Shrinking Trolls and Expanding Minds: Early Symbolic Development
By Judy S. DeLoache, PhD

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No cognitive activity is more uniquely human than symbolization. Our everyday experience is enriched and expanded by a wealth of symbols and symbol systems—printed words, numbers, pictorial representations, maps, models, calendars, and so forth. Although we perceive and can think about these symbolic artifacts themselves, we generally "see through" symbols to their referents. We can judge the technical quality of a photograph or consider the cartographic characteristics of a map, but the photo automatically evokes thoughts of the depicted loved one, and the map primarily serves to provide information about the represented area.

Because of the universality and centrality of symbols to human culture, it is important to examine how and when children come to understand and use symbols as adults do. One thing that is clear from research my colleagues and I have been doing on early symbolic development is that one can never assume that young children will see through a symbol to its referent, no matter how transparent that relation seems.

To study the origins of symbol understanding and use, we ask very young children to solve problems based on information provided by various kinds of symbols (e.g., pictures, models, and maps). In much of our research, the symbol is a scale model that stands for a room. Children watch as a miniature toy is hidden somewhere in the model, and they are told that a similar but larger toy will be hidden in the corresponding place in the room itself. Only if children understand something about the model-room (symbol-referent) relation will they know where to search in the room.

Rapid development is apparent in young children's performance in this task: Three-year-olds readily use their knowledge of the hiding place of the miniature toy in the model to infer where to find the larger toy in the room, but 2-1/2-year-olds do not. The younger children know where the miniature toy is in the room and can retrieve it when asked to do so; however, they seem unaware of any relation between the room and the model that stands for it.

The younger children's failure occurs in spite of the fact that, except for size, the model looks very much like the room. The relation between them is so patently obvious to adults (and to older children) that we quickly learned to warn the parents of our 2-1/2-year-old subjects that most children of that age are unsuccessful at our task. Because the model-room relation seems so obvious, parents would typically be amazed and sometimes upset when their child failed to connect the two spaces.

A major source of difficulty in this task stems from the dual reality of symbolic artifacts. To use such symbols, one must achieve what I have referred to as dual representation, simultaneously representing both the concrete and abstract nature of a symbol. Young, inexperienced symbol users are inclined to respond to novel entities primarily—and often exclusively—in terms of their physical reality, ignoring their symbolic import. They fail to see through the symbol. Thus, young children confronted with a scale model have their attention dominated by the model itself as an interesting, appealing object. The younger the child, the more difficult it is to think about both the concrete model and the abstract "stands for" relation between it and its referent.

We have tested several counterintuitive predictions derived from the dual-representation hypothesis. In the first series of studies, we substituted pictures for the scale model. Our reasoning was that because a picture is much less salient and interesting as an object, children's attention would not be distracted from its representational role. Hence, it should be easier to achieve dual representation with a picture and, thus, easier to use it as a symbol.

Although well-motivated by the dual-representation hypothesis, this prediction goes against the well-established fact that two-dimensional images provide less effective support for cognition in a variety of situations than three-dimensional stimuli do. However, as predicted, we found that 2-1/2-year-old children who fail the standard model task successfully retrieve a hidden object when information about its location is provided via pictures or video images.

The most stringent test of dual representation (and the most enjoyable piece of research I have ever conducted) involved another even more counterintuitive prediction: If 2-1/2-year-old children could be convinced that a shrinking machine had shrunk a room (into the scale model), then they should easily...
transfer what they know about the room to the model. Our reasoning was that if children believe that the model is the room, then there is no symbolic relation between them. Hence, dual representation is not required, and retrieving the miniature toy from the model only requires remembering the location of the large toy in the room.

Each child was first shown “Terry the troll” and “Terry’s room” (a tent-like portable room used in many previous model studies). Then the troll was placed in front of our shrinking machine, which looked suspiciously like an oscilloscope. The machine was turned on, and the child and experimenter waited in an adjoining area, listening to what was described as the “sounds the shrinking machine makes while it’s working.” When the child returned to the lab, a miniature troll reposed in place of the original one. Figure 1 shows the troll before and after the shrinking event. The child was then shown that the machine could also make the troll “get big again.” A demonstration of the power of the machine to shrink and enlarge Terry’s room followed. The sight of the small model in the middle of the large space previously occupied by the portable room was very dramatic.

All the children but one were judged by experimenters and parents alike to completely accept the shrinking room scenario. Keep in mind that most of these children also believe in the tooth fairy and Santa Claus!

The child then watched as the experimenter hid the larger troll somewhere in the portable room. After waiting while the machine shrank the room, the child was asked to find the hidden toy. (The miniature troll was, of course, hidden in the same place in the model as the larger troll was in the room.) Thus, just as in our standard model task, the child had to use his or her knowledge of where the toy was hidden in one space to figure out where to search in the other.

As predicted, performance was significantly better in this nonsymbolic task than in the standard model task, thus providing very strong support for the dual representation hypothesis.

Our research has clear implications for a variety of situations in which young children are expected to use symbols. For example, anatomically detailed dolls are commonly used to interview young children in investigations of suspected sexual abuse. Because young children play with dolls in meaningful ways, it has been taken for granted that they would automatically understand a request to use a doll to show what someone had done to them. It is simply assumed, in other words, that they would have no trouble using a doll as a self-symbol.

The dual representation concept suggests that this assumption may not be warranted, and recent research by my research team and by other investigators agrees. In my lab, we first did a simple, highly artificial laboratory study of 2-1/2- to 3-1/2-year-old children’s use of a doll when recounting what they had done in the lab. We subsequently conducted a very naturalistic study in which preschool children were interviewed about a real event in their everyday lives in which they had become upset by something another child had done to them. Some children were asked to use dolls to describe the incident, and others were interviewed without dolls. The results of the simple lab study and the complex naturalistic study were exactly the same: There was no evidence of any advantage to using dolls; children reported as much without them as they did with them. Furthermore, some children clearly found it difficult to use a doll to represent themselves, and others objected to the request to do so. Again, a symbol-referent relation that is transparent to adults is neither transparent to nor simple for young children. The widespread use of dolls in abuse interviews should be examined from this perspective.

Our research is also relevant to the common educational practice of using 3-dimensional materials, manipulatives, to teach mathematical concepts to young school-age children. It is too often assumed that the relation between the object symbols (e.g., blocks of varying sizes) and the concepts they are intended to represent (e.g., different numerical quantities) will be obvious or easily understood.

Not surprisingly, given our research with other symbols, there is evidence that the point of such manipulatives often eludes children.

In conclusion, using a symbol requires mentally representing the symbol-referent relation, and representing that relation is neither automatic nor without cognitive cost. Adult intuitions are not to be trusted regarding young children’s symbol understanding and use. The fact that adults have little insight into the minds of young children is not so surprising when we remember that those minds are perfectly comfortable with the existence of shrinking machines.