mirror reflections. For the chimpanzees, touching of the marked areas increased seven times from the last half hour of exposure before markings to the first half hour of mirror exposure after the markings. This increase in responding was taken as evidence that the chimpanzees recognized the



marked bodies seen in the mirror as their own.

Three independent investigations have been conducted in attempts to adapt Gallup's procedure to determine when human infants initially show self recognition. Amsterdam (1968, 1972) and Brooks-Gunn and Lewis (1975), using similar procedures, applied rouge to children's noses and observed their reactions when placed in front of a mirror. Self recognition was assumed if the child touched the rouged spot after seeing his mirror reflection. Amsterdam looked at children from 3 to 24 months of age. She reported that between 20 and 24 months 65% of the subjects demonstrated self recognition. Brooks-Gunn and Lewis observed children between 9 and 24 months of age and found that 75% of the 24-month olds and 25% of the 18-month olds showed self recognition. Gallup (1973) criticized Amsterdam's methodology on several accounts. First, no record was made of the number of nose-touching responses prior to the test of self-recognition. Moreover, of the various human facial features, the nose is unique in that it is most readily available to visual inspection without a mirror. Finally, there is a very real possibility that subjects may have been responding to tactual cues associated with rouge and not to the reflection of those spots in the mirror. The last two criticisms could be made of the study by Brooks-Gunn and Lewis as well.

In a pilot study Bigelow (1971) also adapted Gallup's procedure to human infants. Because Dixon (1957) reported self-directed behaviors to occur around one year of age, 12 infants between the ages of 10 and 15 months were used as subjects. Each child was exposed to a

mirror for a few minutes and face-touching responses were recorded. The mirror was then covered and a smudge of green food coloring was applied to the child's forehead. Each subject was again placed before the mirror and face-touching responses were recorded. No child touched his face prior to marking and only one after marking. A 15-month old made a direct response to the marked area upon seeing her reflection after marking.

The most striking finding of the Bigelow (1971) study, however, had little to do with marked faces. The child who recognized herself, as well as several of the older infants, spent much of their mirror exposure time observing movements of their reflected images, particularly repetitive body movements. They appeared to be seriously studying the movements of their reflections, while periodically varying those movements. Some observational studies of mirror behaviors also mention the children's interest in the correspondence between self and image movement. Gesell and Ames (1947) observed that their subjects showed a definite pattern of attending to the image of limb movement and then to the movement of the limb itself. Amsterdam (1968) recorded that her subjects became interested in studying their deliberate movements in the mirror. Prior to the occurrence of self-directed behaviors towards mirrors, Dixon (1957) noted that his subjects were interested in the correspondence of self behaviors and mirror behaviors. Most characteristic was repetitive limb activity while observing the mirror image or a repeated bobbing, bowing, or bouncing while intent on the image. The

frequent occurrence of this répetitive behavior could result from children testing and retesting the correspondence between their movements and those of the image.

Since the interest in the correspondence between self behaviors and mirror behaviors seemed to be a consistent phenomenon in these studies of infant mirror behaviors, it was hypothesized by the author that perhaps recognition of this correspondence was a necessary precursor to self recognition.<sup>2</sup> In pilot work 14 children between the ages of 19 and 30 months were shown two videofilm sequences, one of an immediate playback in which image movement was simultaneous with self movement and another of a delayed playback of a videotape taken moments before in which image movement did not correspond with concurrent self movement. Measures of self recognition consisted of verbal identification of the image and/or turning to look for a puppet which appeared behind and above the child so that it was out of the subject's direct visual field but could be seen on the TV screen. Eleven of the 14 children showed repeated movements such as arm waving, bouncing, shaking head, etc., in the immediate condition and none in the delayed conditions. Four of those 11 children (ages 23, 26, 26, and 30 months) showed self recognitory behaviors (i.e., either verbal identification or turning to look for a puppet) in both the immediate and the delayed conditions and four children (ages 19, 24, 25, and 28 months) showed self recognition only in the immediate condition, while the other three children did not show self recognition in either condition. These results suggested that self recognition occurred only when there had been a testing

of the correspondence between self movement and image movement. Furthermore, self recognition in the immediate condition appeared to precede self recognition in the delayed condition because children recognized themselves in the delayed condition only if they also did so in the immediate condition but not vice versa. The present longitudinal study was conducted to investigate the implications of these findings for the development of self recognition.

#### Theoretical Perspective

The child's earliest response to his reflection is a social one of smiling, talking, and trying to contact the image (Amsterdam, 1968; Dixon, 1957; Gesell and Thompson, 1934). Eye to eye contact seems to be an important component of the reflection in the early months as it is in social interaction (Bergman, Haith, & Mann, 1971; Papousek and Papousek, 1974). Later, however, the reflection takes on a new significance which may begin with the discovery that there is a correspondence between self and image movement.

It may well be possible that the child comes to this discovery through his experience with imitation. Piaget (1962) theorizes that before Stage IV of imitative development in the sensorimotor period the child views neither persons nor objects as autonomous; any movement is perceived as an extension of his own activity. Imitation consists of assimilation of visual input to motor output that usually goes with such input. That is, the child imitates in order to continue the perception rather than to match a model's behavior for the model is not seen as independent of the infant. For example,

when watching a model shake his head the infant might make a similar response but only to continue the perception of the movement from side to side; he might make the same response to a swaying toy (Piaget, 1962). During Stage IV the infant comes to imitate movements which he cannot see himself make but which are already in his repertoire. He is able to do this by means of mobile indices which help integrate schemes which are ends in themselves in order to produce a specific action. For example, a model of Piaget opening and closing his mouth initially did not elicit imitation by J. But later when spontaneously opening and closing her mouth, J. made a slight noise with her saliva caused by the friction of her lips. Piaget imitated the movement with the same noise and the child repeated the response with interest. A few days later J. saw Piaget again open and close his mouth without making any sound. This time the infant successfully imitated. The noise of the saliva served as an index to connect what she saw happening to the model's mouth and the motor impression of her own mouth making a similar movement. Although the child could not picture her own mouth, she understood through the mobile index that the movements she saw made by the mouth of the model were concomitant with certain tactile-kinesthetic impressions of her own mouth (Piaget, 1962).

During Stage V imitation becomes more fully developed. The infant begins to see the bodies of others as autonomous sources of causality and to see that there is similarity between a model's body and his own. The child is able to imitate novel behaviors and deliberately attempts to adjust his behaviors to more closely match the model's.

For example, when imitating touching the middle of one's forehead, the child may first rub his eye, then feel above it and touch the hair, then bring his hand down a little, and finally put his finger on his forehead, satisfied that at last he has succeeded (Piaget, 1962). The child no longer confines himself to known schemes, but differentiates them and experiments with them. Movements of others no longer appear to be continuations of his own activity; they are approaching independent realities which are analogous to what he himself can do yet distinct from his actions. During Stage IV and V of the sensorimotor period imitation has evolved to a deliberate attempt by the child to match the behaviors of others.

The significance of the development of imitation for self recognition is that the connection between the reflection and the child's own gestures is analogous to that between the model and the child. The child's change from a social response to mirrors may be due to his prior experience with imitative matching which leads him to a new awareness that his gestures and those of his reflection are matched. It is interesting that Gesell and Ames (1947), Dixon (1957), and Amsterdam (1968) all noted that their subjects' interest in reflected movement emerged when the infants were between 7 and 11 months of age, i.e., during Stage IV of the sensorimotor period.

After the child becomes aware of the correspondence between his movements and those of the reflection he spends large portions of mirror exposure time regarding his reflected movement. Amsterdam, (1968), Dixon (1957), and Gesell and Ames (1947) noted that this

interest continued for many months. Movements became stylized by their repetitive quality. There was much bouncing, bowing, and waving as well as more subtle movements of the face and limbs. The mood was primarily serious and often a series of repetitive gestures was varied in a seemingly deliberate manner in order to study the effects on the reflection.

It seems to the author that one of the things infants may learn from such activity is that they control the correspondence between their movements and those of the reflection. This knowledge has a much different connotation than earlier omnipotent feelings arising from egocentrism for, by the latter stages of sensorimotor development, the child is well on his way to seeing other persons and objects as autonomous. That is, while the younger infant may have a notion that his movement produces movement in a manner similar to the way his rocking in a crib produces movement of the dolls attached to the crib hood (Piaget, 1962), the older infant is aware that (1) his gestures and those of his reflection are matched and (2) his reflection is in some sense distinct from him. Through continual testing and retesting the correspondence between self and reflected movement, the child becomes aware that he controls the movement of something visually resembling a person which is physically outside of himself and whose movements exactly match his own. The author proposes that it is this knowledge which gives the child a sense of uniqueness about the reflection and ultimately leads to self recognition.

Until the end of the sensorimotor period the correspondence between self and reflected movement and the physical characteristics

of the self reflection are not separable for the infant. That is, as with all relations with persons and objects during the sensorimotor period the child recognizes and understands them only in terms of his interaction with them. For example, an infant's outstretched arms to a mother who just walked into the room may be an activation of a recognitory scheme for mother and not necessarily an expression of a desire to be picked up (Piaget, 1962). Similarly in the sensorimotor period the child may come to recognize his reflected image as his own on the basis of his movement and the visual feedback of corresponding movement from his reflection. It is perhaps only after the development of representational thought and previous experience with reflected surfaces that the child can recognize the image itself without also simultaneously experiencing the corresponding movement. It is only through action that a child understands the world; and only through his interaction with his own reflection that he understands its meaning.

The present study investigated the importance of the correspondence between self and image movement for the development of self recognition. A videotape medium was used in order to expose the infant to his image both with and without movement by means of immediate and delayed procedures. Pilot work by the author indicated that self recognition in a videotape medium may be retarded relative to self recognition in mirrors. It was assumed, however, that within the early ages studied the correspondence between self and



image movement would still be the essential cue to self recognition, i.e., that the physical characteristics of what one looked like would not yet be the dominant factor in determining what was an image of self.

The present investigation was a longitudinal study of infants between the ages of 18 and approximately 25 months. Pilot work by the author showed that for most children self recognition in a videotape medium occurred within this age range. The developmental sequence of behaviors which culminated in the child's ability to recognize his image as his own was observed. The children were exposed to four types of images on a TV screen: self image with simultaneous movement (Simultaneous Condition), self image without simultaneous movement (Discordant Condition), another child's image (Other Child Condition), and parent's image (Parent Condition).

In the Simultaneous Condition the child was exposed to an immediate film feedback. Thus the image was of the child with movement corresponding to his concurrent movement.

The Discordant Condition exposed the child to a film of himself taken moments before. Thus the image was of the child but the movements did not correspond to those he was currently making.

The Other Child Condition exposed the child to a prerecorded film of another child in the same experimental situation. In this condition the physical characteristics of the image were different as well as the movements the image was making.

The Parent Condition exposed the child to a prerecorded tape

of the subject's parent. It was expected from Dixon's (1957) findings that the child would recognize images of significant others before his self image. The Parent Condition was included to verify Dixon's finding and to determine whether the child could recognize images on a TV medium.

Self recognition was measured by verbal identification and by adapting a procedure used by Piaget (1962). A mirror was placed in front of a 12½ month-old infant and Piaget, who was behind the child and hidden by a curtain, held a toy above her head so that she saw its reflection in the mirror. After gazing at the toy momentarily the child turned her head to look at the real toy. Piaget cites this action in a discussion of imitation where the child produced movements related to parts of her body she could not see. In the present study during the Simultaneous, Discordant, and Other Child conditions a clown face was made to appear above and slightly behind the child's image on the TV screen. It was assumed that if the subject turned to look for the face after having seen it appear on the TV, he had recognized the image he saw as his own.<sup>3</sup>

It was predicted that the children would recognize themselves in the condition where there was a correspondence between self and image movement (the Simultaneous Condition) before they would recognize themselves in the condition where there was no correspondence between self and image movement (the Discordant Condition). In addition, it was expected that prior to initial self recognition the children would test the correspondence between self and image movement by moving in a repetitive manner while attending to the image movement.

Movement testing was measured by recording the percentage of attention time to the TV screen that was spent in repetitive movement. Attention time was recorded as an indication of the child's interest in what was on the TV screen.

To further document the development of self recognition, the subjects were exposed to two subsidiary conditions, a Mirror Condition and a Photograph Condition. After the completion of the videotape sequence a mirror was placed in front of the TV screen and the child's behaviors to the mirror were recorded. The clown face appeared above and slightly behind the subject's image as in the videotape conditions. Measures of self recognition, movement testing, and attention were the same as those in the videotape conditions. The Mirror Condition was included to document the development of self recognition in mirrors relative to videotape. Pilot research with videotape in conjunction with the mirror research of Amsterdam (1972), Brooks-Gunn and Lewis (1975), and Dixon (1957) suggested that mirror recognition precedes recognition in videotape, thus this was the prediction in the present study. The difficulty children have recognizing themselves in videotape versus mirrors may be due to a number of factors, some of which may be lack of color, reduced clarity, and laterality of movement.<sup>4</sup>

In the Photograph Condition the child was shown two sets of nine photographs each: a set of adults' pictures one of which was of his parent, and a set of children's pictures one of which was of himself. It was expected that the child would be able to pick out

his parent's picture before he would be able to pick out his own. The ability to recognize self in a still photograph implies that the correspondence between self movement and image movement is no longer an essential factor for self recognition, i.e., that the physical characteristics of what one looks like have become the basis of recognition. Thus the child's ability to pick out his own picture was expected to occur only after he was able to recognize himself in the Simultaneous Condition and may coincide with self recognition in the Discordant Condition.<sup>5</sup> When the child reaches this level of development he probably has a mental image of what he looks like to which he matches his photograph, a feature which would require representational thought.

It was the primary interest of this study to examine the developmental process leading to self recognition. The process is more accurately assessed when the child's level of attainment of underlying skills or simultaneously developing structures are also taken into account. Such skills may contribute to or be prerequisites for the child's ability to recognize his image as his own. The necessity for this type of multivariate approach is becoming increasingly recognized (Flavell, 1971; Pinard and Laurendeau, 1969). In this study additional measures were taken to assess the child's ability to differentiate himself from his environment and his development of representational thought in order to establish their relation to the development of self recognition.

Piaget proposes that somewhere between the ages of 18 and 24 months the child experiences a miniature Copernican revolution. The

child's initial universe is an egocentric one in which the external world is undifferentiated from self. It is transformed into a realistic universe when the child comes to view his body as but one element or entity among others. Piaget postulates that his knowledge stems from the development of object permanence. That is, the final element which receives a constancy with the larger external world of permanent objects is the child's own body (Piaget, 1954). It is proposed that the knowledge of one's body as a distinct entity is an important requirement of the recognition of one's body image. Consequently, an object permanence task was administered to the children to determine the growth of this concept and assess its relationship to the development of self recognition.

Similarly the child's development of representational thought, hypothesized to be necessary before the child can recognize himself in a still photograph or in the Discordant Condition, was assessed by the picture perspective task which looked at the subject's ability to take another's perspective and his ability to use language symbolically. With the child's new awareness of himself as a distinct entity, he becomes increasingly aware of the autonomy of others. Flavell (1971) found that around 2 years of age a child shows the beginnings of the ability to attribute other persons with perspectives different from his own, a process dependent on representational thought.

Interestingly, Bigelow (1972), using Flavell's procedure, found that the initial beginnings of taking another's perspective had language correlates. Specifically, the ability was related to the child's reference to self and others. Bigelow found that (1) children

who could not take another's perspective did not use first or second person pronouns, (2) children who could take another's perspective used both first and second person pronouns, and (3) children in a transitional phase of perspective taking used only first person pronouns. The correct use of first and second person pronouns is indicative of the understanding of the symbolic function of language for the ability is dependent upon the child's knowledge of the reversibility of the specific referents involved. Thus the children's use of first and second person pronouns was recorded as well as their performance on the picture perspective task to determine the growth of representational thought and assess its relationship to the development of self recognition.

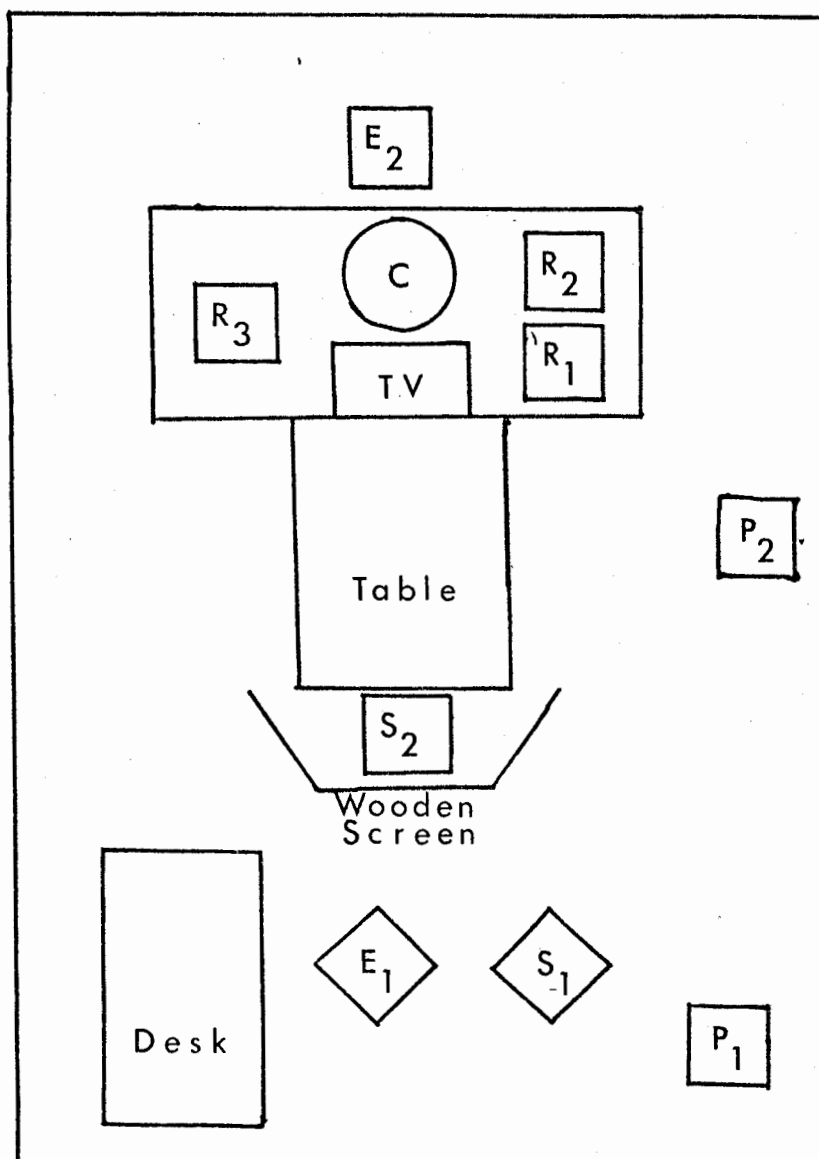
## Method

### Subjects

The children were 11 Caucasian infants, five males and six females, whose names were obtained from parents who, at the time of their children's births, volunteered to participate in child studies. By questioning the mother, the children were screened against the following birth stress conditions: prematurity, under 5 1/2 lbs., labor over 24 hrs., Caesarian birth, breech birth, breathing difficulty, Rh transfusion, and multiple birth. An additional male child began the study but dropped out after six months when his family moved from the city. The children were 18 months of age at the beginning of the study and were seen once a month for eight months. Four of the children were seen for an additional session as they had not yet evidenced self recognition in the Discordant and/or Photograph Conditions. One child was seen at home for a presentation of the Photograph Condition and the Picture Perspective Task one month following the additional laboratory session.

### Apparatus

A diagram of the research room is shown in Figure 1. The research was conducted in an 11 x 15 ft. carpeted office which was divided into two sections by a 6 1/2 x 10 1/2 ft. folding wooden screen. The Object Permanence Task and the Picture Perspective Task took place on one side of the screen and the Self Recognition Task took place on the other.



$S_1$ - $S$ 's position for Obj. Perm. (OP) and Picture Perspective (PP) Tasks

$S_2$ - $S$ 's position for the Self Recognition Task

$P_1$ -Parent's position for the OP and PP Tasks

$P_2$ -Parent's position for the Self Recognition Task

$E_1$ -Experimenter's position for the OP and PP Tasks

$E_2$ -Experimenter's position for the Self Recognition Task

TV-Television screen

C -Camera

$R_{1,2,3}$ -Recorders 1, 2, and 3

Figure 1. Diagram of research room.



Object Permanence Task. On one side of the room there was a desk and a corner chair for the parent ( $P_1$  in Figure 1). The Object Permanence Task took place on the floor and involved a soft plastic horse ( $1\frac{3}{4} \times 1\frac{1}{4} \times 2\frac{1}{4}$  in.), a blue plastic box open at one end ( $2\frac{5}{8} \times 2\frac{1}{4} \times 2\frac{1}{4}$  in.), and three gold 16 in. square linen cloths.

Picture Perspective Task. The Picture Perspective Task also took place on the floor. Six picture cards were used. Each card was a piece of 8 x 11 in. black construction paper on which was mounted a colorful picture cut from cardboard alphabet flash cards. The flash card pictures were chosen by a group of three child psychologists as those most easily recognizable and nameable by young children. The pictures were of a car, a girl, an apple, a horse, a boat, and a dog. The six picture cards were of three types depending on what was on each side of the card: two had a different picture mounted on each side, two had the same picture mounted on each side, and two had a picture mounted on only one side.

A check list designating the ways the child could refer to himself (by proper name, by first person pronouns or incorrectly by second person pronouns) and to the parent (by proper label, by second person pronouns, or incorrectly by first person pronouns) was given to the parent at the end of the task. A sample check list can be seen in Appendix C.

Self Recognition Task. On the other side of the room there was a standard size highchair ( $S_2$  in Figure 1) surrounded on both sides and behind by the wooden folding screen. The highchair was facing a 15 in. TV screen about  $4\frac{1}{2}$  ft. away. Between the highchair and

the TV was a 30 x 50 in. table, 29 in. from the floor. The table directed the child's attention toward the TV screen and gave more play area to the child seated in the highchair.

A Sony portable videocamera (C in Figure 1) was located 16 in. behind and 8 in. above the TV screen. The closeness of the camera to the TV screen was such that a filmed image of a person sitting at the end of the table looking at the TV screen appeared, when played back to the child in his highchair, to be looking almost directly back at him. Three Sony recorders, a camera, and the TV screen were set on a second 30 x 50 in. table, 29 in. from the floor. Each of the recorders was connected in turn to the TV screen by a Sony selector. Recorder 1 was connected to the camera and recorded the child's behavior throughout the test session. Recorder 2 had two prerecorded tape segments, one of the child's parent and the other of the subject in the highchair playing with a red, yellow, and blue wooden train (6 x 4 x 3 1/2 in.) and a green plastic container (7 x 5 x 5 in.). Recorder 3 had a prerecorded tape of another child playing with the multicolored train and the green container while in the highchair. A 14 x 16 in. mirror was placed in front of the TV screen in the Mirror Condition.

A chair for the parent ( $P_2$  in Figure 1) was located to the right of the highchair between the highchair and the TV. The chair was out of the camera's field yet easily seen from the highchair. For the prerecording of the parent, the chair replaced the highchair in front of the camera.

A circular red felt clown face, 4 in. in diameter, with tan eyes and mouth was attached to a clear plastic string which ran from behind the equipment table, across the ceiling, and down behind the highchair, thus allowing the experimenter, from her position behind the equipment table ( $E_2$  in Figure 1), to lower the clown face soundlessly from the ceiling to an area about one foot above and behind the highchair. In the lowered position the clown face could be seen behind the image on the videotape but could not be viewed directly by the child sitting in the highchair.<sup>6</sup>

A Polaroid camera which takes 4 1/2 x 3 1/2 in. black and white photographs was used to take the child's picture and his parent's picture. Two pages from a picture album were presented to the child. One page held a set of nine children's pictures, all of the same sex as the child, taken in the same experimental setting. One of these pictures was of the child. The other page held a set of nine adults' pictures, all of the same sex as the child's parent, taken in the same experimental setting. One of these pictures was of the child's parent. Thus, four pages were prepared with eight photographs in each: male children, female children, male adults, and female adults.

### Procedure

Upon entering the experimental room with his parent, each child was given ample time to acquaint himself with his surroundings. During the time necessary for familiarization, the experimenter was seated on the floor ( $E_1$  in Figure 1) and the parent was seated in the corner chair ( $P_1$ ). The order of presentation of the tasks was

Object Permanence Task, Picture Perspective Task, and then Self Recognition Task.

Object Permanence Task. The test of object permanence consisted of four tasks from Uzgiris and Hunt (1966). These four tasks were empirically selected by Miller, Cohen, and Hill (1970) as representative of all levels of object permanence development. (Another task involving partial hiding was included in the Miller, Cohen, and Hill selection but was excluded from the present study as it was assumed to be in an 18-month old's repertoire.) The tasks were presented to the child in random order so as not to confound performance with order effects. Each task was presented four times in succession in each session until the criterion of three out of four trials was reached. Task 4 continued to be presented on the remaining sessions as the children considered the Object Permanence Task to be the most enjoyable part of the whole study and looked forward to playing this game. The four Object Permanence Tasks are described below.

(1)Task 1: Finding an object involving one visible displacement. The experimenter held the horse until the child showed an interest in it. A cloth was then spread out within reach in front of the child and the horse was slipped under the cloth before the child could grasp it. The child was asked to find the horse. The child was given a score of one if he obtained the horse from under the cloth and a score of zero if he did not. The task was repeated four times in succession.

(2)Task 2: Finding an object involving three visible displacements.

Three cloths were spread in front of the child within his reach. Then the experimenter held the horse in such a way that her hand did not cover it and hid it successively under each of the cloths. Thus, the horse was hidden under each of the three cloths while reappearing in the two spaces between the cloths. The horse was left under the last cloth. The child was then asked to find the horse. The task was repeated four times in succession alternating the directional sequence of the experimenter's hiding path with each trial. The child was given a score of one if he searched directly under the last cloth and obtained the horse and a score of zero if he did not.

(3)Task 3: Finding an object involving one invisible displacement. A single cloth was placed within reach in front of the child. While the child watched, the experimenter hid the horse in the plastic box, tipped the box upside down, moved the box under the cloth, and lifted the box so that the horse was left under the cloth. The experimenter then removed the empty box, handed it to the child, and asked him to find the horse. The task was repeated four times in succession. On each trial the child was given a score of one if he searched directly under the cloth and obtained the horse and a score of zero if he did not.

(4)Task 4: Finding an object involving three invisible displacements. Three cloths were arranged within reach in front of the child. The horse was hidden in the box as in Task 3. The box was then moved successively under the three cloths reappearing in the two spaces between them. The box was lifted leaving the horse under the last cloth. The experimenter removed the empty box,

handed it to the child, and asked him to find the horse. The task was repeated four times in succession, alternating the directional sequence of the experimenter's hiding path with each trial. The child was given a score of one if he searched directly under the correct cloth and obtained the horse and a score of zero if he did not.

Picture Perspective Task. After the completion of the Object Permanence Task, the Picture Perspective Task was administered. The child was shown a card and asked to name the pictures. Afterwards the experimenter named each side of the card again using the child's words. Then the card was held vertically at eye level between the child and the experimenter and the experimenter asked "What do you see?" After waiting for a response, the experimenter asked "What do I see?" If the child reacted with puzzlement, the experimenter showed the child again what was on both sides of the card and repeated the questions. Then the experimenter reversed the card so that the viewers were faced with the side opposite the one they originally saw. The child was asked "What does (child's name) see?" and, then, "What does Ann see?" The procedure was repeated for each of the six cards. On every other card the questions using proper names were asked before the questions involving pronouns, in order to counterbalance the wording of the questions. The cards were presented in the following order: a card with a different picture on each side, a card with the same picture on each side, and a card with a picture on only one side. This was followed by a repeat of the

sequence using the second card of each type. The answers were recorded by the experimenter.

Each child's response to the question, "What do I see?" or "What does Ann see?" was classified as either correct, turned-card or egocentric. A response was correct if the child correctly named what the experimenter was seeing. It was classified as turned-card if the child turned the card over or walked around to see what picture was on the experimenter's side of the card. An egocentric response was one in which the child said that the experimenter was seeing the same picture he was.

At the end of the experimental session the parent was given a check list designating the ways the child could refer to himself (proper name, first person pronouns, or incorrect usage of second person pronouns) and to the parent (proper label, second person pronouns, or incorrect usage of first person pronouns) and a stamped envelope addressed to the experimenter. The parent was asked to record the child's specific references to self and parent during a four to five hour period in the next few days and mail the check list to the experimenter before the following session. Ninety-one percent of the check lists were returned.

Self Recognition Task. After the completion of the Picture Perspective Task and before the onset of the Self Recognition Task proper, videotapes for the Parent Condition and the Discordant Condition were taken. The child was allowed to continue to play with the horse, box and cloths, while the parent<sup>7</sup> was seated in a

chair at the end of the table in front of the camera and videotaped for three minutes. The experimenter stood behind the camera ( $E_2$  in Figure 1) and conversed with the parent during the videotaping. Thus an effort was made to direct the parent's attention toward the camera and keep the movements natural and spontaneous. After the videotaping a Polaroid photograph of the parent was taken by the experimenter. Then the chair was moved to its test position to the right of the highchair ( $P_2$ ) and the highchair replaced the parent's chair in front of the camera.

The child was seated in the highchair ( $S_2$ ) with the multicolored train and the green container in front of him. The parent was seated to the right of the child ( $P_2$ ) as described earlier. A Polaroid photograph of the child was taken by the experimenter. Then the experimenter stood behind the camera ( $E_2$ ) and the child was videotaped for three minutes while he spontaneously played with the train and the container or engaged in verbal exchanges with his parent or the experimenter. Nothing was on the TV at that time. The child was encouraged to look towards the camera by his seating arrangement, the position of the experimenter and the parent, and attempts by both adults to converse with him. After two minutes the clown face was lowered behind the child and remained there for 30 seconds. The tape with the recorded segments of the parent and the child was transferred from Recorder 1 (connected to the camera) to Recorder 2. A new tape was put on Recorder 1 to record the child's behavior throughout the session.



In the course of the test session each subject was shown four different three-minute tape segments which were designated Simultaneous, Discordant, Other Child and Parent conditions. These tape segments were shown in the TV screen in front of the child and the child was asked to look at the TV screen at the beginning of each segment. The multicolored train and the green container were left with the child throughout the entire session.

In the Simultaneous Condition the child saw himself in immediate feedback, i.e., all movements of his image were identical to his concurrent movements. After two minutes the clown face was lowered for 30 sec. so that the child saw it behind his image on the TV screen but so that it was not otherwise in his visual field.

In the Discordant Condition the child saw himself as he was minutes earlier. Thus the movements of his image did not coincide with the movements he was currently making. After two minutes the clown face appeared in this prerecorded tape for 30 seconds.

In the Other Child Condition the child saw a prerecorded tape of another child in the highchair playing with the multicolored train and the green container.<sup>8</sup> After two minutes the clown face appeared behind the other child on the TV screen and remained there for 30 seconds.

In the Parent Condition the child saw the tape of his parent made minutes before.

The tape shown on the TV screen was controlled by plugging the antenna selector into the particular recorder desired. Recorder 1, which was connected to the camera and which was continually recording

the child's behavior throughout the session, was switched on the TV screen for the Simultaneous Condition. Recorder 2 with the prerecorded tape of the parent's image and child's own image minutes earlier was connected to the TV screen for the Parent Condition and the Discordant Condition. Recorder 3 containing the prerecorded tape of another child in the highchair playing with the multicolored train and the green container was connected to the TV screen for the Other Child Condition.

During the final 30 seconds of any condition in which the child did not spontaneously label the image the experimenter pointed to the image on the TV screen and asked the child what he saw.

A Mirror Condition was presented after completion of the videotape conditions. The mirror was placed in front of the TV screen and the child's behavior was videotaped for three minutes. After two minutes the clown face was lowered for 30 seconds as in the Simultaneous Condition. If the child's reflection was not spontaneously named, the experimenter pointed to it during the final 30 seconds and asked the child what he saw.

The order of presentation of these conditions was as follows: Parent, Discordant, Other Child, Simultaneous and Mirror. The Parent Condition was presented first in order to increase the probability that the child would be interested in attending to the TV. The Simultaneous and Mirror conditions were placed last so that (a) any fatigue effect would be biased against the two conditions in which self recognition was expected to occur first, and (b) there could be no within-session carry-over from them to the Discordant Condition.

After the Mirror Condition the child was presented with the Photograph Condition. The child was shown a set of nine photographs of adults of the same sex in the same setting, one of which was of his parent, and asked to find his parent's picture. Then the child was shown a set of nine photographs of children of the same sex in the same setting, one of which was of himself, and asked to find his picture. After each session the filler pictures within each set were rearranged so that the new photographs of the child and his parent taken at the beginning of the next session could be placed in different positions.

The parent was asked to bring the child during the time of day when he was most rested and alert, thus most of the sessions ran smoothly. Occasionally, however, a child cried or became irritable and the session was interrupted until he was ready to resume. On nine occasions involving two children the child could be calmed only by continuous contact with the parent thus testing was completed with the child sitting on the parent's lap or in close contact with the parent.<sup>9</sup>

At the end of the initial session the experimenter interviewed the parent as to the extent of the child's previous experience with mirrors. Although the interview was informal in structure, the following specific questions were asked. How many mirrors or reflective surfaces (e.g., shiny metal refrigerator) are there in the home at the child's level? How often do you hold the child up to a mirror not at his level? Is there a regular time that the child spends in front of the mirror (e.g., bathing or dressing)? Have

you noticed anything about the nature of the child's interaction with and interest in mirrors? What is your interaction with the child when he is in front of the mirror (e.g., peek-a-boo)? Has the child seen home movies of himself? How often does he see slides or photographs of himself? How often does he watch TV? Is he interested in TV? On subsequent sessions the experimenter questioned the parent as to whether there was any change in the child's reaction to or experience with mirrors, photographs, or TV. In addition, the parent was cautioned against training the child on mirror recognition, photograph recognition, etc. In general, the parents cooperated extremely well both in observing their children's behavior, and, to the best of the experimenter's knowledge, in not coaching the children in recognition tasks at home.

The data from the Parent, Discordant, Other Child, Simultaneous, and Mirror conditions were collected from the videotapes of the sessions. The response measures for each child were (1) occurrence of the child looking behind himself in search for the clown face after having seen it appear behind the image on the TV or mirror, (2) verbalizations in which the child identified what he saw on the TV or mirror, (3) attention time expressed as the percentage of time spent attending to the TV screen or mirror in the first two minutes of each condition,<sup>10</sup> (4) movement testing time expressed as the percentage of attention time spent in repetitive movement in the first two minutes of each condition.

Two response measures were used in determining whether the child evidenced self recognition in the videotaped conditions. If the

child turned around to look behind himself after having seen the clown face appear behind the image on the TV or mirror, he was judged to have recognized the image as his own. Likewise, if the child verbally identified his self image with a first person pronoun or his own name and did not also identify the Other Child Condition with a self label, he was judged to have recognized the image as his own. These two different criteria were used in making judgments in order that a more accurate measure of self recognition could be made.<sup>11</sup>

The session on which initial self recognition was said to occur in a given condition was determined by whether the child also showed self recognition in that condition on the following session, thereby indicating the response was a stable one. Thus, a child was said to have recognized himself only when he did so on two successive sessions with the first of these being designated the recognition session.

Reliability indices were obtained for the measures of attention time and movement testing time by having a second person score one session from each child's data. Scoring was done after the study was completed. The author scored all the videotapes and then a second person observed her score attention time and movement testing time in a training tape. The two people then simultaneously rescored the same tape three times. After this training procedure the second person independently scored one session from each child's data. The correlation between the two scores was .97 for attention time and .96 for movement testing time.<sup>12</sup>

In addition to the above measures, scores of two behaviors defined in the present study as deferred imitation and matching behavior were taken from the videotaped conditions. Deferred imitation was scored when the child witnessed an action by the image and proceeded to copy that action while no longer attending to the image. Matching behavior was scored when the child tried to duplicate the ongoing behavior of the image on the TV while attending to the image's behavior and simultaneously correcting his own behavior. By definition, deferred imitation and matching behaviors could occur only in the Parent, Discordant, and Other Child conditions, as the behaviors in the Simultaneous and Mirror conditions were always concurrent with the subject's behavior. Scores for deferred imitation and matching behavior were obtained by viewing the videotaped condition and the child's response to it simultaneously.

Analyses of variance computed on data from the above measures are presented in tables in Appendix D. The raw data are presented in tables in Appendix E.

## Results

All children recognized themselves first in the Mirror Condition, then in the Simultaneous Condition, and finally in the Discordant and Photograph conditions. Recognition of the parent in the videotape and photographs preceded self recognition. This sequence was the same for all children. Table 1 shows the sessions in which the children initially recognized their parents in the Parent Condition and themselves in the Mirror, Simultaneous, and Discordant conditions, their sexes, their ages at recognition, the criteria by which judgments of recognition were made for each child, and the number of sessions given each child. Five children did not evidence self recognition in the Discordant Condition by the end of the study. Two children evidenced self recognition in two conditions in the same session; one recognized herself in the Mirror and Simultaneous conditions in the same session and one recognized himself in the Simultaneous and Discordant conditions in the same session. No child, however, showed a reversal in the developmental sequence described above.

Parent recognition on videotape occurred in the first session for eight children and in the second session for the remaining three children, indicating that they were able to recognize a familiar figure on the TV medium. A child was judged to have recognized his parent when he called the image in the Parent Condition by name. For most children the naming was accompanied by

Table 1

Recognition Session, Age at Recognition, and Recognition Criteria for Each Child in the Parent, Mirror, Simultaneous, and Discordant Conditions

	Subjects											Mean
	1	2	3	4	5	6	7	8	9	10	11	
Parent	1	2	2	1	1	1	1	1	2	1	1	1.3
Condition	18	19	19	18	18	18	18	18	19	18	18	18.3
	Recognition Session	Age in Months	Recognition Criteria	Recognition Session	Age in Months	Recognition Criteria	Recognition Session	Age in Months	Recognition Criteria	Recognition Session	Age in Months	Recognition Criteria
Mirror	4	4	2	3	4	3	2	4	3	3	3	2.9
Condition	21	21 <sup>b</sup>	19	20	21	20	19	21	20	20	20	20.2
	Recognition Criteria	Recognition Criteria	CF <sup>c</sup>	CF	N	CF	CF	N	CF	CF	CF	CF
Simultaneous	5	4	3	6	7	5	3	6	5	4	4	4.7
Condition	22	21	20	23	24	22	20	23	22	21	21	21.7
	Recognition Session	Age in Months	Recognition Criteria	Recognition Session	Age in Months	Recognition Criteria	Recognition Session	Age in Months	Recognition Criteria	Recognition Session	Age in Months	Recognition Criteria
Discordant	7	-	6	-	-	7	-	6	-	6	7	6.5
Condition	24	-	23	-	-	24	-	23	-	25	24	23.5
	Recognition Criteria	Recognition Criteria	N	-	-	N	-	N	-	N	N	N
Total Number of Sessions	8	9	9	9	8	8	8	8	9	8	8	8
Sex	F	F	F	F	F	F	M	M	M	M	M	M

<sup>a</sup>N = name

<sup>b</sup>See Footnote 13.

<sup>c</sup>CF = turn to clown face.



smiles, pointing, and shifted glances back and forth between the real parent and the TV image. The children who were not judged to have recognized their parents in the first session had labels for their parents but did not use them to label the Parent Condition, although they shifted their glances back and forth between their real parent and the TV image. The mean number of sessions to parent recognition was 1.3. The age range in which the children initially evidenced parent recognition was 18 to 19 months. After initial parent recognition the children evidenced parent recognition on 97% of the remaining sessions. Parent recognition in the Photograph Condition occurred at approximately the same time as parent recognition on videotape and is discussed later with the results of the children's performance in the Photograph Condition.

The average age at which the children recognized themselves in the Mirror Condition was 20 months with an age range of 19 to 21 months. The mean number of sessions to mirror recognition was 2.9 with a range of 2 to 4 sessions. Self recognition in the Mirror Condition followed parent recognition by an average of 1.8 sessions with a range of 0 to 3 sessions. Seven children evidenced self recognition by turning to look for the clown face and three by naming their images.<sup>13</sup> After their initial self recognition in the Mirror Condition the children evidenced self recognition in this condition on 93% of the remaining sessions.

The average age at which the children recognized themselves in the Simultaneous Condition was 22 months with an age range of

20 to 24 months. The mean number of sessions to self recognition was 4.7 with a range of 3 to 7 sessions. Self recognition in the Simultaneous Condition followed mirror recognition by an average of 1.5 sessions with a range of 0 to 3 sessions. Two children evidenced self recognition by turning to look for the clown face, five children by naming the image, and four children by both criteria. After initial self recognition in the Simultaneous Condition the children evidenced self recognition in this condition on 88% of the remaining sessions.

Three of the six children who recognized themselves in the Discordant Condition did so at 23 months and the remaining three at 24 months. The mean number of sessions to self recognition for this condition was 6.5 with a range of 6 to 7 sessions. For these children self recognition in the Discordant Condition followed recognition in the Simultaneous Condition by an average of 2.0 sessions with a range of 0 to 3 sessions. All six children evidenced self recognition by naming the image. After initial self recognition in the Discordant Condition, these children evidenced self recognition in 100% of the remaining sessions. Five children completed the study (one at 25 months and four at 26 months) without having evidenced self recognition in the Discordant Condition. These five children, however, did recognize themselves in the Photograph Condition as did five of the children who recognized themselves in the Discordant Condition. The children's performance in the Photograph Condition is presented later.

An interesting pattern emerged with respect to the two criteria for self recognition in the videotaped conditions. The children evidenced initial self recognition by turning to search for the clown face only in the Mirror and Simultaneous conditions. The children did not respond to the clown face in the Discordant and Other Child conditions by turning to look for it behind them. Rather, they responded by orienting toward the TV or by searching the ceiling where the clown face was stored when not in use. The only exceptions to this were one child who after recognizing himself in the Discordant Condition on two occasions turned to look for the clown face in that condition and another who once turned to look for the clown face in the Other Child Condition.

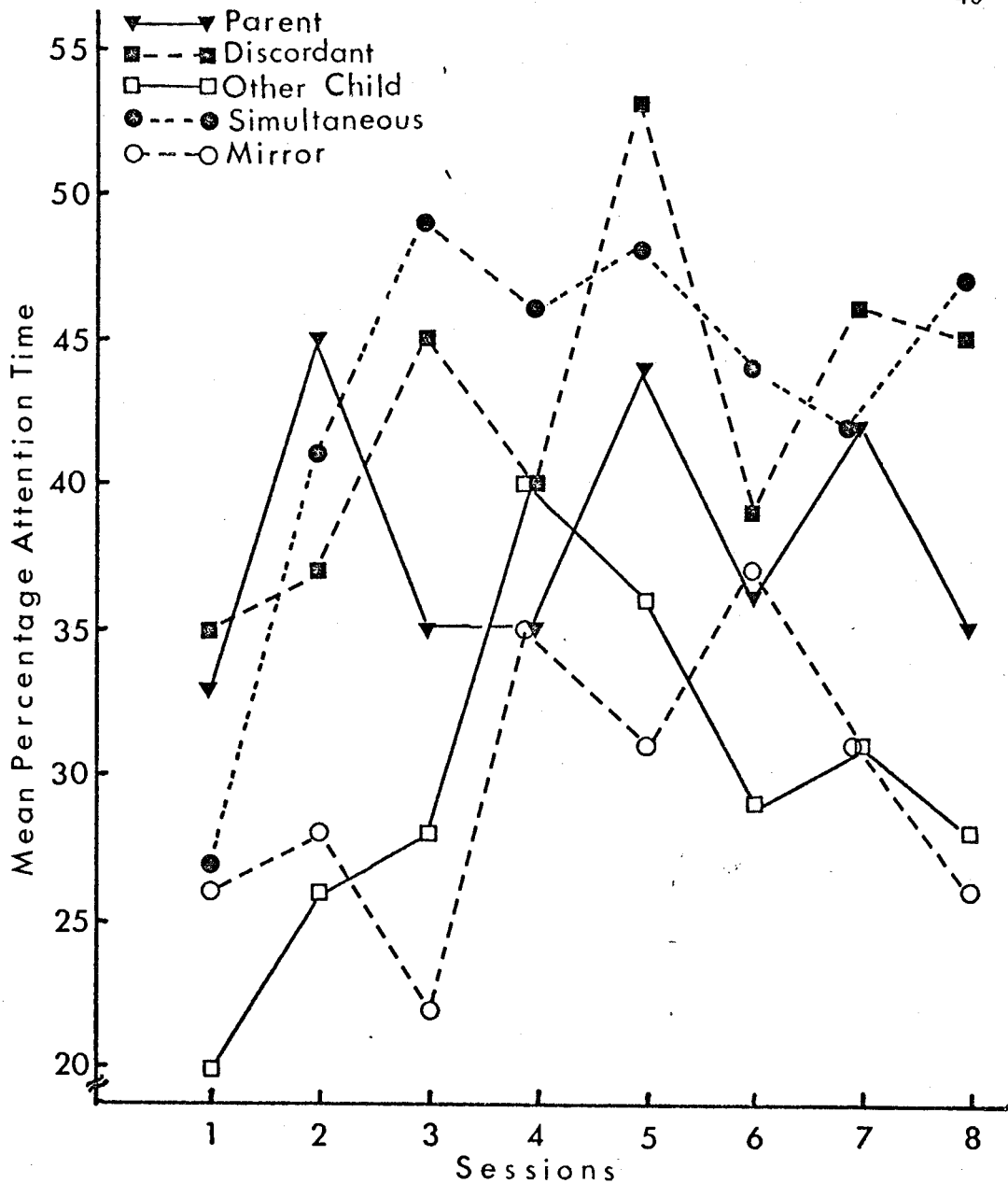
There were two distinct periods during the course of the study when the children named all the child images as themselves. These periods were before self recognition in the Mirror Condition and after self recognition in the Simultaneous Condition. Four children labeled all the child images with their first names before recognition in the Mirror Condition (two children did so for one sessions, two for two sessions). In all four cases when the children began labeling only their own images as self, a first person pronoun was used instead of a proper name. After self recognition in the Simultaneous Condition and before self recognition in the Discordant Condition, nine children labeled all the child images as themselves (five did so for one session, three for two sessions, and one for three sessions).

After self recognition in the Simultaneous Condition four children showed unstable recognition in the Discordant Condition in that they fluctuated from session to session as to whether they verbally identified all the child images as self or just the self images. Only one of these four eventually showed stable self recognition in the Discordant Condition by verbally identifying only the images in the Discordant, Simultaneous, and Mirror conditions as self for two or more consecutive sessions. It was only in the Discordant Condition that such unstable self recognition was observed.

#### Overall Performance

Attention Time. The children attended most to the images in the Simultaneous, Discordant, and Parent conditions as can be seen in Figure 2 which shows the mean percentage of attention time in each condition in each session. The number of children who showed initial self recognition in the Mirror, Simultaneous, and Discordant conditions in each session is shown below the abscissa. The mean percentages of attention time in each condition in each of the eight sessions are found in Table 2.

Attention in the Simultaneous Condition increased before the children showed self recognition in this condition and remained high for the remainder of the study. Attention in the Discordant Condition was also high throughout the study but peaked before the children showed self recognition in this condition. The children's attention in the Other Child Condition was low across all eight sessions, although a peak occurred prior to self recognition in the Discordant Condition. Attention in the Mirror Condition, the last



Number of Children Showing Self Recognition in Sessions 1 - 8

Conditions

Mirror	2	5	4			
Simultaneous		2	3	3	2	1
Discordant					3	3

Figure 2. Mean percentage of attention time in each condition for sessions 1 through 8.

Table 2  
 Mean Percentage of Attention Time in Each Condition in Sessions 1 through 8

Sessions	Conditions						Mean
	Parent	Discordant	Other Child	Simultaneous	Mirror	Mirror	
1	33%	35%	20%	27%	26%	28%	28%
2	45%	37%	26%	41%	28%	35%	35%
3	35%	45%	28%	49%	22%	36%	36%
4	35%	40%	40%	46%	35%	39%	39%
5	44%	53%	36%	48%	31%	42%	42%
6	36%	39%	29%	44%	37%	37%	37%
7	42%	46%	31%	42%	31%	38%	38%
8	35%	45%	28%	47%	26%	36%	36%
Mean	38%	42%	30%	43%	29%	36%	36%

condition shown to the children, was also low throughout the study even before and during the sessions in which most children recognized themselves in the mirror. There was, however, an increase in attention in the Mirror Condition which coincided with the time the children showed self recognition in the Simultaneous Condition. The children's attention in the Parent Condition was moderately high and relatively consistent across the eight sessions.

Attention time in the Parent, Simultaneous, and Discordant conditions was significantly greater than in the Other Child or Mirror conditions when all sessions were considered together. This finding was indicated by a Tukey ( $p < .05$ ) followup of a significant main effect for conditions,  $F(4, 36) = 10.12$ ,  $p < .001$ , which was revealed in a Conditions x Sex x Sessions analysis of variance of the percentage of attention time for sessions 1 through 8. The analysis also yielded a significant main effect for sessions,  $F(7, 63) = 3.33$ ,  $p < .005$ , but there were no significant interactions or main effect for sex.

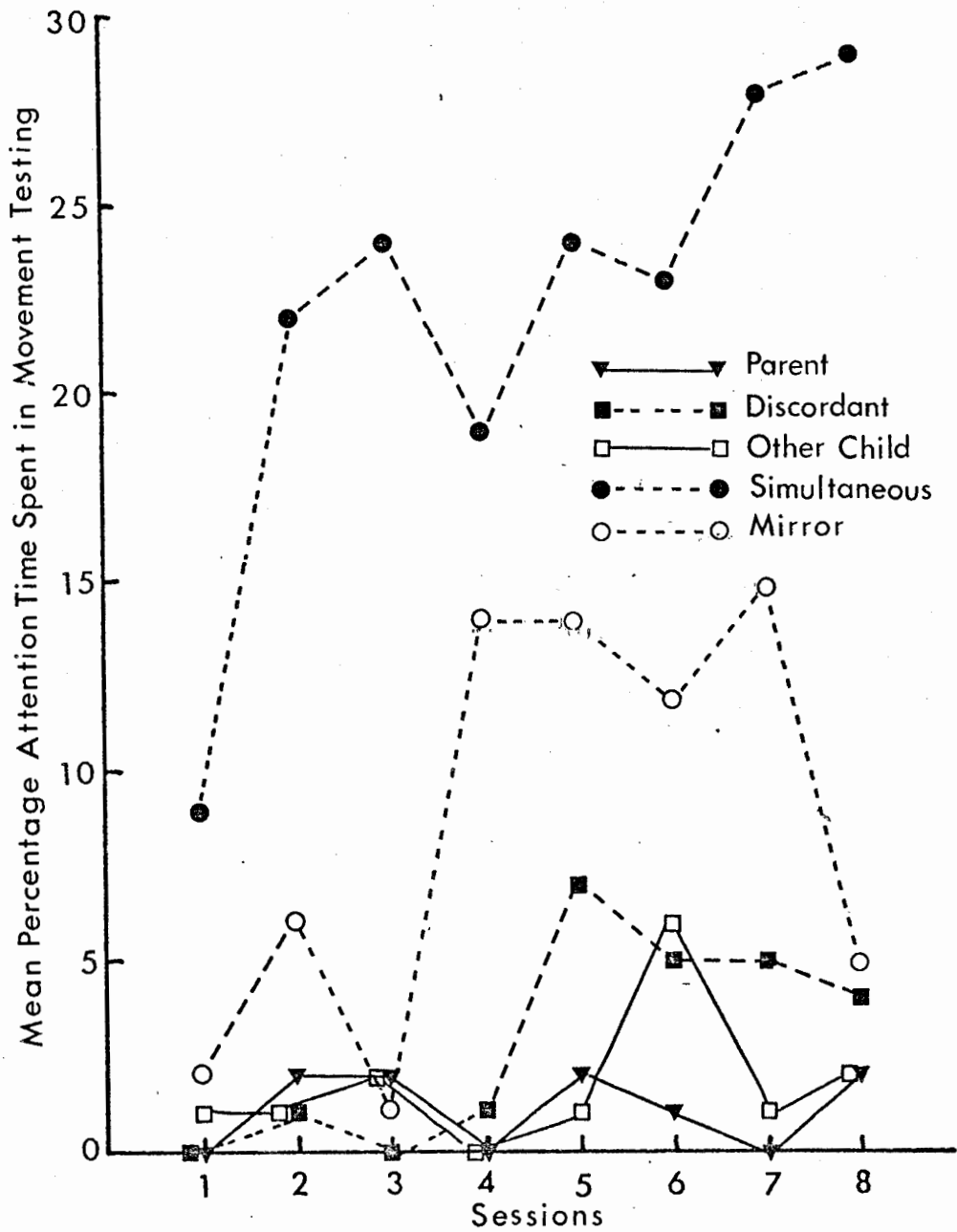
The children showed an overall increase in attention over sessions. The mean percentages for attention time in each session are found in Table 2. A Tukey ( $p < .05$ ) followup of the main effect for sessions showed attention in sessions 4, 5, and 7 to be greater than in session 1.

Movement Testing Time. The children exhibited much more movement testing in the conditions in which there was a correspondence between self and image movement (Simultaneous and Mirror conditions) than in the other conditions in which there was no such correspondence. This

can be seen in Figure 3 which shows the mean percentage of attention time spent in movement testing in each condition in each session. Again, the number of children who showed self recognition in the Mirror, Simultaneous, and Discordant conditions in each session is shown below the abscissa. The mean percentages of attention time spent in movement testing in each condition in each of the eight sessions are in Table 3.

Throughout the study the children exhibited the most movement testing in the Simultaneous Condition. An initial increase in movement testing in the Simultaneous Condition occurred prior to the time the children showed self recognition in this condition. Ten of the 11 children showed movement testing in the Simultaneous Condition before they recognized themselves.<sup>14</sup> Movement testing in the Mirror Condition was less than in the Simultaneous Condition but more than in the other conditions. Although there was relatively little movement testing in the Mirror Condition before or during self recognition in this condition, movement testing in this condition increased when self recognition occurred in the Simultaneous Condition. Movement testing in the Discordant Condition was low throughout the study with a peak prior to the time the children recognized themselves in this condition. The pattern of movement testing in the Other Child Condition was similar to that in the Discordant Condition except that there was a faster drop in the spurt of movement testing which occurred at the time the children showed self recognition in the Discordant Condition. Movement testing in the Parent Condition remained low throughout the study.





Number of Children Showing Self Recognition in Sessions 1 - 8

Condition	1	2	3	4	5	6	7	8
Mirror	0	2	0	0	5	0	0	4
Simultaneous	0	0	2	3	3	2	1	0
Discordant	0	0	0	0	0	3	3	0

Figure 3. Mean percentage of attention time spent in movement testing in each condition for sessions 1 through 8.

Table 3

Mean Percentage of Attention Time Spent in Movement Testing in Each Condition in Sessions 1 through 8

Sessions	Conditions						Mean
	Parent	Discordant	Other Child	Simultaneous	Mirror	Mirror	
1	0%	0%	1%	9%	2%	2%	2%
2	2%	1%	1%	22%	6%	6%	6%
3	2%	0%	2%	24%	1%	5%	5%
4	0%	1%	0%	19%	14%	7%	7%
5	2%	7%	1%	24%	14%	10%	10%
6	1%	5%	6%	23%	12%	9%	9%
7	0%	5%	1%	28%	15%	10%	10%
8	2%	4%	2%	29%	5%	8%	8%
Mean	1%	3%	2%	22%	10%	7%	7%

When all sessions were considered together, movement testing was significantly greater in the Simultaneous Condition than in any of the other conditions and movement testing was significantly greater in the Mirror Condition than in the Parent Condition. These findings were indicated by a Tukey ( $p < .05$ ) followup of a significant main effect for conditions,  $F(4, 36) = 14.63$ ,  $p < .001$ , which was revealed in a Conditions x Sex x Sessions analysis of variance of the percentage of attention time spent in movement testing for sessions 1 through 8. This analysis yielded no significant interactions or other main effects.

#### Parent Recognition

Attention Time. In the session in which the children recognized their parents in the Parent Condition, they showed slightly more attention in that condition than in any of the other conditions. When just this session was considered, the percentage means for attention time were 39% in the Parent Condition, 37% in the Discordant Condition, 21% in the Other Child Condition, 36% in the Simultaneous Condition, and 27% in the Mirror Condition. A Conditions x Sex analysis of variance of the percentage of attention time in the parent recognition session yielded a significant main effect for conditions,  $F(4, 36) = 3.27$ ,  $p < .05$ , with no significant interactions or main effect for sex. A Tukey ( $p < .05$ ) followup showed attention time in the Parent Condition to be significantly greater than in the Other Child Condition.

Movement Testing Time. Movement testing was extremely low in

the Parent Condition in the parent recognition session. The percentage means for movement testing in the session were .3% in the Parent Condition, 0% in the Discordant Condition, .5% in the Other Child Condition, 18.3% in the Simultaneous Condition, and 1.3% in the Mirror Condition. A Conditions x Sex analysis of variance of the percentage of attention time spent in movement testing in this session yielded a significant main effect for conditions,  $F(4, 36) = 5.51$ ,  $p < .001$ , with no significant interactions or main effect for sex. A Tukey ( $p < .05$ ) followup showed that movement testing was significantly greater in the Simultaneous Condition than in any of the other conditions.

#### Self Recognition in the Mirror Condition

Attention Time. Attention in the Mirror Condition, which was the last condition presented, was low prior to and during self recognition in the mirror but increased in the session after self recognition. This increase was perhaps due to a transfer of interest from the Simultaneous Condition which preceded it, in which the children were beginning to recognize themselves. When percentage of attention time was aligned with respect to the session in which self recognition in the Mirror Condition occurred, the percentage means for attention time in the Mirror Condition in the session before recognition, the recognition session, and two sessions after recognition were 24%, 27%, 35%, and 35%, respectively.

Movement Testing Time. Movement testing in the Mirror Condition was also low prior to self recognition in this condition, increased

in the self recognition session, but peaked in the session after self recognition occurred again, perhaps, because of a transfer of interest in movement testing from the Simultaneous Condition. When the percentage of attention time spent in movement testing was aligned with respect to the session in which self recognition occurred, the percentage means for movement testing in the Mirror Condition in the session before recognition, the recognition session, and two sessions after recognition were 1%, 6%, 15%, and 8%, respectively.

The results of the analyses of variance of percentage of attention time and percentage of attention time spent in movement testing before, during, and after self recognition in the Mirror Condition closely paralleled the results of the analyses over all eight sessions and showed attention to be highest in the Simultaneous and Discordant conditions and movement testing to be highest in the Simultaneous Condition. A full description of these results can be found in Appendix A.

#### Self Recognition in the Simultaneous Condition

Attention Time. At the time of self recognition in the Simultaneous Condition the children showed most attention to the videotaped self images. Attention was greatest in the Simultaneous and Discordant conditions and least in the Other Child and Mirror conditions, while the Parent Condition attracted an intermediate amount of attention as can be seen in Figure 4 which shows the mean percentage of attention time aligned with respect to the session in which the children recognized themselves in the Simultaneous Condition. Figure 4 includes the two sessions before self recognition, the session in

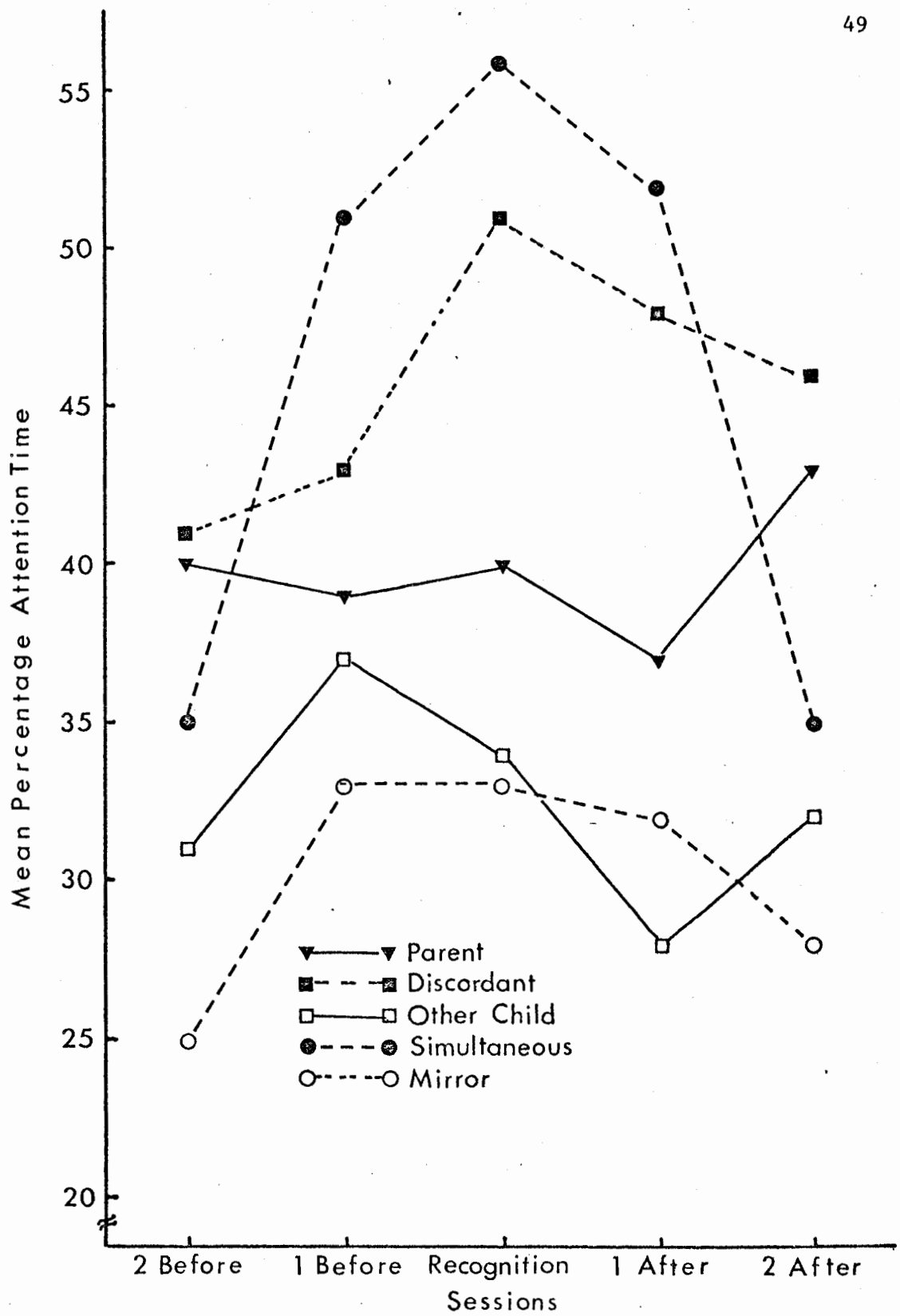


Figure 4. Mean percentage of attention time in each condition before, during, and after self recognition in the Simultaneous Condition.

which self recognition occurred, and the two sessions after self recognition. The mean percentages of attention time in each condition and session are found in Table 4.

Attention in the Simultaneous Condition increased prior to recognition, peaked at recognition at a percentage higher than that in any other condition, and decreased after recognition. Attention in the Discordant Condition also peaked in the session in which children recognized themselves in the Simultaneous Condition and remained relatively high after recognition. The children's attention in the Other Child Condition was relatively low as was their attention in the Mirror Condition. Attention in the Mirror Condition, however, increased prior to self recognition in the Simultaneous Condition and decreased after self recognition, showing a pattern of attention similar to that shown in the Simultaneous Condition. The children's attention in the Parent Condition remained relatively constant and at a moderately high level.

Attention time in the Simultaneous and Discordant conditions was significantly greater than in the Other Child or Mirror conditions when these five sessions were considered together. This finding was indicated by a Tukey ( $p < .05$ ) followup of a significant main effect for conditions,  $F(4, 32) = 8.74$ ,  $p < .001$ , which was revealed in a Conditions x Sex x Sessions analysis of variance of the percentage of attention time in the sessions before, during, and after self recognition in the Simultaneous Condition.<sup>15</sup>

This analysis also indicated that the girls were more attentive than the boys (girls 44%, boys 34%) as there was a significant

Table 4  
 Mean Percentage of Attention Time in Each Condition in  
 Sessions Before, During, and After Self Recognition in the Simultaneous Condition

Sessions	Conditions					Mean
	Parent	Discordant	Other Child	Simultaneous	Mirror	
2 before	40%	41%	31%	35%	25%	35%
1 before recognition	39%	43%	37%	51%	33%	41%
	40%	51%	34%	56%	33%	43%
1 after	37%	48%	28%	52%	32%	40%
2 after	43%	46%	32%	35%	28%	37%
Mean	40%	46%	33%	46%	30%	39%



main effect for sex,  $F(1, 8) = 23.10$ ,  $p < .05$ . Neither the main effect for sessions nor any of the interactions was significant.

Movement Testing Time. The children showed more movement testing in the Simultaneous Condition than in any of the other conditions as can be seen from Figure 5 which shows the mean percentage of attention time spent in movement testing aligned with respect to the session in which the children recognized themselves in the Simultaneous Condition. This figure includes two sessions before self recognition, the session in which self recognition occurred and two sessions after self recognition. The mean percentage of attention time spent in movement testing in each condition and session are found in Table 5.

Movement testing in the session before self recognition was significantly greater than in any of the other sessions and movement testing in the session after recognition was significantly greater than in two sessions before recognition. These findings were indicated by a Tukey ( $p < .05$ ) followup of a significant main effect for sessions,  $F(4, 36) = 2.78$ ,  $p < .05$ , which was revealed in a Sessions analysis of variance of the percentage of attention time spent in movement testing over the five sessions in the Simultaneous Condition. This analysis was computed after a Conditions x Sex x Sessions analysis of variance of the percentage of attention time spent in movement testing in the five sessions and conditions yielded a significant Conditions x Sessions interaction,  $F(16, 128) = 2.40$ ,  $p < .005$ , with no significant main effect for sex. When the interaction was separated by conditions using a Sessions analysis of variance of

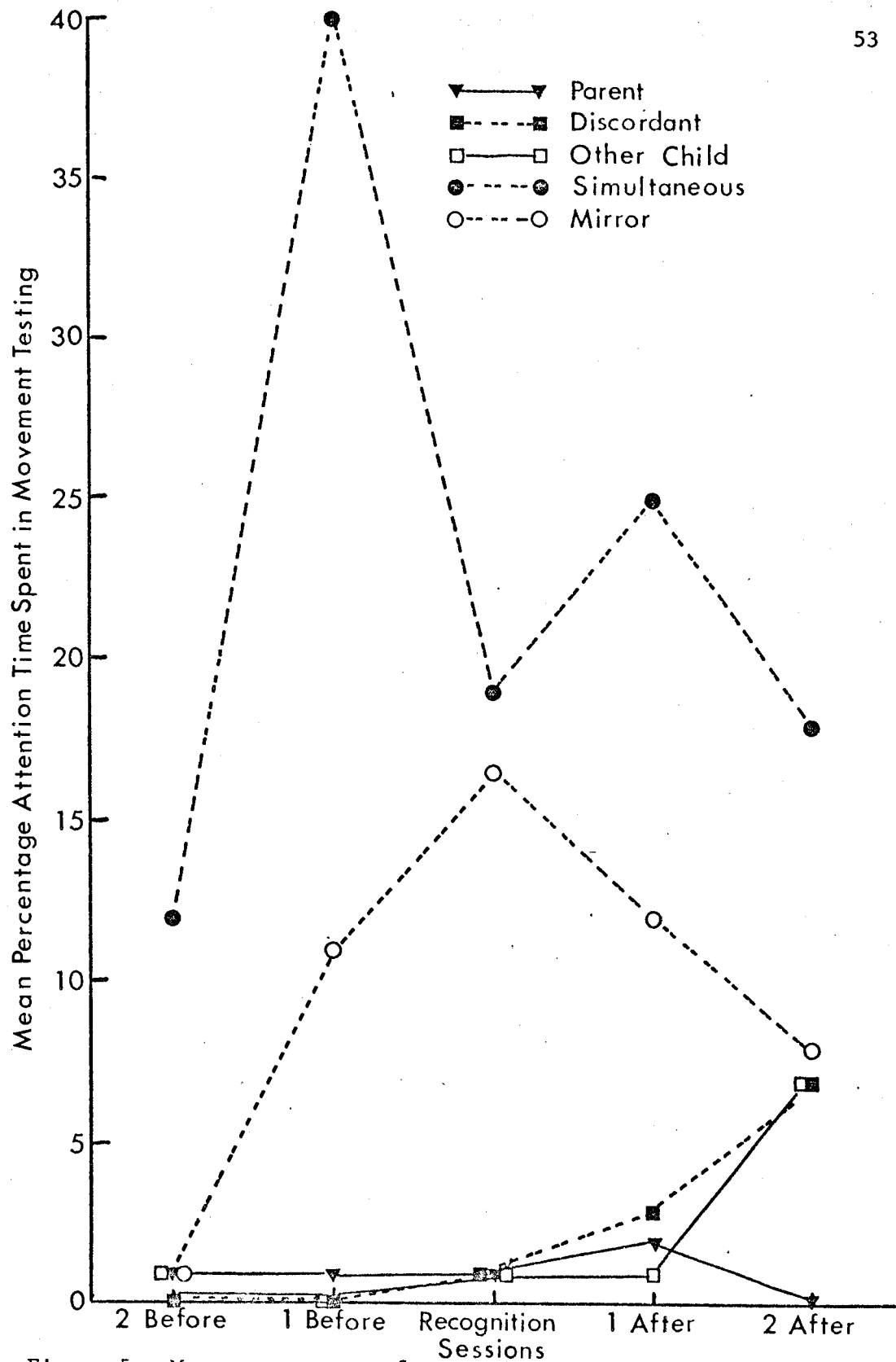


Figure 5. Mean percentage of attention times spent in movement testing before, during, and after self recognition in the Simultaneous Condition.

Table 5

Mean Percentage of Attention Time Spent in Movement Testing in Each Condition in Sessions Before, During, and After Self Recognition in the Simultaneous Condition

Sessions	Conditions					Mean
	Parent	Discordant	Other Child	Simultaneous	Mirror	
2 before	1%	0%	1%	12%	1%	5%
1 before	1%	0%	0%	40%	11%	10%
recognition	1%	1%	1%	19%	16%	8%
1 after	2%	3%	1%	25%	12%	9%
2 after	0%	7%	7%	18%	8%	8%
Mean	1%	2%	2%	23%	10%	8%

the movement testing data for each condition, only the analysis for the Simultaneous Condition yielded a significant main effect.

As can be seen in Figure 5, movement testing in the Mirror Condition increased prior to self recognition in the Simultaneous Condition, peaked at recognition, and decreased after self recognition, indicating that the children became interested in movement testing in the Mirror Condition probably as a result of the interest aroused in the Simultaneous Condition. There was more movement testing in the Mirror Condition than in any of the remaining conditions. The pattern of movement testing in the Discordant and Other Child conditions was low before and during self recognition in the Simultaneous Condition with a slight increase after self recognition. Movement testing in the Parent Condition remained low throughout the five sessions.

#### Self Recognition in the Discordant Condition

Attention Time. Before, during and after self recognition in the Discordant Condition the six children who recognized themselves in this condition attended significantly more to the videotaped self images in both the Discordant and Simultaneous conditions than to the images in the Other Child or Mirror conditions. This finding was indicated by a Tukey ( $p < .05$ ) followup of a significant main effect for conditions,  $F(4, 16) = 6.65, p < .005$ , which was revealed in a Conditions x Sex x Sessions analysis of variance of the percentage of attention time aligned with respect to the session in which the six children recognized themselves in the Discordant Condition. This analysis included the data from two sessions before recognition, the

recognition session, and one session after recognition. The mean percentages for attention time shown by the six children in each condition and session are found in Table 6.

The analysis also indicated that the three girls who recognized themselves in the Discordant Condition were more attentive than the three boys (girls 44%, boys 35%). This was revealed by a significant main effect for sex,  $F(1, 4) = 9.36, p < .05$ . Neither the main effect for sessions nor any of the interactions was significant.

Movement Testing Time. The percentage of attention time spent in movement testing was low in these four sessions and closely paralleled the findings reported for all eight sessions. An analysis of variance of the percentage of attention time spent in movement testing before, during, and after self recognition in the Discordant Condition generally shows movement testing to be significantly greater in the Simultaneous Condition than in the Parent, Discordant, and Other Child conditions and to be significantly greater in the Mirror Condition than in the Parent Condition. A full description of these results can be found in Appendix A.

#### Photograph Condition

The children recognized their parents in the Photograph Condition at approximately the same time they recognized them in the videotaped Parent Condition. Table 7 shows the sessions in which the children recognized their parents and themselves in the Photograph Condition and in the videotaped Parent, Simultaneous, and Discordant conditions. Seven children recognized their parents in the Photograph Condition in

Table 6  
 Mean Percentage of Attention Time in Each Condition in  
 Sessions Before, During, and After Self Recognition in the Discordant Condition

Sessions	Conditions				Mean
	Parent	Discordant	Other Child	Simultaneous Mirror	
2 before	39%	50%	36%	48%	40%
1 before recognition	40%	43%	31%	46%	39%
1 after	44%	41%	29%	45%	59%
	33%	56%	28%	47%	40%
Mean	39%	48%	31%	46%	40%

Table 7

Self and Parent Recognition Sessions in Photographs and Videotaped  
Parent, Simultaneous, and Discordant Conditions

Subject	Recognition Session				
	Parent		Self		
	Photograph	Parent	Photograph	Simultaneous	Discordant
1	1	1	8	5	7
2	2	2	9	4	-
3	1	2	6	3	6
4	1	1	8	6	-
5	3	1	7	7	-
6	1	1	7	5	7
7	1	1	8	3	-
8	3	1	-	6	6
9	1	2	10	5	-
10	1	1	6	4	6
11	1	1	8	4	7
Mean	1.4	1.3	7.7	4.7	6.5

the same session in which they recognized their parents in the Parent Condition, two children recognized their parents in the Photograph Condition before they did so in the Parent Condition, and two children recognized them in the Parent Condition before they did in the Photograph Condition. The mean number of sessions to parent recognition in the Photograph Condition was 1.4 with a range of 1 to 3 sessions. After initially recognizing their parents in this condition, the children continued to recognize them in 99% of the remaining sessions.

Self recognition in the Photograph Condition occurred only after the children recognized themselves in the Mirror and Simultaneous Conditions. Ten children recognized themselves in the Photograph Condition, one of whom was seen at home for an additional session after the study had ended and who recognized himself at that time. The other child who had not recognized himself in the Photograph Condition was not available for an additional home session. The mean number of sessions to self recognition in the Photograph Condition for those who did so was 7.8 with a range of 6 to 10 sessions.

Of the six children who showed self recognition in the Discordant Condition, three recognized themselves in the Photograph and Discordant conditions in the same session, two recognized themselves in the Photograph Condition one session after they did so in the Discordant Condition, and one child did not recognize himself in the Photograph Condition even though the study continued for two sessions after he recognized himself in the Discordant Condition. Five children recognized themselves in photographs but did not show self recognition

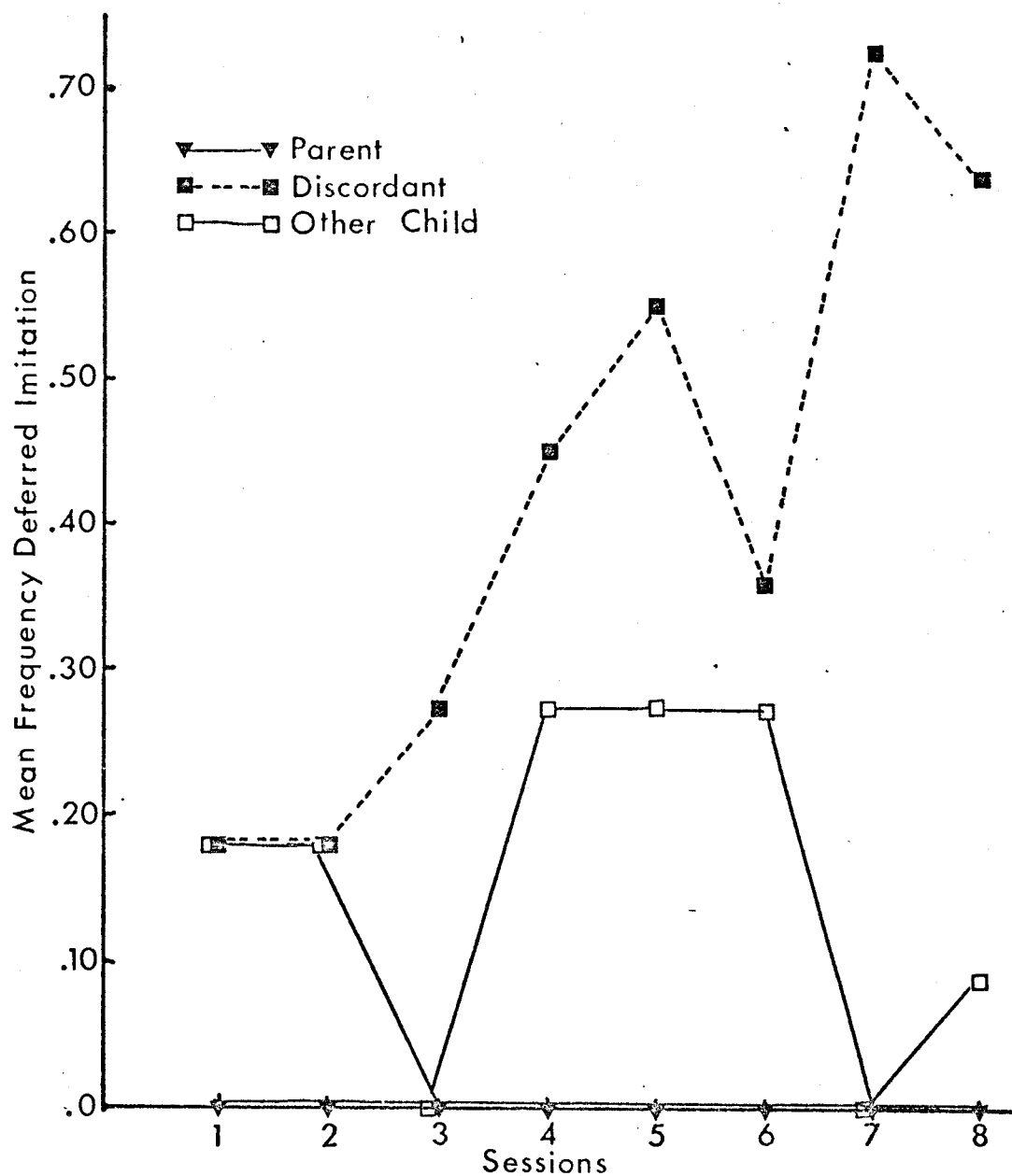


in the Discordant Condition. For these children self recognition in the Photograph Condition followed self recognition in the Simultaneous Condition by an average of 3.4 sessions with a range of 1 to 5 sessions. Therefore, self recognition in both the Photograph and Discordant conditions where there was no correspondence between self and image movement followed self recognition in the Simultaneous Condition. After initially recognizing themselves in the Photograph Condition, the children continued to do so in 95% of the remaining sessions.

#### Deferred Imitation and Matching Behaviors

As noted earlier, deferred imitation occurred when the child witnessed an action by the image and then immediately copied that action while no longer attending to the image. Matching behavior occurred when the child was attending to the image and simultaneously trying to duplicate the ongoing behavior. By definition, deferred imitation and matching behavior could occur only in the Parent, Discordant, and Other Child conditions as actions by the image in the Simultaneous and Mirror conditions were always identical to the child's current actions. The analyses of the children's deferred imitation and matching behavior are presented below.

Deferred Imitation. Most deferred imitation occurred after self recognition in the Simultaneous Condition and before self recognition in the Discordant Condition and was due to an increase in deferred imitation in the Discordant Condition. Figure 6 shows the frequency of deferred imitation in the Parent, Discordant, and Other Child conditions in each of the eight sessions. The number of



Number of Children Showing Self Recognition in Sessions 1 - 8

Conditions

Simultaneous	2	3	3	2	1
Discordant				3	3

Figure 6. Mean frequencies of deferred imitation in the Parent, Discordant, and Other Child conditions in sessions 1 through 8.

children who recognized themselves in the Simultaneous and Discordant conditions in each session are shown below the abscissa. While no incidents of imitation occurred in the Parent Condition and the frequency of imitation in the Other Child Condition remained relatively consistent across sessions, the frequency of imitation in the Discordant Condition increased in the later sessions, particularly after self recognition in the Simultaneous Condition. Seventy-eight percent of the incidents of deferred imitation occurred after self recognition in the Simultaneous Condition and before self recognition in the Discordant Condition. Thus there was more deferred imitation of self images in the period after recognition in the condition where there was a correspondence between self and image movement but before recognition in the condition where there was no such correspondence.

The children imitated images of children more than those of an adult and images of self more than those of another child. The mean frequencies of deferred imitation in each of the three conditions for each of eight sessions are found in Table 8. Deferred imitation was significantly more frequent in the Discordant Condition than in the Other Child Condition and significantly more frequent in the Other Child Condition than in the Parent Condition as indicated by a Tukey ( $p < .05$ ) followup of a significant main effect for conditions,  $F(2, 18) = 14.50$ ,  $p < .001$ , revealed in a Conditions x Sex x Sessions analysis of variance of the frequency of deferred imitation in the three conditions in sessions 1 through 8.

Table 8

Mean Frequency of Deferred Imitation in the Parent, Discordant, and Other Child Conditions in Sessions 1 through 8

Sessions	Conditions			Mean
	Parent	Discordant	Other Child	
1	0	.18	.18	.12
2	0	.18	.18	.12
3	0	.27	0	.09
4	0	.45	.27	.24
5	0	.55	.27	.27
6	0	.36	.27	.21
7	0	.73	0	.33
8	0	.64	.09	.33
Mean	0	.42	.16	.19

Matching Behavior. Most incidents of matching behavior occurred after self recognition in the Simultaneous Condition and before self recognition in the Discordant Condition. Two thirds of the nine incidents shown by five children occurred in this time period. Most matching behavior was observed in the Discordant Condition. Seven incidents occurred in the Discordant Condition, two in the Other Child Condition, and none in the Parent Condition.

After matching their behavior to that of the image, the children (4 out of 5) most often judged the image to be self. Six of the incidents, five in the Discordant Condition and one in the Other Child Condition, were followed by verbal self identification.

Mirror Experience in the Home. The children were exposed to their reflection for an estimated average of three times per day with a range of 0 to 5 times. Table 9 shows the number of reflective surfaces in the home at the child's level and the number of times per day the child was held up before a mirror that was not at his level. Assuming that the children exposed themselves to the reflective surfaces at their level at least once a day, the total number of daily exposures to a reflective surface is estimated for each child in Table 9.

The extent of previous mirror experience was significantly correlated with the session of self recognition in the Discordant Condition. The children were rank ordered as to their exposure to reflective surfaces in the home and the number of sessions until they recognized themselves in the Mirror, Simultaneous, Discordant, and

Table 9

## Exposure to Reflective Surfaces in the Home

Subject	Rank Order of Mirror Exposure	No. Reflective Surfaces at Child's Level	No. Times/Day Held Up to Mirror	Total Daily Exposures to Refl. Surfaces
1	1	2	3	5
2	6	0	0*	0
3	2	3	1	4
4	5	1	0*	1
5	4	1	1	2
6	2	2	2	4
7	3	2	1	3
8	2	2	2	4
9	4	1	1	2
10	3	2	1	3
11	2	3	1	4
Mean		1.7	1.2	2.9

\* Parent reported holding child up to mirror only once every two weeks.

Photograph conditions. The extent of mirror exposure showed a .05 correlation with the session of self recognition in the Mirror Condition, a .11 correlation with the session of self recognition in the Simultaneous Condition, a .54 correlation with the session of self recognition in the Discordant Condition, and a .15 correlation with the session of self recognition in the Photograph Condition. The correlations were determined by the use of Kendall's tau rank order coefficient. Only the correlation between the number of daily exposures to a reflective surface and when self recognition occurred in the Discordant Condition was significant ( $p < .01$ ).

#### Object Permanence Task.

All children successfully completed the object permanence task at or before the time they recognized themselves in the Mirror Condition. Table 10 shows the sessions in which the children completed the object permanence tasks and the sessions in which they showed self recognition in the Mirror Condition. The completion of the object permanence tasks preceded mirror recognition by an average of 1 session with a range of 0 to 3 sessions.

All children were able to do the first three tasks in the initial session when they were 18 months old. The average age at which the children were able to complete the fourth task was 19 months with an age range of 18 to 20 months. The mean number of sessions to the completion of the fourth task was 2.2 with a range of 1 to 3 sessions. After initial mastery of the fourth task, the children showed successful completion of the fourth task in 78% of the remaining sessions.

Table 10

Session of Completion of Object Permanence Tasks and Self Recognition  
in the Mirror Condition

Subject	Completion of Object Permanence Tasks				Mirror Recognition
	Task 1	Task 2	Task 3	Task 4	
1	1	1	1	1	4
2	1	1	1	2	4
3	1	1	1	2	2
4	1	1	1	3	3
5	1	1	1	3	4
6	1	1	1	3	3
7	1	1	1	1	2
8	1	1	1	3	4
9	1	1	1	1	3
10	1	1	1	2	3
11	1	1	1	3	3
Mean	1	1	1	2.2	2.9



Perspective Taking

A detailed analysis of the children's performance on the Picture Perspective Task, their use of first and second person pronouns, and the relationship between the use of pronouns and performance on the Picture Perspective Task is presented in Appendix B. The relationship of self recognition to the children's performance on the Picture Perspective Task and their use of pronouns is presented below.

Picture Perspective Task. Self recognition in the Discordant and Photograph conditions occurred only after the children had started responding to the Picture Perspective Task in a way which would indicate they had some knowledge that others had a perspective different from their own, i.e., after they had begun to respond with turned-card or correct responses. Table 11 shows the initial session in which the children responded to the Picture Perspective Task with a majority of turned-card or correct responses which was followed by at least one consecutive session of similar responding. It also shows the sessions of self recognition in the Discordant and Photograph conditions. Data from cards with the same picture on each side are not included in the table as a correct response was indistinguishable from an egocentric response on these cards. Correct or turned-card responses to the cards with a different picture on each side and with a picture on only one side, however, indicated that the children had begun to infer that the experimenter had a perspective different from theirs. In all cases the children had begun responding with either turned-card or correct responses by the time self recognition occurred in the Discordant and Photograph

Table 11

Initial Session of Turned-Card or Correct Responses in the Picture  
 Perspective Task and Self Recognition in the Discordant and  
 Photograph Conditions

Subject	Initial Session of Turned-Card or Correct Responses	Self Recognition Session	
		Discordant	Photograph
1	1	7	8
2	6	-	9
3	4	6	6
4	5	-	8
5	5	-	7
6	3	7	7
7	2	-	8
8	6	6	-
9	6	-	10
10	2	6	6
11	4	7	8
Mean	4.0	6.5	7.7

conditions where there was no correspondence between self and image movement.

Pronoun Usage. Self recognition in the Discordant and Photograph conditions occurred after the children had begun to use language symbolically with respect to first person pronouns. Table 12 shows the sessions in which the children began using all forms of first and second person pronouns correctly and the sessions of self recognition in the Discordant and Photograph conditions. The children had begun using all first person pronouns by the time self recognition in the Discordant and Photograph conditions occurred. The correct use of first person pronouns suggests that the children realized that these pronouns refer to the speaker and, therefore, their referents change with whomever is speaking.

Table 12

Correct Pronoun Usage and Self Recognition in the Discordant and  
Photograph Conditions

Subject	Initial Session of Correct Pronoun Usage		Self Recognition Session	
	1 <sup>st.</sup> Person	2 <sup>nd.</sup> Person	Discordant	Photograph
1	2	8	7	8
2	9	-	-	9
3	4*	6	6	6
4	6*	-	-	8
5	7	-	-	7
6	7	-	7	7
7	7	-	-	8
8	3*	-	6	-
9	10	-	-	10
10	5	-	6	6
11	3	-	7	8
Mean	5.7	7.0	6.5	7.7

\* On later sessions when these children began to use second person pronouns, the referents for both first and second person pronouns became confused.

### Discussion

A sequential pattern of self recognition was shared by all children. They recognized themselves first in the Mirror Condition, then in the Simultaneous Condition, and finally in the Discordant and Photograph Conditions. This pattern suggests that there is an underlying developmental process for visual self recognition. This process may begin with the child's interest in the correspondence between self and image movement, be followed by a realization that the image which shows such a correspondence with self movement is a self image, and culminate in the child's development of a mental representation of what he looks like to which he can match the images he sees.

It was predicted that prior to self recognition the children would show an interest in the correspondence between self and image movement as indicated by movement testing. This prediction was based on the hypothesis that young children initially recognized themselves primarily on the basis of interactional cues between self and image, i.e., on the correspondence between self and image. This prediction was substantiated. Movement testing peaked in the Simultaneous Condition in the session before self recognition occurred and was greater in this condition than in any of the other conditions as can be seen in Figure 5. Although the most movement testing occurred prior to self recognition, the behavior continued after self recognition and, if anything, became more joyful and varied. Movement testing may have been an important behavior for recognizing self images but it was also fun and the children continued to enjoy

their interaction with their images. This activity exemplifies how children learn about their world through play.

Movement testing in the Mirror Condition, although second in amount to movement testing in the Simultaneous Condition, did not begin in earnest until after self recognition in the Simultaneous Condition which seems to contradict the prediction that movement testing would occur prior to self recognition. This apparent contradiction, however, may be only an artifact of the particular age range of the children.

In observations of children's mirror behavior Amsterdam (1968), Dixon (1957), and Gesell and Ames (1947) reported movement testing began between the ages of 7 and 11 months which interestingly is approximately the age at which children learn to adjust their imitative behavior to correspond to that of a model. The upper age limits for children in the studies by Gesell and Ames, and Dixon were 15 and 18 months, respectively. Although in neither study do the authors specifically mention the cessation of movement testing, the behavior was not mentioned frequently in their observations of older children. Amsterdam, however, reported that movement testing lasted about 9 months, ending around 16 months of age, although self recognition in the mirror did not occur until close to 2 years of age. Perhaps children go through a necessary period of movement testing prior to self recognition in mirrors but there is a time lapse between testing the correspondence between self and image movement and recognizing the image which shows such correspondence. Although the

child notices and tests the correspondence between self and image movement quite early, possibly because of his experience with imitation, the child does not have the cognitive capacities to make the jump to self recognition until later.

Perhaps an important cognitive capacity necessary to make such a jump is the full development of object permanence such that the child knows that his own body is a separate entity among other distinct objects or persons. This knowledge may be necessary before the child can realize that he is an entity that can have a reflection similar to that seen from other bodies. The children mastered the object permanence tasks on an average of one session prior to mirror recognition. All children did so by the mirror recognition session. Perhaps it is the development of this cognitive capacity which is necessary before the previous experience with movement testing leads the child to self recognition.

It was expected that the children might recognize themselves in the Mirror Condition before they recognized themselves in the Simultaneous Condition. While both conditions featured a correspondence between self and image movement, the mirror was more familiar. It also had color which the videotape did not and lacked the lateral reversal present in the videotape medium. This expectation was confirmed. The children recognized themselves in the Mirror Condition before they did so in the Simultaneous Condition.

Self recognition in the Mirror Condition occurred at approximately the same age that Amsterdam (1972) and Brooks-Gunn and Lewis (1975)

reported mirror recognition in the children in their studies. The mean age of recognition in the present study was 20 months. Amsterdam found that most of the children in her study showed behaviors suggestive of self recognition between the ages of 20 and 24 months. Brooks-Gunn and Lewis reported similar behaviors in 75% of their 24-month olds and 25% of their 18-month olds. Likewise, the age of recognition in the Mirror Condition is compatible with the Merrill-Palmer Scale which indicates that most children verbally identify their reflection at 24 months.

The prediction that children would recognize themselves in the conditions which had a correspondence between self and image movement before they would recognize themselves in the conditions without such a correspondence was substantiated. Thus these results further suggest that self recognition is initially cued by the simultaneity between self and image movement. All children recognized themselves in the Mirror and Simultaneous conditions before recognizing themselves in the Discordant and Photograph conditions. This finding is compatible with Zazzo's (1948) report that his son recognized himself in mirrors before he did so in film or photographs.

That the children could recognize themselves in the Mirror and Simultaneous conditions but not in the Discordant and Photograph conditions suggests that they could not then recognize themselves without simultaneously experiencing the corresponding movement. Apparently they could not yet separate the physical characteristics of what they looked like from the image which showed correspondence



with their movement, i.e., they had not formed a mental image of themselves. Their attention in the Discordant Condition, however, was as high as their attention in the Simultaneous Condition and higher than their attention in any of the other conditions. This indicates that the children were more interested in their own images than in the image of another child or a familiar adult even before they actually recognized the images in the Discordant Condition as their own. This suggests that in the Discordant Condition they perceived their images as familiar, perhaps even similar to the image whose movements corresponded with theirs. At the same time since they did not identify the images in the Discordant Condition they must also have perceived that the images in this condition were different from those in the Simultaneous Condition.

The behaviors that the children showed in the period between recognizing themselves in the Simultaneous and Discordant conditions were revealing as to how they tried to understand the similar but different images. During this time some children began movement testing in the Discordant and Other Child conditions, some judged the image in the Other Child Condition to be self along with the self images, some imitated their own images, and some tried to produce a correspondence between self and image movement. Such behaviors either did not occur at any other time in the study or they increased in this period whereas they had been only marginal before. Although all of the children did some of the behaviors, not

all of the children did all of them. Any one of the behaviors was not particularly striking in itself, yet taken together they revealed the confusion the children had and the manner in which they dealt with it.

During this period there was an increase in movement testing in the Discordant and Other Child conditions, although movement testing in these conditions had been virtually nonexistent prior to this time as can be seen in Figure 3. The children may have been trying to identify the images in these conditions by means of the process which facilitated identification in the Simultaneous and Mirror conditions, i.e., by attempting to test for a correspondence between self and image movement. In these conditions, however, there was no visual feedback of a correspondence so the attempts were short lived. Nevertheless, the process used was the same as that used previously.

Also during this period a number of children verbally identified the image in the Other Child Condition as self along with those in the Mirror, Simultaneous, and Discordant conditions. At this time the children had identified two of the images, those in the Mirror and Simultaneous conditions, and were most likely genuinely confused as to the identity of the images in the Discordant and Other Child conditions. Perhaps it was a good guess that since two of the images were of self the others, which were somewhat similar to these, were also. Some children fluctuated from session to session as to whether they identified the image in the Other Child Condition as self along with the self images, indicating the instability of their recognition

of self image when the cues of correspondence between self and image movement were absent.

There was also an earlier period in the study before self recognition in the Mirror Condition when some of the children verbally identified all child images as self. The earlier incidents, however, occurred with only a few children and may have stemmed from a very different source than the later incidents. The parents of the children who showed the earlier behavior reported extensive mirror play with their respective children in which asking the child to identify his image was a regular part. These children may have learned that when asked to identify a child's image the appropriate answer was their first names but they may not have learned to discriminate their own image from those of other children. This may be why these children labeled all the child images with their own names in the experimental situation. This inference is supported by the fact that these children followed a developmental sequence of self recognition later in the study which was identical to that of the other children. Interestingly, when they began identifying only their own images as self, a first person pronoun was used and not their first names, suggesting that they had referred to themselves differently when responding rotely. It is possible that similarly learned behavior accounts for Darwin's (1877) report of self recognition in his 9-month old son who supposedly recognized himself because he turned to his mirror image when his name was called.

During this period there were also increases of incidents of deferred imitation in which the children copied the image's movements

immediately after attending to them, particularly in the Discordant Condition as can be seen in Figure 6. The children could not yet identify the image in the Discordant Condition but they apparently distinguished it from the image in the Other Child Condition. Imitation studies (Rosekrans, 1967; Stotland, Zander, and Natsoulas, 1961) indicate that children are more likely to imitate models perceived to be like themselves. Thus these results also suggest that the children perceived the images in the Discordant Condition to be more similar to the images they recognized in the Simultaneous Condition even though they could not yet identify the image in the Discordant Condition as a self image. The children may have perceived somewhat less of a similarity between the image in the Other Child Condition and the ones they recognized as self in the Simultaneous Condition as less deferred imitation occurred in the Other Child Condition. None, however, occurred in the Parent Condition, suggesting that the children's confusion was limited to the images that were similar to those in the Simultaneous and Mirror conditions and as yet unidentified. Although a possible explanation for the lack of imitative behaviors in the Parent Condition is that many of these behaviors involved the toys which were present in the Discordant and Other Child conditions but were not in the Parent Condition, some of the imitative behaviors were of a type that could have occurred in the Parent Condition. Nevertheless, not a single incident of deferred imitation occurred in the Parent Condition.

Most incidents (6 out of 9) of matching behavior in which the children tried to duplicate the ongoing action of the image also occurred between self recognition in the

Simultaneous and Discordant conditions. This suggests that the children may have been trying to make a correspondence between self and image movement when one did not exist. Again no such incidents occurred in the Parent Condition. The children distinguished between the Discordant and Other Child conditions by making more attempts (7 out of 9) to produce a correspondence in the Discordant Condition suggesting again that the children perceived the similarity between their own images. Perhaps the children were trying to understand these images in terms of the process they used in the Mirror and Simultaneous conditions, that of movement testing. However, since the images in these conditions did not cooperate by providing the appropriate visual feedback, the children themselves produced the correspondence and upon doing so most often (6 out of 9) judged the image to be self. That the child returned to this process in a time of confusion lends support to the hypothesis that it was the matching of self and image movement that originally distinguished the child's reflection for him.

These behaviors which occurred between self recognition in the Simultaneous and Discordant conditions suggest that the children perceived the similarity between those self images which moved as they did and those which did not. The children tried to understand the unidentified images by the processes which facilitated identification of the images in the Mirror and Simultaneous conditions, i.e., those of movement testing and other imitation-related behaviors. Mental representations of what they looked like, although probably in the process of being formed, could not yet be relied upon for

self recognition.

Mental representations must have been formed, however, by the time the children recognized themselves in the Discordant and Photograph conditions. That such representational thought was operating then is indicated by measures independent of self recognition. All the children who recognized themselves in these conditions were first using first person pronouns in a correct manner which indicates that they had begun to use language symbolically. The ability to use the pronouns correctly implies that the children realized that these pronouns refer to the speaker and thus their referents change with whomever is speaking. They were also responding to questions of what another was seeing when they were seeing something different by either correctly identifying what the other was seeing or by putting themselves physically in the place of the other. Both responses indicated that they understood that others had points of view different from their own, a process dependent on representational thought. Thus the representational thinking necessary for self imagery was present when the children recognized their images without the cues of simultaneity of movement. It is likely, therefore, that self recognition in these conditions derived from the child's having a mental image of what he looked like to which he could match the images he saw. The mental image, however, was derived from his interactions with an image which moved as he did.

When self recognition did occur in the Discordant Condition, all the children identified the image verbally; they did not turn to

search for the clown face after seeing it appear behind the image on TV. After initial self recognition the children continued using verbal labels to identify the images in the Discordant Condition. It is possible that the children did not show self recognition in the Discordant Condition by turning to the clown face because although they realized that it was an image of themselves, they perceived that it was not a reflection of them at that moment. Unlike the images in the Simultaneous and Mirror conditions, this one did not move as they did. In coming to recognize their images without the cues of reflected movement, the children may also have learned that only when images move as they do are the images an immediate reflection of themselves. Thus the clown face, although interesting, was not thought to be behind them. This is a rather sophisticated perception of time, especially self placement in time, which alone would seem to require symbolic thought.

Although it is possible that the children turned to look for the clown face only in the Mirror and Simultaneous conditions because they were cued by the sound of the face being lowered and by noticing the movement of the clear plastic string held by the experimenter, rather than by the appearance of the clown face behind the image on TV or in the mirror, it is unlikely. The children's reaction upon seeing the clown face suggested otherwise. When the clown face appeared in the Simultaneous and Mirror conditions the children appeared to orient directly to its image and then turn sharply to look behind them. They did not act as if they had heard a noise or

noticed movement of the string but rather that what they had seen on TV or in the mirror had caused them to turn around. Although the clown face could have been lowered behind the children in the Discordant and Other Child conditions, this was not done so as to minimize the possibility of chance discovery of the face.

The extent of previous mirror experience did not appear to influence when self recognition occurred in the conditions which had a correspondence between self and image movement. While some amount of mirror exposure is undoubtedly necessary for the children to originally notice that the image's movement matches their own, the amount may be minimal compared to that given to the children in the present study and perhaps to most children in this culture. Initial self recognition in young children seems to be cued by simultaneity between self and image movement and not directly by the amount of exposure time. The low correlations between extent of mirror exposure and when self recognition occurred are compatible with the previous study by D. Dixon (1952) who found no differences in mirror behaviors of children between the ages of 4 and 18 months who had differing degrees of mirror exposure.

The significant correlation between the extent of previous mirror exposure and when the child recognized himself in the Discordant Condition suggests that once representational thought is operating the child's development of a mental image of what he looks like may be advanced by extensive mirror experience which familiarizes him with his visual images. The nonsignificant correlation between



previous mirror experience and when the child recognized himself in the Photograph Condition, however, makes this inference tentative.

Self recognition in all the conditions was preceded by parent recognition in the videotapes and photographs. For most children parent recognition in both media occurred on the first session indicating that recognition of known images was not difficult in either medium. This finding is compatible with Dixon's (1957) report that children were interested in the reflection of significant others before being interested in their own reflection. It also suggests the prematurity of Preyer's (1893) report of self recognition in his 14-month old son which was based on the son's recognition of his mother's reflection at this age.

Sex differences in the present study indicated that girls attended to the TV or mirror more than boys. While it might be assumed that girls find people, and their images, more interesting than boys, this assumption has found little experimental support (Maccoby and Jacklin, 1974; Dodd and Lewis, 1969). It may be that the adults' request to attend to the TV or mirror were adhered to more by the girls than by the boys which would indicate that the girls were more strongly socialized to meet adult expectations.

The results of the study support the hypothesis that the young child first comes to recognize himself on the basis of simultaneity of movement between self and image, i.e., the young child initially understands his reflection in terms of his interaction with it. This understanding may come only after the full development of object

permanence. Through interaction with his image and the development of representational thought the child constructs a mental image of what he looks like. The child can then recognize his image by matching his mental self image to the visual images he sees.

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Footnotes

<sup>1</sup>The child referred to may be of either sex. It is only for convenience and lack of an appropriate neutral term that masculine pronouns are used throughout the text.

<sup>2</sup>Previous studies have shown body movement to be an important factor in perceptual learning and development (Held and Bossen, 1961; Held and Hein, 1963).

<sup>3</sup>Extensive pilot work on objective response measures of self recognition revealed this method to be most efficient for it was virtually soundless and required a minimum of experimenter manipulation. Thus the subject's differential behavior was cued only by the appearance of the clown face on the TV screen. It was assumed that if the child recognized the TV image as his own, the clown face appearing behind the image would be perceived as behind him and he would turn to look for it.

<sup>4</sup>In mirror images the left side of the observer corresponds to the left side of the image from the observer's point of view while the reverse is true for videotape images.

<sup>5</sup>Although both the Discordant Condition and the Photograph Condition lack the correspondence between self and image movement, the difference in the media and presentations may cause a difference in the child's response to the conditions. For instance, the Photograph Condition has no movement while the Discordant Condition has noncorresponding movement. The Photograph Condition presents a

series of pictures simultaneously while the Discordant Condition is one of a successive series of presentations. The photograph image is smaller in size than the TV image. There also may be a difference in clarity.

<sup>6</sup>At the beginning of the study the clown face was pulled close to the ceiling when not in use so that it was not immediately visible. But when it was noted that the children could see it by looking directly above their heads, the face was hidden behind the top of the wooden screen when not in use. The experimenter could hide the clown face behind the screen without moving from her position behind the equipment table by raising the clown face to the ceiling and then lowering it again so that it slipped behind the screen instead of in front of it.

<sup>7</sup>The parent filmed for the Parent Condition was either the mother or the father, whoever accompanied the child.

<sup>8</sup>The child in the Other Child Condition was a 22-month old boy who was chosen because his hairstyle and clothing could be taken as appropriate for either a boy or a girl. His age was that of the children at the midpoint of the study.

<sup>9</sup>On those sessions where it was necessary to complete the session with the child in close contact with the parent, an effort was made to keep the filmed or reflected parts of the parent to a minimum. Nevertheless, the background of the Simultaneous and Mirror conditions was different on these sessions than on others. However, the two children did not differ from the remaining children in the developmental sequence of recognition.

<sup>10</sup>When the children turned to find the clown face in the Simultaneous and Mirror conditions, they played with it for varying lengths of time often with their backs to the TV screen. Thus, attention time and movement testing time were calculated for only the first two minutes of each condition before the clown face appeared.

<sup>11</sup>Two criteria were used in making judgments of self recognition in order that a more accurate measure of self recognition could be made, i.e., in order to reduce the Type II error. Turning to look for the clown face provided a behavioral measure which was independent of the child's verbal abilities or desires. The verbal identification provided an additional measure in case the child accidentally saw the clown face behind him before he noticed it behind the image or if the child did not attend to the clown face or become interested in looking for it.

<sup>12</sup>If future investigators wish to train themselves to score for attention and movement testing as the author has done, a copy of the videotape for subject #3 in session 2 is available through Special Collections, Simon Fraser University Library. The author's scores for percentage of attention time and percentage of attention time spent in movement testing in the first two minutes of each condition of this tape are found in Tables E2 and E3 in Appendix E.

<sup>13</sup>In her initial recognition session in the Simultaneous Condition (session 4), child #2 turned to find the clown face behind her for the first time. She became very frightened of it and was still frightened when the Mirror Condition began. She spent little time



looking at the image in the Mirror Condition and turned repeatedly to see if the clown face was behind her, thus a clear judgment could not be made as to whether she showed self recognition in the Mirror Condition. Her parent reported that at home the child named her mirror reflection spontaneously for the first time two weeks before the session. Therefore, the child was judged as recognizing herself in the mirror in the same month that she recognized herself for the first time in the Simultaneous Condition but her data were not included in the analyses of children's behaviors at mirror recognition.

<sup>14</sup>Subject #8, the only child who did not show movement testing in the Simultaneous Condition prior to self recognition, recognized himself in the Simultaneous and Discordant conditions in the same session, suggesting that mental self imagery was the basis of recognition in the Simultaneous Condition as well as in the Discordant Condition. The child's high amount of previous mirror exposure suggests that he may have had prior experience with movement testing.

<sup>15</sup>Analyses of variance of percentage of attention time and percentage of attention time spent in movement testing for the sessions before, during, and after self recognition in the Simultaneous Condition included data from only ten children as one child completed only one, rather than two, session after self recognition in that condition. This child showed the same general trends of behavior as the other children at this time.

### Appendix A

The analyses of the children's performance before, during, and after self recognition in the Mirror and Discordant conditions are discussed below.

#### Self Recognition in the Mirror Condition

A Conditions x Sex x Sessions analysis of variance was computed on attention time aligned with respect to the session in which self recognition in the Mirror Condition occurred. Included in the analysis were the data from the session before self recognition, the session in which self recognition occurred, and two sessions after self recognition. The analysis yielded significant main effects for conditions,  $F(4, 36) = 7.04, p < .001$ , and sessions,  $F(3, 24) = 3.64, p < .05$ , with no significant interactions or main effect for sex. A Tukey ( $p < .05$ ) followup of the main effect for conditions showed that there was significantly more attention in the Simultaneous and Discordant conditions than in the Mirror or Other Child conditions. A Tukey ( $p < .05$ ) followup of the main effect for sessions showed that attention in the second session after self recognition was significantly greater than attention before self recognition. The mean percentages of attention time in each condition and session are found in Table A1.

A similar analysis of variance was computed for the percentage of attention time spent in movement testing in the same sessions. This analysis yielded a significant main effect for conditions,  $F(4, 32) = 15.20, p < .001$ , with no significant interactions or other

Table A1

Mean Percentage of Attention Time in Each Condition in Sessions Before, During, and After Self Recognition in the Mirror Condition

Sessions	Conditions						Mean
	Parent	Discordant	Other Child	Simultaneous	Mirror		
1 before recognition	39%	37%	21%	35%	24%		31%
1 after	43%	39%	34%	51%	27%		39%
2 after	36%	42%	34%	46%	35%		39%
Mean	33%	56%	35%	49%	35%		41%
	38%	44%	31%	45%	30%		38%

main effects. A Tukey ( $p < .05$ ) followup of the main effect for conditions showed significantly more movement testing occurred in the Simultaneous Condition than in any of the other conditions. The mean percentages for attention time spent in movement testing in each condition and session are found in Table A2.

#### Self Recognition in the Discordant Condition

A Conditions x Sex x Sessions analysis of variance was computed on the percentage of attention time spent in movement testing aligned with respect to the session on which self recognition occurred for the six children who recognized themselves in the Discordant Condition. The analysis included the data from the two sessions before recognition, the recognition session, and one session after recognition. The analysis yielded a significant main effect for conditions,  $F(4, 16) = 8.37$ ,  $p < .001$ , with no significant interactions or other main effects. A Tukey ( $p < .05$ ) followup of the main effect for conditions showed that significantly more movement testing occurred in the Simultaneous Condition than in the Parent, Discordant, and Other Child conditions and significantly more movement testing occurred in the Mirror Condition than in the Parent Condition. The mean percentages for attention time spent in movement testing in each condition and session are found in Table A3.

Table A2

Mean Percentage of Attention Time Spent in Movement Testing in Each Condition in Sessions Before, During, and After Self Recognition in the Mirror Condition

Sessions	Conditions						Mean
	Parent	Discordant	Other Child	Simultaneous	Mirror		
1 before	2%	0%	1%	13%	1%	3%	
recognition	2%	0%	0%	25%	6%	7%	
1 after	2%	0%	1%	16%	15%	7%	
2 after	1%	3%	1%	27%	12%	9%	
Mean	2%	1%	1%	20%	8%	6%	

Table A3

Mean Percentage of Attention Time Spent in Movement Testing in Each Condition in Sessions Before, During, and After Self Recognition in the Discordant Condition

Sessions	Conditions						Mean
	Parent	Discordant	Other Child	Simultaneous	Mirror		
2 before	3%	6%	2%	20%	25%		11%
1 before	2%	4%	3%	7%	12%		6%
recognition	0%	4%	9%	24%	11%		9%
1 after	0%	2%	0%	20%	3%		5%
Mean	1%	4%	4%	17%	13%		8%

### Appendix B

The children's use of first and second person pronouns, their performance on the Picture Perspective Task, and the relationship between the use of pronouns and the Picture Perspective Task are discussed below.

#### Pronoun Usage

The children's use of first and second person pronouns evolved in a developmental sequence which was as follows: "my" or "mine", "me", "I", "you", and "yours". Table B1 shows the sessions on which the children began to use first and second person pronouns and personal names for self and parent, the sessions in which first person pronouns were used incorrectly to refer to the parent, and the sessions in which second person pronouns were used incorrectly to refer to self. Data were taken from the monthly charts filled out by parents, parental reports in each session, and the language the children used in the sessions.

All children were using a reference to the parent from the beginning of the study. In all cases the reference was a personal label, e.g., "mama", "daddy".

Commonly the use of a first person pronoun as a self reference preceded the use of the child's first name. Only one child was using his personal name as his only self reference at the beginning of the study. Three others were using their first name and a first person pronoun. The remaining children acquired the use of their name in the course of the study and had acquired at least one first person pronoun

Table B1

Use of First and Second Person Pronouns in Reference to Self and Parent

Subject	Reference to Self				Reference to Parent					
	Correct*		Incorrect**		Correct*		Incorrect**			
	my/mine	I	me	I	hame	2nd. person pronouns	you	yours	name	lst. person pronouns
1	1	1	2	3		3,7	3	4	1	-
2	3	1	9	1		-	-	-	1	7
3	1	1	4	3		1,2,5	4	5	1	2,5,6,7,8
4	2	2	6	5		2,3,5,9	6	8	1	7,8,9
5	6	1	7	3		-	-	-	1	-
6	1	4	7	1		4,5,7,8	5	4	1	-
7	3	4	7	7		-	-	-	1	-
8	3	1	3	1		7,8	7	7	1	1,2,7,8
9	1	6	10	7		-	1	-	1	-
10	1	4	5	3		8	7	-	1	-
11	2	2	3	1		-	-	-	1	2
Mean	2.2	2.5	5.7	3.2			5.3	5.6	1.0	

\*Initial Session Only \*\*Every Session



prior to it. Three parents of the children who began using their names rather late in the study reported that their children had difficulty pronouncing the sounds which were contained in their names. The mean number of sessions until the children used their names as self references was 3.2 with a range of 1 to 7 sessions.

The most frequently acquired first self reference was either "my" or "mine" which was generally used by the children to designate objects of their desire whether theirs or otherwise. Three children acquired "me" before "my" or "mine" but in all three cases "me" was used in place of "my", e.g., "me shoes". For two of the children "me" was used both as an object and a possessive. For the other child "me" was used only as a possessive and was dropped for two months when "my" was introduced. The mean number of sessions until the children used "my" or "mine" as a self reference was 2.2 with a range of 1 to 6 sessions.

The pronoun "I" was acquired after "me" by all the children. The mean number of sessions until the children used "I" as a self reference was 5.7 with a range of 2 to 10 sessions.

The children were using first person pronouns before they began using second person pronouns. Two children acquired "I" and "you" in the same month. One child acquired "you" before "I" and the use of "yours" and "me" in the same month; the second person pronouns, however, were used to refer to both self and parent.

The pronoun "yours" was acquired after "you" except for one child who acquired the use of both pronouns in the same month.

Thus for second person pronouns the possessive form was not the first form acquired as it was for first person pronouns. The mean number of sessions until the children who used second person pronouns to refer to their parents did so was 5.3 for "you" with a range of 3 to 7 sessions and 5.6 for "yours" with a range of 4 to 8 sessions.

Most children confused the referents for either first or second person pronouns for some portion of the study. Those who did not, had not yet begun using second person pronouns. One child who had not used the pronouns incorrectly indicated his confusion, nevertheless, when the parent referred to the child by "you" the child corrected his parent by responding, "no, me".

Only one child was using all the forms of first and second person pronouns with no incorrect usage by the end of the study. Eight children were using all first person pronouns with no incorrect usage by the end of the study. The three other children had been using first person pronouns correctly but when second person pronouns were introduced their previously established use of first person pronouns was confused. One child was using second person pronouns correctly by the end of the study but was still confusing the referents for first person pronouns.

#### Picture Perspective Task

The children's confusion of the referents for first person pronouns may have affected their performance on the Picture Perspective Task. Table B2 shows the percentage of trials which were scored correct, turned-card, or egocentric for trials in which the experimenter's

Table B2

Percentage of Egocentric, Turned-Card, and Correct Responses To  
Questions Using Pronouns and Proper Names

Questions	Responses			Total
	Egocentric	Turned-Card	Correct	
Pronouns	25%	23%	14%	62%
Names	19%	22%	12%	53%

questions included pronouns versus proper names. A higher percentage of questions were answered on the trials in which pronouns were used than on trials in which proper names were used. Although the percentage of correct and turned-card responses were comparable for questions using names and questions using pronouns, there was a higher percentage of egocentric responses to questions using pronouns than to questions using names. Thus the higher percentage of responses to questions using pronouns was mainly due to a greater number of egocentric responses. This finding could indicate that the children had difficulty understanding the referent for the word "I" when spoken by another. They may have responded to the question "What do I see?" (spoken by the experimenter) with what they were seeing because they misunderstood the sentence.

Although there were only three types of cards used (cards with a different picture on each side (Task X-Y), cards with the same picture on each side (Task X-X), and cards with a picture on only one side) the data indicate that they presented four different tasks to the child. The cards with a picture on only one side provided the child with two different tasks: exposure to a blank when the experimenter was exposed to a picture (Task O-X) and exposure to a picture when the experimenter was exposed to a blank (Task X-O).

The tasks varied from the easiest to the most difficult in the following order: Task X-X, Task O-X, Task X-Y, and Task X-O. Table B3 shows the percentage of answered trials which were classified as correct, turned-card, or egocentric on each of the four tasks.

Table B3

Percentage of Answered Trials Scored Egocentric, Turned-Card, or Correct on Each Picture Perspective Task

Task	Responses		
	Egocentric	Turned-Card	Correct
X-X	0%	25%	75%
0-X	21%	43%	36%
X-Y	29%	50%	21%
X-0	49%	35%	16%

The difficulty of the tasks was indicated by the decreasing percentage of correct responses and the increasing percentage of egocentric responses. The order was the same on both measures. Task X-X could have no egocentric responses because if the child named the picture he was seeing he also was naming the picture the experimenter was seeing. This task was judged the easiest because it had the largest percentage of correct responses; it also had the smallest percentage of turned-card responses.

In order to determine the development of responding on each task each child was given a separate score of correct, turned-card, or egocentric for each task on each session. The score was determined by whether the majority of responses to each task was classified as correct, turned-card, or egocentric. If the children's answers were classified half as one response and half as another response, the more developmentally advanced score was given.

A general developmental pattern of responding emerged. Egocentric responses came first, followed by turned-card responses, and finally by correct responses for Task X-Y, Task O-X, and Task X-O. Some children did not show the entire sequence of responses in the course of the study but the tendency toward this developmental pattern was reflected in the responses of all children on all three tasks. The Task X-X showed a pattern of responding which was dependent on responses to the other three tasks. The children responded correctly to this task except on those sessions where the majority of responses to the other tasks were turned-card responses

in which case the children responded to this task with turned-card responses also.

The relative difficulty of the tasks indicated in Table B3 was substantiated by the number of sessions required to begin responding by turned-card or correct responses. Table B4 shows the sessions in which each child received either turned-card or correct scores followed by at least one consecutive session of either turned-card or correct scores and the sessions in which each child received all correct scores followed by at least one consecutive session of all correct scores on each of the four tasks. The mean number of sessions to turned-card or correct responding for those children who did so was 3.3, 4.4, 4.6, and 5.1 for Tasks X-X, O-X, X-Y, and X-O, respectively. The mean number of sessions to only correct responding for those children who did so was 4.7, 6.0, 6.5, and 7.5 for Tasks X-X, O-X, X-Y, and X-O, respectively. The order of difficulty was the same on both measures.

#### Relationship between the Picture Perspective Task and Pronoun Usage

The ability to take another's perspective on the Picture Perspective Task had language correlates. Table B5 shows the sessions in which the children began using first and second person pronouns correctly with no further confusion, the sessions in which they began receiving either turned-card or correct scores on all the Picture Perspective Tasks, and the sessions in which they began receiving only correct scores on all the Picture Perspective Tasks. The child who was using both first and second person pronouns correctly was

Table B4

Initial Sessions of Either Turned-Card or Correct Scores and All Correct Scores on Each Picture Perspective Task

Subjects	Turned-Card or Correct				All Correct			
	X-X	O-X	X-Y	X-O	X-X	O-X	X-Y	X-O
1	2	1	1	1	6	6	6	7
2	4	6	8	8	4	-	-	-
3	5	6	4	-	5	6	-	-
4	2	5	-	-	4	7	-	-
5	5	5	5	5	5	-	-	-
6	4	4	3	5	7	-	-	-
7	5	4	2	5	7	-	-	-
8	2	6	7	7	2	-	-	-
9	3	6	7	8	3	6	7	8
10	2	2	4	2	5	5	-	-
11	2	4	5	5	4	-	-	-
Mean	3.3	4.4	4.6	5.1	4.5	6.0	6.5	7.5



Table B5

Initial Sessions of 1st. and 2nd. Person Pronoun Usage and Perspective Taking on Picture Perspective Task

Subjects	Correct Use of All		Correct Use of All 2nd. Person Pronouns	Turned-Card or Correct Scores on all Picture Perspective Tasks		Correct Scores on All Picture Perspective Tasks	
	1st. Person Pronouns	2nd. Person Pronouns		Perspective Tasks	Perspective Tasks	Perspective Tasks	Perspective Tasks
1	2	8	2	7			
2	9	-	8	-			
3	-	6	-	-			
4	-	-	-	-			
5	7	-	5	-			
6	7	-	5	-			
7	7	-	5	-			
8	-	-	7	-			
9	10	-	8	8			
10	5	-	4	-			
11	3	-	5	-			
Mean	6.2	7.0	5.4	7.5			

also responding correctly to all of the Picture Perspective Tasks. The eight children who were using only first person pronouns correctly were responding with turned-card or correct responses to the Picture Perspective Tasks. One child who was responding correctly to all the Picture Perspective Tasks was not yet using both first and second person pronouns correctly and one child who was receiving either turned-card or correct scores on all the Picture Perspective Tasks was not yet using first person pronouns correctly. Thus in comparing these two measures the more behavioral task of perspective taking preceded perspective taking in the use of language. This finding is consistent with the Piagetian hypothesis that language reflects underlying thought processes rather than instigates them (Sinclair-de-Zwart, 1969).

Appendix C

Sample check list for child's references to self and parent.

Name \_\_\_\_\_ Date \_\_\_\_\_

Child Refers to Himself		Child Refers to Parent	
By Name	By I, Me, Mine (example sentence)	By Name	By You, Yours (example sentence)
	Incorrectly by You, Yours (example sentence)		Incorrectly by I, Me, Mine (example sentence)

Appendix D

Analyses of Variance

Table D1  
 Analysis of Variance of Percentage of  
 Attention Time Over All Eight Sessions

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.593	3.75
Error	9	.158	
Conditions (A)	4	.375	10.11****
A x S	4	.013	.35
Error	36	.037	
Sessions (B)	7	.098	3.33***
B x S	7	.043	1.48
Error	63	.029	
A x B	28	.024	1.36
A x B x S	28	.018	1.01
Error	252	.018	

\*\*\*\*p < .001.

\*\*\*p < .005.

Table D2  
 Analysis of Variance of Percentage of  
 Attention Time Spent in Movement Testing Over All Eight Sessions

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.052	.41
Error	9	.128	
Conditions (A)	4	.676	14.63****
A x S	4	.006	.13
Error	36	.046	
Sessions (B)	7	.035	1.78
B x S	7	.019	.96
Error	63	.020	
A x B	28	.014	1.13
A x B x S	28	.015	1.20
Error	252	.012	

\*\*\*\*  $p < .001$ .

Table D3

## Parent Recognition:

## Analysis of Variance of Percentage of Attention Time

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.292	4.11
Error	9	.071	
Conditions (A)	4	.064	3.27*
A x S	4	.015	.74
Error	36	.019	

\*  $p < .05$ .



Table D4

Parent Recognition: Analysis of Variance of  
Percentage of Attention Time Spent in Movement Testing

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.002	.16
Error	9	.012	
Conditions (A)	4	.068	5.50****
A x S	4	.001	.06
Error	36	.012	

\*\*\*\*  $p < .001$

Table D5

Self Recognition in the Mirror Condition:  
 Analysis of Variance of Percentage of Attention Time

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.181	2.16
Error	8	.084	
Conditions (A)	4	.194	7.04****
A x S	4	.009	.33
Error	32	.028	
Sessions <sup>a</sup> (B)	3	.097	3.64*
B x S	3	.026	.96
Error	24	.027	
A x B	12	.028	1.46
A x B x S	12	.015	.80
Error	96	.019	

<sup>a</sup>Sessions included were one before recognition, recognition session, and two after recognition

\*\*\*\*  $p < .001$ .

\*  $p < .05$ .

Table D6

Self Recognition in the Mirror Condition: Analysis of Variance of Percentage of Attention Time Spent in Movement Testing

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.016	.50
Error	8	.032	
Conditions (B)	4	.275	15.20****
A x S	4	.009	.51
Error	32	.018	
Sessions <sup>a</sup> (B)	3	.027	1.53
B x S	3	.006	.35
Error	24	.018	
A x B	12	.015	1.15
A x B x S	12	.008	.62
Error	96	.032	

<sup>a</sup>Sessions included were one before recognition, recognition session, and two after recognition.

\*\*\*\*  $p < .001$ .

Table D7

Self Recognition in the Simultaneous Condition: Analysis of  
Variance of Percentage of Attention Time

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.701	23.10****
Error	8	.030	
Conditions (A)	4	.265	8.74****
A x S	4	.006	.18
Error	32	.030	
Sessions <sup>a</sup> (B)	4	.052	1.53
B x S	4	.047	1.37
Error	32	.034	
A x B	16	.024	1.15
A x B x S	16	.008	.37
Error	128	.021	

<sup>a</sup>Sessions included were two before recognition, recognition session, and two after recognition.

\*\*\*\*  $p < .001$

Table D8

Self Recognition in the Simultaneous Condition: Analysis of Variance  
of Percentage of Attention Time Spent in Movement Testing

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.054	.29
Error	8	.052	
Conditions (A)	4	.428	16.52****
A x S	4	.006	.23
Error	32	.026	
Sessions <sup>a</sup> (B)	4	.037	2.47
B x S	4	.036	2.43
Error	32	.015	
A x B	16	.032	2.40***
A x B x S	16	.012	.90
Error	128	.013	

<sup>a</sup>Sessions included were two before recognition, recognition session, and two after recognition.

\*\*\*\*  $p < .001$

\*\*\*  $p < .005$

Table D9

Self Recognition in the Simultaneous Condition: Analysis of Variance  
of Percentage of Attention Time Spent in Movement Testing  
in the Parent Condition

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sessions <sup>a</sup>	4	.001	1.03
Error	36	.001	

<sup>a</sup>Sessions included were two before recognition, recognition session,  
and two after recognition.

Table D10

Self Recognition in the Simultaneous Condition: Analysis of Variance  
of Percentage of Attention Time Spent in Movement Testing  
in the Discordant Condition

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sessions <sup>a</sup>	4	.009	2.22
Error	36	.004	

<sup>a</sup>Sessions included were two before recognition, recognition session,  
and two after recognition.

Table D11

Self Recognition in the Simultaneous Condition: Analysis of Variance  
of Percentage of Attention Time Spent in Movement Testing  
in the Other Child Condition

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sessions <sup>a</sup>	4	.007	1.06
Error	36	.007	

<sup>a</sup>Sessions included were two before recognition, recognition session, and two after recognition.



Table D12

Self Recognition in the Simultaneous Condition: Analysis of Variance  
of Percentage of Attention Time Spent in Movement Testing  
in the Simultaneous Condition

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sessions <sup>a</sup>	4	.105	2.78*
Error	36	.038	

<sup>a</sup>Sessions included were two before recognition, recognition session,  
and two after recognition.

\*  $p < .05$

Table D13

Self Recognition in the Simultaneous Condition: Analysis of Variance  
of Percentage of Attention Time Spent in Movement Testing  
in the Mirror Condition

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sessions <sup>a</sup>	4	.028	1.28
Error	36	.022	

<sup>a</sup>Sessions included were two before recognition, recognition session, and two after recognition.

Table D14

Self Recognition in the Discordant Condition: Analysis of Variance  
of Percentage of Attention Time

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.239	9.36*
Error	4	.025	
Conditions (A)	4	.136	6.65***
A x S	4	.033	1.64
Error	16	.020	
Sessions <sup>a</sup> (B)	3	.001	.07
B x S	3	.054	2.88
Error	12	.019	
A x B	12	.015	.76
A x B x S	12	.031	1.52
Error	48	.028	

<sup>a</sup>Sessions included were two before recognition, recognition session, and one after recognition.

\*\*\*  $p < .005$

\*  $p < .05$

Table D15

Self Recognition in the Discordant Condition: Analysis of Variance  
of Percentage of Attention Time Spent in Movement Testing

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.000	.01
Error	4	.052	
Conditions (A)	4	.113	8.37****
A x S	4	.018	1.33
Error	16	.014	
Sessions <sup>a</sup> (B)	3	.028	1.50
B x S	3	.007	.39
Error	12	.019	
A x B	12	.017	1.24
A x B x S	12	.009	.66
Error	48	.013	

<sup>a</sup>Sessions included were two before recognition, recognition session, and one after recognition.

\*\*\*\*  $p < .001$

Table D16

Analysis of Variance of Frequency of Deferred Imitation in the  
Discordant and Other Child Conditions Over All Eight Sessions

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Sex (S)	1	.001	.00
Error	9	.489	
Conditions (A)	1	3.007	7.90*
A x S	1	.007	.02
Error	9	.380	
Sessions (B)	7	.264	.85
B x S	7	.147	.47
Error	63	.310	
A x B	7	.359	1.49
A x B x S	7	.191	.79
Error	63	.240	

\*  $p < .05$

Appendix E

Raw Data

Table E1

## Recognition Responses

Subject	Condition	Sessions								
		1	2	3	4	5	6	7	8	9
1	Parent	N <sup>a</sup>	N	N	N	N	N	N	N	N
	Discordant	-	-	-	-	N	N	N	N	N
	Other Child	-	-	-	-	-	N	-	-	-
	Simultaneous	-	-	-	-	CF,N	CF,N	CF,N	CF,N	CF,N
	Mirror	-	-	-	N	N	CF,N	CF,N	CF	
2	Parent	-	N	N	N	N	N	N	N	N
	Discordant	-	N	-	-	-	-	-	N	N
	Other Child	-	N	-	-	-	-	CF	-	N
	Simultaneous	-	N	-	CF,N	N	CF,N	-	CF	N
	Mirror	-	N	-	-	CF,N	CF,N	-	-	CF,N
3	Parent	-	N	N	N	N	N	N	N	N
	Discordant	-	-	-	N	N	N	N	N	N
	Other Child	-	-	-	N	N	-	-	-	-
	Simultaneous	-	-	N	CF,N	CF,N	CF,N	CF,N	CF	CF,N
	Mirror	-	CF	CF	CF,N	CF,N	CF,N	CF,N	CF	CF,N
4	Parent	N	N	N	-	N	N	N	N	N
	Discordant	-	-	-	-	-	-	-	-	N
	Other Child	-	-	-	-	-	-	-	-	N
	Simultaneous	-	-	-	-	-	CF,N	CF	-	CF,N
	Mirror	-	-	CF	CF	CF	CF	CF	CF	CF,N
5	Parent	N	N	N	N	N	N	N	N	N
	Discordant	-	-	-	-	-	-	N	N	
	Other Child	-	-	-	-	-	-	-	N	
	Simultaneous	-	-	-	-	-	-	N	CF,N	
	Mirror	-	-	-	N	CF	CF	-	CF,N	
6	Parent	N	N	N	N	N	N	N	N	N
	Discordant	-	-	-	-	-	-	N	N	
	Other Child	-	-	-	-	-	-	-	-	
	Simultaneous	-	-	-	-	CF	CF	N	CF,N	
	Mirror	-	-	CF	CF,N	CF,N	CF	N	-	
7	Parent	N	N	N	N	N	N	N	N	N
	Discordant	-	-	-	-	-	-	N	N	
	Other Child	-	-	-	-	-	-	N	N	
	Simultaneous	-	-	CF	CF	CF	-	CF,N	N	
	Mirror	-	CF	CF	CF	CF	CF	CF,N	CF,N	
8	Parent	N	N	-	N	N	N	N	N	N
	Discordant	-	N	N	-	-	N	N	N	
	Other Child	-	N	N	-	-	-	-	-	
	Simultaneous	-	N	N	-	-	N	CF,N	N	
	Mirror	-	N	N	N	N	CF	CF,N	CF	

Table E1 (Continued)

Subject	Condition	Sessions								
		1	2	3	4	5	6	7	8	9
9	Parent	-	N	N	N	N	N	N	N	N
	Discordant	-	-	-	-	-	N	N	N	N
	Other Child	-	-	-	-	-	-	N	N	N
	Simultaneous	-	-	-	-	N	N	N	CF,N	CF,N
	Mirror	-	-	CF	CF	N	CF	CF	CF,N	CF,N
10	Parent	N	N	N	N	N	N	N	N	N
	Discordant	-	N	-	-	N	N	CF,N	CF,N	
	Other Child	-	N	-	-	N	-	-	-	-
	Simultaneous	-	N	-	CF,N	CF,N	N	N	CF,N	
	Mirror	-	N	CF	CF,N	CF,N	CF,N	CF	CF	
11	Parent	N	N	N	N	N	N	N	N	N
	Discordant	N	N	-	-	N	N	N	N	N
	Other Child	N	N	-	-	N	N	-	-	-
	Simultaneous	N	N	-	N	CF,N	N	CF	N	
	Mirror	N	N	CF	CF	N	CF	CF	CF	

<sup>a</sup>N = name

<sup>b</sup>CF = turn to clown face



Table E2

## Percentage of Attention Time

Subject	Condition	Sessions								
		1	2	3	4	5	6	7	8	9
1	Parent	34	45	35	51	63	55	63	43	
	Discordant	42	75	58	61	45	70	42	54	
	Other Child	15	48	46	47	30	38	51	31	
	Simultaneous	46	64	62	65	56	48	68	73	
	Mirror	30	28	37	46	35	36	36	38	
2	Parent	44	63	51	42	60	49	48	44	69
	Discordant	39	48	48	30	58	73	37	49	53
	Other Child	21	52	31	40	61	73	49	16	50
	Simultaneous	33	59	41	43	75	18	41	64	33
	Mirror	28	15	27	22	15	36	13	43	48
3	Parent	35	42	31	13	66	28	29	41	58
	Discordant	45	48	64	44	64	28	58	39	36
	Other Child	42	42	8	33	37	16	28	38	27
	Simultaneous	21	83	63	75	43	70	60	71	73
	Mirror	22	31	45	61	53	58	6	32	42
4	Parent	39	51	36	49	22	40	52	23	13
	Discordant	37	39	34	83	50	45	43	27	53
	Other Child	25	33	40	67	26	43	23	15	36
	Simultaneous	8	47	63	45	38	64	44	45	50
	Mirror	36	50	23	47	39	61	43	35	23
5	Parent	40	31	11	46	28	22	23	14	
	Discordant	12	27	33	17	32	18	21	29	
	Other Child	3	18	22	34	18	24	23	12	
	Simultaneous	18	8	36	41	30	6	48	33	
	Mirror	33	37	15	37	34	55	42	10	
6	Parent	36	58	47	38	42	50	44	27	
	Discordant	74	36	38	32	73	47	48	48	
	Other Child	64	11	20	48	58	13	19	31	
	Simultaneous	56	46	50	51	75	53	21	42	
	Mirror	41	8	19	29	9	43	12	35	
7	Parent	50	67	45	23	52	45	54	58	
	Discordant	43	42	59	57	46	35	66	35	
	Other Child	8	35	26	39	37	31	34	62	
	Simultaneous	38	41	59	43	26	48	41	64	
	Mirror	15	43	11	25	30	36	28	5	
8	Parent	25	21	37	43	26	31	33	54	
	Discordant	20	6	40	35	24	54	61	61	
	Other Child	5	18	14	32	36	38	4	15	
	Simultaneous	8	13	9	11	21	38	29	13	
	Mirror	28	21	15	19	44	40	58	12	

Table E2 (Continued)

Subject	Condition	Sessions								
		1	2	3	4	5	6	7	8	9
9	Parent	25	63	32	33	58	14	24	12	18
	Discordant	33	50	30	33	90	3	43	50	32
	Other Child	18	10	23	38	28	9	33	17	35
	Simultaneous	29	44	20	35	62	50	25	11	50
	Mirror	14	31	27	43	47	8	36	6	52
10	Parent	18	22	30	27	25	43	30	31	
	Discordant	24	18	32	38	34	38	57	40	
	Other Child	5	20	28	40	38	18	39	38	
	Simultaneous	17	21	68	23	53	28	37	65	
	Mirror	10	4	18	29	26	26	28	13	
11	Parent	18	27	32	22	43	15	57	38	
	Discordant	13	13	57	13	67	20	35	60	
	Other Child	13	4	50	26	24	21	34	33	
	Simultaneous	18	22	71	74	50	58	44	38	
	Mirror	31	43	10	29	9	13	35	52	

Table E3

## Percentage of Attention Time Spent in Movement Testing

Subject	Condition	Sessions								
		1	2	3	4	5	6	7	8	9
1	Parent	0	0	0	0	12	0	0	0	
	Discordant	0	16	0	0	5	0	0	8	
	Other Child	0	7	5	0	0	0	0	0	
	Simultaneous	0	5	20	9	18	0	9	11	
	Mirror	0	0	0	5	52	0	0	0	
2	Parent	0	3	0	0	0	0	0	0	0
	Discordant	0	0	0	0	0	0	0	0	0
	Other Child	12	5	0	0	0	0	0	0	0
	Simultaneous	38	38	86	4	44	0	0	84	0
	Mirror	0	0	3	0	0	0	0	20	0
3	Parent	0	2	0	0	0	0	0	0	0
	Discordant	0	0	0	6	9	0	4	13	16
	Other Child	0	0	0	0	0	0	0	15	0
	Simultaneous	0	46	13	36	0	65	33	42	29
	Mirror	0	0	7	25	27	36	0	5	16
4	Parent	0	0	0	5	0	0	0	0	0
	Discordant	0	0	0	0	0	0	0	0	0
	Other Child	0	0	0	0	0	0	0	0	0
	Simultaneous	0	27	0	15	38	22	57	11	17
	Mirror	0	0	0	14	33	0	24	6	0
5	Parent	0	0	0	0	0	0	0	12	
	Discordant	0	0	0	0	0	0	0	0	
	Other Child	0	0	0	0	0	0	0	0	
	Simultaneous	0	0	0	0	8	43	26	18	
	Mirror	9	5	0	0	0	0	22	0	
6	Parent	0	22	0	0	0	13	0	0	
	Discordant	0	0	0	0	0	0	0	0	
	Other Child	0	0	4	0	0	0	0	0	
	Simultaneous	13	0	7	13	9	11	0	38	
	Mirror	0	0	0	0	25	29	0	0	
7	Parent	0	0	0	0	0	0	0	0	
	Discordant	0	0	0	0	36	36	32	19	
	Other Child	0	0	10	0	0	0	7	0	
	Simultaneous	42	61	23	69	68	67	99	52	
	Mirror	0	58	0	33	19	40	88	0	
8	Parent	0	0	20	0	0	0	0	0	
	Discordant	0	0	0	0	0	0	0	0	
	Other Child	0	0	0	0	0	0	0	0	
	Simultaneous	0	0	0	0	0	0	0	0	
	Mirror	0	0	0	0	0	0	9	0	

Table E3 (Continued)

Subject	Condition	Sessions								
		1	2	3	4	5	6	7	8	9
9	Parent	0	0	0	0	0	0	0	0	0
	Discordant	0	0	0	0	0	0	0	0	0
	Other Child	0	0	0	4	0	0	0	0	12
	Simultaneous	0	28	0	0	38	0	47	0	18
	Mirror	12	5	0	0	0	0	0	0	6
10	Parent	0	0	0	0	0	0	0	5	
	Discordant	0	0	3	0	0	7	0	0	
	Other Child	0	0	0	0	0	55	0	0	
	Simultaneous	10	0	49	37	19	29	4	25	
	Mirror	0	0	0	49	0	10	0	13	
11	Parent	0	0	0	0	10	0	0	0	
	Discordant	0	0	0	0	25	17	14	0	
	Other Child	0	0	0	0	14	16	0	2	
	Simultaneous	0	0	63	29	17	11	38	33	
	Mirror	0	0	0	23	0	13	20	10	

Table E4

## Recognition in the Photograph Condition

Subject	Recognition	Sessions									
		1	2	3	4	5	6	7	8	9	10 <sup>a</sup>
1	Parent	Y <sup>b</sup>	Y	Y	Y	Y	Y	Y	Y		
	Self	N <sup>c</sup>	N	N	N	N	N	N	Y		
2	Parent	N	Y	Y	Y	Y	Y	Y	Y	Y	
	Self	N	N	N	N	N	N	N	N	Y	
3	Parent	Y	N	Y	Y	Y	Y	Y	Y	Y	
	Self	N	N	N	N	N	Y	Y	N	N	
4	Parent	Y	Y	Y	Y	Y	Y	Y	Y	Y	
	Self	N	N	N	N	N	N	N	Y	Y	
5	Parent	N	N	Y	Y	Y	Y	Y	Y		
	Self	N	N	N	N	N	N	Y	Y		
6	Parent	Y	Y	Y	Y	Y	Y	Y	Y		
	Self	N	N	N	N	N	N	Y	Y		
7	Parent	Y	Y	Y	Y	Y	Y	Y	Y		
	Self	N	N	N	N	N	N	N	Y		
8	Parent	N	N	Y	Y	Y	Y	Y	Y		
	Self	N	N	N	N	N	N	N	N		
9	Parent	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Self	N	N	N	N	N	N	N	N	N	Y
10	Parent	Y	Y	Y	Y	Y	Y	Y	Y		
	Self	N	N	N	N	N	Y	Y	Y		
11	Parent	Y	Y	Y	Y	Y	Y	Y	Y		
	Self	N	N	N	N	N	N	N	Y		

<sup>a</sup>Home session given only to Subject #9.

<sup>b</sup>Y = Yes

<sup>c</sup>N = No

## Frequency of Daferred Imitation

Subject	Condition	Sessions								
		1	2	3	4	5	6	7	8	9
1	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	1	-	2	1	1	2	
	Other Child	-	-	-	1	1	-	-	-	
2	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	1	1	1	1	-	1	-	1
	Other Child	-	2	-	-	-	-	-	-	1
3	Parent	-	-	-	-	-	-	-	-	-
	Discordant	1	-	1	1	1	-	1	-	2
	Other Child	-	-	-	-	-	-	-	-	-
4	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	-	-	-	1	1	-
	Other Child	-	-	-	1	-	2	-	-	-
5	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	1	-	-	-	-	-
	Other Child	-	-	-	-	-	-	-	-	-
6	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	-	-	-	-	-	-
	Other Child	1	-	-	-	-	-	-	-	-
7	Parent	-	-	-	-	-	-	-	-	-
	Discordant	1	-	-	-	-	1	1	1	
	Other Child	1	-	-	-	-	-	-	-	
8	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	1	-	1	-	-	-
	Other Child	-	-	-	1	1	-	-	-	-
9	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	-	-	-	-	1	-
	Other Child	-	-	-	-	1	-	-	-	1
10	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	1	-	1	1	1	-	-	-
	Other Child	-	-	-	-	-	-	-	-	-
11	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	-	1	-	3	2	
	Other Child	-	-	-	-	-	1	-	1	

Table E6

## Frequency of Matching Behavior

Subject <sup>a</sup>	Condition	Sessions								
		1	2	3	4	5	6	7	8	9
1	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	-	-	-	-	-	-
	Other Child	-	-	-	1	-	-	-	-	-
2	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	1	-	1	-	-	-	-	-
	Other Child	-	-	-	-	-	-	-	-	-
3	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	-	-	-	-	-	1
	Other Child	-	-	-	-	-	-	-	-	-
7	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	-	-	1	1	1	-
	Other Child	-	-	-	-	-	-	-	-	-
11	Parent	-	-	-	-	-	-	-	-	-
	Discordant	-	-	-	-	-	-	1	-	-
	Other Child	-	-	-	-	1	-	-	-	-

<sup>a</sup>Only those subjects who showed matching behavior.

Table E7

## Number of Correct Trials in the Fourth Object Permanence Task

Subject	Sessions								
	1	2	3	4	5	6	7	8	9
1	4	4	2	2	3	4	4	4	
2	2	3	2	1	0	3	3	4	4
3	1	3	1	2	4	3	3	2	3
4	0	2	4	2	3	4	3	4	3
5	1	1	4	3	4	4	4	4	
6	2	1	3	3	0	4	4	4	
7	4	4	2	4	4	4	4	4	
8	0	1	3	0	2	4	3	2	
9	3	4	3	4	3	4	4	4	4
10	2	4	4	3	4	4	4	4	
11	0	1	3	0	0	3	3	2	



Table E8

## Scores on Each of the Picture Perspective Tasks

Subject	Task	Sessions								
		1	2	3	4	5	6	7	8	9
1	X-X	-	T <sup>a</sup>	T	C <sup>b</sup>	T	C	C	C	
	O-X	T	T	-	C	T	C	C	C	
	X-Y	T	T	T	C	T	C	C	C	
	X-O	T	T	-	E <sup>c</sup>	T	T	C	C	
2	X-X	-	C	-	C	C	C	C	C	C
	O-X	-	-	E	-	E	T	T	C	T
	X-Y	-	T	E	E	E	T	E	C	T
	X-O	-	E	E	T	E	T	E	C	C
3	X-X	-	-	-	-	C	C	C	C	T
	O-X	-	-	E	E	-	C	C	C	T
	X-Y	-	-	-	C	T	T	T	T	T
	X-O	-	-	E	E	-	E	-	C	E
4	X-X	-	T	T	C	C	C	C	C	C
	O-X	-	-	-	E	T	T	C	C	C
	X-Y	-	T	-	E	-	E	E	E	C
	X-O	-	-	-	E	-	-	E	E	E
5	X-X	-	-	-	-	C	C	C	-	
	O-X	-	-	-	-	T	T	T	-	
	X-Y	-	E	-	E	T	T	T	-	
	X-O	-	-	-	-	T	T	T	C	
6	X-X	-	-	-	T	C	T	C	C	
	O-X	-	-	E	T	T	T	T	-	
	X-Y	E	E	T	T	T	T	T	-	
	X-O	-	-	-	E	T	T	C	-	
7	X-X	-	-	-	-	T	T	C	C	
	O-X	-	-	-	T	T	T	C	T	
	X-Y	-	C	T	T	T	T	T	T	
	X-O	-	-	-	E	T	T	C	C	
8	X-X	-	C	C	C	C	C	T	T	
	O-X	-	E	E	E	E	T	C	T	
	X-Y	E	E	E	C	E	E	T	T	
	X-O	-	E	E	E	E	E	T	T	
9 <sup>d</sup>	X-X	-	-	C	C	C	C	C	C	C
	O-X	-	-	-	T	E	C	C	C	C
	X-Y	-	E	E	T	E	E	C	C	C
	X-O	-	-	E	E	C	E	E	C	C

Table E8 (Continued)

Subject	Task	Sessions								
		1	2	3	4	5	6	7	8	9
10	X-X	-	T	T	-	C	C	C	C	
	O-X	-	T	T	T	C	C	T	C	
	X-Y	-	T	E	T	C	T	T	C	
	X-O	-	T	T	-	E	T	T	T	
11	X-X	-	C	T	C	C	C	C	C	
	O-X	T	-	-	T	T	T	T	T	
	X-Y	E	E	T	E	T	T	T	C	
	X-O	E	E	-	E	T	T	E	C	

<sup>a</sup>T = turned-card

<sup>b</sup>C = correct

<sup>c</sup>E = egocentric

<sup>d</sup>Subject #9 received a tenth presentation of this task at home in which scores on all four tasks were correct.