

THE STAGE IV ERROR IN PIAGET'S THEORY OF OBJECT  
CONCEPT DEVELOPMENT: AN INVESTIGATION  
OF THE ROLE OF ACTIVITY

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A Dissertation  
Presented to  
the Faculty of the Department of Psychology  
University of Houston

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In Partial Fulfillment  
of the Requirements for the Degree  
Doctor of Philosophy

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By  
Wilson Frederick Evans  
December, 1973

## ACKNOWLEDGMENTS

My sincere thanks to Guney LeCompte, Diana Saal and Muriel Meicler for their invaluable aid in the formulation of the problem and the collection of this data.

My sincere thanks also to the many mothers who were interested enough to bring their children to our lab with no reward other than the knowledge that they had made a contribution to our understanding of infants. One of these mothers, Muncy McKinney, also deserves my special thanks for her assistance in arranging for the typing and editing of the final manuscript.

My wife, Donna, also deserves my gratitude for her help in the typing of preliminary drafts and for her understanding, love, and patience during the five years of graduate school which we endured together.

Finally, my sincere thanks to Dr. Gerald Gratch for his kind patience and friendship over the last five years and his invaluable assistance in the completion of this dissertation.

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## ABSTRACT

Piaget defines Stage IV of infants' development of object permanence in terms of an interesting error. Infants can find an object hidden at one place (place A), but after attentively watching the same object being hidden at place B, they search at A ( $A\bar{B}$  error).

Piaget says that the error occurs because the infant's limited understanding of space enables him to keep in mind only those places at which he has recently acted. In this explanation, the overt search activity at A plays a critical role in marking A as "the-place-where-objects-are-found."

However, activity at A plays no such critical role in determining correct search on the initial A trial. The sight of the object disappearing at A in itself appears to specify A as the place where the object is to be found. Given this fact, one might ask whether the repeated place specifying disappearance and reappearance of the object at A might also not be the effective stimulus leading to the  $A\bar{B}$  error.

Forty-eight nine-month-old infants were given a two-position delayed response problem involving a two second delay period. Twelve infants saw a toy covered and uncovered at A twice and then were allowed to search for a toy hidden at B. Twelve had five such observational trials. Another twelve actively searched for a toy hidden at A for two trials prior to their B trials, while still another twelve actively

searched at A for five trials.

The four groups did not differ significantly; in all four half, or slightly more than half, of the infants made the A $\bar{B}$  error. Thus the effective stimulus leading to the A $\bar{B}$  error appears to be observation of the disappearance and reappearance of the object at A rather than overt searching at A. From the point of view of Piaget's theory, this finding points to a need for a clarification of the relation between perceptual activity and instrumental motoric activity.

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## CHAPTER I

### INTRODUCTION

An important part of the recent surge of interest and research in infancy has been directed toward understanding how the infant comes to form what is commonly known as the "object concept." Since the impetus for most of this research came from the work of Jean Piaget, it is fitting that I first describe what he felt is involved in the object concept, and then briefly describe some of his observations concerning the stages the infant goes through in reaching this end state. Following this brief summary of the six stages, I will discuss in greater detail Piaget's account of Stage IV, which will be the focus of the present study.

In Piaget's (1954) view, in order for a child to be described as having developed a mature object concept, he must first of all conceive of an object as being an entity separate from himself, and existing and moving in a space common both to the object and to him. In addition, the child must view the object as existing independently of the activity which he exerts on the object. In other words, the child must believe that the object continues to exist even when he is no longer acting on it (acting being used here in the broad sense, including looking at and listening to the object as well as actually manipulating it). A final and very important requirement which must be met before Piaget is

willing to admit that the child has achieved a mature object concept is that the child must recognize that he himself is but one object among others and, like the others, has his own space filling properties and his own movements in the common spatial field.

Although the object concept as it was just described seems to be a complicated affair, Piaget believed that the infant has essentially mastered it by the end of the sensorimotor period, or by about two years of age. In Piaget's thinking the object concept represents an integrated structure of internalized actions or schemes. This structure is constructed by the infant through the successive coordinations of actions performed upon objects within a spatial field. This construction process, however, is a gradual one, being divided by Piaget into six stages which occur in an invariant sequence during roughly the first two years of life. This process can perhaps be best explained by a brief description of each of Piaget's six stages.

Piaget feels that during Stage I, the newborn experiences objects as sensations or images which come and go without any apparent connection between them. More important, he says that the infant "may consider the picture which he contemplates as the extension, if not the product, of his effort to see (Piaget, 1954, p. 8)."

During Stage II, however, the infant begins the coordination of action schemes which will ultimately lead to the

object concept. First among these is the coordination of vision and hearing, in which the child gradually becomes able to make the association between an auditory and a visual experience. This means that the child learns to turn his head toward the source of a sound not in his immediate visual field. Also during Stage II, the infant shows an important type of response which could be characterized as a "passive expectation." This means that once a moving object has left the visual field, the infant will sometimes continue to stare at the spot where the object disappeared. Piaget views this as simply an effort on the part of the infant to prolong or recapture the pleasing image by continuing the action with which it was associated.

The Stage III infant makes several important advances toward attaining a genuine object concept. For example, the infant is able to visually anticipate the future position of moving objects by extrapolating from their visible trajectories. When an object is dropped or thrown in front of the infant, he will look down at the correct location, even though the entire movement of the object has been too fast for him to follow. A similar accomplishment involves what Piaget calls "interrupted prehension." If the infant has already set in motion certain movements of the hand in grasping an object and then loses it, he will seemingly search for the object by continuing the movements. However, the infant in this situation originates no new movements to retrieve the

lost object, but merely repeats his past gestures of holding or attempting to hold the object. Also, if a screen is placed over an object as he reaches, the infant will immediately abandon his apparent search for the object. The reason for this, says Piaget, is that for the child to remove the screen would involve the use of an action scheme not immediately associated with the object. Piaget feels, then, that the object must still be more of an extension of the action associated with it than a separate, enduring entity. This extended action is related to the "secondary circular reaction" characteristic of Stage III in which the child seeks to maintain a spectacle (experience of the interesting object) through continuation of the action schema associated with it.

It is during Stage IV that objects become permanent. That is, they are independent of the action sequences directed toward obtaining them, and their traces exist sufficiently in the child's mind to allow delay and removal of the obstacle, and then continuation of the interrupted action with the object. In Piaget's words, the reason for this new behavior "rises from the fact that the child begins to study displacements of objects (by grasping them, shaking them, swinging them, hiding and finding them, etc.) and thus begins to coordinate visual permanence and tactile permanence... (Piaget, 1954, p. 44)." Thus the child, by holding an object while he brings it closer or further from his eyes, or by turning it around in his hand, becomes aware that the object

remains the same even though many visual changes have taken place. This new awareness of continuity within the previously unrelated experiences associated with the object causes the child to attribute some sense of permanence to it, and thus he searches for it even if he is not directly experiencing it at the moment.

However, Piaget sees an important limitation to the child's sense of the permanence of the object during Stage IV because, even though he is able to seek out an object that is hidden at one place (place A), when he subsequently observes that the object is hidden at a second place (place B), he does not search at B, but instead searches at A, the place at which he just found the object ( $A\bar{B}$  error). Briefly, Piaget's explanation for this error is that the child still has not completely separated the meaning of objects and their locations from his actions, i.e., he understands the nature of hidden things and their locations only in terms of where and how he has successfully acted upon them in the past. Therefore, when an object is hidden at B in the  $A\bar{B}$  situation, the child sees "the-thing-that-I-find-at-A" being hidden, and so searches at A.

Going on to Piaget's Stage V in the development of the object concept, we see that the child has, in most situations, overcome his previous dependence upon previous action to determine search behavior and will now search only at the place where the object was last seen. However, when the

object's movement is not directly visible and must be inferred, the child is once again unable to find it. For example, if the object is placed within the experimenter's closed fist, then under cloth A and left there where the child cannot see it, the child will search within the opened fist, but will not think to look under cloth A. Often, then, not finding the object within the fist where the last visible displacement occurred, the child will revert to Stage IV behavior and look under cloth B, where he has previously found the object. Piaget's explanation for this failure is that the child is not yet capable of imagining or inferring invisible displacements, such as occurred when the object was transferred from the closed fist to under the cloth. In Piaget's words, "...from the moment that the displacements are too complicated to be arranged in groups accessible to representation (and to memory), the object again becomes dependent on the context of the whole and on the practical schema leading to its possession (Piaget, 1954, p. 78)." In other words, if the infant cannot follow the movements perceptually, but must imagine them, he no longer endows the object with the property of permanence. The object reverts to its earlier status of being associated with a previously successful scheme.

Finally, it is during Stage VI that the mature object concept as it was described earlier becomes fully developed within the child. The major reason for this is that the

Stage VI infant has become capable of using representational and symbolic adaptations. This is apparent in the realm of the child's search for hidden objects. For example, while the child watches, an object is placed within the experimenter's closed fist. The fist, still closed, is then placed in sequence under cloths A, B, and C, the object being finally deposited (unknown to the child) under cloth C. The Stage VI child's response to this would be a systematic search pattern, e.g., searching first at A, then B, and finally C. Piaget feels that in this kind of sequence of events, the child shows that he can imagine a series of possible locations for an object which is conceived of as substantial and permanent by existing in the common space, i.e., the object is completely free of the child's action on it.

Finally, by another kind of behavior, the child shows that he has mastered another of Piaget's criterion for a mature conception of objects, i.e., the requirement that the child recognize that he himself is but one object among others and moves in a spatial field common to all objects. In an example cited by Piaget, the child demonstrates that he understands this when, after he has walked some distance from his house and is then asked where his house is, he immediately turns around and points in the correct direction.

As a final point, it should be made clear that Piaget is unable to isolate the development of the object concept from other, concurrent, aspects of cognitive development.

This is made clear in the following passage from his book,  
The Construction of Reality (1954):

To the extent that things are detached from action and that action is placed among the totality of the series of surrounding events, the subject has power to construct a system of relations to understand these series and to understand himself in relation to them. To organize such series is to form simultaneously a spatio-temporal network and a system consisting of substances and of relations of cause and effect. Hence the construction of the object is inseparable from that of space, of time, and of causality (p. 92).

## CHAPTER II

### REVIEW OF LITERATURE AND STATEMENT OF PROBLEM

#### Piaget's Explanation of the Stage IV Error

At this point I will return to Stage IV and discuss Piaget's thoughts about this important stage in more detail. Within Piaget's framework, the fourth stage is pivotal. In the first three stages, the infant knows objects only when they are in view. However, in the fourth stage the infant does have a measure of object permanence, and is able to seek out an object that is hidden in a particular place, place A. However, there is an important limitation to his sense of the permanence of the object because when he subsequently observes that the object is hidden at the second place, place B, he does not search at B, but instead searches at A, the place at which he first found the object.

This error, which we shall call the A $\bar{B}$  error, poses an interesting puzzle for Piaget, and he discusses it in a number of places (e.g., Piaget, 1950, 1954, 1967, 1969). However, his book The Construction of Reality (1954) contains the most lengthy and detailed of his observations and speculations about the error. In this book he poses a number of alternative explanations for the error, and then discusses in some detail his own hypothesis as to why the error occurs.

In the first such alternate explanation, which he refers to as "absent-mindedness," he considers the possibility that

the phenomenon is a not particularly noteworthy infantile version of a common experience of adults in which the adults place an object in a sequence of positions, forget that sequence, and then "search for it in the place where... attempts are ordinarily crowned with success (1954, p. 69)." However, Piaget dismisses this explanation. He argues that his own three infants did not have the opportunity to forget the sequence because they would turn to A immediately after they attentively watched the object disappear at B. Also, he believes that place A was not really a familiar place because the infants found the toy there only once or twice. In other words, Piaget believes that the  $A\bar{B}$  phenomenon cannot be accounted for by saying that the infant follows the movement of the object while it is in view, registers this movement in short-term memory, and then forgets the movement over the course of time.

Instead, Piaget argues that the infant fails to comprehend the movements he watches, and he offers three explanations of how this occurs--difficulties in memory, difficulties in spatial localization, and difficulties in object conceptualization. After offering these three explanations, he makes it clear that he considers the first two to be but different aspects of the object conceptualization explanation.

The "difficulties in memory" explanation is perhaps the most confusing of the three. What he actually means by the phrase "difficulties in memory" seems to be "difficulties in

encoding or registering." This is clearest in the following passage:

...to the extent that a defect of memory intervenes it would only involve a systematic difficulty in arranging events in time and consequently, in noting the sequence of displacements. Seeing the object disappear, the child would not try to reconstruct its itinerary; he would, without reflection or memory, go straight to the position where his action had already succeeded in finding it (p. 64).

The memory explanation, then, is one way of saying that the infants have trouble keeping track of places, and the second, or "spatial localization" explanation provides a reason for this difficulty. In this explanation Piaget argues that the infant localizes objects in terms of a scheme based upon his recent actions. According to this argument, the  $\overline{AB}$  error occurs because there has been no previous action at B, and therefore the infant has trouble registering B as a new place. On the other hand, he is able to localize A because it was here that his practical action brought him a toy. When he sees a toy being hidden at B, he registers only that a toy is being hidden at a "place" and so searches at the only place he is able to localize.

The third explanation adds a significant facet to the "place" argument. Piaget points out that we, as adults, are able to think of particular objects because we assume objects are independent of the many places they may occupy. However, if we did not make this assumption, that is, if we did not distinguish thing from place, we would be aware only of such

impressions as "ball-under-the-arm-chair," "ball-under-the-cushion," etc. In other words, we would be aware of a multiplicity of similar but distinctive "things-of-particular-places." Piaget feels that his third explanation provides the most adequate account of the  $A\bar{B}$  phenomenon and of the mind of the Stage IV infant. Such a child is confused about the relation between thing and place because he understands the nature of things and their locations only in terms of where he has successfully acted upon them in the past. Therefore, when an object is hidden at B in the  $A\bar{B}$  situation, the child sees "the-thing-that-I-find-at-A" being hidden, and so searches at A.

In the words of Piaget:

Whereas we think of the ...(object) as able to occupy an infinitude of different positions, which enables us to abstract it from all of them at once, the child endows it with only a few special positions without being able, consequently, to consider it as entirely independent of them. In a general way, in all the observations in which the child searches in A for what he has seen disappear in B, the explanation should be sought in the fact that the object is not yet sufficiently individualized to be dissociated from the global behavior related to position A (p. 63).

#### Review of the Literature Relevant to the $A\bar{B}$ Error

Piaget's observations and explanations of the Stage IV error raise several interesting questions, some of which have been the focus of recent research. Examples of such questions are: (1) Does the  $A\bar{B}$  error occur in all children and in the same developmental sequence that Piaget describes?

(2) Is Piaget correct in his assumption that the error is basically the result of a failure to register the information rather than a breakdown in short term memory? (3) Is Piaget correct in his assumption that the child errs because he associates a particular thing with the place where he first found it? and, finally, (4) Is Piaget correct when he says that it is the instrumental activity at A which establishes A as a "special place"?

In regard to the first question mentioned above, several investigators have found that the task of finding an object hidden only at A is less difficult than the task of finding an object hidden first at A and then at B (Bell, 1968; Escalona & Corman, 1967; Gouin-DeCarie, 1965; Miller, Cohen, & Hill, 1969; Uzgiris & Hunt, 1966). However, none of these studies have made entirely clear whether failure at B is due to search at A or by a failure to search at all. It is also unclear from these studies exactly how prevalent and age-related the AB phenomenon is. In a recent longitudinal study, Schofield and Uzgiris (1969) found that 6 out of 14 Ss made the error in the first testing session in which they found an object hidden at A. On the other hand, Bell (1968) found that only two of the 25 eight and one-half month olds who searched successfully at A failed at B. Her report also makes it unclear whether either of the two Ss failed at B because they searched at A, or whether they simply failed to search.

Gratch and Landers (1971) performed a longitudinal study where results appear more in line with Piaget's findings. In their study, thirteen six-month old infants were observed bi-weekly until they were about 12 months of age. They found that, for that testing session in which Ss for the first time found a toy at place A on two successive trials, ten of thirteen Ss searched at A when the toy was hidden at B. Further, all thirteen infants showed the  $A\bar{B}$  behavior pattern at least once during their sessions. Like Piaget, Gratch and Landers found that the infants continued to make the error over a number of trials. The median length of the run of A going errors during the first session in which  $A\bar{B}$  occurred was five trials, and the run lengths varied between one and fifteen trials. Also, the median age at which the  $A\bar{B}$  pattern first occurred was 8 months, 2 days, while the median age at which Ss could reliably find a toy irrespective of side of hiding was 11 months, 20 days.

The Gratch and Landers findings also tended to support Piaget's contention that the Stage IV error is caused by the infant's failure to register a new place. In the first few sessions in which  $A\bar{B}$  occurred, the Ss most often looked toward A during the three-second delay period. Further, when they erred, they made no attempt to correct their errors by searching at B. This behavior suggests that they had, indeed, failed to register the new hiding place. During later sessions, the infants tended to be in more conflict over the two

positions, most looking at both A and B during the delay period, and a few looking back and forth between the two sides as if they were trying to reach a decision. Finally, during the last sessions, Ss came to orient only to the side where the object was hidden, and made few errors.

The discrepancy between the findings of Gratch and Landers and the investigations mentioned previously suggested to Harris (1972) that perhaps the introduction of a three-second delay interval played an important role. He points out that both the Schofield and Uzgiris (1969) and the Miller, Cohen, and Hill (1970) studies allowed the infants to search immediately, and they found few infants making the  $A\bar{B}$  error. In one of three studies reported by Harris, he set out to investigate the effects of varying the delay interval by having half of his Ss wait five seconds before allowing them to search, while allowing the other half to search immediately. The side of hiding was randomized between A and B for four trials, and then the delay interval was reversed for the two groups, and four more hiding trials introduced. Harris found that when the infants had to wait five seconds before they could search, they would make the  $A\bar{B}$  error, but they did not err when they could search as soon as the toy was covered.

Harris' results raise some questions concerning Piaget's contention that the error involves a failure to register the new place of hiding rather than a breakdown in short-term

memory. If a registration error lay behind the A $\bar{B}$  phenomena, it seems reasonable to assume that a child who searches immediately will be just as likely to err as a child who searches somewhat later. On the other hand, if the information is registered but then forgotten, an increase in the delay interval should increase the possibility of forgetting and thus increase the probability of error. Gratch, Appel, Evans, LeCompte and Wright (1973) set out to shed more light on this question by varying the delay interval in a more systematic manner. Their infants waited either 0, 1, 3 or 7 seconds before the experimenter moved the tray to within their reach following the covering of the toy. For all of the infants, the toy was hidden five times on one side and then was hidden on the other side. In this study it was found that the great majority of the subjects in the 1, 3, and 7 second conditions erred; however, almost none of the subjects in the 0-second condition erred.

The behavior of the subjects who had to wait before they were allowed to search suggests that Piaget is correct in saying that a breakdown in memory is not involved in the error. However, the 0-second results contradict this notion. As a possible explanation for these 0-second results, Gratch et al. point out that the infants' gaze was drawn to B by the hiding procedure and that this "motor set" was maintained for a fraction of a second, i.e., just long enough for the tray to be pushed forward. They suggest that this "motor set"

then guided the infants' search when the tray was directly in front of them. On the other hand, when a longer delay was introduced, the infants assimilated the hiding of the toy into their scheme of finding the toy at A. This explanation does not contradict Piaget's notion that infants fail to register the place of hiding, but does imply that more than one process is at work when infants search for hidden toys.

Gratch et al. also found some evidence that, while younger infants may make the error because they interpret the hiding of the toy at B as a hiding of the toy at A, older infants make the error because they forget the new hiding place. They classified the infants' delay behavior according to how attentive they were and where they directed their gaze. Infants who leaned forward and looked at the hiding wells through the delay phase were called highly attentive. Those infants who looked away from the wells for only a brief time and infants who essentially left the game were called inattentive. It was found that those infants classified as inattentive were likely to err irrespective of whether their orientation was primarily to the A well, to the B well, or was directed toward both wells. Such behavior is consistent with the notion that these infants were distracted and forgot where the toy was hidden. On the other hand, those infants classified as attentive were likely to err only when they pointed towards A during the delay. It seems likely that an infant who shifts his gaze toward A immediately after the

hiding and remains there has in some way interpreted the hiding of the toy as occurring at A. Infants demonstrating this behavior tended to be younger than the others, suggesting that different processes are at work when the younger infants err.

Harris (1972) reports a study which tends to verify the Gratch et al. finding that older infants make the error because they forget the location of the object. In this study, the 10-month old infants were allowed to search as soon as the toy was covered. There were four variations on the hiding procedure, formed from the combination of the following two factors: (1) toy hidden in the same or the other well, and (2) empty well covered before or after the well containing the toy. When the toy was placed in the other well and that well was covered first, the infants erred, but they did not err under the other three conditions. Harris suggests that the infants erred because they were distracted from the place where the toy was hidden by the covering of the empty well, the well where they previously had searched successfully. In other words, he concluded that the A-B error was due to proactive inhibition. However, Gratch and his associates have found that nine-month olds do consistently make the error when the hiding procedure that did not lead to error in Harris' study is used, i.e., the empty well is covered first and then the toy is placed in the well and covered. Apparently the older infants are not susceptible to

the misinterpretation of the hiding sequence that characterizes the younger infants.

It seems reasonable, then, that infants who are further along developmentally do in some way register the new place of hiding, but their relatively weak memory is easily disrupted. Piaget himself admits this possibility when he talks about what he calls the "residual reaction" of Stage IV. In his words, the residual reaction occurs when "...the child follows with his eyes the object in B, searches for it this second place, and if he does not find it immediately (because the object is buried too deeply, etc.) he returns to A (1954, p. 50)." As to why the residual reaction occurs, he says, "In residual reactions in general it is permissible to think that the child, after having failed to find the object in B, no longer remembers the order of events very well and tries at all events to seek the object at A (p. 61)."

Another important aspect of Piaget's explanation of the  $A\bar{B}$  phenomena is his contention that the Stage IV infant is seeking "the-thing-that-I-find-at-A" when he searches. This explanation implies that the child has some sense of the particular object that disappeared, and errs because he associates that particular object with a particular place, place A. Evans and Gratch (1972) questioned this interpretation, suggesting that perhaps the  $A\bar{B}$  phenomenon could more simply be viewed as a place-going error. They reasoned that if infants err because they associate the particular object with

the place where they found the object before, the introduction of a discriminably new object at B should lead to few errors, since the new object would not yet be associated with a place. Using a three-second delay period, they had their subjects find a toy twice at the A side, and then introduced a markedly different toy at B for half of the subjects. The other half of the subjects saw the same toy hidden at B that they had found at A. It was found that the infants were as likely to commit the  $A\bar{B}$  error when a different toy was hidden as when the same toy was hidden at B. Evans and Gratch concluded from this study that the  $A\bar{B}$  phenomenon occurs because A has somehow become "a place where hidden toys are found," rather than because, as Piaget argues, the particular object belongs at A.

This study raises an interesting question, i.e., "What do infants have in mind when they pull covers?" Do they search with the intention of retrieving an object, or are they perhaps only engaging in operant cover-pulling, the objects disappearance only being a diffuse signal to engage in search behavior? To answer this question, Appel and Gratch (1969) used a one position hiding tray. Half of their nine- and twelve-month old infants saw a toy hidden in the tray and half saw "no toy" hidden. Half of the "no toy" infants saw the experimenter wave an empty hand, put it in the well, cover it, withdraw it and show it to them, and then push the covered tray toward them. The other "no toy"

infants saw the experimenter rap on the front of the covered tray to call their attention to it. The infants who saw a toy hidden searched on all five of the trials administered, while the "no toy" infants pushed the tray back at the examiner on all five trials. After these five trials, the toy hidden--"no toy" hidden conditions were reversed for the next five trials. In this situation, both the nine-month olds and the twelve-month olds who formerly saw "no toy" hidden searched on each trial when they saw a toy hidden. The twelve-month olds who had seen a toy hidden before now refused to search on all trials when they saw "no toy" hidden. All of the results mentioned so far indicate that the infants were sensible and only searched when they actually saw something hidden. However, the nine-month olds who now saw "no toy" hidden followed a different pattern. They tended to search, many for a second and some for a third time.

These results suggest that nine-month olds have a diffuse notion of the relationship between disappearances and reappearances of objects. Is it possible, then, that Stage IV infants would make the  $A\bar{B}$  error after seeing "no toy" hidden at B? The answer to this apparently is "no," i.e., the hiding of a toy at B is a necessary cue for the  $A\bar{B}$  search of the Stage IV infant. Appel (1971) demonstrated this in a study using nine-month olds. All of his subjects saw and found a toy hidden at A for five trials. After this, half saw the toy hidden at B, while the other half saw "no toy" hidden at

B. In this case the "no toy" was a rap on the front of the covered B-well. The great majority of the nine-month olds made the error when they saw a toy hidden at B, but significantly fewer searched at A when they saw "no toy" hidden at B.

Another important question raised by Piaget's explanation for the A $\bar{B}$  phenomenon has to do with the role of activity. It will be recalled that Piaget argues that the child errs because he tends to localize possible hiding places in terms of his previous actions at those places. Landers (1971) set out to investigate this aspect of the explanation. He reasoned that if Piaget were correct, then infants who observe objects being hidden and then uncovered at A should not err, since they have not engaged in any physical activity with the object at place A. He also was interested in examining the effect that varying the amount of experience infants have at A would have on the A $\bar{B}$  error. Landers suggests that some traditional learning theorists (e.g., Hull, 1943; Spence, 1945) would predict that increasing the number of reinforced repetitions of instrumental responses to A should lead the infant to have greater difficulty in overcoming a response tendency toward A when the toy was hidden at B. Piaget, on the other hand, makes no clear statements about what the effects of varying the amount of experience at A might be. In his own observations, he almost always hid the object twice at the A side.

Landers used a two-position hiding tray similar to that

used by Gratch and his associates in the other studies discussed in this chapter. In one of his three experimental conditions, infants searched at A twice in succession before the toy was hidden at B. For this group, as with the other two groups, a three-second delay interval was used on all trials. A second group of infants searched either eight or ten times in succession at A. A third group observed the toy covered and uncovered at A either six or eight times and then found it twice in succession at A. In this latter condition, subjects were handed the toy after they saw it uncovered. The subjects in this study ranged from seven and one-half to ten and one-half months of age.

Landers found that on the first B trial, the great majority of the infants in all three conditions searched at A. On the other hand, members of the second group tended to make a longer run of such searches than did either of the other two groups, who behaved comparably. Landers concluded from these results that "simply watching the experimenter hide and uncover a toy at A does not establish the A side as a 'special' place, while active search does."

Unfortunately, Landers' results do not warrant this conclusion. In order to refute Piaget's argument that it is essentially the instrumental activity at A that establishes A as a special place, it would be necessary to show that infants make the error without such instrumental activity at A. It is impossible to establish on the basis of Landers'

data whether the infants would have erred had they been exposed only to observational experience at A. Therefore, Landers' initial question remains essentially unanswered.

In addition, the results Landers obtained with his "run of errors" measure pose an interesting puzzle. The "run of errors" measure represents that number of errors the child makes, starting with the first B trial, before he searches correctly to B for the first time. Landers found that very few of his subjects erred on B trials subsequent to their first correct search at B. The puzzle concerns the meaning of this measure in relation to a measure representing the number of subjects erring on their first B trial. There were no significant differences between the three experimental groups on this last measure, i.e., subjects in all three groups were equally likely to err on their first B trial. This apparently means that the experimental manipulations of the number and type of A trials had no bearing on whether or not a given child was going to err, but did have a bearing on how long he was going to persevere if he did err.

Why this perseveration effect occurred is not clear. Landers speculated that perhaps the experimental conditions had their effect upon the subject's delay behavior, which in turn mediated their search behavior. He categorized the delay behavior on the B-trials according to three categories: (a) simple - the subject looked to B throughout the delay or looked to B initially and to the midline or away; (b) mixed -

the subject looked to B initially and then to A or looked to B and A several times during the delay; (c) other - the subject looked at B briefly, but did not show any definite direction of orientation for the remainder of the delay period. He found that the percentage of B trials in which these three categories appeared did not differ significantly between the three experimental groups. Therefore, the experimental conditions did not have a differential influence upon subjects' delay behavior. However, he did find that there was a significant relation between the kind of delay behavior a child displayed and whether or not he would err on a given B trial. The  $A\bar{B}$  error occurred most after mixed orientation during the delay, and least after simple orientation. It seems, then, that both the experimental conditions and the pattern of delay behavior were associated with the occurrence of  $A\bar{B}$  errors, yet were not associated with one another. Therefore, why the perseveration effect occurred is still unclear.

#### Statement of the Problem

An essential element of Piaget's explanation of the  $A\bar{B}$  error is his notion that the child's activity at A somehow marks A as a special place. This is clear, for example, when he says, "...the object is not...a substantial thing remaining in the place to which it was moved but a thing at disposal in the place where the action has made use of it (1954, p. 50)."

If it is true that the child's memory of activity at the original place of hiding serves as a mediator which guides subsequent search, what is the cue which guides the child's initial attempt to find a hidden object? That is, why does the child almost always search correctly on the very first trial in a two-position delayed-response paradigm? The answer must be that the sight of the desired object disappearance must somehow specify to the infant that A is a place where the use of coordinated action schemes will allow the thing to be retrieved.

Given this fact, the question might be raised that if visual experience alone is sufficient to mark A as the place to search after the initial hiding at A, might it not be that visual experience alone establishes A as the place to look on subsequent hiding trials? Put another way, does the active role the infant takes when he successfully searches at A supply the essential information leading to the  $A\bar{B}$  error, or does the repeated place specifying disappearance and reappearance of the object at A supply the crucial information?

The primary purpose of the present study was to determine whether or not the active, overtly instrumental aspect of an infant's search at A plays an essential role in the  $A\bar{B}$  error. To do this, a portion of the nine-month old subjects were exposed to observational experiences in which they saw a toy being hidden and uncovered at A, but never themselves actually searched for and found the toy. The reasoning was

that if subjects receiving only observational experience are as likely to make the error as another group of subjects having instrumental experience at A, then one can conclude that the active, physical search at A need not play an essential role in the  $A\bar{B}$  error, as Piaget seems to imply in his explanation.

A second purpose of the present study was to investigate the role played by the amount of experience the infant has at A. The "perseveration effect" discovered by Landers (1971) poses a puzzle which needs to be clarified. Landers found that increasing the amount of instrumental experience a child had at A did not increase the probability that he would err on his first B trial, but did increase the probability that he would persevere if he did err. The present study seeks, first of all, to see if Landers' results can be supported. Some infants will have few A trials while others will have relatively more A trials. If the "perseveration effect" is obtained in the present study, both the A-trial and B-trial behavior of those infants who became "set in their ways" will be focused on in an attempt to see how these subjects differ from the other subjects. It is possible, for example, that for some infants the effect of having many A-trials will be to set up a type of "automatic" search procedure in which the child does not really attend to where the toy is going when it is hidden. Such a child may then continue this pattern through several B-trials before he starts to attend more

carefully to the hiding process. Such behavior patterns can easily be detected and should shed considerable light on why the perseveration effect occurs.

The present study, then, was designed to answer two major questions. The first question pertains to the role of activity in the Stage IV error, and the second question concerns the role played by the amount of experience an infant has at A. To answer the first question, half of the nine-month old subjects observed a toy covered and then uncovered at A and half were allowed to search for and retrieve the toy themselves. To answer the second question, half of the subjects received more trials at A than did the other half. Thus, four experimental groups were generated: a group receiving many observational experience A trials, a group receiving few observational experience A trials, a group receiving many instrumental experience A trials, and a group receiving few instrumental experience A trials. Such a design allows one to not only examine the roles of activity and amount of A-experience, but allows one to look at the interaction between these two variables as well.

## CHAPTER III

### METHOD

#### Subjects

Forty-eight healthy, full term, middle-class infants were used as subjects in this study. Their ages ranged from eight months fifteen days to nine months fifteen days. This particular age range was chosen because previous studies (e.g., Gratch & Landers, 1971; Landers, 1971) have shown this to be the optimum age range for observing the occurrence of the  $A\bar{B}$  error.

Subjects for this study were secured from two main sources: (1) children of University of Houston students, and (2) children of parents visiting the offices of several Houston pediatricians. The university students were contacted either through notices in the school newspaper or through announcements read aloud to several psychology classes. Others were contacted through signs posted in pediatricians' offices giving a brief description of the experiment and a phone number for interested parents to call. All Ss were brought to the Infant Behavior Laboratory in the Psychology Department by their mothers at a time determined by them to be a play period in the infants' daily routine.

### Experimental Design

The 48 Ss were randomly assigned to four groups, consisting of 12 Ss each. These four groups were formed from the four possible combinations of two factors: the type of A trials S received, instrumental or observational; and the number of A trials S received, two or five. The two A trial condition was selected because this was the same number of A trials used by Evans and Gratch (1972) and Landers (1971) as well as by Piaget in most of his observations. The five A trial condition was chosen after attempts with preliminary Ss indicated that it was going to be extremely difficult to keep the infants attentive and involved for more than five A trials, particularly those Ss receiving only observational experience at A.

Half of the 12 Ss in each group had their first A trial on their right side and half had it on their left side. Previous studies by Landers (1971) and Gratch et al. (1973) have demonstrated that there is no association between Ss' side preferences and their likelihood of finding a toy at A or B; therefore, no attempt was made to control for this variable. The mean age for Ss in the group receiving two instrumental A trials was eight months twenty-six days, and the mean ages for Ss in each of the other three groups was nine months one day. Of the 48 Ss, twenty-six were boys and twenty-two were girls. The proportion of boys and girls in each of the four groups was approximately the same.

Two experimenters were used at various times during the course of the study. One, a female, served as experimenter for 13 of the 48 Ss. These 13 Ss were distributed fairly evenly throughout the four experimental groups. The other experimenter was a male. Both had considerable experience in working with infants and both followed the same experimental procedure throughout the study.

#### Apparatus

The apparatus for the study consisted of a table on which the hiding tray was placed, two white washcloths to cover the hiding wells in the tray, the tray itself, an electronic timing device used to achieve a standard delay interval, and Ampex 5000 Videotape recording equipment used to obtain a visual record of Ss' behavior.

The timing device consisted of a foot operated starting switch and a signaling device using a light which was placed behind S and out of his sight. The starting switch was placed below the table in front of S. This device was virtually noiseless and did not seem to pose a distraction for any of the infants used in the study. The device was adjusted such that upon being activated by E's foot, the light remained on for two seconds and then switched itself off automatically.

Toys were hidden in a gray plywood tray with two wells spaced 12 inches apart. The dimensions of the tray were

30 x 16 x 2½ inches and the wells were 7 x 7 x 2 inches. The two wells were lined with white felt so as to minimize cues that might be produced from sounds made by the objects when the tray was moved. Two 12 x 12 inch white washcloths were used to cover the wells. The height of the table was adjusted so that a normal-sized infant sitting in a normal-sized lap could see into the bottom of the wells. With smaller infants and/or smaller laps, a cushion was used to raise the level of the infants.

A number of small, interesting toys were available for use, and typically, the toy selected was used throughout the whole series of experimental trials. On occasion, an infant seemed to be getting tired of the game and a new and hopefully more interesting toy was introduced. The exception to this was on those trials in which the toy was being hidden at B. A comparison of infants who experienced a toy change during the A-trials with those who did not indicated no difference between their behavior during the B-trials.

The Ampex recording device was placed in a separate part of the laboratory and it and its operator were screened from the view of subjects. The TV camera was placed about ten feet in front and slightly to the left of S and was itself completely silent. At no time did the camera seem to pose a distraction for Ss. All experimental trials were recorded and preserved for later and more careful viewing and rating.

### Procedure

There was an initial warm-up period outside of the test situation which enabled S to explore the environment of the lab and get acquainted with the experimenter. The procedure then consisted of two steps. The first step was the warm-up trials to acquaint S with the game. The second step was the two-position hiding game itself.

Warm-up trials. The subjects were seated on their mother's lap in front of a table and across from the experimenter. Each child was required to perform two different warm-up tasks with a one-position hiding box placed directly in front of him. These warm-up trials served the purpose of acquainting the child with the type of game to be played as well as screening those infants who were unable to search for a completely hidden toy. Three Ss were either unable or unwilling to search for a completely hidden toy and were not used in the study. No other infants were eliminated for any reason.

The first warm-up task involved placing a toy which the child had just handled and seemed interested in into the hiding well, covering about two-thirds of the toy with a white washcloth, and immediately pushing the box forward to within the child's grasp. Two of these trials were given to every child. Typically Ss had no difficulty in performing this task, usually by grasping the exposed portion of the toy and pulling it from under the washcloth.

The second warm-up task also involved the one-position hiding box. This time the toy was completely covered, preferably as the child was reaching for it. The box was always pushed to within the child's grasp as soon as the toy was completely covered. Some Ss had difficulty with this task and required several repetitions before they mastered it. When S had successfully searched on two successive trials on this task, the two-position tray was produced and the experiment proper was begun.

Observational A trials. On the trials to the A-side involving observational search, E attracted S's attention to the toy which was held about one foot over the A well, slowly lowered the toy into the well and covered it, making sure S was watching. If S's attention was distracted during this baiting procedure, the entire procedure was repeated until S was attentive to the hiding process. The B-well was covered before the trial began. A two-second delay interval ensued once the toy and the A-well had been covered, and then E pushed the tray forward slightly, keeping it, however, out of S's reach (mother was instructed to hold her infant around the middle so that he could not lunge across the table). At this point E slowly uncovered the A-well, pulled the toy out of the well and handed it to S. After S handled the toy for about ten seconds, E retrieved it and repeated the procedure just described. Twelve of the Ss received two of these observational A trials and 12 received five such trials.

Instrumental A-trials. Subjects receiving instrumental A trials were administered essentially the same procedure described above, except that the tray was pushed forward until it was within reach of S who was then allowed to remove a screen and take the toy himself. If S searched at B he was allowed to correct himself by searching at A. If he did not immediately do so he was prompted by E. A trials were continued until S searched correctly at the A side for either two or five consecutive trials.

B trials. All Ss were allowed to physically search on the B trials and all received at least five such trials. The hiding procedure used at B was the same used for the instrumental A trials. If S searched at the A side on any of the B trials, the tray was pulled back before he had an opportunity to search at B. The experimenter then drew S's attention to the B well, uncovered the toy, and then after about a five-second delay, initiated the next B trial. The child was not allowed to handle the toy after an incorrect search on the B trials. If S had not found the toy at B on the fourth and fifth trials, the B trials were continued until S found the toy twice in succession.

#### Ratings of Subjects' Behavior During Experimental Trials

The use of Ampex 5000 Videotape recording equipment allowed every experimental trial to be recorded and then rated very carefully at a later date. The aim of the rating schemes was to document the degree to which the infant

attended to the hiding game during its various phases and to record the various places toward which his gaze was directed during each phase. For rating purposes the game was divided into four phases. The first phase began when E started to lower the toy into the well and ended when E brought both hands back to the middle of the tray after having covered the toy (bait). The second phase of the game began when E's hands ended their movement to the middle of the tray and ended when E began to push the tray toward S (delay). The third phase was that very brief period which began when E started moving the tray and ended when the tray stopped its movement (present). The final phase covered the time during which the tray was in front of the child (search).

The rating system which was used to rate Ss' behavior during the bait phase was based on a four-point scale. A rating of "0" was given if the child did not have eye contact with the toy when the bait was initiated and remained inattentive thereafter. A rating of "1" was given if the child focused on only part of the bait procedure, i.e., if his eye contact with the toy and the hiding sequence was only intermittent. A rating of "2" was given when the child maintained eye contact throughout the entire bait, but the rater felt that the child was not really attending very closely to what he was looking at. When the rater made this kind of judgment, the reason was indicated by means of marginal notes on the rating form. Examples of such notes are: "Has eye

contact but slumped back," "Looking to B, reaching toward A." Finally, a rating of "3" was given for the bait if the child maintained eye contact with the entire hiding procedure and seemed to be attending to and interested in the events he was looking at.

The other three phases of the hiding game were rated on a three-point scale. For the delay, a rating of "1" was given if S "left the game," i.e., if he directed his attention away from the hiding game for most of the period. A rating of "2" was given if S was oriented to the hiding tray most of the time but occasionally looked away. A rating of "3" was given if S attended to one or both wells throughout the period.

For the present phase, a rating of "1" signified that the child was looking away from the tray and made no attempt to move toward the tray as it moved toward him. A "2" rating indicated that the child watched the tray move toward him and was oriented toward one or both wells, but made no effort to meet the toy "halfway." A rating of "3" denoted a child who looked toward one or both wells and moved in an "anticipatory" manner toward the tray as it moved toward him.

Two sets of ratings were required for the search phase of the hiding game. One set of ratings was used for those A trials in which Ss received observational experience, and another set was used for those trials in which Ss were allowed to physically search. For those trials in which Ss

were allowed to physically search, a rating of "1" was given if the child refused to search at all. A rating of "2" was given when S was interested in something besides the game and only searched after the tray had been in front of him for a brief period (delayed search). A rating of "3" signified that the infant searched either as soon as the toy was in front of him, or after a short period of indecision during which he clearly was involved in the game but was unable to decide at which side to search.

Finally, special ratings were devised for the search phases of those trials in which the child was not allowed to physically search at A, but instead watched E uncover the toy and hand it to him. A rating of "1" in this case indicated that the child did not have eye contact with the uncovering sequence, i.e., the child was looking elsewhere. A rating of "2" denoted a child who was looking at something besides the A well when the box completed its forward movement, but whose gaze was drawn to the A well by the movement of E's hand to that well and who subsequently watched the uncovering sequence. A rating of "3" was given when the child was already looking at the A well before E's hand began its movement in that direction and who then watched the entire uncovering sequence. These particular ratings were designed to show to what extent S was focusing on A as a "special place."

Besides the ratings just discussed, the observer

recorded the direction of S's gaze during each of the phases of the hiding game. Note was made of whether S gazed only at the A well, only at the B well, or looked at both, and in the latter case, the pattern of fixations

### Reliability of the Ratings

The first six infants were rated jointly by the author and his advisor in order to establish the reliability of the rating system. At least 85% agreement was obtained on the attentiveness ratings for each of the four phases of the hiding game, and over 90% agreement was obtained for the recordings of Ss' direction of gaze. Both the author and his advisor were experienced raters and the fact that they had used essentially the same rating system in previous studies contributed to the high percentage of agreement. Subsequent to these initial six Ss, all ratings were accomplished by the author. The exceptions to this were the 20th and 30th infants to be rated. These Ss were also rated by both the author and his advisor in order to check for possible drifts in "rater calibration." Levels of agreement comparable to those achieved earlier were obtained.

## CHAPTER IV

### RESULTS

The major question asked in this study was whether instrumental search activity at A is necessary for A to be established as a "special place." An answer to this question presumes that Ss in both Observational and Instrumental conditions did indeed attend to the covering and uncovering of the toy. If Ss who were given only Observational experience did not attend to these events, then one would not know whether differences in error rates between Ss in the Instrumental and Observational experience conditions were due to differences in instrumental activity or to differences in attention to the relevant events at A.

Table 1 shows the numbers of Ss who were attentive to the hiding of the toy (i.e., the bait) on each of the A trials. In this table, those labeled "attentive" received ratings of "3" on the bait, those labeled "mildly inattentive" received ratings of "2" and those rated "partially inattentive" received ratings of "1." None of the infants were completely inattentive; i.e., none received a rating of "0." The reader will recall that the "3" rating signifies that the infant kept his eye on the hiding of the toy in a highly focused way. A "2" rating indicates that S kept his eye on the hiding sequence, but the rater felt, for various reasons, that S was not actively trying to extract information from

TABLE 1  
NUMBER OF ATTENTIVE Ss DURING A TRIAL BATTIS

Two A Trial Condition						
A trials	Observational Experience			Instrumental Experience		
	Attentive	Mildly Inattentive	Partially Inattentive	Attentive	Mildly Inattentive	Partially Inattentive
Trial 1	11	1	0	10	1	1
2	11	1	0	9	2	1
Total Ss	22	2	0	19	3	2

  

Five A Trial Condition						
A trials	Observational Experience			Instrumental Experience		
	Attentive	Mildly Inattentive	Partially Inattentive	Attentive	Mildly Inattentive	Partially Inattentive
Trial 1	10	0	2	11	0	1
2	10	1	1	11	1	0
3	11	0	1	9	2	1
4	9	3	0	9	3	0
5	9a	2	0	9a	2	0
Total Ss	49	6	4	49	8	2

a On each of these trials one S was not ratable.

the hiding sequence. Finally, the "1" rating was given to a child who did not keep his eyes on the whole hiding sequence. As can be seen from an inspection of this table, the majority of the infants in each condition were highly attentive to the covering of the toy on each of the A trials.

Table 2 shows the number of Ss who attended to the uncovering of the toy on each A trial for the two groups receiving Observational experience at A. As can be seen, the majority of the infants were looking toward the A well before E's hand began its movement toward that well ("3" rating). On each trial, a smaller number of Ss were looking away from the A well at the start of the search phase, were drawn to the A well by the movement of E's hand, and subsequently watched the uncovering sequence ("2" rating). Only one S failed to attend to the uncovering of the toy, and this occurred on his first trial. The Instrumental Search infants all attended to the toy as they removed the cloth from the A well. On 10 of their A trials this search was slightly delayed (rating of "2"), but on all other trials the search occurred immediately (rating of "3"). It appears, then, that there are no significant differences between the A trials of the Instrumental and Observational search Ss, at least as regards their attentiveness to the covering and uncovering of the toy.

However, there are two other important ways in which the A trials of the four major groups could differ. First, they

TABLE 2

VISUAL ORIENTATIONS OF OBSERVATIONAL EXPERIENCE Ss DURING A TRIAL SEQUENCE

A trials	Two A Trial Condition		
	Looks toward A and watches uncover	Drawn to A and watches uncover	Looks away during uncover
Trial 1	8	4	0
2	8	4	0
Total Ss	16	8	0

  

A trials	Five A Trial Condition		
	Looks toward A and watches uncover	Drawn to A and watches uncover	Looks away during uncover
Trial 1	9	2	1
2	9	3	0
3	9	3	0
4	9	3	0
5a	11	0	0
Total Ss	45	11	1

a On this trial one S was not ratable.

could differ in the degree to which they either attended or failed to attend to the game during the delay. If it were to be found that the Observational experience Ss were less attentive during this period, then one might conclude that they were, in fact, less involved in the hiding game than were the Instrumental experience Ss, even though they appeared to be attending to the covering and uncovering of the toy. Second, the four groups might differ in the extent to which they expressed interest in the B side during the period between the covering and uncovering of the toy. If the Observational experience infants were to spend more time gazing at the B side than did the Instrumental experience infants, it would be reasonable to assume that Observational experience at A is not as potent in establishing A as a special place as is Instrumental experience at A.

Table 3 shows the number of Ss in each group whose attention wandered from the game during the delay. Those labeled "attentive" received ratings of "3," which meant that for virtually the entire delay S was looking expectantly at the hiding box. Those labeled as "mildly inattentive" received ratings of "2," while those labeled "inattentive" received ratings of "1." A rating of "1" meant that the child was looking away from the box for virtually the entire delay, while a rating of "2" meant that S looked away from the hiding box only part of the time. As one can see from an inspection of Table 3, the majority of infants were attentive

TABLE 3  
NUMBER OF ATTENTIVE Ss DURING A TRIAL DELAYS

Two A Trial Condition						
A trials	Observational Experience			Instrumental Experience		
	Mildly			Mildly		
	Attentive	Inattentive	Inattentive	Attentive	Inattentive	Inattentive
Trial 1	10	2	0	9	2	1
2	9	3	0	8	3	1
Total Ss	19	5	0	17	5	2

  

Five A Trial Condition						
A trials	Observational Experience			Instrumental Experience		
	Mildly			Mildly		
	Attentive	Inattentive	Inattentive	Attentive	Inattentive	Inattentive
Trial 1	9	1	2	9	1	2
2	8	4	0	10	2	0
3	9	0	3	9	3	0
4	10	2	0	9	2	1
5	7a	4	0	9a	1	1
Total Ss	42	11	5	46	9	4

a On each of these trials one S was not ratable.

during the delay for every trial, indicating that both Observational and Instrumental Ss were maintaining their interest throughout the A trials.

Table 4 shows the number of infants within each condition who glanced toward the B well during the interval between the covering and uncovering of the toy. Since all Ss should have received essentially the same sequence of events up until the time that the first search occurred, any variation in B glancing on the first A trial should be random. However, there is a striking but non-significant tendency for the four groups of Ss to differ on this first trial ( $\chi^2=6.86$ , 3df,  $.10 > p > .05$ ). Inspection of Table 4 indicates that those Ss receiving two Observational or Instrumental A trials glanced toward B more often on this first A trial than those Ss receiving five Observational or Instrumental A trials. The difference between Ss in the Two A trial and Five A trial conditions becomes less noticeable on the second trial; moreover, for all four groups, there is a relatively clear tendency for Ss to glance less frequently toward B as the number of A trials increases. It appears, then, that Ss in the Observational and Instrumental conditions are essentially alike in their tendency to focus on A as a special place.

So far, then, we have shown that Ss in both Observational and Instrumental conditions tended to fix their attention on the toy's place of disappearance during the whole

TABLE 4

NUMBER OF Ss GLANCING TOWARD B DURING INTERVAL  
BETWEEN COVERING AND UNCOVERING OF TOY

Two A Trial Condition				
A trial	Observational Experience		Instrumental Experience	
	B Glances	No B Glances	B Glances	No B Glances
Trial 1	8	4	6	6
2	5	7	2	10
Total Ss	13	11	8	16

  

Five A Trial Condition				
A trial	Observational Experience		Instrumental Experience	
	B Glances	No B Glances	B Glances	No B Glances
Trial 1	2	10	4	8
2	3	9	5	7
3	3	9	3	9
4	2	10	2	10
5	1a	10	1a	10
Total Ss	11	47	14	44

a On these trials one S was not ratable.

disappearance-reappearance sequence. As such, it is possible to now examine the B trial data. Table 5 shows, for each group, the number of consecutive errors made by Ss, starting with the first B trial. As can be seen, there are no meaningful differences between the four groups with respect to either the number of Ss erring on the first B trial, or the lengths of the runs of consecutive errors. In each group, approximately half of the infants erred on the first B trial and only 4 out of the total 48 infants (one in each experimental group) made more than two consecutive errors starting with the first B trial. Also, although not shown in Table 5, there were no differences between those Ss whose A trials were to their left and those whose A trials were to their right. Twelve of those with A trials to their left erred while 12 did not, and 14 of those with A trials to their right erred while 10 did not.

On the whole, Ss never erred after their first B trial success. However, seven of the 26 Ss who erred on their first B trial did make at least one error after their first successful search. Of the infants who searched correctly on their first B trial, only one later made an error. There was no meaningful relation between the tendency to err after a successful search at B and the experimental conditions since at least one S in each condition made such an error.

Sex of Ss and sex of E were also varied in the study, but they proved to have no relation to Ss' tendency to err.

TABLE 5  
NUMBER OF CONSECUTIVE ERRORS AT B MADE BY Ss  
AS A FUNCTION OF EXPERIENCE AT A

Experimental Conditions	Consecutive Errors									Total Ss
	0	1	2	3	4	5	6	7	8	
Two Observational Experience trials at A	6	4	1	1	0	0	0	0	0	12
Five Observational Experience trials at A	5	4	2	0	0	0	0	0	1	12
Two Instrumental Experience trials at A	6	4	1	0	0	1	0	0	0	12
Five Instrumental Experience trials at A	5	3	2	0	0	2	0	0	0	12
Total Ss	22	15	6	1	0	3	0	0	1	48

Fourteen out of 26 boys and 12 out of 22 girls erred on the first B trial. Seven out of 13 Ss examined by the female E erred, while 19 of 35 Ss studied by the male E erred.

At this point, since none of the variables manipulated in the study seem to have a bearing on the  $A\bar{B}$  error, and since about half of Ss erred and half did not err, one might wonder whether the errors were simply "chance" events. That is, perhaps whenever a new hiding place is introduced into the two-position hiding game, infants of this age simply guess randomly about which side they should search at. Such an explanation would mean that prior experience at A would have no influence on the infants' decision about where to search. One way to refute this argument would be to show that when the first A trial was introduced, Ss were much less likely to err than when the first B trial was introduced. The first A trial, of course, also involved introducing a new hiding trial since Ss' previous searches on the warm-up were at a mid-line hiding place. Only four out of 24 Ss erred on the first A trial (for obvious reasons only the Instrumental Search infants could be used in this comparison), while 13 out of the same 24 Ss erred on their first B trial. Application of the McNemar test for the significance of changes (Siegel, 1956) indicates that this difference is significant ( $\chi^2=5.81$ , 1df,  $p<.01$ ). It is clear, then, that the  $A\bar{B}$  error is not a random event, and that the A side experience plays an important role in the error.

This study was initiated primarily to answer two questions. The first question was whether Observational and Instrumental search experience at A are equally likely to establish A as a place where infants go to find hidden toys. The answer to this question appears to be "yes." The second question was whether the amount of experience at A, be it Observational or Instrumental, had any effect on the  $A\bar{B}$  error. The answer to this question appears to be "no." We have established, then, that the kind and amount of A experience are not important to the  $A\bar{B}$  error, at least within the range of parametric variation investigated in the present study. It is clear, however, that some type of A experience is necessary in order for the error to occur with any frequency, the question which remains to be answered is why this experience at A carries more weight than the input the child supposedly receives when he sees the toy hidden at B. In order to shed light on the answer to this question, we have performed several analyses of the first B trial data, focusing on those behaviors occurring during the bait, the delay, and the present phases of the trial.

One possible explanation for why the experience at B did not serve as an effective guide to the infants' search is that the child failed to correctly register where the toy was when it was hidden. There could be two reasons for this. First, the child may fail to look while the toy is being hidden. Such behavior would be coded a "0" according

to the rating scheme. However, none of the 48 infants received this rating for their first B trial baits. A second reason could be that, while the infants actually had eye contact with at least part of the hiding sequence, they were not "actively" trying to extract information from this sequence. Such children should have been coded as either "1" or "2" on their baits.

Table 6 breaks the 48 Ss into four groups: (1) those who did not actively attend to the entire hiding sequence and who erred, (2) those who did not actively attend and then did not err, (3) those who did actively attend and erred, and finally, (4) those who actively attended and did not err. As can be seen in Table 6, those who failed to actively attend to the entire hiding sequence were highly likely to err (13 out of 15), while those who did actively attend were very likely not to err (20 out of 33). This difference is statistically significant ( $\chi^2=7.48$ , 1df,  $p<.01$ ).

So far, then, we have identified one reason why Ss erred on their first B trial, i.e., they did not actively attend to the whole toy hiding sequence. The next question to be answered is obviously, "Why didn't these infants actively attend?"

An examination of the protocols of these 15 Ss suggests two reasons, corresponding to two groups of infants. The first group of seven Ss failed to actively attend to the events at B because they were, in various ways, already

TABLE 6  
THE RELATION BETWEEN ATTENTIVENESS DURING THE BAIT  
AND ERRORS ON THE FIRST B TRIAL

Errors	Attentiveness of Ss	
	Subjects actively attending to entire bait sequence	Subjects failing to actively attend to entire bait sequence
Subjects erring on first B trial	13	13
Subjects not erring on first B trial	20	2

$$\chi^2_{xy} = 7.48, df = 1, p < .01$$

pointing toward A. Five of these kept their eyes on the whole sequence of events at B, but their heads and bodies were oriented more toward A and they seemed poised to move in that direction at any time. Two others watched only the first portion of the bait and then shifted their gaze and body orientation toward A before the toy was actually covered. Of these seven "A-oriented" babes, five erred on their first B trial. These five infants seem to support Piaget's theory that at first the child makes the error because he does not "understand" that a new hiding place is involved. The child understands only that a toy is being hidden and that hidden toys are found at A. Such a child might not actually attend to the hiding process, then, because once he has registered that a toy is being hidden, he immediately begins pointing, or preparing to point, towards A.

The infants in the group just described were not classified among those actively attending to the first B trial hiding sequence because of their early orientation toward A. They were, however, still focusing on the game, even if they were not focusing entirely on the events occurring at B. The second group of eight infants, on the other hand, were not really focusing in an active way on any aspect of the game during the bait, seemingly because they were "uninterested" in these events. Six of these eight kept their eyes on the entire hiding sequence but by various means indicated that they were not trying very hard to extract information from

what they were watching. For example, the protocols of two representative Ss of this type indicate that the first was "watching, but lethargic and slumped back" during the bait, while the second was "fussy" and "loudly vocalizing his displeasure" while at the same time he kept his eyes on the entire hiding sequence. The two remaining infants of the eight in this group had their eyes on the first part of the bait, but then looked up at E just before the toy was covered. The fact that each of these eight infants searched at A in a prompt, eager manner when the opportunity arose suggests that they were not simply "bored" with the game itself. It may be that they somehow "knew" where the toy was and therefore did not feel that it was necessary to attend to the bait.

These fifteen infants deserve further examination and we will return to them later. At this point, however, we will examine those 33 Ss from Table 6 who actively attended to the first B trial bait, but then erred. Is there anything we can discover about their post-bait behavior that will give us a clue as to why they erred?

In Table 7, the post-bait behavior for the 33 Ss who actively attended to the first B trial bait is classified in terms of three dimensions. The first dimension lets us look at Ss in terms of four possible patterns of glancing between the A and B wells during the delay and present phases, i.e., between the time S sees the toy covered and the time he actually searches. The first category is one in which S

TABLE 7

THE RELATION BETWEEN AB GLANCING PATTERNS, ATTENTIVENESS DURING  
THE DELAY-PRESENT PHASE, AND ERRORS ON THE FIRST B TRIAL  
FOR Ss WHO ATTENDED TO THE FIRST B TRIAL BAIT

Errors	Attentive				Inattentive				Total Ss
	BA Early	BA Late	BAB	B Only	BA Early	BA Late	BAB	B Only	
Subjects Erring	2	4	2	2	0	1	0	2	13
Subjects Not Erring	1	1	5	8	0	2	1	2	20
Total <u>Ss</u>	3	5	7	10	0	3	1	4	33

changes his direction of gaze toward A relatively early in the trial (i.e., up until the end of the delay) and never looks back toward B (BA Early category). A second category also involves a shift toward A, but this time one which occurs after the delay (BA Late). A third category involves those Ss who glance back and forth between B and A (BAB), and the final category consists of those Ss who never look toward the A well during the delay-present interval (B Only).

The BA Early pattern was originally selected for scrutiny because it seemed to best characterize those infants who failed to register A as the place of hiding, even though they may have watched the hiding process rather carefully. The BA Late pattern was identified because it seemed to involve those Ss who registered B, but subsequently forgot it and turned to A. Those infants displaying a BAB pattern, on the other hand, obviously registered B in some way, but were in a state of conflict between that side and the old side. Finally, the B Only pattern infants were those who would seem least likely to err since they showed no indication of a pull towards A throughout the trial.

The dimension just discussed indexes the patterns followed by Ss when they attended to either the A or B sides. The second dimension shown on Table 7 indexes the degree to which the Ss were attending to the hiding game during the delay-present interval. The reader will recall that ratings of "1" and "2" for both the delay and present phases

signified that Ss were uninvolved and away from the game during these phases. More specifically, a rating of "1" indicated that S was looking away from the hiding box for virtually the entire delay or present, while a rating of "2" meant that S only spent a part of the period looking away from the box. A rating of "3," on the other hand, was given when S spent virtually the entire period attending to the hiding box. The ratings for the delay and present phases were combined into a single score by adding the two, and Ss receiving a combined rating of five or six were labeled "attentive," meaning that they had spent the majority of the delay-present period looking at one or the other of the well. Those receiving a rating of four or less were labeled "inattentive," indicating that these infants had spent a large part of the period away from the game. The third and final dimension shown on Table 7 categorizes the 33 infants into those who did and those who did not err on this first B trial.

A close inspection of Table 7 reveals several interesting facts. First, most Ss were attentive during the delay-present portion of the last B trial. Only eight out of the 33 were not attentive. Of these eight inattentive Ss, three erred while five did not. These eight Ss are distributed among all but one of the AB glancing patterns, but the N for each pattern is too low to draw any inferences. About all that can be said is that the error rate for the group as a

whole is close to an even split between those who err and those who do not, suggesting that perhaps the disruption during the intra-trial interval caused them to forget both where the toy was hidden and where they once found it. If such were the case, any searching would be based on a guess, and the pattern of errors would tend to be random.

Looking at the other half of Table 7 we see those Ss who actively watched the toy disappear and who then expectantly waited to retrieve it. Their pattern of orientation to the A and B sides seems to have a clear relation to whether or not they erred. The clearest and most easily interpretable group are those Ss who pointed toward B throughout the trial (B Only infants). These babes actively attended to the toy and its disappearance and then kept close tabs on its hiding place throughout the delay and present phases of the trial. As one would expect, very few (two out of ten) erred.

Another interesting group consists of those Ss whose last orientation to a side was A (BA Early and BA Late Ss). Of these eight infants, only two failed to err, a pattern just the opposite of the group just discussed. It seems that for this group and for the B Only group the side last attended to during the delay-present phase was the side most likely to be searched at.

The last group to be discussed seems to pose the greatest puzzle. These Ss, through their glancing behavior, showed an ambivalence that should have led one to expect

about an even split between those erring and those not erring. However, five of the seven Ss in this group did not err. A closer analysis of the protocols for these infants reveals that all seven glanced towards the B side last during their delay-present interval. This finding suggests, then, that the BAB infants behaved in a manner consistent with the other groups. That is, they all tended to search at the last side looked at during the intra-trial interval.

At this point we will summarize what we have discovered from our examination of Table 7. First, when Ss are attentive during both the bait and the delay-present phases of the trial, they are very unlikely to err, provided they keep tabs on the B side. This is true both when no glances are taken toward A (B Only Ss) and when the infant glances to A as well as B (BAB Ss). On the other hand, if the infants focus on A at some point during the interval and never glance back to B, then they are quite likely to err. For those Ss who were inattentive during the intra-trial interval, very little can be said because they were so few. At best, one can speculate that perhaps because their involvement was disrupted during the delay, they guessed when it came time to search.

Having analyzed the post-bait behavior of the 33 Ss who actually attended to the bait, it is appropriate at this point to do the same kind of analysis for those Ss who did not attend to the bait. Table 8 portrays the post-bait behavior of these infants in essentially the same terms used

TABLE 8

THE RELATION BETWEEN AB GLANCING PATTERNS, ATTENTIVENESS DURING THE  
 DELAY-PRESENT PHASE, AND TYPE OF INATTENTIVENESS DURING THE BAIT  
 FOR THOSE Ss WHO DID NOT ATTEND TO THE FIRST B TRIAL BAIT

Type of inatten- tiveness during bait	Attentive				Inattentive				Total Ss
	BA Early	BA Late	BAB	B Only	BA Early	BA Late	BAB	B Only	
Ss who were "A oriented" during bait	4a	1	2a	0	0	0	0	0	7
Ss who were "uninterested" during bait	2	0	1	1	0	0	1	3	8
Total <u>Ss</u>	6	1	3	1	0	0	1	3	15

a One child in each of these cells did not err.

for Table 7. The major difference is that these 15 Ss are further divided into the two groups discussed earlier, i.e., those who failed to completely attend to the bait because at some point they became "A oriented," and those who failed to attend actively because they seemed "uninterested."

As can be seen from Table 8, the majority of these 15 Ss were attentive after their bait (11 out of 15), suggesting that for this majority, something besides general boredom lay behind their failure to attend closely to the bait. Also, it is significant that none of the four inattentive Ss came from the "A oriented" group, but rather from the group which was labeled "uninterested" for their bait.

Focusing first on the group of infants who were "A oriented" during the bait, we see that four of these followed a BA early glancing pattern, i.e., they shifted their gaze toward A early in the trial and did not glance back to B during the intra-trial interval. Three of these infants went on to search at A when the toy was pushed to within their reach. These three Ss most clearly support Piaget's contention that the error occurs because infants encode A when the toy is hidden at B. However, the three Ss who were "A oriented" during the bait and subsequently displayed BA late or BAB glancing patterns also can be described as supporting Piaget's explanation on the basis of their behavior during the bait. Also, the two infants who were seemingly "uninterested" during the bait but whose direction of gaze followed

the BA early pattern can be considered to support Piaget's view since they focused on A so early in their trials. Following the same logic we can bring into this group the three BA early infants from Table 7. All of these infants together, then, give us 12 who can reasonably be described as infants who in some way registered the hiding of the toy as occurring at A. Of these 12 infants, only three failed to err.

A group of infants whose behavior does not appear to support Piaget's explanation can also be isolated from Table 8. These are the six infants who were "uninterested" during the bait and who demonstrated either BA3 or B only glancing patterns. The behavior of these infants is more compatible with an explanation of the  $A\bar{B}$  error which says that infants err because they have learned an A-going habit and therefore stop attending carefully to the toy's disappearance. All six of these infants erred on their first B trials.

Going back to Table 7, we can isolate a group of infants whose behavior also suggests that they registered but then forgot where the toy was hidden. These are the infants who were attentive during the delay-present interval and who followed a BA late glancing pattern. These Ss seem to have registered B but at some point forgot that side and returned to the side at which they had found the toy previously. Four of these five Ss err. Thus, together with the six comparable Ss referred to in Table 8, there are 11 Ss who appear to

conform to a habit-forgetting account of the A $\bar{E}$  error, and 10 of these 11 Ss err.

The 17 infants from Table 7 who were attentive during the intra-trial interval and who showed EAB or B only glancing patterns also can be thought of as a separate group. These infants clearly registered and kept tabs on the B side and, as one would expect, very few of them erred (four of 17). However, the behavior of those four who did err seems more compatible with a "forgetting" explanation than with Piaget's notion that the infants do not register the new place.

The final group to be isolated also comes from Table 7. These are the seven infants who attended to the hiding of the toy but were relatively inattentive thereafter. Since about half of these infants erred (three out of eight) it seems reasonable to suppose that the intra-trial distraction caused these infants to forget both sides and thus search on a random basis.

In our analysis of the infants' first B trial behavior, then, we have isolated four different groups accounting for all 48 infants. Two of the groups are highly likely to err and each provides support for a different interpretation of the error. Piaget's explanation of the error is supported by 13 infants who early on seemed to act as if they saw the toy was hidden at A, and nine of these Ss erred. A habit-forgetting account of the error is supported by 11 Ss who

oriented to B early and only later oriented to A, and 10 of these Ss erred. The other two groups, the seven Ss who seemed to forget both the A and the B sides and the 17 Ss who seemed to register and not forget B as the hiding place, can be interpreted equally well from either of the two points of view.

## CHAPTER V

### DISCUSSION

The major finding of this study is the fact that neither variations in the amount nor type of A experience had any effect on the  $A\bar{B}$  error. Subjects exposed to either five or two instrumental or observational A trials were equally likely to err on their first trial at B and generated error strings of comparable length.

In terms of the effect of variations in the amount of A experience, the most striking finding was the failure to obtain Landers' (1971) "perseveration effect." Landers found that subjects exposed to ten instrumental A trials tended to generate longer strings of consecutive errors than subjects exposed to two such trials, although they were equally likely to err on their first B trials. Why this perseveration effect was not obtained in the present study is unclear. There are, however, two procedural differences between the two studies which might have a bearing on this question. The first, and most obvious, pertains to the number of A experiences subjects were exposed to in the two studies. Landers' infants received either ten or two A trials while infants in the present study received either five or two A trials. It is possible that the tendency to perseverate is a positively accelerating function of the number of A trials infants receive. If this is true, the perseveration effect might not

be noticeable with five A trials compared with two, while it is noticeable with ten A trials compared with two.

Another, possibly important, difference in procedure between the two studies concerns the differences in the experimenters' behavior when the infant erred on a B trial. In Landers' study, the experimenter removed the toy from the A well and gave it to the child. This procedure may have had the effect of reinforcing an already well-established habit of going to A, and thus may have led the infants receiving ten A trials to generate longer strings of errors. In the present study this possibility was excluded by the experimenter's procedure of allowing the infant to see him removing the toy from the A well, but not allowing the infant to handle it during the intra-trial interval.

The finding which has the greatest significance for Piaget's theory is the fact that infants who only observe an object disappear and then reappear at A are as likely to make the  $A\bar{B}$  error as are infants who physically search for and find the toy themselves. This finding is important because it suggests that Piaget is incorrect in his emphasis on the role of instrumental activity in the  $A\bar{B}$  error. It does not rule out the possibility that activity in a more general sense is important to the child's understanding of objects and places, since even when the child is only observing he is still engaging in an activity. However, when Piaget characterizes the action scheme which underlies the Stage IV

infant's behavior with respect to hidden objects, he emphasizes that the location of things in terms of the activity of looking at things is not functionally independent of how the infant manually acts on them. This is clear from how he characterizes both Stage V and Stage III. In Stage V, the infant seeks for the object at whichever location it disappears. His search is no longer tied to where he has found and handled things. On the other hand, search at Stage III is egocentric and dominated by the infant's activity. When he watches an object move behind a screen, he looks beyond the screen because he continues his activity, not because he knows the object will reappear. When an object goes under a cover, the Stage III infant searches for the hidden object only if he was already in the process of reaching at the moment it was hidden. Piaget interprets this to mean that the object is still only an extension of the child's activity, and in the framework of removing covers, he clearly means that the infant's action of reaching and grasping is dominant and looking at the object only serves to support the former activity. Stage IV is a time intermediate between that of Stage III and Stage V. The infant's looking is not as subordinate to his reaching as in Stage III because the infant will search for the object at A even when he has not reached for it before it has disappeared. However, with respect to the localization of objects, looking is still subordinate to instrumental activity because the place of the object will

now be defined by the result of this successful search and will lead the child into the  $A\bar{B}$  error.

The results of the present study suggest that Piaget is incorrect in arguing that the Stage IV infant's observation of the places of object disappearance is dominated by the infant's instrumental actions on the object. The event that appears responsible for the error is the infant's "reification" of the place of the object's observed disappearance-reappearance rather than the "reification" of the place where he has found the object.

The results of this study also bear on another aspect of Piaget's theory, namely his contention that the infant interprets the events at B as occurring at A. Nine of the erring infants in the present study behave in a way which is reasonably consistent with this theory. However, 10 erring subjects behave in a manner more consistent with a hypothesis which says that infants register but then forget where the toy went during the delay interval.

The fact that infants make the error for different reasons is not inconsistent with Piaget's thinking about the Stage IV error nor with previous research. As mentioned in Chapter II of this study, Piaget stated that forgetting may play a role in what he calls the "residual reaction," i.e., the situation in which an infant searches at B for a toy he saw hidden there, but if he cannot immediately find the toy returns to A to search. Piaget felt that this behavior

involves a disruption in the child's relatively weak memory of the events at B and represents a more mature level of development than what he called the "typical" Stage IV error. In support of this, Gratch et al. (1973) found evidence that older infants make the  $A\bar{B}$  error because of forgetting while younger infants make the error because they interpret the events at B incorrectly. It would seem reasonable, then, to suppose that the less mature infants in the present study made the error because they misinterpreted the events at B while the more mature infants made the error because they registered but then forgot that the toy was hidden at B.

One way to test this possibility would be to show that the infants in the present study who err because of "absent-mindedness" tend to be older than infants who err because they misinterpret the hiding of the toy. The result of this test does not support Piaget's contention. Seven of the nine infants who seem to err because they misinterpreted the events at B fall into the older range (nine months, one day to nine months, 15 days) while 10 of 17 infants erring from "absent-mindedness" fall into the younger range (eight months, 15 days to nine months). This difference is in the opposite direction than expected and falls short of reaching significance using Siegel's (1956) Tables of Critical Values in the Fisher Test. No support can be found, then, for the notion that the infants erring because they misinterpret the events at B are less mature than the infants who err because they register but then forget these events.

The discrepancy between the age trends found in the present study and that of Gratch et al. (1973) may be a result of the more restricted age range of the sample employed in the present investigation. However, the present study provides little support for Piaget's contention that the principal reason for the A $\bar{B}$  error is that children misinterpret the events at B as occurring at A.

This study has also shown that Piaget is wrong in his emphasis on the role of instrumental activity in the A $\bar{B}$  error. One must ask, then, if there is not some theoretical position which is able to better explain the observed facts. However, before answering this question, it would seem important to attenuate the criticisms of Piaget's theory in two ways. For one, while no clear evidence was found to support the hypothesis that the principal reason for the error was a misconstrual of place B, there is ample evidence that the infants may have had difficulty in making sense of the change of the place of hiding. As was noted in Table 6, 15 of the 48 Ss did not attend to the whole first B trial bait sequence in an attentive manner, seven because they were orienting to A and eight because they did not seem to focus clearly on the event or looked at E at some point. It is possible to argue that the latter eight were not, as previously argued, completely attentive because they "knew" where the toy was going, but rather were confused over the change of sides. The latter interpretation is supported by the fact that only eight of

48 3s were not attentive to the whole bait sequence on the last A trial. If the argument of confusion is warranted, then the results of the present study are quite in line with Piaget's central thrust, namely that Stage IV infants are not able to appreciate that objects are to be localized in terms of their places of disappearance.

Secondly, it can be argued that our claim that Piaget would expect the instrumental group to be more likely to err than the observational group is in error. It is clear that Piaget does not mean to make a response-learning argument. He is talking about schemes, dispositions which determine both what the infant perceives and does. Certainly for Piaget looking at an object's disappearance and reappearance is as much an activity as is the activity of finding an object that was observed to disappear. However, we feel that such a criticism of the present study would be misplaced. The problem does not lie in this study, but rather in the vagaries of Piaget's solution of the problem of action, of the relation between schemes and overt actions and their consequences. With respect to the AB error, Piaget has emphasized the importance of the overt act of finding an object at a place, and within this framework his emphasis seems misplaced. In this regard, Moore (1973) has recently made some suggestions which offer some promise of a better explanation of the observed facts. He agrees with Piaget that the young child has a great deal of difficulty sorting

out the difference between changes in objects from changes in places. However, he disagrees with Piaget's notion that the child has a special difficulty in keeping track of places, and he also disagrees with Piaget's emphasis on the role of activity. Piaget says that the child starts to sort out the bewildering array of objects and places in terms of his activity, i.e., objects achieve identity (sameness) by means of their association with the child's activity at certain places. This identity, then, assumes a "thing-that-I-act-on-there" quality. Moore, on the other hand, suggests that identity is not specified by activity, but by place of disappearance and reappearance. For example, when the child sees an object disappear and then reappear in the same place, then he recognizes it as same. When an object disappears in one place and then reappears in another, then the child sees it as different. In terms of the Stage IV error, when a child sees the toy disappear and then reappear at place A, he recognizes it as same. When the child sees the toy disappear at place B, however, he sees the toy as "different" because, for the child, the identity of the toy is specified by its disappearance and reappearance at place A. When the child searches at A, then, it is not because he did not see a toy hidden at B, but because he saw a "different" toy hidden and wants the original toy which is to be found at A.

This theory explains the results of the present study rather nicely. First, it explains why looking is as effective

as doing in establishing A as a special place. For Moore, it is the observed disappearance and reappearance that is important. The child's instrumental activity is relevant only insofar as it causes the child to focus on these events. Second, it offers an explanation of the various B trial orientations which gets away from the difficulties of deciding whether the infants erred because they forgot or failed to register the new place. It is still possible that forgetting could play a role in the error in that a child who somehow becomes distracted could forget that he had seen a toy hidden at B and so search at A. But forgetting would be an occasional event, limited to those infants who became less attentive to the hiding tray during the absence of the toy. In terms of Moore's theory, those attentive infants who initially dwelled at B and then shifted to A shortly before searching would be described as having changed their minds as to "which toy" they wanted rather than as infants who forgot where "the toy" was hidden. Those infants who were oriented to A initially or early in the delay would be described as having made an early decision about "which toy" they wanted. Those infants who glanced back and forth between A and B would be described as infants who could not decide which toy they wanted rather than as infants who were undecided as to where "the toy" was hidden. Finally, those infants who did not follow the whole baiting sequence attentively would be described as having become confused over which toy was being hidden.

There are two obvious problems with this theory. Why do infants search for the "old" toy rather than the "new" one? How is one to decide whether infants who search correctly at B are searching for the "new toy" or are searching for "the toy" which is now being hidden at B? In other words, one cannot tell if the child searches correctly because he is "smart" or because he is "dumb." This is a difficult problem to resolve. However, there is still much to be said for Moore's notion in that it brings into sharp focus one aspect of object knowing which Piaget recognizes but does not develop clearly and which "featural theorists" ignore completely. This is the fact that one ordinarily uses more information than simply object features to decide that when an object disappears and reappears it is the same and not just similar. There are rules concerning space and time which also apply when one makes these decisions and the problem of how and when the infant acquires these rules is an important problem which deserves to be resolved.

Moore is suggesting that the infant's lack of awareness, or his awareness of only some of these spatial rules for identity are essential in determining how he will orient to hidden objects, perhaps even more so than object features. The Evans and Gratch (1972) study fits with this notion in that it shows that changing object features has no effect on the A-B error. Another study, this time by LeCompte and Gratch (1972), also is in accordance with this view. They

had infants find the same toy for three trials in a one-position hiding paradigm. On the fourth trial, when the infants searched for the toy they had seen hidden, a radically different toy was in the hiding box. In this situation nine-month olds responded with mild puzzlement and then would handle the toy in a disoriented manner, or they would stare with interest at the toy and then would begin to examine it systematically. On the other hand, 18-month olds in the same situation tended to react initially with surprise or deep puzzlement and then would either combine systematic searching for the missing toy with looking at the examiner in a questioning manner or would simply search for the missing toy. It would seem that the older infants knew that a different object was involved, presumably because a thing that disappears in a place must remain identical to itself, i.e., cannot change its features. On the other hand, Moore's view would suggest that the younger infants have no identity notion. These infants note the feature change, yet do not seem to be bothered by it, and so by implication they do not use place of disappearance as an identity marker. If they did, then an identity rule would be violated by the featural change and they should show more of a reaction.

Moore's insight also suggests other possibilities for research into the old question of how we acquire object knowledge. One possibility would involve posing featural information specifying same or different against spatial

information specifying same or different. For example, how would a child react to finding a different toy at B than the one he had seen hidden there and had earlier seen hidden and found at A? This may be a means of solving the dilemma posed earlier, i.e., are nine-month olds who search at B seeking the "new toy" or "the toy"? If the child seems genuinely surprized and/or looks for the other toy, then one can assume that he was indeed searching for "the toy." On the other hand, if he shows no reaction or is only mildly puzzled, then one may suspect that he was searching for the "new toy" which had been specified by the new place of hiding. Another new line of research would involve violating the rule complementary to the one Moore invoked in accounting for the  $AB$  error. Namely, one would violate the rule that two things cannot occupy the same space at the same time. In Moore's view, an infant who does not have the notion of object identity and yet searches at B will not be surprized by such an event. If he seeks a "new toy," perhaps he will even be pleased to discover such a multitude of riches. These kinds of questions would add a long neglected dimension to our understanding of object concept development.

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