# Reports

## Rapid Change in the Symbolic Functioning of Very Young Children

JUDY S. DELOACHE

**A remarkable difference in the understanding of the symbolic relation between a scale model and the larger space that it represented was displayed by two age groups of young children. Three-year-old children who observed an object being hidden in a model knew where to find an analogous object hidden in the corresponding location in a room, but 2.5-year-old children did not. The success of the group of older children reveals an advance in their cognitive flexibility: they think of a model in two ways at the same time—both as the thing itself and as a symbol for something else.**

THE RESULTS OF THE RESEARCH described here reveal the sudden achievement, in a group of children between 2.5 and 3 years of age, of an important developmental milestone: the realization that an object can be understood both as a thing itself and as a symbol of something else. Symbolization is a hallmark of human cognition, and the development of symbolic functioning has been assigned a prominent role in many major theories of cognitive development (*1*). The specific symbolic relation examined here is that between a scale model and the larger space it represents. It is argued that understanding the representational role of a symbolic object requires thinking about one thing in two different ways at the same time—a crucial aspect of mature, flexible thought.

Previous research has established that very young children are extremely competent at remembering the location of a hidden object (*2*). For the research reported here, a young child watched as an attractive toy was hidden within a scale model of a room. (For example, a miniature dog was hidden behind the small couch in the model.) The child was then asked to find an analogous toy that had been concealed in the corresponding place in the room itself (for example, a larger stuffed dog hidden behind the full-sized couch). To succeed, the child had to realize that the model represented the room and that, by remembering the location of the object hidden in the model, he or she could determine the location of the object concealed in the room.

Each experimental session began with an extensive orientation phase highlighting the correspondence between the room (4.80 m by 3.88 m by 2.54 m) and its scale model (71 cm by 65 cm by 33 cm), which was located in an adjoining room. The experimenter explicitly described and demonstrated the correspondence between the two toys to be hidden, between the room and the model, and between the individual items of furniture (the hiding places) within the two spaces.

Immediately after the orientation phase, each child was given four trials, each of which involved three parts. (i) Hiding event—the subject watched as the miniature toy was hidden under or behind an item of furniture in the model. (The toy was hidden in a different place for each trial.) (ii) Retrieval 1—the child was asked to retrieve the larger toy from the room. On each trial, the child was reminded that the larger toy was hidden in the "same place" as the miniature one. (iii) Retrieval 2—as a memory check, the child was returned to the model and asked to retrieve the toy that he or she had observed being hidden at the beginning of the trial (*3*). Thus, retrieval 2 tapped the child's memory for the original hiding event, and retrieval 1 assessed transfer of that memory to a new context.

The subjects for experiment 1 were 32 children, 16 in a younger group (30 to 32 months; mean age, 31 months) and 16 in an older group (36 to 39 months; mean age, 38 months). The hiding space was counterbalanced with age: half the subjects in each age group watched as the miniature toy was hidden in the model, as described above, and half saw the larger toy being hidden in the room.

The results were dramatic. Figure 1 shows the mean number of errorless retrievals of the analogous toy (retrieval 1) and of the original memory object (retrieval 2). The mean level of performance of the older children (old) was better than that of the younger children (young) (old − young = 1.34, SE = 0.17), and overall performance on retrieval 2 (R2) was higher than overall performance on retrieval 1 (R1) (R2 − R1 = 1.59, SE = 0.23). More importantly, the pattern of performance differed for the two age groups. The difference between performance on retrievals 1 and 2 for the older subjects was only 0.27, whereas for the younger children it was 2.69 (SE = 0.32) (*4*). This difference in the performance of the younger and older children is highly replicable (*5*). The results were unaffected by whether the toy was originally hidden in the room or in the model.

For retrieval 2, the younger and older children showed little difference in memory for the original hiding event; their equivalently high performance on the memory check was expected in light of previous memory research (*2*). However, the large difference between the two age groups on retrieval 1—retrieving the analogous object—indicated that they differed dramatically in the use of their memory of one event to reason about another. The older children drew on their knowledge of the location of one hidden object to infer the location of a different object. They were highly adept at making this inference; there was no significant difference between their success as a group in finding the object they had seen and finding the one they had not seen being hidden.

In contrast, the younger children did not use what they knew about the original hiding event to figure out where the other toy had to be. The absence of any systematic pattern to their searching (that is, few correct responses and no identifiable error patterns) suggests that they were unaware that they had any basis for knowing where the toy was without looking for it. Indeed, they gave no evidence, either in their search or in other behavior, that they realized that the two spaces had anything to do with each other.

Why did the younger children in experiment 1 fail to understand the correspondence between the model and the room, to

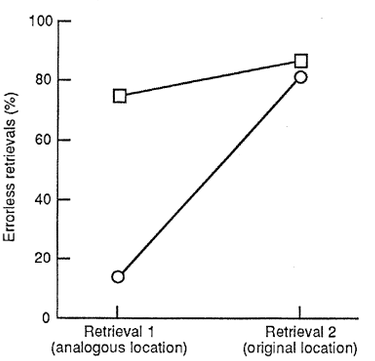


**Fig. 1.** Percentage of errorless retrievals achieved by the two age groups in experiment 1 ($n$ = 16 in each age group). The trials of the older children are represented by □ and those of the younger children by ○.

Department of Human Development and Family Ecology, University of Illinois, Urbana, IL 61801.

realize that the model represented the room? Experiment 2 evaluated the hypothesis that the problem had to do with a limitation on the symbolic capabilities of the younger children. Success in a model task such as this one requires a dual orientation to the model. On the one hand, it is a real, three-dimensional object (actually, a set of objects) that the child manipulates. On the other hand, the child must realize that the model also stands for or represents something else, in this case, that it is a symbol for the room. Perhaps the younger children think of the model in only one way; the fact that it is a real, three-dimensional object may preclude their realizing that it also stands for something else.

If it is the three-dimensional nature of the model that interferes with the younger children's appreciation of it as a symbol, performance should be better with a purely symbolic medium. A photograph, unlike a real object, typically has no role other than as a symbolic representation of something else (*6*) and, hence, does not require a dual orientation. Therefore, in experiment 2, the information about where the object was hidden in the room was provided through photographs, rather than through the model, and it was predicted that performance would be better with the photographs than with the model. This prediction is directly contrary to the standard view of the efficacy of pictures versus real objects. Two-dimensional stimuli are generally thought of as less salient and less informative relative to three-dimensional objects. Developmental and cross-cultural studies have repeatedly shown better learning and memory result with real objects than with pictures (*7*).

Sixteen children of about the same ages as the younger subjects in experiment 1 (30 to 33 months; mean age, 31.6 months) were observed twice, once in the standard task with the model and once with photographs used in place of the model. Half the children participated in the photograph task first and half in the model task first. For each of the four trials of the photograph task, the child was shown an array of four color photographs (20.3 cm by 25.4 cm), each of which pictured one or more of the hiding places (items of furniture) in the room. On each trial, the experimenter pointed to a different one of the photographs and said, "He's hiding back [under] here." Then the child was taken into the room and encouraged to find the toy.

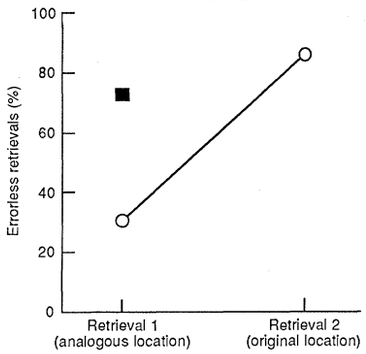


**Fig. 2.** Percentage of errorless retrievals with photographs and with model, experiment 3 ($n$ = 16). The trials using a model room are designated by ○ and those using a photograph by ■.

Figure 2 shows the results of experiment 2. Just like the comparable age group in experiment 1, these children were unable to find the toy after seeing it hidden in the model; they were, however, able to find it after seeing a photograph of its hiding place. Performance in the photograph task (photo) was significantly better than performance on retrieval 1 in the model task (model) (photo − model = 1.56, SE = 0.44) (*8*). Although performance on retrieval 1 was slightly higher for those children who had had the photograph task first, the order effect did not approach significance.

The results of experiment 2 support the hypothesis that the source of 2.5-year-old children's difficulty with the model task was the necessity of maintaining a dual orientation to the model (*9*). Although a photograph is a less rich and less salient stimulus than a model, its only function is as a symbol, and even very young children have had substantial experience with pictorial representation. The younger children in this research understood that the photographs represented the room, and they were thus able to apply the pictured information to the room. When faced with a model, they treated it only as a real object. Hence, their knowledge about the location of the hidden object remained specific to that particular toy and that particular space.

One would expect the pattern of developmental change reported here only in domains in which the symbol to be understood is a real object, in line with recent claims that different symbol systems show divergent patterns of development (*10*). The current research does not establish the generalizability of these findings; we need to know, for example, to what extent young children's understanding of the relation between a model and a larger space is affected by the degree of difference in scale between the two spaces, the extent of physical similarity between them, and the congruence of the spatial relations among the objects in the spaces.

In conclusion, the failure of 2.5-year-old children to think about a symbolic object both as an object and as a symbol prevented them from generalizing their experience; in other words, it limited their knowledge to the particular instance, rather than the general rule. Understanding the dual role of symbolic objects is thus a crucial developmental step (*11*). The possibility of a strongly maturational underpinning for this step is raised by the abrupt nature of the developmental change displayed by the children in these experiments—from failure to nearly universal success in the space of a few months.

## REFERENCES AND NOTES


1. H. Werner and B. Kaplan, Eds., *Symbol Formation* (Wiley, New York, 1963); L. S. Vygotsky, Ed., *Mind in Society* (Harvard Univ. Press, Cambridge, 1978).
2. J. S. DeLoache and A. L. Brown, *Child Dev.* **54**, 888 (1983); *Dev. Psychol.* **20**, 37 (1984); J. S. DeLoache *et al.*, *Child Dev.* **56**, 125 (1985).
3. Retrieval 2 also provided a motivation check; high performance here would rule out low motivation as an explanation of poor performance on retrieval 1.
4. According to an age by hiding space by sex by retrieval mixed analysis of variance (ANOVA) of the number of correct responses, there were statistically significant main effects for age [$F(1,24) = 62.33$, $P < 0.00001$] and retrieval, [$F(1,24) = 49.70$, $P < 0.00001$], but no statistically significant effects for sex or for hiding space. The primary result of the analysis was the significant interaction of age by retrieval [$F(1,24) = 23.41$, $P < 0.0001$].
5. The results of experiment 1 have been replicated several times with the same model and room, as well as with different spaces and with substantial variations in the instructions and orientation procedures. The results are not attributable to differences in verbal skills: the younger children clearly understood every aspect of the instructions except the correspondence between the spaces, and this was in spite of the fact that they did understand the meaning of "the same," as shown in independent comprehension checks.
6. M. C. Potter, in *Symbolic Functioning in Childhood*, N. R. Smith and M. B. Franklin, Eds. (Erlbaum, Hillsdale, NJ, 1979), pp. 41–65.
7. M. Cole and S. Scribner, *Culture and Thought* (Wiley, New York, 1974); J. S. DeLoache, *Cog. Dev.* **1**, 123 (1986); D. G. Hartley, *Dev. Psychol.* **12**, 218 (1976).
8. There was a significant main effect for task in a task (photograph versus model, retrieval 1) by order by sex ANOVA [$F(1,12) = 12.42$, $P < 0.005$].
9. Further support has been provided in subsequent studies. Retrieval 1 performance is the same when a wide-angle photograph or line drawing of the room is used in place of the individual photographs used here. Also, pointing to the correct place in the model produces the same low level of performance that hiding the object in the model does.
10. D. Wolf and H. Gardner, in *Early Language Acquisition and Intervention*, R. Schiefelbusch and D. Bricker, Eds. (University Park Press, Baltimore, MD, 1981), pp. 286–327.
11. This step may be related to other developmental phenomena involving the appreciation that a single reality can be understood in different and even conflicting ways by one person or by different people, for example, the appearance-reality distinction [J. H. Flavell *et al.*, *Cog. Psychol.* **15**, 95 (1983)]; level 2 perspective taking [J. H. Flavell *et al.*, *Dev. Psychol.* **17**, 99 (1981)]; and understanding false belief [H. Wimmer and J. Perner, *Cognition* **13**, 103 (1983)].


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