OBJECT PERMANENCE AND INFANT MEMORY DEVELOPMENT

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*OP = Object Permanence

ABSTRACT

This research examined (1) whether cognitive level affected infant and toddler performance and affective responses in part-whole tasks; (2) whether salience of the missing body parts of a doll affected infant's performance and affective responses in part-whole tasks; (3) if the interaction between cognitive level and salience of the missing body parts affected infant's performance and affective responses in part-whole tasks. Infants were first given Uzgiris and Hunt's (1975; 1989) object permanence tasks to determine their cognitive levels. After the object permanence tasks, infants at cognitive levels four, five, and six were given the part-whole tasks where the arm, leg, or head of a doll with removable parts were dismembered. Amount of visual and manual search were later scored at a range of 1 - 7, latency to visual and manual search were timed in seconds, and affective responses were scored at a range of 1 - 3. Infants were given two trials with the part-whole tasks. Results for the part-whole tasks were added to give a total score for each missing body part. Results showed significant differences in the cognitive levels in the amount of visual and manual search, latency to visual and manual search, and affective responses of infants' performance in the part-whole tasks.

CHAPTER I

INTRODUCTION

Piaget's (1952; 1954) studies of children's cognitive development have dominated past research (Small, 1990; Bjorklund, 1989). A majority of this research focused primarily on the sensorimotor stage of infant development between zero to 24-months.

The development of object permanence closely follows Piaget's (1952; 1954) stages of sensorimotor development. Object permanence is referred to as the knowledge that an object exists in time and space independent of one's perception or action on the object (Baillargeon, 1986; Bjorklund, 1989; Piaget, 1954; Small, 1990). As adults, we understand that objects still exist even if they are not visible. Infants, however, do not have the concept of an "absent" object. Objects that are not visible to infants may well be non-existent to the infants (Bjorklund, 1989; Small, 1990; Piaget, 1954).

The development of object permanence is one of the most widely researched topics within the sensorimotor stage (Bjorklund, 1989; Sophian, 1980; Townes, 1979).
To attain object permanence, infants must be able to coordinate their visual, audio, and tactile skills (Piaget,

1954). Piaget (1954) suggested that before infants succeed in object permanence tasks, they go through a stage of reconstructing part of an object and inferring it as a whole object. For example, Piaget (1954) described the behavior pattern of part-whole perception in this observation:

> When I make only part of the bottle disappear and Laurent sees a small fraction of it near my hand, or a cloth, or the table, the manifestations of his desire are more imperious than when he saw the whole bottle
>
> (1954, p. 31).

> ... Laurent recognizes his bottle no matter what part of it is visible. If he sees the nipple, his reaction is natural, but even when he sees the wrong end his desire is the same; hence he admits to the virtual entireness of the bottle.
>
> (1954, p. 31).

From these behaviors Piaget inferred that infants remembered the whole object(s) when only a small portion was visible. Therefore memory development in infants is among the factors ınfluencing ınfants' performance on object permanence tasks.

Although research in object permanence is plentiful, (Baillargeon, 1986; 1987; Bjorklund, 1989; Sophian, 1980; Townes, 1979), research on part-whole perceptions in infancy remains sparse. One exception was a study by Shafie, Self, and Allen (1984). Their findings supported Piaget and Inhelder's (1973) ideas on three types of

memory: recognition, reconstruction, and recall. Shafie, Self, and Allen (1984) suggested that younger infants performed poorly on reconstructive memory tasks mainly due to their lack of representational capacity. The responses of infants in the twelve to fifteen and sixteen to nineteen month age groups as they retrieved the incomplete part of an object provided evidence of reconstructive memory at these ages. The diversity of infant behaviors which have been examined have offered a rich source of evidence concerning different forms of memory in infancy (Sophian, 1980).

The majority of studies on part-whole perceptions, however, have focused on preoperational children's perceptions of ıncomplete pictures of objects, animals, or fruits and vegetables (Elkind & Scott ,1962; Elkind, Koegler, & Go, 1964; Gollin, 1960; 1961; 1962,; 1966; Whiteside, Elkind, & Golbeck, 1976; Lange & Geis, 1977; Murray & Szymczyk, 1978). These studies have indicated that correct responses to the incomplete pictures were correlated with children's higher cognitive level. Subjects in these studies were considerably older than the subjects used in the present study of object permanence.

This present study explored infant's part-whole perception within the context of object permanence. It was expected that there would be a positıve relationshıp between latency of visual and manual search, the infant's amount of visual and manual search, the infant's affective

response, and the salience of a feature of an object when it is being transformed invisibly with an infant's cognitive level. It was also expected that gender differences would not be significant in this study because literature on object permanence does not reveal gender as significant (Bjorklund, 1989).

Object permanence was measured by levels of manual search, visual search, and affective response. Upon determining the child's level of object permanence, part-whole relations were ascertained through the child's responses to the salience of various missing parts.

Purpose of Study

Piaget's (1954) study of cognitive development, especially object permanence, has generated numerous studies. When looking at infants' achievements of various tasks in each stage of development, Piaget failed to include the importance of infants' socio-emotional development in his literature. This study attempted to look at infants' socio-emotional development by looking at affect when they retrieved an object (i.e, a doll) which was whole when it was displaced visibly. The experimenter complicated the procedure by removing the limb of the doll beneath the cover while at the same time, exposing the part of the limb that was intact in order to entice infants to retrieve the doll. Following retrieval of the object, infants' reactions to the now incomplete object were noted.

This study will hopefully generate interests in the area of infants' part-whole perceptions in cognitive development.

The primary purpose of this study was to examine the amount of visual and manual search, latency of visual and manual search, and affective response of infants between the ages of nine and twenty-four months following retrieval of an incomplete object.

A secondary purpose of this study was to determine whether infants, within their stage of development, use memory structures, such as reconstructive, recollection, or recall memory, to search for the doll's missing body parts.

The following literature review addressed several aspects of object permanence: visual tracking, visible displacement tasks, memory, and part-whole relations. Before addressing the literature pertinent to object permanence, however, several theories regarding object permanence were explored.

CHAPTER II

THEORETICAL PERSPECTIVES

Piaget

The understanding of object permanence does not usually occur until infants reach the fourth substage of the sensorimotor period. At this time infants are capable of searching actively for vanished objects. Prior to this stage, when objects disappear in front of ınfants, they continue gazing at the spot where objects had disappeared (Baillargeon, 1986; Baillargeon & Graber, 1987; Bjorklund, 1989; Piaget, 1954). When objects failed to reappear, infants gave up searching for the object (Baıllargeon, 1986; Baillargeon & Graber, 1987 Bjorklund, 1989; Piaget, 1954). Infants who searched actively for the object, however, had obtained object permanence.

Piaget (1954) determined that there were three types of search. First, visual tracking involved looking at the place where the object disappeared. Second, knowledge of visible displacement occurred when ınfants searched for the vanished object withın their perceptual field. Finally, knowledge of invisible displacement took place if infants searched for the object that disappeared outside of their perceptual field. Infants were also capable of following

multiple displacements of objects as they grew older. Such behaviors normally occurred when infants were between the ages of eight to twenty-four months.

In addition, Piaget examined part-whole perceptions, visual tracking, AB error, visible displacement of objects, invisible displacement of objects, and infant's memory and information processing as infants attained object permanence. Part-whole perceptions referred to infants' reconstructions of an invisible whole from a visible part of an object (Piaget, 1954). Visual tracking referred to the tracking of the trajectory of an object visually when infants were incapable of grasping or actively searching for the hidden object. AB error occurred when an object was hidden under a first screen, and infants removed the screen to recover the object. In the next task, when the object was hidden under screen B, infants instead of looking for the object at the second location, tried retrievıng the object at location A. Visible displacement was when an object was hidden within the full view of the infants. Invisible displacement referred to the object being hidden without the infants' knowledge. Finally, memory and ınformation processing referred to, (1) whether infants would use recall, long term, or short term memory to retrieve the hidden object and, (2) to see how infants' code, or encode information to look for the object.

Stages played an important role in Piaget's model of development (Beilin, 1989, p. 88). Stages of development,

according to Piaget, were constant, (i.e.) independent of speeding up or delays due to experience or the social context (Piaget, 1983).

Development of object permanence, therefore, occurred within the six sensorimotor stages of Piaget's theory. Infants went through these stages at different times. Skills achieved were not lost as infants moved on to different stages (Piaget, 1952).

Piaget (1952; 1954) described the development of the object concept as one of the major accomplishments of sensorimotor intelligence. According to Piaget (1954), infants did not understand the concept of object permanence the way adults understood object permanences. Adults believed that an object cannot exist at two separate places in time without having also existed during the interval between them (Baillargeon, 1987; Piaget, 1954). The infants' world, on the other hand, consisted of pictures which might be analyzed and recognized, and which disappeared and reappeared (Piaget, 1954).

In order for infants to develop object permanence, Piaget (1954) believed that they must go through some very rigid stages involving coordination of sight and behavior, which resulted in integration of different schemata. Children must know how to visually follow the displaced image. When they learned to extend movement of their eyes by an appropriate shift of their heads and torsos, they very quickly revealed behavior patterns comparable to a search

for the thing which vanished. Piaget (1954) called this example visual accommodation. For example,

> Laurent, as early as the second day, seems to seek with his lips the breast which has escaped him. From the third day he gropes more systematically to find it. He searches the same way with his thumb, which brushed his mouth or came to it. Thus it seems that contact of the lips with the nipple and the thumb gives rise to a pursuit of those objects, once they have disappeared, a pursuit connected with the reflex activity in the first case and with a nascent or acquired habit in the second case (P. 9).

Sensorimotor Stage

The first stage of the neonates' life was characterized by their incessant use of reflexes (e.g., the sucking reflex). In **The Origins of Intelligence**, Piaget (1952), reported that sucking reflexes were hereditary, functioned from birth, and could be seen as "global schema of coordinated movements" (p. 35). The first stage of sensorimotor development lasted from birth to the first month of life (Dunst, 1982; Piaget, 1952).

Newborn infants came into this world fully equipped with reflexes which later would provide a basis for further development (e.g., the sucking reflexes). Neonates might not suck simply because they were hungry. Rather the sucking was functional assimilation, or a means of getting a behavior started (Piaget, 1952).

During the second substage, roughly from one to four months, reflexes such as sucking, looking, hearing,

vocalizing, and the act of grasping, seizing or, taking hold of objects began to develop (Flavell 1985; Piaget, 1952). During this period, infants had strong tendency to bring anything that they found into their mouths. According to Piaget (1952), infants must establish eye-hand coordination before succeeding in these tasks.

In the third substage (i.e., from about four to eight months) involved infants expanding their horizons. They no longer were satisfied with finding objects and bringing them to their mouths. They began to incorporate their other abilities, including crawling and manipulating of objects. Piaget (1952) called this the "secondary circular reactıons" stage. Infants during this stage were more aware of the external environment (Ginsburg & Opper, 1979; Piaget, 1952).

The fourth substage, from about eight to twelve months, marked the beginning of intentionality and means-ends behavior of infants (Flavell, 1985). The infants intercoordinated the secondary schemata to obtain object permanence. It is during the fourth substage that infants knew that objects continued to exist even if they, the objects, were outside of the infants' perceptual field (Gratch & Landers, 1971; Piaget, 1952). Piaget (1952) explained the fourth stage as such (p. 211):

> Now, in order that two schemata, until then detached, may be coordinated with one another in a single act, the subject must aim to attain an end which is not directly within reach and to put to work, with this intention, the schemata thitherto related to other situations. Hence there exists simultaneously

> the distinction between the end and the means, and the intentional coordination of the schemata.

The fifth substage, according to Piaget (1952), marked the beginning of novelty search in infants between twelve to seventeen months. Piaget (1952) called this the "tertiary circular reactions" stage. Piaget (1954) reported that infants at this stage used "manifested unexpected behavior patterns or experimentation to find out in which aspect an object or the event is new" (p. 266). The tertiary circular reactions often led infants to develop new acts of intelligence which Piaget (1954) called "discovery of new means through active experimentation" (p. 267).

Infants during the sixth substage began using internalization and mental representation in problem solving. They were capable of searching for objects that were displaced invisibly (Flavell, 1985; Piaget, 1952; Uzgiris & Hunt, 1989). The most important achievement during substage six remained the "essential attribute of cognitive functioning for the rest of the individual's life" (Flavell. 1985, p. 26). In addition, during this stage, infants were also capable of symbolic thoughts (Flavell, 1985; Piaget, 1952; Uzgiris & Hunt, 1989).

Object Permanence

Piaget

In describing the development of object permanence, Piaget (1954) claimed that object permanence was linked

closely to development in the sensorimotor stages, and was 'constructed little by little'. Piaget (1954) used these same six sensorimotor stages to describe infants ' acquisition of object permanence.

During the first two substages, (i.e., zero to four months), infants did not exhibit special behavior when objects disappeared within their perceptual field. Therefore, they did not attempt to search actively for the vanished objects. Hence, infants were thought to recognize objects only as accompaniments of their own actions. Infants might look in the direction the object had disappeared, or they might continue to reach for the object in the direction of last previous contact with the object. When the object failed to reappear, infants assumed that the object no longer existed (Piaget, 1954).

According to Piaget (1954), infants limited themselves to looking at the place where the objects had vanished if experiencing disappearing visual image. Infants merely preserved the attitude that if nothing reappeared, they would soon give up the search. However, if infants had object concept, they would engage in active search for the object, removed obstacles, or changed the position of presenting objects at hand (Piaget, 1954).

During the third substage (i.e., between four to eight months), infants' development was seen as the "beginning of prehension of things seen and the beginnings of active search for vanished objects" (Piaget, 1954, p. 13). Infants

were no longer following moving objects, but they were beginning to anticipate the future position of the objects, finding them after an interruption in following the trajectory of the object. Infants, having interrupted an activity with an object, were able to locate the object in its previous position when returning to the activity. Infants would also retrieve a partially hidden object if they were capable of reaching for the object. It was still too early in infants' development to predict active search behavior, which, according to Piaget (1954), would not happen for several more months For example, Piaget (1954) described that when he presented a small doll to Lucienne for the first time, she grasped the doll, examined it excitedly, and let it go (unintentionally). Almost immediately, Lucienne started looking for the doll in front of her but did not see it right away. After she found the doll, Piaget took it away from her and hid it under a cover before her eyes. Piaget noted that there was no reaction from Lucienne (p. 15).

During the fourth substage, (i.e., between eight to twelve months), infants were said to have acquired the beginning of active search for the vanished object, but they were still unable to take into account the sequence of visible displacements. This was the beginning of active search behavior (i.e., object permanence) ın infants. During the beginning of object permanence, Piaget (1954) found that infants were no longer satisfied with just

searching for the vanished object when it was found in the extension of accommodation movements. Therefore, they actively searched for the object outside of their perceptual fields (Gratch & Landers, 1971; Piaget, 1954). That is, infants searched for the object even if it was completely hidden. Infants, at this substage, were capable of removing a screen to continue the activity of searching for the object.

Piaget (1954) discovered that when he hid an object in full view of infants in position A, (i.e., when the object was hidden under the first screen), they quickly discovered the object by removing the screen or the cover. When Piaget repeated the same experiment in full view of the infants, but, instead of hiding the object in the first screen, (position A), he hid the object in position B, (i.e., when the object was hidden under the second screen), the infants instead of searching at position B where the object was now hidden, continued searching at A, making what Piaget called the "residual reaction" (1954, p. 51), or perseverative or AB error (Bjork & Cummings, 1984; Butterworth, 1977; Dunst, 1982; Evans & Gratch, 1972; Flavell, 1985; Harris, 1974; Pasnak, Kurkjian, & Triana, 1988; Uzgiris & Hunt, 1989).

During the fifth substage, (i.e., between twelve to eighteen months), infants took account of the sequential displacements of the object.

> The child learns, during this period, to take into account of the sequential

> displacements perceived in the visual field; she no longer searches for the object in a special position but only in the position resulting from the last visible displacement.
>
> (Piaget, 1954: 66).

For example, when seeing an object being placed in a container, which was then covered with a cloth and removed to a different place, infants would searched for the object in the container or where it was last seen, not under the cloth.

The fifth substage of development began when infants no longer searched for the object in position A at the time they saw the object placed in location B. Infants, however, were still incapable of searching for an object if it was displaced invisibly. The next substage marked the beginning of infants' understanding of invisible displacements.

The sixth substage (i.e., between eighteen to twenty-four months) marked the beginning of infants' accomplishments of representation of invisible displacements. During this substage, infants could construct objects when "displacements are not all visible". By this substage, infants had the capability of resolving problems by mental representation (Piaget, 1954, p. 79). This skill was not acquired in any of the preceding substages. Piaget (1954) described the infant's capability to represent invisible displacement of objects in the following example:

> Jacqueline watches me when I put a coin

> in my hand, then put my hand under a coverlet. I withdrew my hand closed; Jacqueline opens it, then searches under the coverlet until she finds the object. I take back the coin at once, put it in my hand and then slip my closed hand under a cushion situated at the other side (on her left and no longer on her right); Jacqueline finds it without hesitation.
>
> (Piaget, 1954, p. 79)

Memory

Piaget and Inhelder

According to Piaget and Inhelder (1973), memory could be divided between memory in the strict sense, and memory in the wider sense (p. 387), Memory in the wider sense was mainly the conservation of everything learned in the past, including the various aspects of schemata, or the retention of all the products and achievements of one's cognitive development to date (Flavell, 1985, p. 208). Memory in the strict sense included those forms of conduct that reflected the past in terms of the subject's consciousness (e.g., recognition, reconstructions, recollections and their respective fixations (Piaget and Inhelder, 1973). In other words, memory involved the remembering of a specific event, accompanied by the definite feeling on the rememberer's part that this event occurred at a particular time and place in the past, and that he/she personally experienced it (Flavell, 1985). This meant that there were developmental changes in memory processes during infancy (Flavell, 1985; Piaget & Inhelder, 1973).

Piaget and Inhelder (1973) established three major hierarchic types of memory: recognition, reconstruction, and recall memory. A detailed discussion of each type of memory follows.

First, recognition memory relied on perception and sensorimotor scheme alone (Piaget, 1968). Recognition memory was present during the first few months of life (Piaget, 1968). The first of recognition memory appeared during the re-awareness of a given object. The time at which infants first distinguished their mothers from strangers, for example, would be considered recognition memory (Piaget and Inhelder, 1973). There were three sub-levels in recognition memory. Elementary recognition, the first of the three sub-levels in recognition memory, was bound up in the continuation or repetition of a reflex action or a potential habit extending that reflex. Recognition memory, which follows elementary recognition, involved the assimilation of an existing schema, In other words, recognition memory encompassed recognition of signs as signifiers and was bound up with habits and acts of the sensorimotor intelligence. Recognition at the higher levels, the third sub-level in recognition memory, was bound up with mobile and differentiated schemata.

The second type of memory, reconstruction memory, involved the intentional reproduction of a particular action and its results. It involved the recognition of signs and was divided into four sub-levels: First, the elementary

form of reconstructive memory such as the intentional reproduction of an action performed by oneself, or by somebody else. Second, the reproduction of an isolated and not fully schematized action and subsequent reconstruction of its result, third, reconstruction of an object or a configuration without prior constructions of an imitative or spontaneous kind, and fourth, the reconstruction of a schematized action.

Recall memory depended on actions and action schemata, along with ensuring the complete continuity as between reconstructions by actions and internalized reconstructions represented by the memory-image as the instrument of recall. There were three sub-levels of recall memory:
First, the memory-image of a schematized action or simple recall memory which involved complete internalization of reconstructive procedures, second, the direct internalization of imitation by images, and third, recall by images of objects or events extraneous to the action. In summary, there were three hierarchic types of memory, each with their sub-levels: recognition memory, reconstruction memory, and recall memory.

Alternative Models

Cummings and Bjork

Several investigators have criticized Piaget's theory of object permanence. Notable among these are Schuberth

1983; Cummings & Bjork 1981; Bower 1967; 1973a; 1973b; 1975; and Moore 1978. In his review of The Infant's Research for Objects, Schuberth, (1983) suggested three shortcomings of Piaget's theory. First, recent data have suggested that the AB errors defining the fourth and fifth stages in the developmental sequence postulated by Piaget (1954) were artifacts of the two-choice search tasks that Piaget employed. Another problem attributed to Piaget's (1954) theory involved demonstrations of young infants' perception of nonchanging properties of objects and their ability to mentally represent absent objects. Such demonstrations suggested that the theoretical assumptions concerning infants' view of the surrounding world were in error (Schuberth, 1983). Finally, Schuberth (1983) suggested that there was insufficient consideration given in the theory to infants' use of contextual cues in coding the location of objects in the environment. The above studies were important for evaluating Piaget's theory. This became apparent when one considered that it was Piaget's observation of the Stage 4 AB error that led him to interpret his infants' earlier behaviors toward absent objects. Such observations demonstrated their egocentric tendencies rather than their objective responses (Piaget, 1954).

Cummings and Bjork (1981) argued that infants were aware of object permanence and of the systematic nature of spatial relations. Their conclusions were based on their

findings in studies of infants' search tasks performance in five locations. They expanded the argument by saying that errors made by infants in searching for hidden objects could be understood in terms of an information-processing model of memory (Cummings & Bjork, 1981).

The model suggested that infants' search for objects can be understood in terms of the processes of encoding, storage, and retrieval of stimulus information. Infants were capable of locating hidden object even after the object was moved to another location or position (Cummings & Bjork, 1979). For example, infants were inclined to search for an object near or in position A during the first trial (Cummings & Bjork, 1979). The infants' tendency to continually search at or near A also increased over successive hiding trials at A. The same observations occurred when the location was changed to B. Cummings and Bjork (1979) assumed that on the initial trial at A and B, infants were capable of encoding the location of the object by directing their search to the correct location. This ability to encode the location of the object increased over successive trials (Cummings & Bjork, 1981).

Cummings and Bjork's (1981) theory was different from Piaget's theory. While Cummings and Bjork (1984) focused on infants' ability to encode locations of object on more than two locations, Piaget was concerned with providing the infant with only two locations to search for a hidden object (Cummings and Bjork, 1984).

Since search for hidden objects (object permanence) requires memory for previous events (Flavell, 1985, p. 210), the development of memory is pertinent to the study of part-whole relations within the context of object permanence Investigators of early memory development often capitalized on young children's readiness to search for objects within the environment (Deloache, 1985). Cummings and Bjork (1984) used the memory hypothesis to predict that search attempts of eight- to ten-month old infants should occur at or near the object's current location on A or B hiding trials. In addition, Sophian (1983) believed that object permanence was a useful tool to study infant memory development.

Information processing approach looks at cognitive development as a system from the processing and the storage of information (Small, 1990). Though information processing has been used to look at how adults process information, there is yet to be a model looking at infant cognitive development (Small, 1990). According to Howard (1983), there are several bases of information processing. First, humans process environmental information in stages. Time is considered a factor between the occurrence of stimulus and the production of a response. Next, information is transformed from a visual code to a verbal code. Finally, there is a limitation in the amount of information being processed each time.

The composition of Howard's (1983) information processing such as sensory registers, short term memory,

long term memory, central processor, and response system are impertinent to the study of object permanence and infant development. It is interesting to investigate which aspect(s) of information processing can explain infants' successes in their search for the missing body part of the doll in this study.

Bower

Bower (1967) disregarded the part of Piaget's theory that explained difficulties in infants' search behavior as being due to the lack of attainment of object permanence. Bower (1967) theorized that very young infants (e.g., as young as 20 days old), behaved as though they were aware of the continued existence of an object that disappeared when the object was made to disappear by some means other than by covering. Also, the errors that infants made in searching for objects in full view resembled the mistakes they made when searching for hidden objects (Schuberth, 1983). Bower, Broughton, and Moore (1971) indicated in their study that infants as young as seven weeks of age may manifest a belief in the continued existence of vanished objects, provided that infants were given the "appropriate stimulation". This theory was considered controversial, and so was rejected by theorists such as Piaget (1971). In the meantime, Bower (1979) claimed that young infants used simple search methods such as continually looking along the path of an object. At

the same time, the infant followed the object visually until it stopped (Bower, 1971).

There were three stages to Bower's theory of how infants obtained object permanence. Each stage will be discussed in order. In the first stage, Bower and Paterson (1973a) studied the development of infants' visual tracking of objects. They concluded that infants between the ages of four to five months developed accurate visual tracking of objects. This behavior would diminish at approximately nine to twelve months. Infants during this stage displayed two characteristic errors in visual tracking behavior. First, infants failed to understand that when an object had stopped moving along the path, it remained the same object. Infants in Bower's (1971) study, however, continued to look along the path where the object had previously moved. A second error during this stage was concerned with infants' tracking behavior of objects that move cyclically. That is, when twelve to twenty-four weeks old infants were presented with an object that moved from place one to place two, and back again, (while stopping at both places), the infants learned to track the objects at both places. When place three was added to the above, the infants continued to look at the object at place two, thus, erring in the search (Bower & Paterson, 1973). According to Bower and Paterson (1973), both of these behaviors decreased when infants were about 23 weeks old.

The second stage of development was the transition from stage four to stage five of the object concept. Bower and Paterson (1973) believed that when infants were in substage 4, they could retrieve an object that had been hidden under a cloth or in a container. If allowed to retrieve the object from A more than once, however, infants would continue to search for the object at A even when it was moved to place B. When infants were in substage five, though, they would not commit such an error (Bower & Paterson, 1973).

In the final stage of Bower's (1979) theory of development, infants were moving from substage five to substage six of object concept. Infants were capable of not only searching for objects that were displaced visibly (Bower & Paterson, 1973) but also for objects that were displaced invisibly. This final stage of development, according to Bower and Paterson (1973), resembled Piaget's (1952; 1954) development of the fifth and sixth substages of sensorimotor and object permanence.

Moore

Moore and his associates (1978) expanded Piaget's (1954) and Bower's (1971) theories. Moore's theory (1978) differed from Piaget's theory in several aspects. First, Moore (1978) assumed that the ability to mentally represent an object which was no longer in view marked the beginning rather than the end point, of the developmental sequence in

which infants achieved an understanding of object permanence. Even though infants could mentally represent object that was being hidden, the infants did not understand that an object was a permanent entity until they understood that an object still maintained its identity when it disappeared and then reappeared.

In contrast to Piaget's (1954) theory, Moore assumed that spatial and featural rules for determining object identity were the structural elements underlying an understanding of object permanence. According to Moore, therefore, the development of an understanding that objects were permanent was the understanding that an object had an identity in and of itself.

Moore and Meltzoff (1978) came up with three levels in determining the development of object identity. The first level encompassed ages zero to four months, and it is characterized by rules for the solution of identity problems associated with the steady structure of the visual world. In other words, moving objects continued to move and resting objects continued to rest. Infants during this stage could determine that the identity of the moving object was the same at any point on its path and that the identity of an object at a particular point in time remained the same.

Five to eight month old infants were included in level two, which was associated with the solution of identity problems associated with changes in the steady state structure of the visual world. An infant, for example,

could determine that the moving object, while it became stationary, was the same object (Moore and Meltzoff, 1978). Infants in level three were eight to ten months old. During this phase, infants employed rules for determining the identity of visible objects throughout transformations that rendered the objects temporarily invisible, (e.g., the object that was being covered by a moving screen or the moving object that disappeared behind the stationary screen (Moore and Meltzoff, 1978).

Memory

Watson

Watson (1984) distinguished between three levels of memory development in infancy, First, reactive memory occurred if one sensed that an experience was one that had occurred on some previous occasion as opposed to a novel experience. Second, reactive memory corresponded with Piaget's recognition memory in definition (Piaget & Inhelder, 1973; Sophian, 1983). Finally, regenerative memory took place if present experience was altered so that either stimulus structure or behavioral content was affected in such a way as to share some features with any past experience. An example would be infants' imitation and search for hidden objects (Sophian, 1983). Regenerative memory was comparable to Piaget's and Inhelder's (1973) reconstructive memory. Finally, associative memory was the

joining of two or more memories of different experiences occurring at different points in time. It was somewhat similar to Piaget's and Inhelder's (1973) recall memory. Associative memory entailed the activation of memory not only for that event but also for an associated, but not absent, event (Sophian, 1983). According to Watson, each of the three categories could benefit from further classification into either short term memory (i.e., a few seconds) or to long-term memory (i.e.., more than a few minutes). With current literature available on infant memory, Watson (1984) concluded that there was evidence that human infants displayed memory capacity in each of the categories, and that the developmental picture varied from one category to another.

As mentioned previously, infant memory development is pertinent to the study of part-whole relations within the context of object permanence. Hopefully, the present study concerning part-whole relations and object permanence will clarify which form of memories infants utilize in the retrieval of the dismembered parts of a doll.

CHAPTER III

REVIEW OF LITERATURE

> To understand how the budding intelligence constructs the external world, we must first ask whether the child, in its first months of life, conceives and perceives things as we do, as objects that have substance, that are permanent and of constant dimensions. If this is not the case, it is then necessary to explain how the idea of an object (object concept) is built up (Piaget, 1954, p. 3)

Object Permanence

There is an abundance of research on the concept of object permanence (Flavell, 1985; Harris, 1975; and Sophian, 1983). It has been widely documented that object permanence is attainable when the infants are about nine-months old. Several studies, however, have challenged Piaget's (1954) theory, by noting that object permanence can be shown in much younger infants. Among the studies challenging Piaget's (1954) concept are studies by Baillargeon (1985; 1987), Bower and associates (1967; 1973a; 1973b; 1975), and Hood and Willats (1986).

Baillargeon (1985) tested five-month old infants by letting them habituate (i.e., visually attending) to a screen that moves back and forth in a 180 degree arc, like a drawbridge. After infants reached habituation, a box was

put behind the screen. The infants were later tested on the possible event, where the screen stopped when it reached the occluded box, and the impossible event, where the screen moved through space occupied by the box. Results indicated that the infants looked longer at the impossible event. Hence, the investigator postulated that the attainment of object concept had occurred (Baillargeon, 1985). A similar study by Baillargeon (1987) with three- and a-half and four- and a-half month infants showed the same results.

Bower and Wishart (1972) used another approach to challenge Piaget's theory. They tested a group of five-month old infants with an object suspended on a string, which was within reaching distance. The room lights were turned off, leaving the infant in darkness for approximately three minutes. It was reported that these infants reached out to grasp the object in the dark, and that reaching behavior was accurate (Bower & Wishart, 1972). A similar study by Wishart, Bower, and Dunkeld (1978) replicated Bower's previous study. Other studies by Bower, Broughton, and Moore (1971) found that infants of 20 weeks old were able to anticipate when the object was to reappear, should the object be moved out of sight. Bower et al, (1971) claimed that object permanence was attainable prior to Stage IV (about nine months) when infants were tested on visual tracking behavior, rather than tradıtional manual search behavior (Bower, 1972). In fact, Bower, Broughton, and Moore (1971); Bower and Paterson, (1972; 1973b) and Hood and

Willats (1986) all indicated that young infants, (i.e., about 16 weeks old), manifested notions of object permanence in visual tracking when the lights in the room were extinguished, as infants reached out for the object(s).

The above studies indicated that infants younger than nine months-old had notions of object permanence, as evidenced in their visual tracking behavior. There were studies, however, that disputed these studies. Moore, Borton, & Darby (1978) tested five to nine-month old infants to determine if the infants would anticipate the reappearance of an object disappearing behind a screen. They found that five-month old infants showed disruptions of visual tracking, therefore, challenging Bower and associates' (1967; 1971; 1972; 1973a; 1973b; 1975) findings that younger infants understood object concept. Other studies failed to replicate the results of Bower et al (1967; 1971; 1972; 1973a; 1973b; 1975) Baillargeon (1985; 1987), while Hood & Willats' (1986) study of infants' visual tracking showed that infants had mastered the concept of object permanence. Goldberg (1976), in her study of 36 infants aged twenty to twenty-four weeks, used visual fixation and cardiac deceleration to assess the status of three kinds of events in which objects moving on a linear trajectory were temporarily occluded by a screen. Goldberg's (1976) rationale for using cardiac deceleration suggested that these were sometimes more sensitive in discriminating infant's visual tracking behavior than visual

fixation. The results of her study failed to demonstrate existence constancy or object permanence in five-months old infants. Muller and Aslin (1978) extended the findings from past object tracking experiments by looking at infants' spontaneous visual tracking experiments and the disruptions in that tracking behavior. They did not find any indication in their study that infants at age two, four, and six months old were able to attain stage IV searching behavior.

In summary, the use of visual tracking as a measure of object permanence in infants younger than nine months old could not be duplicated in the studies mentioned (Goldberg, 1976; Moore, Borton, & Darby, 1978; Muller & Aslin, 1978).

Stage IV Search Error

Probably, according to Horobin and Acredolo (1986), the stage IV search error was the most frequently researched finding in Piaget's (1952; 1954) stages of sensorimotor development. Infants at substage IV, that is between eight to twelve months, were able to retrieve an object hidden within reach at one location (A). If the same object was visibly moved to location (B), the infants would commit what Piaget (1954) called the AB error. According to Horobin and Acredolo (1986), infants erred in search because of "profound egocentrism". During this stage infants had a subjective conception of objects, position, and movement, which was conceived relative to the infant's own body and action, and infants would continuously search at location A

even when they saw the object moved to a different location (B) (Horobin and Acredolo, 1986).

In their findings, Horobin and Acredolo (1986) reported that visual attentiveness was a determinant of whether or not infants would successfully retrieve hidden objects. Perseverative errors were most likely to occur when the hiding locations were close together as infants may have trouble perceptively discriminating these. However, in Piaget's (1954) theory, when children acquired knowledge of the external world through actions, the occurrence of AB search errors was considered critical evidence that infants were egocentrically concerned with their own actions. The infants, therefore, did not comprehend the systematic nature of spatial relationships or the concept of object permanence (Bjork & Cummings, 1984).

Lingle & Lingle (1978), in investigating the influence of familiarity and motivational factors on eight to thirteenth-month old infants' search behavior, found that infants' search for familiar or attached objects on the AB locations were insignificant. According to the investigators, infants' successes on search behavior were best explained by motivational factors (Lingle & Lingle, 1978).

Sophian and Sage (1985) examined perseverative errors and the ability to select between conflicting sources of information of 20 nine-month old infants and 15 sixteenth-month old infants by using ıdentical location conditions and

distinctive locations. The nine-month old infants perseverated more significantly in three choice hiding places (Sophian & Sage, 1985). They also made more errors in selecting inappropriately between the conflicting sources of information by relying more on prior information (A location) when current information (B location) was available (Sophian & Sage, 1985).

Harris (1973) found that if there was a delay prior to allowing infants to search for the hidden object, the infants were more likely to make the A, not B error. Similar findings were reported in Horobin and Acredolo (1986) where they looked at infants' attentive behavior prior to searching for the object (Gratch, et al, 1984; Webb, Massar, & Nadolny, 1972). Besides studies showing that perseverative errors were likely to occur when there was a delay before the actual search, Butterworth (1975) reported that if the object was hidden away from the infant's midline, AB error was likely to occur as well. Whether infants in the present study are likely to make the AB error in the event of searching for the hidden parts of the doll when the object/parts are hidden away from the infants' midline remains to be seen.

Infant's Part-Whole Perception

Few studies in part-whole relations with infants have been conducted. With the exception of studies on part-whole perceptions described above, one study by Shafaie, Self, and

Allen (paper presented, 1984) used infants as their subjects.

In this study, Shafaie, Self and Allen (1984) looked at memory processes during infancy. They found age differences in infants' search and affective behavior. Older infants tended to search actively for the missing part of the object and the success rate for this group of infants was much higher than the younger group of infants (Shafaie, Self, & Allen, 1984).

Conclusions

Object permanence has indeed generated considerable research, particularly at stage IV of Piaget's (1952) sensorimotor development (Horobin & Acredolo, 1986; Sophian & Sage, 1985). Studies have shown the controversial nature of Stage IV perseverative or AB error. Another area that generated controversial results was the use of visual tracking of an object as a means of proving that infants had developed object permanence (Baillargeon, 1985; 1986; 1987; Bower & associates, 1967; 1973a; 1973b; 1975; Hood & Willats, 1986). This theory was rejected by several researchers. Little research has been done on the part-whole relations within object permanence. The present research, therefore, proposed to look at the affective and search behavior of infants between the ages of nine to 24-months in relation to the development of object permanence and part-whole relations, which are parts of cognitive

development. The present research attempted to relate the importance of part-whole relations and infant memory development within the context of object permanence. To fulfill this ambition, the investigator used the methodology of Shafie, Self, & Allen (1984) to this neglected aspect of object permanence.

CHAPTER IV

HYPOTHESES

The purpose of the present study was to examine the search behavior and affective responses of infants between the ages of nine to twenty-four months to further understand the relationships of object permanence , part-whole relations, and infant memory development. A variety of behavioral measures were used: Visual and manual search behavior, latency to search, as well as affective behaviors. Uzgiris and Hunt (1975; 1989) described object permanence as "infant's reaction to an object disappearing from view changes from one end of turning his gaze immediately from the point of disappearance to one of holding his gaze at the point of disappearance until the object returns". The change implies an increasing stability of those central processes through which the infant apprehends the object which mediate what Piaget (1954) calls 'object permanence'.

Infants' cognitive levels for this study were determined prior to the part-whole tasks by using Uzgiris and Hunt's object permanence scale.

The following hypotheses were explored based on the review of the literature in this study.

1. There will be no effect on gender on measures of object permanence (cognitive level).
2. There will be no differences in latency to visual search on the change tasks as a function of cognitive level
3. There will be no differences in visual search on the change tasks as a function of cognitive level.
4. There will be no differences in latency to manual search on the change tasks as a function of cognitive level.
5. There will be no differences in manual search on the change tasks as a function of cognitive level.
6. There will be no differences in affect on the change tasks as a function of cognitive level.
7. There will be no differences in latency to visual search on the change tasks as a function of salience of the missing part of the object.
8. There will be no differences in visual search on the change tasks as a function of salience of the missing part of the object.
9. There will be no differences in latency to manual search on the change as a function of salience of the missing part of the object.
10. There will be no differences in manual search on the change tasks as a function of salience of the missing part of the object.
11. There will be no differences in affect on the change tasks as a function of salience of the missing part of the object.

12. There will be no differences in latency to visual search on the change tasks as a function of the interaction of cognitive level and salience of the missing part of the object.

13. There will be no differences in visual search on the change tasks as a function of the interaction of cognitive level and salience of the missing part of the object.

14. There will be no differences in latency to manual search on the change tasks as a function of the interaction of cognitive level and salience of the missing part of the object.

15. There will be no differences in manual search on the change tasks as a function of the interaction of cognitive level and salience of the missing part of the object.

16. There will be no differences in affect on the change tasks as a function of the interaction of cognitive level and salience of the missing part of the object.

CHAPTER V

METHODOLOGY

Infants who participated in this investigation were solicited from day care centers in a medium agricultural university town in the south west. Additional infants were solicited from day care centers in a larger city about 60 miles south of the university city. The infants were videotaped playing with the experimenter in a non-threatening, familiar room, such as, a small group room in the day care center.

Subjects

Infants between the ages of nine to twenty-four months (sixteen in each of the cognitive levels of four, five, and six) participated in the present study. An equal sample of male and female subjects participated in this study. The mean age for male infants for cognitive level four was 10.38, the mean age for female infants for cognitive level four was 10.63. The mean age for male infants for cognitive level five was 16.63 and the mean age for female infants was 15.63. Finally, the mean age for male infants for cognitive level six was 22.13 and 22.50 for the female infants (see Table II).

Stimuli

The following stimuli were used during the tasks.

1. A non-sexist doll approximately six inches in length with removable parts
2. A smaller doll approximately 3.5" in length with nonremovable parts.
3. Two small covers, one white non-transparent felt cloth about 18" by 18", and one blue non-transparent felt cloth were used.
4. A pillow about 12" by 12" was used for multiple displacements.
5. A small box of about 4.5" by 4.5" was used to hide the smaller doll for invisible displacement tasks.

Measures

Though Piaget (1954) never intended to use his theory of sensorimotor development as an assessment of early cognitive competencies (Dunst, 1982), it has been used widely to assess cognitive development of infants. Casati Lezine (1968), Escalona and Corman (1966), and Uzgirıs and Hunt (1975; 1989) have used Piaget's (1954) theory as a framework in constructing their versions of ordinal scales of infant psychological development (Dunst, 1982).

By far the most comprehensive work on Piagetian Scales has been compiled by Uzgiris and Hunt (Dunst, 1982). These scales, known as Infant Psychological Development Scale (IPDS), measure seven related areas in infant development:

(1) visual pursuit and object permanence; (2) the development of means and obtaining desired environmental events; (3a) the development of vocal imitation; (3b) the development of gestural imitation; (4) the development of operational causality; (5) the construction of object relations in space; (6) the development of schemes for relating to objects. For the purpose of this study, the investigator used Uzgiris and Hunt's (1975;1989) version of visual pursuit and object permanence as a measure of object permanence.

For scoring purposes in this study, a numerical system will be given to the response for eliciting behaviors for the tasks. For both manual and visual search, a (1) will be given for no detection; (2) will be for possible detection; (3) skepticism, puzzlement, possible search after a period of time; (4) possible or chance search; (5) definite search; (6) active search but not found; and (7) actively searched and found the missing part.

Affect

Charlesworth's (1969) level of surprise procedure will be used to look at the infant's affective behavior. It is expected that the dismembered doll will elicit an observable surprise reaction, the infant should react to a changed stimulus with a strong orienting reflex accompanied by an arresting of gross motor behavior. This should immediately follow at times by changes in facial expression and posture

(Charlesworth, 1969. p. 280). The following scoring system is adapted for this study.

1. There is no change in the infant's affect. That is, upon retrieving the dismembered doll, infants' affect remain 'emotionless'. The investigator and her rater are unable to observe raised eyebrows; wide opened eyes; roundish mouth among the infants. There is no indication that infants are even aware that the doll has a body part missing.

2. There is some puzzlement in the infant's affect. For example, infants, upon retrieving the dismembered doll, are aware that the same doll has a part missing. Instead of showing total surprise with raised eyebrows; wide-opened eyes; and roundish mouth, infants show only partial puzzlement with their affect by raising only the eyebrows or creasing their eyebrows.

3. There is marked puzzlement or surprise with the infant's affect. For example, infants' eyebrows are raised accompanied by wide-opened eyes and roundish mouth after they have retrieved the doll and have discovered that the doll has a body part missing.

Interrater reliability

A rater who was blind to the study was trained to code the data. The rater was told to look for infants' facial expressions when they retrieved the dismembered doll from under the cover. For example, if infants were surprised,

they would raised their eyebrows, followed by wide-opened eyes, and roundish mouth. When infants elicited the above emotions, they were given a score of three for affective response. A score of two was given when infants showed only partial surprise by raising only their eyebrows or opening their mouth. A score of one was scored when infants did not elicit any emotions or when they showed no interests in the dismembered doll.

Overall reliability for visual search, manual search, and affect for all forty-eight infants was 94%. Interrater reliability for visual search was 91.44% (with a range of 50% to 100%). For manual search, the interrater reliability was 91.30% (with a range of 50% to 100%). Finally, interrater reliability for affect was 89.57% with a range of (50% to 100%).

Procedure

Following obtaining parental consent, infants were brought to a familiar room in their respective day care centers to be videotaped playing with the investigator. For the first task, that is the standard object permanence task, each infant was allowed to play with the smaller doll for approximately 60 seconds. Each infant was given three trials on the standard object permanence tasks. That is, the investigator would hide the doll under a white, non-transparent cloth in full view of the infants. The investigator then would ask the infants to search for the

hidden doll each time. This was to determine that success in obtaining the hidden doll was the result of the infants' understanding that the doll had disappeared from their view. This is also the criteria for scoring infants' success with the object permanence tasks (Uzgiris & Hunt, 1975; 1989).

Following the standard object permanence task, the investigator tested each infant with three more trials of AB error tasks, alternate AB error tasks, superimposed three obstacles tasks, invisible displacement task with one screen, and finally, invisible displacement tasks with two screens. These tasks were taken from Uzgiris and Hunt's (1975; 1989) infant assessments scale and used to determine infants' cognitive levels with object permanence tasks. Infants at cognitive level four were successful with the standard object permanence tasks but erred in the AB error tasks. Subsequently, in this study, infants who failed AB error tasks and alternate AB error tasks more than once were not tested further with superimposed three obstacle tasks, invisible displacement tasks with one and two screens. Sixteen infants in this study were at cognitive level four. This was based on their performances with the above mentioned tasks.

Infants at cognitive level five must succeed at least twice in retrieving the doll in AB error tasks, alternate AB error tasks, superimposed three obstacles tasks. Eighteen infants (eight males and ten females) fit into this

category. Two females were later dropped from the study to comply with having equal sample of the subjects.

Infants at cognitive level six succeeded at least twice in invisible displacement of tasks with one or two screens besides the preceding object permanence tasks mentioned. Nineteen infants (eleven males and eight females) succeeded in all the tasks mentioned. Three males were later dropped from the study.

After these tasks, the part-whole tasks were given. The investigator partially hid the non-sexist doll under a cover exposing only the parts of the body that were not detached. The investigator then dismembered the arm or the leg of the doll. The first two tasks involved the dismembering of either the arm or the leg of the doll randomly. After dismemberment of the arm or the leg, the investigator asked the infants to look for the doll. The final part-whole task involved the dismembering of the doll's head. Pilot work indicated the level of surprise in the infant to be overpowering when the head was removed. Once again, infants were asked to look for the doll. The infants were given two trials for each part-whole task. The whole procedure was videotaped and lasted between five to fifteen minutes. Affect was measured as level of surprise on a scale of 1, 2, or 3 for each arm, leg, and head.

For scoring of visual search and manual search, a score of one to seven was given with (1) indicating no visual search or manual search and (7) indicating full visual

search or full manual search. Latency to visual search and latency to manual search were timed according to how long the infant took to begin to search for the missing part of the doll. Affect of the infant was also scored after each trial (total six trials in all). A score of 1 was given for no visible affect, and a 3 was given for surprise or total puzzlement.

CHAPTER VI

RESULTS

Several analyses were carried out with the data obtained from infants in cognitive levels four, five, and six in this study. Cognitive levels for these infants were determined with object permanence tasks given prior to part-whole tasks. Of these, many were significant. The following paragraphs examine the various results concerning latency to visual search, amount of visual search, latency to manual search, amount of manual search, and affect.

Preliminary Analyses

For the preliminary analysis examining the impact of gender, an analysis of variance indicated there was no significant difference as a function of gender on the object permanence tasks ($F = 0.5928$; $p < 0.4453$). The means for gender were as follows: Male = 101.6667, female = 97.7500. As such, gender was ignored in the other analyses. These results are shown in Table I.

(Insert Table I about here)

The primary analyses used cognitive level and salience of the missing body parts as independent variables. The

dependent variable dependent variables, depending on the analysis, included visual search, latency to visual search, manual search, latency to manual search, and affect. Three by three (cognitive level by salience of the missing body parts) repeated measures analyses of variance were used to examine the impact of cognitive level and salience on the various means. Post hoc Scheffe's tests were used when necessary to determine which groups accounted for the significant difference.

Primary Analyses

Latency to visual search

A repeated measures analyses of variance (3 x 3) examining cognitive level and salience of the missing body part revealed cognitive level to account for significant differences in latency to visual search ($F = 55.11$, $p < 0.0001$)(Table II). The means were as follows: For cognitive level four = 198.3958, cognitive level five = 96.3333, and cognitive level six = 42.0000)(Table III). Follow up Scheffe's tests revealed that the means for only cognitive levels five and six were significantly different ($F = 2.02$; 2-tailed $p < 0.018$)(Table IV).

(Insert Tables II, III, and IV about here)

Salience of the missing body part of the object showed no significant effects on latency to visual search ($F =$

1.64, $p < 0.1977$) (Table V). The mean scores for the various body parts were as follows: Arm = 126.8958, leg = 110.0833, and head = 99.7500) (Table VI). No significant difference was revealed for the interaction effect of cognitive level and salience of the missing body part for latency to visual search ($F = 0.71$, $p < 0.5841$). (Table V).

As for latency to visual search, infants took the longest time (in seconds) to realize that the arm was missing, followed by the leg, and then the head. It took infants in all three cognitive levels an average of 126.8958 seconds to visually searched for the missing arm, 110.0833 to visually searched for the missing leg, and 99.7500 seconds to visually searched for the missing head. (Table VI).

(Insert Tables IV, V, and VI about here)

Amount of visual search

Repeated analyses of variance (3 x 3) with cognitive level and salience of the missing body part revealed cognitive level was significant in accounting for in the amount of visual search ($F = 62.25$, $p < 0.0001$) (Table V). The means were as follows: For cognitive level four = 4.7292, cognitive level five = 11.0625, and cognitive level six = 13.1042) (see Table III). Post hoc Scheffe's tests located the significant differences between children of cognitive levels four and six ($F = 2.71$; 2-tailed $p < 0.001$)

and between children of cognitive levels five and six (F = 3.15; 2-tailed p < 0.000) (Table IV).

This analysis also showed no significant differences as a result of the salience of the missing body parts of the doll (F = 0.57, p < 0.5677) (Table V). The means for missing body parts were as follows: Arm = 9.2292, leg 2 = 9.6042, and head = 10.0625 (Table VI).

There was no significant difference for the interaction effect of visual search by cognitive level and salience of the body part (F = 0.32, p < 0.8637).

Latency to manual search

Similar to previous variables, this repeated measures analysis used cognitive level and salience of the missing part to measure latency to manual search.

Result of this analysis showed a significant difference for latency to manual search by cognitive level (F = 51.11; p < 0.0001) (Table V). The means for cognitive levels were as follows: Cognitive level four = 197.9167, cognitive level five = 82.1667, and cognitive level six = 35.0625 (Table III). Follow up Post hoc Scheffe's test revealed a significant difference among cognitive levels five and six (F = 1.78, p < 0.50) (Table IV).

There was no significant difference in latency to manual search by salience of the missing body part of the doll (F = 1.13, p < 0.3277) (Table V). The means for

missing body parts were as follows: Arm = 119.0417, leg = 100.8333, and head = 95.2708 (Table IV).

Results showed no significant interaction in latency to manual search by cognitive level and salience of the body part ($F = 0.66$, $p < 0.6203$) (Table V). The infants performed slightly better in their latency to manual search for the three missing body parts. Infants took approximately 119.0417 seconds to manually searched for the arm, 100.8333 seconds to manually searched for the leg, and 95.2708 seconds to manually searched for the head (Table VI).

Amount of manual search

Once again, the repeated measures analysis (3 x 3) used cognitive level and salience of the missing body part to measure the amount of manual search.

The analysis revealed differences in the amount of manual search by cognitive level to be significantly different ($F = 61.80$; $p < 0.0001$) (Table V). The means for cognitive levels were as follows: Cognitive level four = 4.7291, cognitive level five = 11.0625, and cognitive level six = 13.0833 (Table III) when repeated analyses of variance was used to examine the result. Further Post hoc Scheffe's test revealed a significant difference among cognitive levels four and six ($F = 2.65$; $p < 0.001$) and cognitive levels five and six ($F = 3.07$; $p < 0.000$) (Table IV).

There was no significant difference in the amount of manual search by salience of the missing body part of the doll ($F = 0.59$, $p < 0.5533$) (Table V). The means for missing body parts were as follows: arm = 9.2083, leg = 9.6042, and head = 10.0625) (Table VI).

The interaction of cognitive level and salience of the missing body parts did not significantly affect the amount of manual search ($F = 0.31$, $p < 0.8695$) (Table V).

Affect

The repeated measures analysis (3 x 3) for affect showed a significant difference by cognitive level ($F = 59.82$; $p < 0.0001$) (Table V). The means for cognitive levels were as follows: Cognitive level four = 2.3333, cognitive level five = 3.8333, and cognitive level six = 4.9583 (Table III). Further Post hoc Scheffe's test revealed the significant differences among cognitive levels four and five ($F = 2.85$; $p < 0.000$) and cognitive levels four and six ($F = 1.96$; $p < 0.023$) (Table IV).

There was a significant difference of the main effect for affect by salience of the missing body parts of the doll ($F = 5.57$, $p < 0.0047$) (Table V). The means for the missing body parts were as follows: Arm = 3.4167, leg = 3.5417, and head = 4.1667) (Table VI). Post hoc Scheffe's test did not indicate which missing body part elicited more affective responses from the infants.

There was not a significant interaction of cognitive level and salience of the missing body part on affect ($F = 1.77$, $p < 0.1377$). Table V shows these means.

TABLE I

MEAN SCORES FOR GENDER ON OBJECT PERMANENCE TASKS

Group	N	Mean
Male	24	101.6667
Female	24	97.7500

TABLE II

MEAN AGE BY GENDER AND COGNITIVE LEVEL

	COGNITIVE LEVELS		
GENDER	**4***	**5***	**6***
Male	10.38	16.63	22.13
Female	10.63	15.63	22.50

*4 (Age is approximately between 8 to 12 months)
*5 (Age is approximately between 13 to 17 months)
*6 (Age is approximately between 18 to 24 months)

TABLE III

MEAN SCORES BY COGNITIVE LEVELS

VARIABLES	**4**	**5**	**6**
Amount of Visual search	4.7292	11.0625	13.1042
Latency to visual search	198.3958	96.3333	42.0000
Amount of Manual search	4.7292	11.0625	13.0833
Latency to manual search	197.9167	82.1667	35.0625
Affect	2.3333	3.8333	4.9583

TABLE IV

POST HOC SCHEFFE'S

	F	Pr < F
Cognitive Levels Four and Six		
Visual Search	2.71	0.001*
Latency to Visual Search	1.46	0.198
Manual Search	2.65	0.001*
Latency to Manual Search	1.16	0.618
Affect	1.96	0.023*
Cognitive Levels Four and Five		
Visual Search	1.16	0.614
Latency to Visual Search	1.38	0.268
Manual Search	1.16	0.614
Latency to Manual Search	1.54	0.143
Affect	2.85	0.000*
Cognitive Levels Five and Six		
Visual Search	3.15	0.000*
Latency to Visual Search	2.08	0.018*
Manual Search	3.07	0.000*
Latency to Manual Search	1.78	0.050*
Affect	1.46	0.202

*Significant at 0.05 level.

TABLE V

RESULTS OF ANALYSES OF VARIANCE

VISUAL SEARCH	**DF**	**F**	**PR < F**
COGNITIVE LEVELS	2	62.25	0.0001*
SALIENCE	2	0.57	0.5677
COGNITIVE LEVEL X SALIENCE	4	0.32	0.8637
LATENCY TO VISUAL SEARCH			
COGNITIVE LEVELS	2	55.11	0.0001*
SALIENCE	2	1.64	0.1977
COGNITIVE LEVEL X SALIENCE	4	0.71	0.5841
MANUAL SEARCH			
COGNITIVE LEVELS	2	61.80	0.0001*
SALIENCE	2	0.59	0.5533
COGNITIVE LEVEL X SALIENCE	4	0.31	0.8695
LATENCY TO MANUAL SEARCH			
COGNITIVE LEVELS	2	51.11	0.0001*
SALIENCE	2	1.13	0.3277
COGNITIVE LEVEL X SALIENCE	4	0.66	0.6203
AFFECT			
COGNITIVE LEVELS	2	59.82	0.0001*
SALIENCE	2	5.57	0.0047
COGNITIVE LEVEL X SALIENCE	4	1.77	0.1377

*Significant at 0.05 level

TABLE VI

MEANS BY SALIENCE OF BODY PARTS

VARIABLES	1(ARM)	2(LEG)	3(HEAD)
Amount of Visual search	9.2292	9.6042	10.0625
Latency to visual search	126.8958	110.0833	99.7500
Amount of Manual search	9.2083	9.6042	10.0625
Latency to manual search	119.0417	100.8333	95.2708
Affect	3.4167	3.5417	4.1667

CHAPTER VI

DISCUSSION

This study explored the relationships of object permanence, part-whole relations, and infant memory development. It was anticipated that cognitive level and salience of a missing part of an object would alter the child's performance on part-whole tasks. While the results yielded unequivocal support for the importance of cognitive level on the tasks, salience of the missing parts of the object only seemed important for affective responsiveness. In addition, there were no significant interaction effects between cognitive level and salience of the missing part.

The initial hypothesis concerned the impact of gender on cognitive level. No gender differences were found in the performance of the boys and girls on the various Uzgiris and Hunt's tasks in this study. These results confirmed the data from other studies that reported no gender differences on object permanence tasks (Cummings & Bjork, 1982; Shafie, Self & Allen, 1984).

The next hypotheses examined the impact of cognitive level on the various measures. In each of these analyses, cognitive level of the child significantly affected the

outcome. For the amount of visual and manual search, latency to visual and manual search, and affect, cognitive level was a significant factor in performance. Mean scores in this study indicated that infants and toddlers differed significantly in their performances on part-whole tasks.

These findings are consistent with Piaget's (1954) claim that children in cognitive level six have the capacity for mental representation within the sensorimotor stages. Piaget (1954) based this statement on the observation that infants were able to search for objects through invisible displacements only after demonstrating their abilities to search for visible displacements of objects. This theory was further substantiated by Ramsay and Campos' (1978) study looking at infants' performance in two search tasks. They found that infants' ability to mental representation was related to their entering substage six of Piaget's object permanence development. Piaget (1954) however, did not mention that children younger than cognitive level six were also capable of mental representation (Ramsay & Campos. 1978; 1979). There are studies showing infants younger than substage six also had the capacity to mental representation (Baillargeon, Spelke, & Wasserman, 1985; Baillargeon, 1986; Baillargeon, & Graber, 1987; Bower, 1967; 1975; Bower & Paterson, 1973a; 1973b; LeCompte and Gratch, 1972; Ramsay and Campos, 1975).

Infants and toddlers in this study of part-whole relations at cognitive level six did remarkably well in the

tasks specified. They were more successful in searching for the missing body parts of the doll. In the visual and manual search tasks, children in cognitive level six scored higher in their search for the different missing parts of the doll. For latency to visual and manual search, children in cognitive levels five and six took less time (in seconds) to successfully retrieve the missing body parts. Several infants, after recovering the missing body parts, attempted on their own to put the parts together. Failing to succeed, they gave the doll and the body part to the investigator. The shortest time taken for infants in cognitive levels five and six to search for the missing body parts was 1 second and the longest time taken was 50 seconds. In this study, infants at cognitive levels five and six demonstrated their abilities to search for the missing body parts of the doll that was displaced visibly first followed by their success in searching for the missing body part that was displaced invisibly. In this study, infants in cognitive level five showed mental representation of the doll even though according to Piaget (1954); and Ramsay & Campos (1978; 1979) only cognitive level six infants were capable to search successfully for objects that were displaced invisibly. Perhaps other part-whole relations tasks can be studied using invisible displacements of a doll with body parts missing.

Infants in cognitive levels five and six were more active in their search for the missing body part. Upon

retrieving the doll from under the cover and realizing the difference, infants at cognitive levels five and six immediately searched for the missing body part. Most of the older infants were able to remove the cover to look for the missing body part. Some of the infants looked at the investigator wondering if she kept the missing body part. Others searched under the table, looked behind themselves, looked at the cover, and then lifted the cover to find the missing body part. One infant searched for the missing body part by persistently searching in her pockets. Infants in cognitive levels five and six, besides succeeded more in the visual and manual search behavior, also revealed more surprise and puzzlement upon retrieving the incomplete object from under the cover.

On the other hand, infants in cognitive level four scored lower on the visual and manual search tasks. Most of the infants at this level did not successfully search for the missing body parts in this study. That is, after retrieving the doll from under the cover, the infants in cognitive level four, instead of searching for the missing body parts, spent more time looking at the doll, returning their gaze to the cover and then back at the investigator. Infants at this level also spent more time mouthing the doll. It never occurred for these infants to search for the missing body parts of the doll directly under the cover since the doll was displaced visibly prior to the

dismembering of the body part. After which the investigator dismembered the body part invisibly under the cover.

The infants had about 60 seconds to play with the doll before visible displacement and dismemberment of the doll occurred. Maybe the time given for these younger infants to become familiarized with the doll was insufficient. It was clear to the infants at cognitive level four as measured by the affect scores that something was definitely different about the doll they had retrieved.

Another possible explanation could be that the part-whole tasks were simply too difficult for these infants. Infants at cognitive level four had difficulty remembering that the limb of the doll were all attached together prior to having the limbs detached from the doll. Possibly the doll used in this task was small and may have failed to generate interest from these infants.

As for the affective response scores in this study, infants in all three cognitive levels were significantly different. Children in cognitive level six scored significantly higher in the means for affective response than the other two cognitive levels. Means for affective response for cognitive level six is 4.9583; cognitive level five is 3.8333, and cognitive level four is 2.3333. The affective response scores for cognitive level six explained that these infants were more aware of the transformation of the object and were able to manifest their emotions following retrieval of the incomplete object. Ramsay and

Campos (1978; 1979) in determining the relation between particular behaviors in infants by using the surprise paradigm to measure infants' smiling responses found out in their study that infants at cognitive level four showed significant affective responses. Similar findings recorded in another study (Ramsay & Campos, 1979) supported the relationship between cognitive level and infants' surprise responses.

Hiatt, Campos, and Emde (1979) investigated the facial expressions and discrete emotional states of infants by studying infants and by eliciting affect expressions in situations which were not unusual in a lifelike situation. They tested the differentiation of facial expressions of emotion using two situations designed to elicit happiness, two designed to elicit surprise, and two to elicit fear. Results for the two surprise eliciting conditions (that is, looking at infants' reaction to toy-switch and vanishing object) revealed that these tasks elicited blends of emotions rather than a single emotion such as surprise or fear or happiness. There is a high possibility that infants in all three cognitive levels in this study also elicited blends of emotions when retrieving the doll with a body part missing. However, infants in cognitive levels five and six were able to manifest their emotions more strongly than infants in cognitive level four. This could explain the extremely low means for affective responses in the study of part-whole relations with infants at cognitive level four.

The general failure to observe facial expressions in cognitive level four infants indicated that the stimulus (that is, dismemberment of the limbs) was not effective in causing these infants to be particularly surprised, or that the infants were unaware that the object was incomplete after the transformation.

Past research suggests that it is not easy deciphering facial expressions (Hiatt, Campos, & Emde, 1979; Izard 1977; Ramsay & Campos 1978; 1979) due to the blend of emotions elicited in affective responses. Another explanation could be that the emotions were fleeting (Hiatt, Campos, & Emde, 1979). While coding the data, the raters looked at the video playback in real times and could have missed the salient features that might hint at surprise or puzzlement (Ramsay & Campos, 1979). In the future, raters might look at video playback at a slower time. This might enable the raters to pick out emotions easier than when the video playback is at regular time, as suggested by Ramsay and Campos (1979). The features that the raters looked at in determining the affective responses of the infants were eyebrow/forehead/nasal root, eyes/nose/cheeks, and mouth/lips regions (Izard 1980). Therefore, if the emotion elicited was surprise, the infant should have displayed curved and high eyebrows, wide open eyes, and roundish opened mouth. A component of these features is shown in Appendix A.

The analysis of this study showed some differences from Shafie, Self, and Allen's (1984) study. Their study revealed that twelve to fifteen months old infants showed stronger surprise and puzzlement than both younger and older infants. This present study showed that infants in cognitive levels five and six, that is, approximate age is between thirteen to twenty-four months, showed stronger affective responses than cognitive level four infants. Included in this study were infants twenty to twenty-four months old which the previous study omitted.

Shafie, Self, and Allen (1984) looked at infants' affective responses using ages eight to eleven months, twelve to fifteen months, and sixteen to nineteen months. The present study looked at the last three cognitive levels of Piaget's (1954) sensorimotor stage, that is, cognitive levels four, five, and six. The approximate ages of the infants were divided as such: Nine to twelve months old, thirteen to seventeen months old, and finally eighteen to twenty-four months old. Eight-month-old infants were excluded from the present study. Besides excluding eight-month-old infants in the present study, the tasks presented differed from those of Shafie, Self, and Allen (1984). Testing infants with other tasks was included in the present study in addition to the standard object permanence task. For example, finding an object which was completely covered with a single screen in two places alternately (AB error task), finding an object which was completely covered with a

single screen in three places, finding an object following one invisible displacement with a single screen, and finding an object following one invisible displacement with two screens. Infants in this study are given the tasks that are appropriate for their cognitive levels. Therefore, infants in cognitive level 4 will not be given invisible displacement tasks since they may not have exhibited the capacity to mental representation. Following failure of a task not specified in Uzgiris and Hunt (1975; 1989) and Dunst (1985) manuals for these infants, they were not given further tasks other than the standard object permanence task. The purpose of testing cognitive levels five and six infants with the aforementioned tasks was to look at the completion of these tasks and the success in searching for the missing body part. The older infants had the abilities to search for invisible displacements of objects by mental representation. Infants at cognitive level four failed in invisible displacement tasks due to their lack of representational skills (Hiatt, Campos, & Emde, 1979; Piaget, 1954; Ramsay & Campos, 1978; 1979; Shafie, Self, & Allen, 1984). Infants in cognitive levels five and six were more likely to succeed in searching for the missing body part after having accomplished mental representation. Also, infants in cognitive level six were able to use recall memory to search for the missing body part.

This present study supported Shafie, Self, and Allen (1984), and Piaget and Inhelder (1973) claims that infants

in cognitive level six were able to use their reconstructive memory to search for objects. Whereas infants in cognitive level four relied mainly on their recognition memory, which, according to Piaget and Inhelder (1973), was the most basic form of memory, to see if they noticed the differences in the object. Substage six infants were able to use their recall memory to look for the missing body part since they were able to match the missing body part to the incomplete object even though they had difficulties 'fixing' the parts together. Piaget (1954) claimed that infants in substage three, that is between ages four to eight months, had the abilities to infer incomplete objects when only parts were made visible to them. By the time they reached cognitive level four, they should be able to differentiate between parts and wholes. Thus, infants in cognitive level four should be able to search for the missing body part of the doll. However, that was not the case in this study. If infants did not successfully searched for the missing body part by 120 seconds, the investigator would scored that task as unsuccessful. The only difference with success of the tasks with cognitive levels five and six could be the time or latency factor.

The salience of the missing part did not impact generally upon infants' performance. Surprisingly, this factor was significant only in affect. It did not impact the infants' performances for the amount of visual and manual search, and latency to visual and manual search.

The results showed that infants in all three cognitive levels showed significant affective responses when they retrieved the incomplete object from beneath the cover. The head of the object generated more visual and manual search than the other two missing body parts. One explanation was that infants in all three cognitive levels were more likely to focus on the face of the doll since the face was more animated. Perhaps the feature of the face proved more interesting and more life like to the infants. It was not surprising that the arm generated the lowest means in visual and manual search. The arm was the smallest part of all three body parts in this study. The infants could have dismissed the importance of the arm since it was not as salient as the head or the leg. Once again, these infants were more likely to notice the feature of the face of the doll than the other two body parts. The time taken for the latency to visual and manual search is lower for the head than either the arm or the leg.

Salience of the missing body parts did not reveal significantly affect in the amount of visual and manual search, and latency to visual and manual search. An affective response was shown by infants in all three cognitive levels. They elicited more affective responses for the missing head than either the leg or the arm. Means for the affective responses for the head is 4.1667, followed by 3.5417 for the leg, and 3.4167 for the arm.

The interaction of cognitive levels of infants and salience of the missing body parts showed no significance for the outcome. For the amount of visual and manual search, latency to visual and manual search, and affect, cognitive level and salience of the missing part were not significant in the infants' performances. However, it approached significance on the measure of affective responsiveness. In actual scores, it was revealed that infants in cognitive level four found the arm twice (n = 16). These infants found the missing leg five times (n = 16), and they found the missing head three times (n = 16). However, four infants in cognitive level five did not succeed in looking for the missing arm (n = 16), five missed the leg (n = 16), and three did not look or failed to recover the head (n = 16). Three infants at cognitive level six, however, missed the arm (n = 16), one did not succeed in looking for the leg (n = 16), and all 16 infants at cognitive level six found the head underneath the cover.

Infants at substage four according to Piaget (1954) were capable of active search for visible displacement of object. They were also capable of removing the cover to look for the object. In this study, the tasks were slightly modified so that when infants in cognitive level four retrieved the incomplete object, they were required to look for the missing body part. In order to accomplish the part-whole tasks, the infants had to rely on their recognition memory to look for the missing body part. There were three

parts to Piaget and Inhelder (1973) recognition memory. They were elementary recognition; recognition memory, which involved the assimilation of an existing schema; and recognition at the higher levels, which bound with mobile and differentiated schemata. The majority of the infants at cognitive level four in this study were not able to use recognition memory to look for the missing body parts. One explanation could be that they were not given enough time to search for the missing body parts. The investigator allowed the infants about 120 seconds to search for the missing body parts. After the time limit, she immediately performed another tasks thus depriving the infants from further searching of the missing body parts.

Moore, Borton, & Darby (1978) on the other hand, believed that mentally representing of an object marked the beginning of achieving an understanding of object permanence rather than the end (Piaget, 1954). Therefore, according to Moore, Borton, & Darby, infants at cognitive level four had achieved the ability of mental representation. However, Moore, Borton, & Darby (1978) claimed that even if infants at cognitive level four were capable of mental representation, they were still unable to understand that an object has an identity of its own when disappeared and then reappeared. Therefore, in this study, the inability of most of the infants in substage four to look for the missıng body parts could attribute to the failure of their comprehension of the identity of the object.

Another explanation in this study with infants in cognitive level four was that infants at this level had a subjective conception of objects, position, and movement. Therefore, they were likely to make what Piaget (1954) called the stage four search error, or the AB error. AB error occurred when infants continuously search at a specific location (A) even when the object was hidden at another location (B). In this study, the retrieving of the incomplete object was considered A. The missing body part, which was still hidden, was in location B. Thus, infants failure to retrieve the missing body part in this study had made the AB error.

According to Piaget and Inhelder (1973), infants in cognitive level five had the ability to intentional reproduction of a particular action and its results. These infants were able to reconstruct an object or a configuration without prior constructions of a 'schematized action'. Therefore, then infants in cognitive level five in these study were able to succeed in the recovery of the missing body parts.

For infants in cognitive level six, they combined intentionality and mental representation to discover solutions to problems. The problem in this study is that a body part is missing. The solution is for these infants to look for the missing body part. Combining the skills they have acquired, it is not surprising that infants at cognitive level six were more successful in searching for

the missing body part. Infants in cognitive level six were more successful in the search for the missing body parts could also attribute to their ability to complete internalization of the object (Piaget & Inhelder, 1973) or what was considered to be associative memory (Watson, 1980).

This study showed the importance of cognitive level in infants' performance of the part-whole tasks in the amount of visual and manual search, latency to visual and manual latency, and affective responses. However, salience of the missing body part was not significant in this study in the amount of visual and manual search and latency to visual and manual search. Salience of the missing body parts in the amount of affective responsiveness was significant. For the interaction of cognitive level and salience of the missing body part, no significant differences were accounted for by the amount of visual and manual search, latency to visual and manual search, and an almost significance with affect responses.

In conclusion, Piaget and Inhelder's (1973) theory of recall memory is better differentiated in this study. The level of recall memory is discernable between cognitive levels four and six, cognitive levels five and six but not between cognitive levels four and five.

Future studies in object permanence and infant memory development are encouraged to look at theories by other scientists such as Cummings and Bjork, Watson, and Sophian. To further substantiate the literature on object permanence

and infant memory development, future studies need to look at different aspects of information processing as per Howard's model (1983). Also, further studies need to include how infants, who are blind from birth, process information with object permanence, especially part-whole tasks, without ever having seen the object(s). There is also a need to look at how infants who are developmentally delayed, and how infants from diverse cultural background, process information.

REFERENCES

Acredolo, L.P. (1978). Development of spatial orientation in infancy. Developmental Psychology, 14, 224-234.

Acredolo, L.P., & Adams, A., Goodwyn, S.W. (1984). The role of self-produced movement and visual tracking in infant spatial orientation. Journal of Experimental Child Psychology, 38, 312-327.

Baillargeon, R., Spelke, E. S., & Wasserman, S. (1985). Object permanence in 5-month-old infants. Cognition, 20, 198-201.

Baillargeon, R. (1987). Object permanence in 3 1/2 and 4 1/2-month-old infants. Developmental Psychology, 23, 655-664.

Baillargeon, R. (1986). Representing the existence and the location of hidden objects: Object permanence in 6 and 8 month-old infants. Cognition, 23, 21-41.

Baillargeon, R., & Graber, M. (1987). Where's the rabbit? 5.5 months old infants' representation of the height of a hidden object. Cognitive Development, 2, 375-392.

Beilin, H. (1989). Piagetian Theory. In Ross Vasta (Ed.), Annals of Child Development (pp. 85-131). Greenwich, Jai Press, Inc.

Bell, S.M. (1970). The development of the concept of object as related to infant-mother attachment. Child Development, 41, 291-309.

Bigelow, A.E. (1983). Development of the use of sound in the search behavior of infants. Developmental Psychology, 19, 317-321.

Bjork, E. L., & Cummings, E. M. (1984). Infant search errors: Stage of concept development or stage of memory development. Memory Cognition, 12, 1-19.

Bower, T. G. R. (1967).. The development of object-permanence: Some studies of existence constancy. Perception and Psychophysics, 12, 411-418.

Bower, T. G. R. (1975). Infant perception of the third dimension and object concept development. In L. B.Cohen & P. Salapatek (Eds.), Infant Perception: From Sensation to Cognition (Vol. 2). New York: Academic Press.

Bower, T. G. R., & Paterson, J. G. (1973a). Stages in the development of the object concept. Cognition, 1, 47-55.

Bower, T. G. R., & Paterson, J. G. (1973b). The separation of place, movement, and object in the world of the infant. Journal of Experimental Child Psychology, 15, 161-168.

Brown, A. L. (1975). The development of memory: Knowing, knowing about knowing, and knowing how to know. In H.

W. Resse (Ed.), Advances in child development and behavior (Vol. 10). New York: Academic Press.

Butterworth, G. (1977). Object disappearance and error in Piaget's stage IV task. Journal of Experimental Child Psychology, 23, 391-401.

Cowan, P. A. (1978) Piaget with feeling: Cognitive, social, and emotional dimensions. New York: Holt, Rhinehart, and Winston.

Crain, W. C. (1985). Theories of development: Concepts and applications. New Jersey: Prentice Hall.

Cummings, E. M., & Bjork, E. L. (1981). The search behavior of 12 to 14 month-old infants on a five-choice invisible displacement hiding task. Infant Behavior and Development, 4, 47-60.

Cummings, E.M., & Bjork, E.L. (1983). Search behavior on multi-choice hiding tasks: Evidence for an objective conception of space in infancy. International Journal of Behavioral Development, 6, 71-87.

Deloache, J. S. (1985). Memory based searching by very young children. In H. Wellman (Ed.), The development of search ability (pp. 151-183). Hillsdale, New Jersey: Erlbaum.

Diamond, A. (1985). Development of the ability to use recall to guide action, as indicated by infant's performance on AB. Child Development, 56, 868-883.

Dunst, C. J. (1982). The clinical utility of Piagetian-based scales of infant development. Infant Mental Health Journal, 3, 259-275.

Elkind, D. & Scott, L. (1962). Studies in perceptual development: 1. The decentering of perception. Child Development, 33, 619-630.

Elkind, D., Koegler, R. R., & Go, E. (1964). Studies in perceptual development. Child Development, 35, 81-90.

Evans, W. F. & Gratch, G. (1972). The stage iv error in Piaget's theory of object concept development: Difficulties in object conceptualization or spatial localization? Child Development, 43, 682-688.

Flavell, J. (1985). Cognitive Development (2nd Edition). Englewood Cliffs: Prentice-Hall, Inc.

Gardner, B. T., & Wallach, L. (1965). Shapes of figures. Perceptual Motor Skills, 20, 135-142.

Ginsburg, B. T. & Opper, S. (1974). Piaget's theory of intellectual development. Englewood Cliffs: Prentice Hall, Inc.

Gollin, E. S. (1960). Developmental studies of visual recognition of incomplete objects. Perceptual and Motor Skills, 11, 289-298.

Gollin, E. S. (1961). Further studies of visual recognition of incomplete objects. Perceptual and Motor Skills, 13, 307-314.

Gollin, E. S. (1962). Factors affecting the visual recognition of incomplete objects. Perceptual and Motor Skills, 15, 583-590.

Gollin, E. S. (1966). Serial learning and perceptual recognition in children: Training, delay,and order effects. Perceptual and Motor Skills, 23, 751-758.

Gratch, G., Landers, W. F. (1971). Stage IV of Piaget's theory of infant's object concepts: A longitudinal study. Child Development, 42, 359-372.

Hiatt, S.W., Campos, J.J., & Emde, R.N. (1979). Facial patterning and infant emotional expression: Happiness, surprise, and fear. Child Development, 50, 1020-1035.

Horobin, K. & Acredolo, L. (1986). The role of attentiveness, mobility, history, and separation of hiding sites on stage IV search behavior. Journal of Experimental Child Psychology, 41, 114-127.

Lange, G. & Geis, M. F. (1977). Part whole transfer and organization in children's and adult's multitrial free recall. Journal of Experimental Child Psychology, 23, 292-304.

Lingle, K. M., & Lingle, J. H. (1981). Effects of selected object characteristics on object permanence gest performance. Child Development, 52, 367-368.

Moore, M. K., Borton, R., & Darby, B. (1978). Visual tracking in young infants: Evidence for object identity or object permanence? Journal of Experimental Child Psychology, 25, 183-197.

Murray, F. S., & Szymcyzk, J. M. (1978). Effects of distinctive features on recognition of incomplete pictures. Developmental Psychology, 14, 356-362.

Piaget, J. (1952). The Origins of intelligence in children. New York: W. W. Norton & Company.

Piaget, J. (1954). The Construction or reality in the child. New York: Basic Book.

Piaget, J. (1969). The mechanisms of perception. New York: Basic Books.

Piaget, J. (1983). Piaget's theory. In P. H. Mussen (Ed.), Handbook of child psychology. (4th Edition). Vol. 1. W. Kessen (Ed.), History, theory and methods (pp. 103-128). New York: Wiley and Sons.

Schacter, D. L., & Moscovitch, M. (1984). Infants, amnesia, and dissociable memory systems. In M. Moscovitch (Ed.), Infant memory: Its relation to normal and pathological memory in human and other animals (pp. 173-216). New York: Plenum Press.

Schuberth, R. E. (1983). The infant's search for objects: Alternatives to Piaget's theory of object concept development. In Lewis Lipsitt (Ed.) Advances in infancy research. Vol. II. New Jersey: Ablex Publishing Corporation.

Shafie, S., Self, P. A., Allen, R. (1984). Developmental differences in infant memory. Paper presented at the biennial meetings of the Southern Society for Research

in Human Development (Denver, Co., March, 1984). (8 pages).

Small, M. Y. (1990). Cognitive Development. Orlando, Florida: Harcourt Brace Jovanovich.

Sophian, C. (1980). Habituation is not enough: Novelty preferences, search, and memory in infancy. Merrill-Palmer Quarterly, 26, 239-257.

Townes, R. L. (1979). A multidimensional scaling approach to developmental dimensions in object permanence and tracking stimuli. Paper presented at the meeting of the Jean Piaget Society (Philadelphia, PA., June, 1979). (23 pages).

Uzgiris, I. C. & Hunt, J. McV. (1989). Assessment in Infancy. (2nd edition). Urbana and Chicago: University of Illinois Press.

Whiteside, J. A., Elkind, D., & Golbeck, S. L. (1976). Effects of exposure duration on part whole perception in children. Child Development, 47, 498-501.

APPENDIXES

APPENDIX A

MAXIMALLY DISCRIMINITIVE FACIAL MOVEMENTS (MAX) CODES

Brow (B) Forehead (F); Nasal root (N)

20. B: Raised in arched or normal shape. (F: Long transverse furrows or thickening; N: Narrowed.)
21. B: One brow raised higher than other (other one may be slightly lowered).
22. B: Raised; drawn together, straight or normal shape. (F: Short transverse furrows or thickening in mid-region; N: Narrowed).
23. B: Inner corners raised; shape under inner corner; (F: Bulge or furrows in center above brow corners; N: Narrowed).

Eyes/Nose/Cheeks

30. Enlarged, roundish appearance of eye region owing to tissue between upper lid and brow being stretched (upper eye furrows may be visible); upper eyelids not raised.
31. Eye fissure widened, upper lid raised (white shows more than normal).
33. Narrowed or squinted (by action of eye sphincters or brow depressors.
36. Gaze downward, askance.
38. Cheeks raised.

Mouth/Lips

50. Opened, roundish or oval.
51. Opened, relaxed.
52. Corners pulled back and slightly up (open or closed).
53. Opened, tense, corners retracted straight back.
54. Angular, squarish (open).

(Adapted from Berger, K.S. The Developing Person Through Childhood and Adolescence, 2nd Edition, 1984).

APPENDIX B

OBJECT PERMANENCE

scale step	eliciting context	critical behaviors	scoring 1 2 3
5	visible displacement	secures object hidden under a single screen	
6	visible displacement	secures object hidden under one of two screens hidden alternately	
7	visible displacement	secures object under one of three screens hidden alternately	
9	invisible displacement	secures object hidden with a single screen	
11	invisible displacement	secures object hidden with two screens hidden alternately	

APPENDIX C

PART WHOLE TASKS

	arm		leg		head	
	*T1	T2	T1	T2	T1	T2
amount of visual search						
Range 1-7						
amount of manual search						
Range 1-7						
latency to visual search						
In seconds						
latency in manual search						
In seconds						
affect (1-3)						

*T1 T2 = Trial 1 and Trial 2

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