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The role of familiarity and sound in the development of person and object permanence

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A cross-sectional study investigated the development of search for objects that differed in animism (people vs. toys) and familiarity (mother vs. stranger, laboratory vs. home toy) in 37 infants at 6, 8 and 10 months. In different conditions, the objects either were (*a*) visible only prior to hiding, (*b*) audible during hiding, or (*c*) visible and audible prior to hiding, and then audible during hiding. Analyses of successful performance (criterion) and length of time infants took to reach criterion (latency) revealed the following. When infants were required to search for their mothers who interacted with them in a game of hide and seek, they performed better then when they were required to search for strangers or inanimate objects under similar conditions, especially during condition (*c*). The presentation conditions had little differential effect in search for inanimate objects or the stranger. Although performances became better with age, a substantial number of 6-month-old infants searched for hidden objects. The conditions facilitating search focused on intermodal information and a familiar social context. The findings forge important links between studies of object permanence, object perception and social knowledge.

Although Piaget studied infants' development of object permanence using only inanimate objects, he proposed that infants would show their understanding of their mother as a permanent entity sooner since they are more motivated to learn about her whereabouts. Piaget termed such a difference in performance on tasks that require the same underlying cognitive structures 'horizontal decalage'. Several researchers (Bell, 1970; Decarie, 1965; Paradise & Curcio, 1974) empirically supported Piaget's hypothesis.

These studies, however, have confounded the type of stimuli hidden (person vs. object; familiar vs. novel) with method of hiding (cf. Jackson, Campos & Fischer, 1978). For instance, in the Bell (1970) study, infants of 8, 11 and 13 months of age were presented with tasks in which person permanence was assessed by having the infants search for their mother (and sometimes for the experimenter) behind furniture, and object permanence was assessed by allowing infants to search for an interesting toy under cloth covers. Jackson *et al.* (1978) showed that, when the hiding spots of people and objects were identical and when familiarity of the stimuli was varied, the lag in performance in favour of mother was not consistently obtained with 6- and 8.25-month-old infants in longitudinal and cross-sectional studies. On occasions when decalage did

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occur, it was in favour of people rather than objects (longitudinal study), or in favour of the familiar person (mother) and unfamiliar toy (cross-sectional studies). According to the authors, 'the occurrence of decalage, therefore, cannot be neatly summarized as one of person over object' (p. 6).

However, studies showing differences in search for persons over objects tested infants between 8 and 13 months rather than 6 to 8 months as Jackson *et al.* (1978) did. If differential search is related to attachment as previous studies suggest (Bell, 1970; Piaget, 1954) then perhaps difference in search is present in infants older than those tested by Jackson *et al.*, when proximity-seeking behaviours toward mother become increasingly stronger (Kotelchuk, Zelazo, Kagan & Spelke, 1975). In addition, it is not clear what effect sound has on the behavioural manifestations of the infants. Bell (1970) indicated that she had people engage in a game of hide and seek. People saying 'peek-a-boo' or 'where am I?' during hiding present the infants with a continuous, perceptually available stimulus. Reaching for sounding objects cannot be taken as evidence of object permanence. The object concept is a fully representational ability that allows for the *recall* of an absent object when neither visual nor auditory cues reveals its presence (cf. Bremner, 1988; Harris, 1983). Searching for invisible sounding stimuli is evidence of intermodal recognition since infants treat *sound* as specifying the position of a substantive object. Therefore, when investigating whether permanence for people and objects proceed in parallel it is important to control the sound of the stimuli.

Unfortunately, studies investigating whether infants treat sound as specifying the position of a substantive object and manually search for it provide contradictory results. For instance, Piaget (1954) did not find that sound cues helped his infants find a hidden *inanimate* object prior to Stage IV of the sensorimotor period. Piaget's casual observations have been replicated in more controlled studies (Bigelow, 1983; Freedman, Fox-Kolenda, Margelitch & Miller, 1969; Uzgiris & Benson, 1980). According to these authors, there was no retrieval of sounding objects until the infants became capable of retrieving non-sounding objects. On the other hand, Ginsburg & Wong (1973) found that, when sound was associated with the object prior to being hidden, sound increased frequency of search for a hidden object by Stage III infants. However, the authors had the infants handle the sounding object prior to hiding and it is not clear whether the infants' actions were simply a continuation of the actions with the visual object, or whether sound had become an important stimulus dimension in identifying the object's location in space.

Recently, studies have shown that, if infants are required to search for a sounding object in the dark rather than in the light, they apparently will reach in the direction of the sounding object as early as 5–6 months of age (Clifton, Rochat, Litovsky & Perris, 1991; Clifton, Perris & Bullinger, 1991; Stack, Muir, Sherrif & Roman, 1988; Wishart, Bower & Dunkeld, 1978). It is possible that functional use, such as the use of sound in actually obtaining objects, has not been demonstrated during the second half of the year because requiring infants to search for objects in the light may present them with a visual conflict. Hearing an object, but not seeing it, may be confusing to older infants, who have had a lengthy period during which sight and sounds are often paired when visible.

Thus, as matters stand now, it is not clear whether search for people precedes search for inanimate objects and whether search for sounding objects occurs at the same time as search for silent objects. The lack of consistency in the conclusions of the various studies

cited appears due largely to difference in methodology. Taken together, the studies on decalage have used different age groups (6–8 months vs. 9–12 months), different tasks (Stage III [infants manipulated toys prior to hiding] vs. Stage IV task [no prior interaction was allowed]), and used different stimuli (sounding vs. silent, and novel vs. familiar people and objects). The studies investigating the use of sound in object construction also used different age groups (first or second half of the year), were either performed in the light or in the dark, and measured manual search or orientational reaching to assess the infant's competence. Clearly, further research is needed to clarify the role of animism (people vs. toys) and familiarity (mother vs. stranger, laboratory vs. home toy) on the development of search for objects. The purpose of the present study therefore was to investigate whether 6-, 8- and 10-month-old infants will search more for people than for objects using the traditional Stage IV object permanence task. In different conditions, the objects either were (*a*) visible only prior to hiding, (*b*) audible only during hiding, or (*c*) visible and audible prior to hiding, and then audible during hiding.

Method

Subjects

Forty-one infants were recruited from published birth announcements. The data from one 8-month-old girl were lost due to experimental error and the data from one 8-month-old and two 10-month-old boys could not be used due to persistent crying. The final data set consisted thus of responses of 37 infants (mean age and SD given in parentheses), fourteen 6-month-old infants (6.2 months ± 4 days; six girls; eight boys); thirteen 8-month-old-infants (8.1 months, ± 4 days; four girls; seven boys) and nine 10-month-old infants (10 months ± 5 days; four girls; five boys). The infants came from mostly white, middle-class families, as judged from parental educational level, and most infants had one or more siblings.

Apparatus

The play table used for hiding the objects is shown in Fig. 1. The table top measured 75 cm from door to door and 62 cm from front to back. The right and left vertical sides fastened on the table top each measured 62 cm in length and 75 cm in height and contained a small door (25 cm high) that when opened was sufficiently large that a person's head, or a toy, could be put through. The 75 × 75 cm wooden back contained an opening 23 cm in width and 75 cm in height, which allowed a research assistant to stand behind the infants and to hold them by the waist. She was required to stop the infants from crawling off the play table, but to hold them loosely enough to allow for exploration. The play table was open in the front and was fastened on four legs that were 65 cm high. Total play table height was 140 cm.

The infants' activities at the right and left sides of the play table were filmed with two video cameras mounted on a wall facing the front of the table top, but above and to the side of the infants' head and therefore out of their visual field. One camera had a zoom lens and was remotely controlled by a camera operator from a separate control room. The zoom lens allowed for a closer look at the infant's search activities when required and the remote control enabled the assistant to continue filming the baby's responses whenever the baby changed position. Using a split-screen generator, the pictures of the two cameras were recorded on one tape by a video recorder (JVC BR 9050U) that contained a date–time generator to record onset and offset of the sessions.

Stimulus

The infants were presented with their mother, a female stranger and a familiar and novel object in three conditions: vision, sound and combined conditions. The unfamiliar objects used for the visits consisted

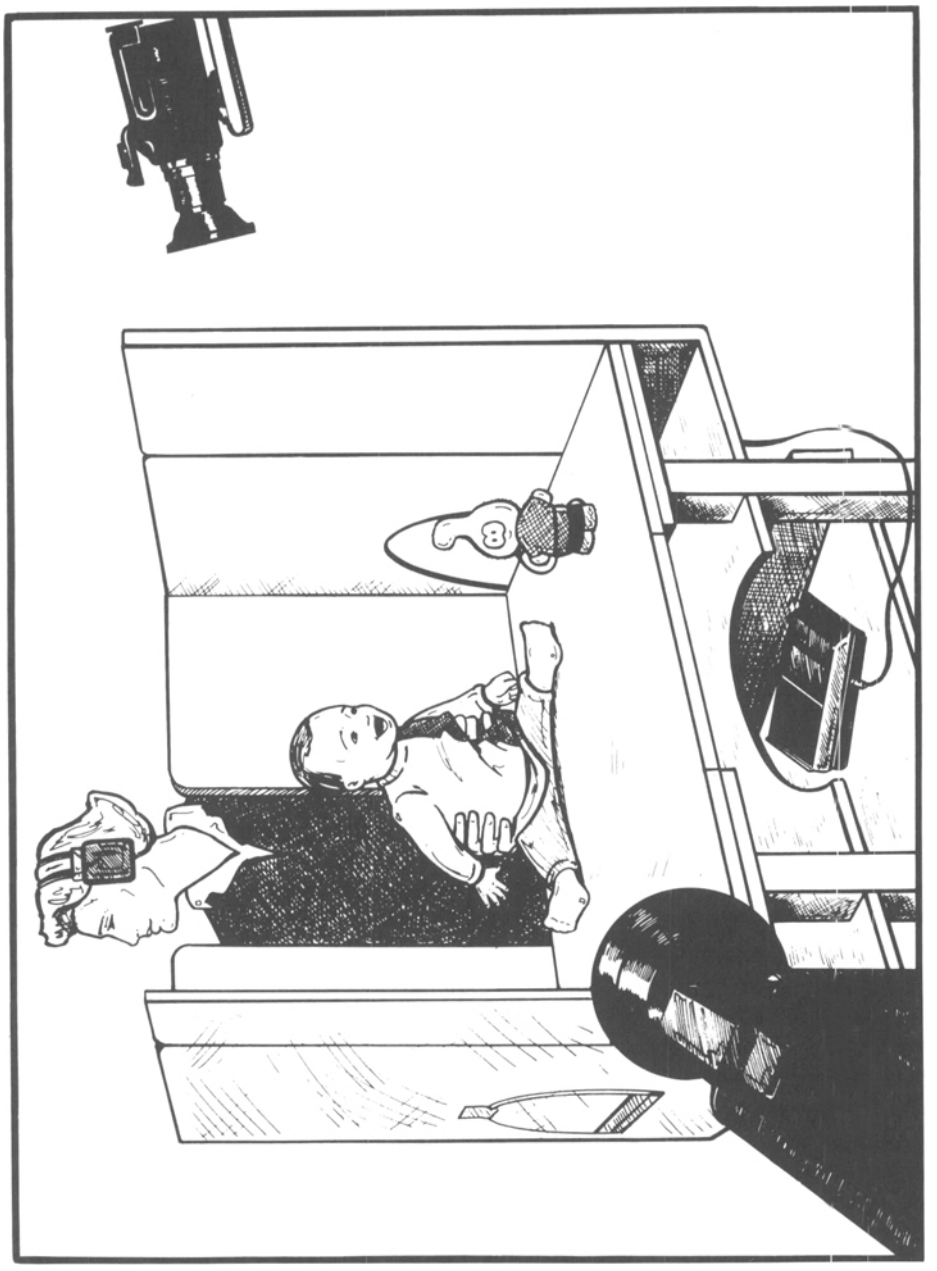

Figure 1. Play table to equate task demands in search for familiar and novel people and objects in three conditions.

of a bright orange and yellow snorkel doll, a blue and white smurfette, a bright pink and white doll and a brown and yellow bear. Two different objects were used during the combined and vision novel object condition. The sound of the object in the vision condition was used in the sound-only condition. The other two objects were used during the familiarization condition. All objects has been chosen because they had on previous occasions attracted sustained interests in these age groups. In the sound condition, the toys produced a sound through speakers that were hidden in their bodies and wired to a recorder that played the various sounds (squeaky, rattle-like, melody and bells). The familiar object was the infant's favourite toy that the mother brought from home that would make sounds when handled. In the laboratory these sounds were recorded prior to testing and then played through a small speaker attached to the back of the toy (invisible to the infant) in the sound conditions. Thus, both the novel and familiar toys provided synchronous visual and auditory stimulation in the combined conditions. If the sound was a squeak, rattle or bell, the experimenter would shake the toy slightly when it was presented to the infant. In the person sound conditions, mothers and female strangers said, 'Hello (name of baby), where am I?'. The women continued to repeat this phrase while hiding. Pilot work had indicated that all sounds were clearly audible to the infants, since all infants would turn their heads to the onset of the sounds at all ages studied. Two different female strangers were used for the vision and combined conditions. The experimenter used in the vision condition would talk behind the door in the sound-only condition.

Procedure

All babies were tested when they were in an alert and attentive state. Prior to testing, the infants were familiarized with the play table and the hiding procedure by playing games of hide and seek with the experimenter and some toys, while the mother would hold the infant from behind. Stimuli used during the familiarization session were not used to interact with the infant during the experimental sessions.

As the sessions began, the infants were placed upright in the middle of the table, slightly off-centre, so that they were approximately 20 cm away from the exit door (see Fig. 1). At this distance, infants could either crawl or lean forward to push open the exit door, which would fall open after a light tap, since it was hinged at the bottom and held loosely closed at the top with a small Velcro strip. Only the exit door was opened and closed by either the experimenter, after the infant had oriented toward the toy or sound, or by the stranger or the mother after they had shown their faces. The door was also opened during the sound-only conditions and closed as soon as the infants oriented toward the sound. Thus the door behind which the stimulus was hiding was opened in all three conditions to make sure that differences in responding were a function of the different stimuli and their properties, rather than of the different hiding procedures. It was easy to see whether the infants had noticed the visible stimulus or the sound since they had to turn 45° toward the exit in order to fixate the object or orient to the sound. Choice of the right or left exit door was randomly determined by a flip of the coin.

In order to prevent the research assistant that held the infant from biasing the responses of the infants, she remained uninformed about the experimental hypotheses and wore stereophonic earphones through which music played. She was further instructed to watch over her shoulder and away from the infant to a video that recorded the infant's face. Thus, she was in a sense deaf and blind to the location of the various stimuli.

Recording of the *vision* conditions began when the person's face, or the object, was shown to the infant through the door. To prevent the infant from contacting the stimuli, the door was closed as soon as the infant fixated the stimulus. The type of object was then hidden until the infants reached criterion. If no criterion was reached by 15 s, the trial was terminated at this point. Pilot work had shown that if infants reached criterion, they would more likely do so within 15 s.

Recording of the *sound* conditions began when the person said 'Hello (name of baby), where am I?', or when the object made sounds behind the closed door. As soon as the infant's gaze turned toward the sound, the door closed and the response period began while the stimulus continued to sound without becoming visible until infants reached criterion, but again not longer than 15 s.

Recording of the *combined* conditions began when the person's face or the toy were shown to the baby through the door while sounding until the infant fixated the stimulus. Then the door was closed while the stimuli continued to sound until the infants reached criterion, or for 15 s, whichever came first.

Thus, each infant received a total of 12 conditions, each having a 15 s response period. Order of

presentation of the 12 conditions was randomized within each session and between ages as follows. Each condition was given a number. The 12 numbers were put in an envelope and one number was drawn blindly each time a condition was to be administered.

Data scoring

The tapes were coded by two trained students working independently. Sound was turned down during coding. Although the coders were able to see the type of object on the tape when the infants opened the door, they were naïve to the nature of the experimental hypotheses, and it was therefore unlikely that they would influence the results of this study in one way or another. Scoring commenced with the closing of the door, after the infant had turned their head to fixate the stimulus or to orient to the sound. Two infant behaviours were recorded: (1) criterion; and (2) latency to reach criterion.

Criterion

In order to reach criterion, infants had to push open the exit door after the stimulus had disappeared or behind which the stimulus was sounding. This action did not require the infants to change into a crawling position. Infants were able to reach the door while leaning forward. To take into account the maturing motor abilities of the infants, criterion was also scored for two 6-month-old infants when, while reaching for the novel object in the combined condition, and for the familiar object in the sound condition, the door failed to open but the infant continued to pat the door while looking at it. Criterion was further scored for two 10-month-old infants that stood up and looked over the side in all conditions and also for another infant that lay down to look underneath the play table in the direction of the hidden object each time an object had disappeared or continued to sound. The coders were also instructed to code such search behaviours at the door where the object had not been hidden.

Latency scores

Latency to reach criterion was defined as the time between door closing and criterion. If no criterion was reached at 15 s, the trial was terminated at this point. This method indexed the latency to reach criterion in either the social and non-social auditory, visual or combined conditions, across age.

Inter-observer reliabilities were calculated for 30 per cent of the experimental sessions. Observer agreement for criterion was .86, and for latency .92.

Results

Criterion responses

Table 1 shows the pattern of criterion responses for each baby in the various tasks. Since none of the babies exhibited search behaviours at the wrong door these scores are not reported.

To determine whether infants would display reliably different responses to the social and non-social stimuli from an early age, and whether sound of the stimuli would facilitate search in infants, the infant criterion responses were submitted to log linear analyses in which age (three: 6, 8, 10) was the between factor and condition (three: combined, sound, vision), stimulus (two: person, object), and familiarity (two: familiar, novel) were the within factors. The significant interactions were submitted to *post hoc* log linear analyses ($p < .05$). Table 2 shows the percentage of babies that reached criterion in each condition.

A significant main effect for condition ($\chi^2(1) = 15.24$, $p < .001$) and subsequent *post hoc* analyses indicated that the probability of searching for stimuli in the combined

Table 1. Number of infants reaching criterion in the combined, sound and vision conditions to familiar and unfamiliar people and objects at 6, 8 and 10 months

Id.	Age	CPF	CPU	COF	COU	SPF	SPU	SOF	SOU	VPF	VPU	VOF	VOU
ZE	6												
JB	6											1	
JM	6												
KL	6		1	1									
MCO	6												
NL	6									1			
PM	6												
SH	6												
BJ	6	1				1			1	1			
SM	6	1	1	1	1	1						1	1
SS	6	1								1			
BM	6	1		1	1			1	1	1	1		1
BMC	6	1	1	1	1		1	1		1	1	1	1
PH	6	1	1			1	1	1		1			
CH	8												
AN	8	1	1	1				1	1				
BK	8	1	1	1	1	1	1	1	1	1		1	1
ED	8	1		1	1	1	1		1	1		1	1
GF	8	1	1	1	1	1	1	1	1	1	1	1	1
JR	8	1				1				1			
JRA	8	1	1		1								
MC	8	1	1	1	1	1	1			1		1	1
NB	8	1	1		1	1	1			1			
NS	8	1	1	1	1	1	1	1	1	1	1	1	1
NT	8	1		1	1			1					
SD	8	1	1	1	1	1		1	1	1	1	1	1
TS	8	1								1			
AX	10	1	1	1	1	1	1	1	1	1	1	1	1
AO	10	1	1	1	1	1	1	1	1	1	1	1	1
BS	10	1	1		1	1	1	1	1	1			
CG	10	1	1	1	1	1	1	1	1	1	1	1	1
DH	10	1	1	1	1	1	1	1		1		1	
DMC	10	1	1	1	1	1	1	1	1	1	1	1	1
DP	10	1	1	1	1	1	1	1	1	1	1	1	1
JP	10	1	1	1	1	1	1	1	1	1	1	1	1
NG	10	1	1	1	1	1		1	1	1	1	1	1

C, combined; S, sound; V, vision.
P, person; O, object; F, familiar, U, unfamiliar.

condition was higher than in the sound ($\chi^2(1) = 10.94, p < .001$) or vision ($\chi^2(1) = 11.09$, $p < .001$) conditions, between which there was no difference (see Fig. 2).

The stimulus main effect was not significant ($\chi^2(1) = 2.13, p < .148$). However, a significant main effect for familiarity ($\chi^2(1) = 16.29, p < .001$), and a subsequent significant stimulus × familiarity interaction ($\chi^2(1) = 7.24, p < .0071$) indicated that the

Table 2. Number of infants reaching criterion as a function of stimulus, condition and age

		Combined				Sound				Vision			
Age		F	%	U	%	F	%	U	%	F	%	U	%
6 (N = 14)	Person	6	43	4	29	3	21	2	14	6	43	2	14
	Object	4	29	3	21	3	21	2	14	3	21	3	21
8 (N = 13)	Person	12	92	8	62	8	62	6	46	9	69	3	23
	Object	8	62	9	69	6	46	6	46	6	46	6	46
10 (N = 9)	Person	9	100	9	100	9	100	8	89	9	100	7	78
	Object	8	89	9	100	9	100	8	89	8	89	7	78

F, familiar; U, unfamiliar.

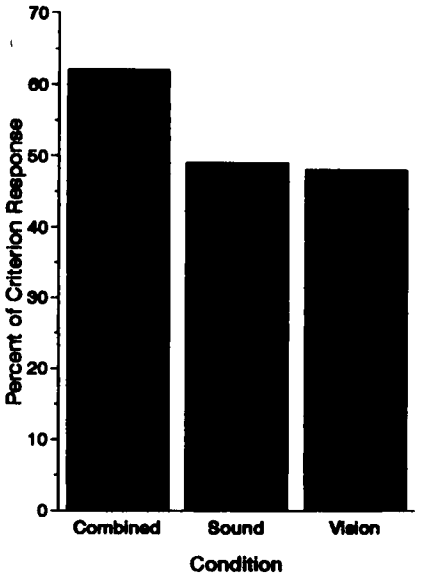

Figure 2. Percentage of infants reaching criterion in the combined, sound and vision conditions.

probability that the infants searched for the familiar person (the mother) was significantly greater than the probability that the infants searched for the familiar object ($\chi^2(1) = 6.11, p < .05$). The probability that the infants searched more for their mother than for the unfamiliar person (female stranger) was also significantly greater ($\chi^2(1) = 18.32, p < .0001$). There was no significant difference in search behaviour between unfamiliar person and object. The interaction is depicted in Fig. 3.

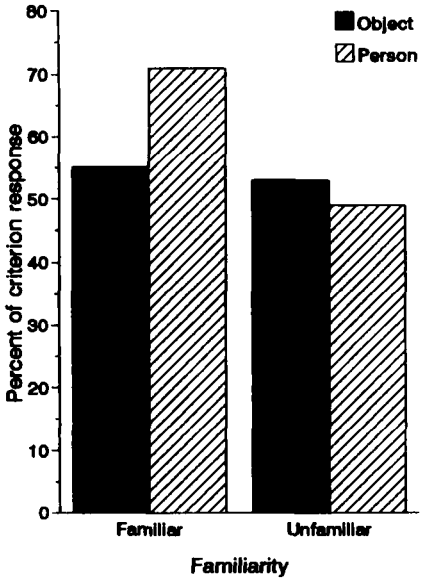

Figure 3. Percentage of infants reaching criterion toward familiar and unfamiliar people and objects.

The analysis further showed a significant main effect for age ($\chi^2(2) = 70.02, p < .001$). *Post hoc* analyses indicated that performance increased significantly between 6 and 8 months ($\chi^2(1) = 12.65, p < .001$), and significantly between 8 and 10 months ($\chi^2(1) = 13.3, p < .001$) toward all stimuli and under all conditions.

Latency scores

The mean latency scores and standard deviations are presented in Table 3. An ANOVA on the latency scores was deemed inappropriate since a large number of the younger infants failed to reach criterion. However, on looking at the data, it was clear that averaged across conditions and familiar and novel stimuli, latency to reach criterion became faster with age (M = 10.4 s at 6 months; M = 8.9 s at 8 months; M = 5.6 s at 10 months). When averaging across age and familiar and novel stimuli, latencies to reach criterion were fastest in the combined condition (M = 7.5 s), followed by vision (M = 8.3 s) and sound (M = 8.4 s) conditions. Finally, when averaging across age and conditions, latencies to reach criterion to mother was fastest (M = 6.7 s), followed by familiar object (M = 8.05 s), stranger (M = 8.6 s) and novel object (M = 9.7).

In summary, when infants' manual search behaviours to animate and inanimate objects are investigated under conditions that are both more natural than in previous research (because in some conditions the person interacts with the child) and more comparable to each other (because people and toys are hidden in the same manner), more infants searched for their mother than for the other stimuli. They also searched faster for her than for the other objects, especially in the combined condition. Performance also

Table 3. Mean length of time infants took to reach criterion (latency) and standard deviations for each stimulus, in each condition at each age

Age	*N*	Condition	Mean	SD
6 ($N = 14$)	6	CPF	8.0	3.1
	4	CPU	9.5	1.0
	4	COF	7.2	2.7
	3	COU	8.3	2.8
	3	SPF	6.6	7.2
	2	SPU	15.0	0.0
	3	SOF	7.6	5.0
	2	SOU	15.0	0.0
	6	VPF	10.0	5.0
	2	VPU	11.0	5.6
	3	VOF	11.0	6.9
	3	VOU	13.0	3.4
	9	Overall mean latency	10.4	2.9
8 ($N = 13$)	12	CPF	6.0	3.3
	8	CPU	11.0	4.0
	8	COF	9.0	4.7
	9	COU	11.0	4.9
	8	SPF	7.3	4.0
	6	SPU	8.1	3.6
	6	SOF	9.0	3.4
	6	SOU	10.2	4.3
	9	VPF	8.3	3.0
	3	VPU	9.3	6.6
	6	VOF	8.5	4.1
	6	VOU	8.1	4.4
	12	Overall mean latency	8.9	2.4
10 ($N = 9$)	9	CPF	3.5	1.5
	9	CPU	7.0	3.8
	8	COF	4.6	3.3
	9	COU	5.6	3.3
	9	SPF	6.7	5.2
	8	SPU	3.7	1.6
	9	SOF	6.6	3.3
	8	SOU	6.8	5.1
	9	VPF	5.8	5.3
	7	VPU	6.1	5.5
	8	VOF	4.5	2.6
	7	VOU	4.5	2.5
	9	Overall mean latency	5.6	2.0

C, combined; S, sound; V, vision.
P, person; O, object; F, familiar; U, unfamiliar.

improved with age. More infants reached criterion and they reached it faster as they became older.

Discussion

The results showed that, although retrieval of people and objects appears to progress similarly, at 6 and 8 months more infants searched for their mother than for the inanimate objects or the female stranger. At 10 months most infants were equally competent in their search for people and objects. The fact that mother talked to her baby while hiding did not seem to have influenced search in infants, since more infants searched for her than for the other stimuli in the vision condition as well. Overall these findings support the results Bell (1970) obtained with 8–13-month-old infants, but not those of Jackson *et al.* (1978) with 6–8.25 month-old infants. There are a number of possible explanations for this discrepancy. It appears that the 6-month-old infants of the Jackson *et al.* (1978, p. 5, Fig. 2) study were only able to complete a Stage III task and not a Stage IV task. Stage III tasks assessed infant search for partially hidden objects. Since the infants may have simply reached for the visible part, no inferences of object permanence and possible decalages can be made. The reason that some of our 6-month-olds succeeded in the Stage IV task, and that both our 6- and 8-month-old infants showed decalage in favour of mother, may be because our conditions were more natural and interactive and thereby facilitated search.

It is not unreasonable to suggest that infants are more motivated to search for their mother than for the other stimuli. First, although attachment to mother can be noted as early as 3-months (Legerstee, Pomerleau, Malcuit & Feider, 1987; Watson, Hayes, Vietze & Becker, 1979), it becomes firmly established by 6 months (Schaffer & Emerson, 1964) and grows more intense thereafter (Kotelchuk *et al.*, 1975). Therefore, disappearance of mother may have greater consequences for the emotional well-being of the infant than the disappearance of physical objects or the female stranger (Gelman & Spelke, 1981; Gratch, 1982; Piaget, 1981). Second, there are various non-verbal communicative gestures indicating that throughout the first year of life infants become more attuned with their mother's behaviour. There are significant developments in joint attention, verbal exchanges and social gesturing (Butterworth & Grover, 1990; Legerstee, Corter & Kienapple, 1990; Legerstee *et al.*, 1987), indicating that infants have become more aware of their mother as an important source of information about their environment.

According to cognitive developmental theorists (Pascual-Leone & Johnson, 1991; Piaget, 1954, 1981), this stimulation of infant by mother has both affective and cognitive consequences. The infant has noticed people to be independent sources of causality and not objects. Consequently people are more cognitively motivating to infants than objects, and should produce more rapid accommodations than objects. In that sense, infants should acquire permanence for people sooner than for objects. However, because of the interaction of the affective and cognitive schemata, the infant is driven more toward seeking out mother (or other primary caretaker) as a source of attention rather than unfamiliar people. This results in greater cognitive accomplishments toward the mother and hence an earlier understanding of her permanence.

Alternatively, one could argue that infants learn early in life to bring back mother

without representing her as an independent entity. When mother leaves, infants may exhibit a variety of emotional responses that are a function of her *disappearance* (cf. Gelman & Spelke, 1981). Protesting when mother disappears has been described by Piaget (1954, p. 12) as an example of Stage II behaviour. However, in order for infants in this study to recover mother, they had to push open a *specific* door and thus diffuse emotional responses would not count as a criterion.

This study was not designed to answer questions about the origin of permanence. Infants younger than 6 months of age are not capable of performing coordinated actions. That is why studies aiming at identifying the youngest age at which infants come to understand the properties of objects have relied on habituation and preferential looking paradigms to infer such an appreciation. These studies seem to indicate that infants as young as 4–5 months of age acknowledge the continued existence of physical objects (Baillargeon, 1992; Spelke, 1988). These habituation studies may need to be extended to include people in order to address questions of the onset of decalage.

Not only did more infants search for their mother in the vision and combined conditions, but also in the sound-only condition. Uzgiris & Benson (1972) found that 35 per cent of their 9–10-month-old infants searched for a sounding toy, whereas 62 per cent of our 8-month-old infants, and 100 per cent of our 10-month-old infants searched for the voice of their mother. The authors suggested that 'had we used objects having highly familiar sounds, our findings might have been different' (p. 8). Lack of the use of a highly familiar stimulus may also explain why earlier studies (Bigelow, 1983; Freedman *et al.* 1974; Piaget, 1954) failed to find that sound cues helped search for a hidden object.

Interestingly, even though the infants improved performance between 6 and 10 months of age, their pattern of responding remained the same. Their more successful accomplishments with age may be attributed partly to physical maturation, increased motivation and perhaps a better understanding of what the search task requires. The finding that infant search increases when they are required to search for their mother supports the idea that searching for things in young infants is influenced by their motivation to search, as well as by their developing understanding of the permanence of things (Bremner, 1988; Butterworth, 1981; Harris, 1989). Piaget (1954), when assessing conceptual development in infants from the way they responded to hidden objects, sorted out differential motivation by ensuring that infants were interested in the objects. By allowing infants to search for their mother under interactive conditions the present study revealed not only something about the infants' social understanding, but also some of their more advanced cognitive abilities. It provided evidence that substantial numbers of 6-month-old infants can search for hidden objects under suitable conditions. The conditions facilitating search focused on inter-modal information and a social context. The present findings forge important links between studies of object permanence, object perception and social knowledge.

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