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Mnemonic Precedence in Amnesic Patients: An Analogue of the A$\bar{B}$ Error in Infants?

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SCHACTER, DANIEL L.; MOSCOVITCH, MORRIS; TULVING, ENDEL; MCLACHLAN, DONALD R.; and FREEDMAN, MORRIS. *Mnemonic Precedence in Amnesic Patients: An Analogue of the A$\bar{B}$ Error in Infants?* CHILD DEVELOPMENT, 1986, **57**, 816–823. Amnesic patients were able to retrieve an object hidden at an initial location after a brief delay, but subsequently failed to retrieve an object at a new location, and instead searched for it at the old place. This phenomenon, which we call mnemonic precedence, resembles the A$\bar{B}$ error that has been observed in 8–10-month-old infants. The parallel performance of amnesics and infants on object search tasks is consistent with the hypothesis that memory deficit, rather than defective object concept, plays a major role in the A$\bar{B}$ error. The influence of memory processes on tests of symbolic representation is discussed.

The A$\bar{B}$, or Stage IV, error is observed when 8–10-month-old infants are required to search for objects hidden at two successive locations. They can find the object after it has been hidden at a first location, but when an object is subsequently hidden at a different location, many infants continue to search at the initial place, even though the displacement is visible and the infant attends to it. The error has been viewed by Piaget and many others as a key source of evidence concerning the development of object permanence in infancy. According to the Piagetian interpretation, 8–10-month-old infants lack the capacity for symbolic representation and have an immature concept of the object that is tied inextricably to the sensorimotor operations that are performed on it.

In spite of the popularity of the Piagetian view, several alternative accounts of the A$\bar{B}$ error have been offered. These include the possibility that the error occurs as a result of the difficulties that 8–10-month-old infants have with spatial orientation (e.g., Butterworth, 1975, 1976), object identity rules (Moore & Meltzoff, 1978), and the coordination of action sequences (e.g., Diamond & Goldman-Rakic, 1983). However, the most frequently proposed alternative to the Piagetian view is that infants do not remember the second hiding location (e.g., Bjork & Cummings, 1984; Cummings & Bjork, 1983; Fox, Kagan, & Weiskopf, 1979; Gratch, Appel, Evans, LeCompte, & Wright, 1974; Harris, 1973). By this view, infants may have the capacity for symbolic representation of objects but are prevented from expressing it by their limited memory abilities. Evidence favoring a memory-based interpretation derives from studies that have demonstrated that the frequency of A$\bar{B}$ errors increases with longer delays between object hiding and search (e.g., Fox et al., 1979; Gratch et al., 1974), and that similarity of test alternatives influences the accuracy of search (Bjork & Cummings, 1984; Cummings & Bjork, 1983). Consistent with this interpretation is a good deal of evidence that 8–10-month-old infants perform poorly on tests that require delayed recall of recently experienced stimuli, whereas 14–16-month-old infants perform relatively well on delayed recall tests, when they no longer commit the A$\bar{B}$ error (see Schacter & Moscovitch, 1984, for review).

A possibly converging operation (Garner, Hake, & Eriksen, 1956) concerning a mem-

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ory-based interpretation of the A$\bar{B}$ error is to study adults whose memory is impaired but who clearly have the capacity for symbolic representation of objects, such as patients with severe memory disorders (amnesic patients). Such patients typically have sustained damage to limbic structures that mediate memory functions, and thus have difficulty remembering events that have occurred since the trauma (for review, see Hirst 1982; Moscovitch, 1982; Schacter & Crovitz, 1977; Squire, 1982). However, these same patients possess relatively normal intellectual and linguistic abilities, can gain access to general knowledge, and have no difficulty describing familiar objects when they are out of view. The logic of the converging operation is as follows: If the A$\bar{B}$ error reflects the absence of object permanence, it should occur in infants but not in adults with intact object permanence. If, on the other hand, the A$\bar{B}$ error is attributable to a deficiency in memory processes, then patients with memory disorders may perform like 8–10-month-old infants on an object search task.

In the present article, we report two experiments in which amnesic patients exhibited a pattern of search that resembles in several respects the classical phenomenon observed by Piaget: The patients could remember the first location, but not the second. We will refer to this analogue of the A$\bar{B}$ error as *mnemonic precedence.*

We developed two object search tasks for use with amnesic patients. In the *room search* task, common objects were placed at different locations in a testing room. In the *container search* task, small items were placed in different drawers of a square container. In both tasks, objects were hidden at one location (A) for three successive trials, and were then hidden at a new location (B) on the fourth trial. Patients were required to remember the location of the object on each trial.

Experiment 1

Method

Subjects.—Eight patients with organic memory disorders participated in the study (Table 1). Five were diagnosed as in the early stages of Alzheimer's disease; the others became amnesic after closed-head injury, ruptured anterior communicating artery aneurysm, and anoxia secondary to cardiac arrest, respectively. All patients are characterized by severe memory disorders; they have little or no recollection of everyday events and per-

TABLE 1

CHARACTERISTICS OF AMNESIC AND CONTROL PATIENTS

Diagnosis	Age	Education (Years)	WAIS-R[a]	WMS[b]
Amnesics:				
1. Alzheimer	58	13	86	62
2. Alzheimer	61	21	92	79
3. Alzheimer	60	17	90	74
4. Alzheimer	68	12	82	63
5. Alzheimer	70	11	101	82
6. Aneurysm	58	13	89	79
7. Head injury	31	15	94	79
8. Anoxia	56	19	99	85
M	57.8	15.1	91.6	75.4
Controls:				
1. Alzheimer	78	21	95	90
2. Aneurysm	56	8	88	93
3. CVA	60	13	85	92
4. CVA	65	13	93	90
5. Uncertain	60	10	88	91
6. Uncertain	67	13	117	101
7. Head injury	31	17	91	122
8. Head injury	26	12	92	96
M	55.4	13.4	93.6	96.9

[a] Wechsler Adult Intelligence Scale—Revised (IQ).
[b] Wechsler Memory Scale (MQ).
NOTE.—The amnesics' WMS was significantly lower than that of the controls, $t(14) = 4.42$, $p < .01$. For all other comparisons, $t(14) < 1$.

form poorly on standard laboratory tests of memory. However, their overall level of intellectual function is in the normal range. None of the patients has any difficulty describing familiar objects when they are out of view. All patients, for example, find it easy to describe the appearance and function of common objects such as radios, clocks, or automobiles even when they are not present in the immediate perceptual environment. In addition, none of the patients has difficulty using or understanding language, executing motor acts and sequences, or perceiving the environment through any sensory modality. Also participating in the experiment were eight control patients, one left-sided and one right-sided cerebral vascular accident (CVA), one in the early stages of Alzheimer's disease, one with a ruptured anterior communicating artery aneurysm, two with closed head injuries, and two without a firm diagnosis. Their overall level of intellectual function was similar to that of the amnesic patients, but their memory problems, by comparison, were mild (Table 1).

Materials.—Several different common objects were used in the room search task: a stapler, pencil, stopwatch, cassette tape, eraser, fork, and styrofoam cup. Smaller objects were used in the container search task: a metal clip, elastic band, twist tie, and piece of paper. They were hidden in one of four drawers of an 8.5 × 8.5-cm plastic container. Each drawer of the square container had a different color—red, yellow, blue, or green—and was located on a different side of the container. This single container was used in all trials of the container search task.

Design and Procedure

The room task was always administered prior to the container search task. Both tasks began with a patient sitting across a testing table from the experimenter. The experimenter indicated either that he would be placing some objects in different parts of the room, or that he would place them in different drawers of the small container; in both cases, patients were instructed that they should try to remember the location and identity (name) of the objects on each trial. In the room search task, the experimenter then got up and placed an object in back of some books that were on a desk located 10 feet directly behind the patient. In the container search task, the experimenter placed an object in one of the four drawers of the container, which was situated on the testing table in front of the patient. We will refer to this first location as location A. In both tasks, the experimenter verified that the patients registered the hiding place by having them state immediately the location and identity of the object. This was followed by a 2½-min interval filled with conversation. Patients were then asked to state the location and identity of the object, and they attempted to retrieve it by walking to the desk (location A) in the room search task, or by opening a drawer in the container search task. If a patient retrieved the object from the correct location on any trial, he or she returned it to the experimenter, who placed it out of the patient's view. Following completion of the first trial at location A (A_1), different objects were placed at the same location on each of two consecutive trials (A_2 and A_3), and the tests of object location and identity were administered in the same fashion. A new object was then hidden at a new location (we refer to it as location B) in a different part of the room or in a different drawer, and the same immediate and delayed tests were repeated. If subjects searched incorrectly on the B trial, they were immediately asked if they remembered whether an object had been placed at any other location on that trial. The experimenter then showed the subject the correct location, either by walking to location B and retrieving the object in the room search task, or by opening the correct drawer and removing the object in the container search task.

In the room search task, the trial at location B was followed by two additional trials at location A (A_4 and A_5). Then a new object was placed in a third location (C). Location C was a place on the desk directly in front of the books that concealed location A. Thus, the object placed at location C was not hidden, but was plainly visible to the patient. Several other objects were placed on the desk near location C. None of these objects had been used at any point in the experiment. The tests were the same as on previous trials, with one exception. If a patient searched incorrectly on the C trial, he or she was then required to look carefully at the various objects on the desk and to state which, if any, had been placed there by the experimenter at the beginning of the trial. This trial was included because we wanted to determine whether amnesic patients would also exhibit mnemonic precedence even when the object was visible.

In both the room and container search tasks, the objects that were used on particular trials were determined randomly. These objects were kept in a box by the experimenter, out of subjects' view, on all trials except the one in which the object was used. In the container search task, the drawer that served as location A was decided randomly for each subject. The drawer that served as location B was always one of the two drawers on a side of the square container adjacent to location A, the exact one being selected randomly for each patient.

Results

Table 2 presents the outcome of each trial for each patient in the room and container search tasks. Consider first the results concerning patients' memory for object location in the room search task. On all immediate tests, each patient stated the location of the object when it was out of view and then retrieved it, indicating that they had registered the object's location on each trial. On delayed tests, both amnesics and controls retrieved the object correctly from location A on each of the first three trials. On the B trials, however, six of the eight amnesics failed to recall the location of the object, and instead searched perseveratively at location A, whereas all of the controls remembered that the object had been placed at location B, $\chi^2(1, N = 16) = 9.60$, $p < .01$. When asked if there was anywhere else that an object had been hidden, one of the patients who had searched perseveratively stated that he thought the object might be at location B; the other five either denied or were uncertain that another location had been used, or made erroneous guesses about a possible location. When the object was returned to location A after the B trial, six of the eight amnesic patients searched correctly on trial A_4, and all of them did so on trial A_5. On the C trial, with the object in full view, seven of the eight amnesic patients searched perseveratively at location A, whereas only one control did, $\chi^2(1, N = 16) = 9.00$, $p < .01$, and this patient immediately corrected his error without any prompting. At the conclusion of trial C, when patients were required to examine the several objects visible on the desk and to indicate which one had been "hidden" there, only two of the seven amnesics who had searched at location A chose the correct one.

An almost identical pattern of results was obtained in the container search task (Table 2). Performance on the immediate test was perfect for all subjects at all locations. On the delayed recall test at location A, all subjects searched correctly, except for one error com-

TABLE 2

RECALL OF OBJECT LOCATION AND IDENTITY IN THE ROOM AND CONTAINER SEARCH TASKS

	Trials																					
	Room Search														Container Search							
	Location							Identity							Location				Identity			
	A_1	A_2	A_3	B	A_4	A_5	C	A_1	A_2	A_3	B	A_4	A_5	C	A_1	A_2	A_3	B	A_1	A_2	A_3	B
Amnesics:																						
1	+	+	+	−	+	+	−	+	−	+	−	+	−	−	+	+	+	−	+	−	−	−
2	+	+	+	−	+	+	−	−	+	+	−	+	−	−	+	+	+	+	+	−	+	−
3	+	+	+	+	−	+	−	+	+	−	+	−	+	−	+	+	+	+	+	−	−	−
4	+	+	+	+	+	+	+	+	−	−	−	−	−	+	−	+	+	−	+	−	−	+
5	+	+	+	−	+	+	−	+	−	−	−	−	−	−	+	+	+	−	+	+	−	−
6	+	+	+	−	+	+	−	+	−	−	−	−	−	−	+	+	+	−	+	+	+	−
7	+	+	+	−	+	+	−	+	−	+	−	−	−	−	+	+	+	−	+	+	−	+
8	+	+	+	−	−	+	−	−	−	−	−	−	+	−	+	+	+	−	+	+	−	+
No. correct	8	8	8	2	6	8	1	6	2	3	1	2	2	1	7	8	8	2	8	4	2	3
Controls:																						
1	+	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	−
2	+	+	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+
3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6	+	+	+	+	+	+	−	+	+	−	+	+	+	−	+	+	+	+	+	+	+	+
7	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
8	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+
No. correct	8	8	8	8	8	8	7	8	8	7	7	7	7	7	8	8	8	8	8	8	8	7

NOTE.—Correct responses are indicated by "+," erroneous ones by "−." The order of patients in each group corresponds to the order in Table 1.

mitted by an amnesic. On the delayed test at location B, all controls performed perfectly, whereas six of the eight amnesics searched at location A, $\chi^2(1, N = 16) = 9.60, p < .01$.

Consider next the patients' recall of object identity. Performance was nearly perfect on the first trial (A_1) in both the room and container search tasks (Table 2). On the second trial (A_2), the amnesic patients' performance dropped substantially and remained low on subsequent trials. In contrast, performance of control patients was near-perfect on all trials and was higher than that of amnesics on each trial except the first one, all $\chi^2(1, N = 16) > 4.26$. The 54 recall errors made by amnesic patients on the two tasks consisted of 29 perseverative recalls of an object from one of the previous trials and 25 nonperseverative errors of commission and omission. Only six recall errors were made by the controls; three were perseverative and three were errors of omission.

Taken together, the results of the room and container search tasks indicate that amnesic patients exhibit a phenomenon of mnemonic precedence that resembles the A$\bar{B}$ error made by infants. Before considering seriously the idea that mnemonic precedence and A$\bar{B}$ errors are attributable to memory failure, we will first examine an alternative interpretation drawn from the work of Diamond and Goldman-Rakic (1983). These authors proposed that the A$\bar{B}$ error is attributable to perseverative tendencies associated with poorly developed frontal lobes in infants. As evidence for this view, they showed that adult monkeys with dorsolateral frontal lesions committed the A$\bar{B}$ error, whereas normal monkeys did not. Though compelling, this finding does not demonstrate conclusively that the source of error in adult humans, or even infants, is impaired frontal functions. It is often difficult to distinguish between the effects of perseverative tendencies associated with frontal damage and memory difficulties produced by limbic damage, particularly the hippocampus, unless there is a detailed comparison of performance of two groups with the appropriate lesions. Since Diamond and Goldman-Rakic did not include a hippocampal control group, we do not know whether similar deficits would be observed in monkeys with hippocampal lesions. With respect to the present study, the work of Diamond and Goldman-Rakic raises the possibility that patients' failure to find objects at locations B and C results from perseverative tendencies attributable to frontal lobe damage, and not from poor memory. It is well known that patients with frontal lobe damage whose memory is relatively unimpaired perseverate on tasks that are similar to ours (Milner, 1964). Indeed, the effects of this perseverative tendency can be misinterpreted as a memory deficit in different situations (Moscovitch, 1982). Our amnesic patients have some signs of frontal lobe pathology, as indicated by their poor performance on the Wisconsin Card Sort, a widely used test that is sensitive to dorsolateral frontal lobe damage. Amnesics completed an average of two out of six categories, and made a fairly high percentage of perseverative errors (30.3%). However, their card-sorting performance did not differ significantly from that of patient controls, who completed an average of 2.5 categories and committed 32.0% perseverative errors. This observation suggests that frontal impairment alone is not sufficient to produce deficits on our object search tasks. Nevertheless, to evaluate the hypothesis that mnemonic precedence is solely attributable to frontal lobe damage in humans, it is necessary to test patients with bilateral frontal lesions who are not densely amnesic. Consequently, in Experiment 2 we administered both of our object search tasks to three patients with verified bilateral frontal lobe damage and perseverative tendencies.

Experiment 2

Method

Experiment 2 was identical to Experiment 1 in all respects except that only three patients with bilateral frontal lesions participated in it. The etiologies of the three frontal patients are, respectively, gunshot wound (patient 1), trauma (patient 2), and meningioma (patient 3). CT scans showed large bilateral frontal lobe lesions in each of the three patients. The lesions extended over four to 15 consecutive 7-mm slices on the CT scan and involved primarily the medial frontal regions bilaterally with slight extension to the dorsolateral surface (patient 1); the right inferomedial and left orbital, medial, and dorsolateral frontal areas (patient 2); and the medial frontal regions bilaterally (patient 3). Patient 1 (age = 47; IQ = 84; MQ = 99) and patient 3 (age = 63; IQ = 80; MQ = 89) were similar to our controls in terms of age and cognitive ability. Patient 2 was somewhat younger (age = 35) and had more memory problems than our controls (IQ = 106; MQ = 84), although he is not characterized clinically as amnesic. All three patients perseverated frequently on the Wisconsin Card Sort. None obtained more than three categories, and they committed, respectively, 22%, 23%, and 72% perseverative errors.

Results and Discussion

All three patients easily remembered all locations of the object in both the room and container search tasks; there was no hint of perseverative search at location A. In recall of object identity, only one patient made a single error on a trial at location A in the room search task. The excellent performance of these patients suggests that perseverative tendencies associated with frontal lobe damage are not sufficient to produce mnemonic precedence; poor memory appears to be necessary for obtaining the phenomenon. Nevertheless, the present results do not permit us to reject the hypothesis that frontal lobe damage plays a role in generating precedence effects, because our amnesic patients had some signs of frontal lobe pathology. Mnemonic precedence may thus depend on a combination of poor memory and perseverative tendencies associated with frontal lobe damage. It remains to be determined whether severely amnesic patients who are entirely free of frontal lobe signs exhibit mnemonic precedence.

General Discussion

The present experiments have demonstrated that the performance of amnesic adults on object search tasks is similar to the performance of 8–10-month-old infants. Amnesic patients remembered the location of an object at an initial place and continued to search there even after another object had been hidden at a second location.

Before considering the possible implications of our results for theoretical interpretation of the A$\bar{B}$ error, it must be acknowledged that the phenomenon of mnemonic precedence that we have observed differs in several respects from the classic A$\bar{B}$ error. The most obvious difference is that the 2½-min delay used in our tasks is substantially longer than the delays used in studies of infants, which typically do not exceed 10–12 sec. We used this longer delay because adult amnesics have at their disposal rehearsal strategies and cognitive capacities, poorly developed in infants, that can be used to prolong their intact short-term or primary memory. The inclusion of 2½ min of distracting conversation, however, forced amnesic patients to rely on their impaired long-term memory. It is this kind of memory that we assume is required for performance on object search tasks that are given to infants, even though the nominal delays are quite short. Thus, although the delays may differ in absolute terms, our hypothesis is that their functional consequences are similar.

A second difference is that the actual tasks that we gave to the amnesic patients are not identical to the ones that have been given to infants. Admittedly, the room search task differed substantially from the typical infant search task, which usually involves looking for objects placed in hiding wells that are directly in front of the infant. The container-search task, however, resembled the traditional object search tasks in most respects. The fact that the pattern of results on the two tasks was identical suggests that our findings have some generality and are not attributable to an idiosyncratic feature of one task. In both tasks, however, we used different objects on each trial, whereas the typical procedure in studies of infants is to use the same object across trials. Also, the verbal instructions that our subjects received were, of course, different from nonverbal task demonstrations that are necessarily used to "instruct" infants. We gave verbal instructions because our patients would have attempted to code any type of instructions verbally and because we knew no good reason why such an instructional difference would be crucial.

Consideration of experimental findings concerning infants' search behavior also suggests possible differences between mnemonic precedence and the A$\bar{B}$ error. For example, Cummings and Bjork (1983; see also Bjork & Cummings, 1984) failed to observe perseverative search on B trials under conditions in which infants had the opportunity to err by searching at locations other than A (i.e., on a five-choice hiding task). Infants in their experiments tended to search at places spatially proximate to location B. By contrast, patients in our study searched perseveratively at location A even though they could have searched elsewhere in both tasks, and even though location A was not spatially proximate to location B in the room search task (in the container search task, location A was one of two locations spatially proximate to location B). However, our tasks differed from the one used by Cummings and Bjork, which involved a linear array of five hiding places, each marked by a blue cover. Although we do not know how amnesic patients would perform on their task, the question clearly merits experimental investigation. Another possible difference between mnemonic precedence and the A$\bar{B}$ error is suggested by evidence that infants' search performance improves across repeated tests within a session (Cornell, 1981). No pertinent evidence exists regarding possible improvements in amnesics' search performance. Note, however, that amnesics' performance on various learning tasks does improve with repetition (e.g., Cohen & Squire, 1980; Glisky, Schacter, & Tulving, in press; Milner, Corkin, & Teuber, 1968; Moscovitch, 1982; Schacter, Rich, & Stampp, 1985), and it is possible that search performance would improve with repeated testing. A further potential discrepancy between infants' and amnesics' search performance arises from our finding that most of the amnesic patients failed to *recognize* the object at location C. We do not know whether infants would exhibit an analogous phenomenon under similar conditions.

In view of the foregoing considerations, we must be cautious in attempting to relate our results to developmental studies. We are also aware that the resemblances between mnemonic precedence and the A$\bar{B}$ error need not imply that they are mediated by the same underlying processes. Nonetheless, we wish to note some implications of our data for theories of cognitive development in infancy. Foremost among these is that the A$\bar{B}$ error may not reflect an immature object concept in infants. The fact that adult amnesic patients with well-developed object concept make errors similar to those made by infants on object search tasks suggests that committing the A$\bar{B}$ error need not imply defective object concept. Our data are, however, consistent with memory-based interpretations of the A$\bar{B}$ error.

Studies of memory development in infancy provide support for the idea that the kind of memory capacity necessary for performing object search tasks is poorly developed in 8–12-month-old infants. Schacter and Moscovitch (1984), in a review of the infant memory literature, noted that the period from 8–12 months appears to be a watershed in the development of infant memory. Prior to 8 months, memory in infants can only be demonstrated with habituation and conditioning tests that may not require recollection of past events; after 8 months, infants begin to exhibit forms of recall and recognition that share some characteristics with adult memory abilities. Schacter and Moscovitch further noted that this late-developing form of memory resembles the kind of memory that is impaired in amnesia. It is the inefficient functioning of this late-developing form of memory in infants and amnesics, we believe, that is largely responsible for the A$\bar{B}$ error and mnemonic precedence, respectively. More specifically, amnesics and infants may be extremely susceptible to the effects of proactive interference generated by search at location A. Patients' nearly perfect recall of location and object on the first A trial in both of the present tasks suggests that interference played a major role in subsequent forgetting. Excellent recall on initial A trials has also been observed in infants (Cummings & Bjork, 1983). In addition, there is ample evidence from a variety of paradigms that amnesics can be highly sensitive to proactive interference (Kinsbourne & Winocur, 1980; Warrington & Weiskrantz, 1974; Winocur & Weiskrantz, 1976), and data along these lines have also been reported in studies of infants (Harris, 1973).

A more general point to consider in light of our results and of our view of memory development is that tests of symbolic representation, as formulated by Piaget and others, almost invariably require infants to call to mind objects that are not available perceptually. If, however, poorly developed recall abilities and consequent sensitivity to interference contribute to infants' apparent failure to demonstrate the capacity for symbolic representation on object search tasks, then it may be necessary to alter the kinds of tasks that are used to determine whether an infant has developed these capacities. What is needed are tasks that do not make demands on late-developing forms of memory, because it may be these abilities, rather than the capacity for symbolic representation or object permanence, that are undeveloped in young infants (see Moscovitch, 1985, for further discussion). One such task has been reported by Baillargeon, Spelke, and Wasserman (in press). They devised a habituation technique for studying object permanence in which infants are exposed to an object, and then view possible and impossible events involving the object when it is occluded. Baillargeon et al. found that infants looked longer at an impossible event involving the occluded object (e.g., another object moving freely through the space occupied by the occluded object) than at a possible event involving the occluded object. On the basis of this observation, they argued that 5-month-old infants know that objects continue to exist even when they are occluded. This finding suggests that evidence for object permanence may be obtained even in young infants when a task does not make demands on late-developing forms of memory and thereby supports the notion that apparent absence of symbolic representation is sometimes attributable to memory failure.

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