

Becoming symbol-minded

Judy S. DeLoache

University of Virginia, Psychology Department, PO Box 400400, Charlottesville, VA 22904, USA

No facet of human development is more crucial than becoming symbol-minded. To participate fully in any society, children have to master the symbol systems that are important in that society. Children today must learn to use more varieties of symbolic media than ever before, so it is even more important to understand the processes involved in symbolic development. Recent research has greatly expanded what we know about early symbol use. We have learned, for example, that infants initially accept a wide range of entities as potential symbols and that young children are often confused about the nature of symbol-referent relations. During the first few years of life, however, children make rapid progress towards becoming competent symbol users.

Symbolic artifacts are a ubiquitous and crucially important feature of modern life [1]. Not a day goes by in the life of an adult anywhere in the world that does not involve substantial exposure to symbols and symbolic artifacts. A large proportion of the knowledge of most adults was acquired indirectly, through symbolic artifacts of various sorts. Everything most of us knows about aardvarks, Antarctica and Andromeda came from books, pictures and films. To become fully functional members of any society, children must gain competence with the symbols and symbol systems through which knowledge is acquired. Fortunately, the first few years of life are characterized by impressive progress toward becoming symbol-minded.

Unfortunately, the importance of symbols is not matched by clarity or consensus regarding the proper use of the term. **Box 1** provides some relevant context on this definitional debate. In the first part of this article, I offer a working definition of 'symbol' and review recent research embodying each aspect of the definition. In the second part, I review research on very young children's ability to use symbolic artifacts as a source of information.

Defining characteristics of symbols

I find it most useful to think of symbols very broadly: to offer a working definition, *a symbol is something that someone intends to represent something other than itself* [2]. Every component of this definition is essential.

Symbols and human development

The component 'someone' points to humans as 'the symbolic species' [3]. Although remarkable success has been achieved teaching non-human primates and some other animals to use certain symbols [4–6], the creative and

flexible use of a vast array of different types of symbols is unique to humans. The emergence in evolution of the symbolic capacity irrevocably transformed our species [3,7], vastly expanding our intellectual horizons and making possible the cultural transmission of knowledge to succeeding generations [8].

The emergence of symbolization in the development of individual children also has a transformative effect. An obvious example is the dramatic alteration in the nature of children's interactions with other people, and hence in their opportunities for learning, that is brought about by the onset of language in the second year of life. A less obvious, but very important, example is the contribution of language development to the functional lateralization of the brain [9].

Box 1. Perspectives on the definition of 'symbol'

Although 'more philosophic ink has been spilt over attempts to explain the basis for symbolic reference than over any other problem' ([3], p. 43), substantial confusion and disagreement persist about symbol use, including what the term 'symbol' properly refers to in the first place. This confusion stems in part from the fact that different theorists have distinguished in very different and inconsistent ways among terms such as 'symbol', 'sign', 'signal', 'index', 'icon', and so on. Some, such as the philosopher Peirce [42] and psychologists Bruner, Olver and Greenfield [43] reserve the term 'symbol' for entities that have purely arbitrary, formal, conventional relations to what they stand for. The prototypical example of a symbol is a word, whereas pictures and models are considered icons. Others, including philosopher Goodman [44] and psychologists Huttenlocher and Higgins [45], take a broader view and have argued equally forcefully that iconicity or physical resemblance is irrelevant to whether some entity serves a symbolic function. The ubiquity of symbolic artifacts can be illustrated by Ttelson's accounting of the variety of visual media accompanying his breakfast:

'As I sit here at my breakfast table, my morning newspaper has printing on it; it has a graph telling me how the national budget will be spent, a map trying to tell me something about the weather; a table of baseball statistics, an engineering drawing with which I can build a garden chair, photographs of distant places and people, a caricature expressing what the editor thinks of a political figure... On the wall in front of me hangs... a calendar [and above it] is a clock. All this and more, and I haven't even turned on the TV or the computer...' ([1], p. 171).

In the broad view that I have adopted here regarding what constitutes a symbol, intention and use are criterial, but iconicity is not. This view encompasses language and symbolic gestures that are used to communicate something, but bear no physical relation to what they represent, as well as a host of objects that have been designed to serve a symbolic function, many of which resemble their referents. One reason that iconicity should not be considered criterial in thinking about symbols is that even the most realistic color photograph expresses a point of view regarding its referent.

Symbols represent things

Symbols '*represent*'; they refer to, they denote, they are about something. They are not merely associated with their referents. In the study of early symbolic development, it is often difficult to be sure whether a young child's use or understanding of words or other entities is truly symbolic. Consider a young child who looks at a picture of a dog and says 'dog'. He or she could very well understand that both the word and the picture represent a general class of entities in the world. Alternatively, the child could simply have learned an association from repeatedly experiencing the word 'dog' paired with that particular picture.

Preissler and Carey [10] directly addressed this issue and found evidence that very young children can interpret words and pictures symbolically. 18- and 24-month-old children repeatedly heard an unfamiliar novel word – 'whisk' – paired with a small line drawing of an unfamiliar object (to them) – a whisk. Then the children were presented with the original picture paired with a real whisk and asked for the 'whisk'. They almost always chose either the real object alone or the real object and its picture, indicating that they assumed that the word referred to the object, not just to the picture with which the word had been paired. The fact that the children picked the real object, either alone or in combination with its picture, tells us that they interpreted the picture and word symbolically, that is, as representing something else.

Symbols are general

The very indefinite term '*something*' is quite deliberately used twice in the above definition to emphasize that virtually anything can be used to represent virtually anything else: spoken words, printed words, pictures, video images, numbers, graphs, a block of wood, a chair in a store window, maps, and an infinite list of other possibilities can be exploited to stand for something that someone wants to symbolize.

There is substantial evidence that young children start the process of acquiring symbolic competence with a remarkably general symbolic ability. Although every child of anywhere near normal intelligence who is exposed to language (whether spoken or signed) will come to use it, infants and very young children are quite open in terms of what they are willing to adopt as labels for objects. This was established long ago with respect to the development of sign language in deaf children [11,12]. In addition, the majority of very young hearing children acquire a repertoire of 'baby signs' – idiosyncratic gestures used (and often invented) by the child to communicate with others [13]. Examples include a child who routinely indicated 'dog' by sticking out her tongue as if panting and another who sniffed to refer to 'flower'. Interestingly, children whose parents had taught them a set of baby signs when they were 11 months old were found to have larger vocabularies at 3 years of age [14]. This finding suggests a relation between symbolizing in different modalities.

Recent research has expanded the inventory of entities very young children regard as acceptable names for things. Children between 13 and 18 months of age appear to learn nonverbal 'labels' for objects just as easily as verbal labels. They readily accept as the name of a novel object not only a

novel word, but also a whistle or other type of nonverbal human sound, a gesture, or a pictogram [15–20]. Starting around 20 months, however, a preference for the verbal modality emerges and grows increasingly stronger [18–20]. Thus, with experience with language, children's initial amodal orientation to communicative labels gradually becomes focused on spoken words.

Symbols are intentional

Human '*intention*' is at the heart of symbolization, both in the philosophical sense of being about something and in the everyday, psychological sense of being intended by someone, of being done for a purpose. A person's intention that one entity represent another is both necessary and sufficient to establish a symbolic relation. Nothing is inherently a symbol; only as a result of someone using it with the goal of denoting or referring does it take on a symbolic role.

Infants and toddlers are sensitive to the intentions of other people in interpreting their symbolic activity (see [21–24]). This fact has been demonstrated many times with respect to very early word learning. When infants and toddlers hear a novel word (or other sort of novel label), they learn it as the name for something only if they have reason to believe that the speaker intends for it to name that thing. For example, young children learn a novel word as a label for an unfamiliar object only if the person saying the word is present and looking at the object; they do not map the word onto the object if the speaker is behind a curtain, talking over a loudspeaker, or looking at television. When a present adult utters a novel word but children see no novel object for it to refer to, they look around for one (described in [24]) or they look inquiringly at the speaker [25].

The fact that pictures are intentionally created artifacts is appreciated by children as young as two to three years of age. They reject as a picture an image that they have been told was produced accidentally by someone spilling some paint, but they consider the same image to be a picture of something when told that a person worked hard to create it [26].

Slightly older children take their own intention as criterial with respect to pictures. Bloom and Markson [27] asked 3- and 4-year-old children to draw four pictures – a balloon, a lollipop, themselves, and the experimenter. As Figure 1 shows, the children were not very skilled artists, so their drawings of the balloon and lollipop were basically indistinguishable, and the same was true of their portraits of the two people. However, when later asked to name the drawings they had produced, the children insisted that a given drawing was of whatever they had originally intended it to be. Their rendition of a balloon was a balloon, even though it looked just as much like a lollipop.

Further evidence of the importance of the social context of symbol use comes from research in which young children were asked to draw simple objects [28]. Three- and four-year-olds produced better drawings when they understood that their drawings would be used to communicate to an adult which object to use in a game than when they were just asked to draw the objects. When informed that their drawings had not communicated clearly enough, children

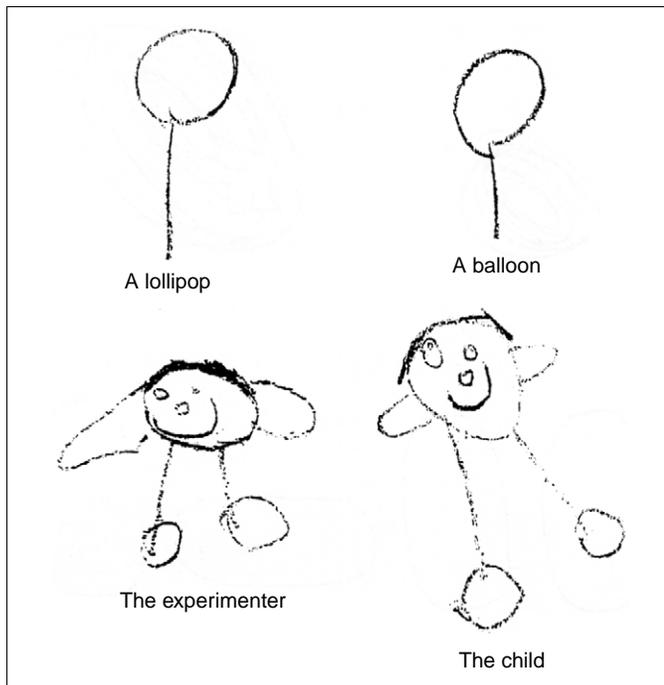


Figure 1. When asked to draw a balloon and a lollipop, 4-year-olds produced drawings that could have been either one. The same was true of their renderings of the experimenter and themselves. Nevertheless, when asked to name a given picture, the children were adamant that it was whatever they had intended to draw when they produced it. Reproduced with permission from [27].

of this age subsequently improved them. Thus, having a communicative intent enhanced the children's appreciation of the symbolic function of their drawings.

Learning symbol–referent relations

One might think that it goes without saying that a symbol always represents something 'other than itself', but only gradually do infants appreciate how some symbols differ from their referents. They have to figure out through experience that a depicted toy cannot be picked up and milk cannot be obtained from a photograph of a cup.

When presented with books containing highly realistic photographs of individual objects, 9-month-olds do not simply look at the pictures, as an older person would [29,30]. Instead, they behave like the infant in Figure 2a. They manually explore the images, frequently feeling, rubbing and striking the picture surface. Sometimes they even grasp at the pictures as if trying to pick up the

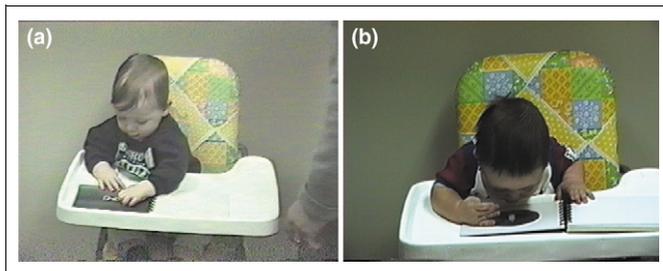


Figure 2. (a) Nine-month-olds often manually explore realistic photographs, revealing that they do not fully understand the critical difference between a picture and its referent. This child is making grasping motions at a highly realistic color photograph of an object. (b) This 9-month-old boy is leaning over preparing to put his lips on the nipple of the bottle. He apparently recognizes the content of the photograph, but does not appreciate how the depicted bottle differs from a real one. Reproduced with permission from [29].

depicted objects. Similar behavior occurs to images of still and moving objects on a television screen [31].

The manual exploration of depicted objects presumably arises from uncertainty. Although infants can perceive a difference between real and depicted objects, they do not understand the significance of that difference, so they investigate. This interpretation is supported by the fact that the more a depicted object looks like a real object, the more infants explore it. Color photographs elicit the most exploration and black-and-white line drawings the least [30]. Thus, because infants do not understand the nature of pictures, they sometimes respond to depicted objects as if they were real objects.

This conclusion has recently been challenged by Yonas and his colleagues (pers. commun.), who presented 9-month-old infants with pictures of an object, simple color patches, and textured patterns. Using a relatively stringent definition of grasping, they found that the infants in their study made very few grasping motions toward the depicted entities. From this, they concluded that although the infants did manually explore the depicted objects, they did not respond to them as if they were real objects. Inspired by this report, we recoded the videotapes of the infants in some of our studies using the more stringent criteria for grasping. We found substantial evidence of infants' grasping at the depicted objects, supporting our original interpretation.

Furthermore, additional relevant evidence comes from behaviors like that depicted in Figure 2b. This 9-month-old has leaned over to place his lips on the nipple of a depicted baby bottle. Thus, infants' behavior toward depicted objects is sometimes related to the specific meaning of the real objects they represent. With age – and presumably experience with pictures and video – manual exploration of depicted objects steadily declines. By 18 months of age, children point to and talk about pictured objects instead [29,31]. Thus, through experience, infants gradually come to treat pictures symbolically, as objects of contemplation and communication, not action.

Very young children's use of symbolic artifacts as information

As mentioned earlier, a vital function of symbols is to enable humans to acquire information without direct experience. Our vast stores of cultural knowledge exist only because we can learn indirectly through symbolic representations.

Research that my colleagues and I have done has revealed many factors influencing very young children's ability to exploit the informational potential of symbolic artifacts. In this research, very young children are provided with information about the location of a hidden toy via a symbolic object – scale model, picture, video, map. For example, in the model task, children observe an experimenter hide a miniature toy somewhere in a realistic scale model of a room, and they are told that a larger version of the object is hidden in the corresponding place in the room itself. If the child understands the relation between the model and the room, finding the toy is relatively easy. If, however, the child does not appreciate

the symbol–referent relation, he or she has no basis for knowing where to find it [32,33].

Several studies have revealed dramatic age differences in the performance of children between 2 and 3 years of age in this task. Three-year-old children very successfully use the model–room relation to find the hidden toy, but 2.5-year-olds give little evidence of understanding that relation (see [32] for a review). The success of the older children depends on several factors, including the need for the experimenter to make the intentional basis for the symbol–referent relation clear by explaining everything about the task [34].

Dual representation

The age difference in this task is attributed to the difficulty young children have achieving ‘dual representation’ (see Box 2). The younger the children, the more inclined they are to focus on the concrete object itself rather than its relation to what it represents. Several highly counter-intuitive results provide strong support for the dual representation hypothesis. For example, it has been shown that *decreasing* the salience of a model as an object by placing it behind a window enables 2.5-year-olds to succeed in the model task [35]. When the children never touch the model, its representational function is more obvious to them than when they physically interact with it. Conversely, *increasing* the physical salience of the model by letting 3-year-olds play with it for several minutes before the retrieval task leads to a decrement in their performance [35]. Interacting with the model as an object blocks the child’s appreciation of its symbolic function.

The strongest evidence for dual representation comes from eliminating the need for dual representation altogether [36]. 2.5-year-olds were led to believe that a shrinking machine (that looked much like an oscilloscope) could shrink a room, turning a large tent into a small scale model. The idea was that if the children believe the scenario, the model *is* the larger space, so dual representation is not required. The children first observed a large toy being hidden in the tent, and then left the room while the shrinking machine worked its magic. When they returned, the small model was in the place of the large tent. Believing the model to actually be the larger space, the children successfully retrieved the miniature toy.

Further support for the importance of dual representation comes from the fact that 2.5-year-old children who fail the model task nevertheless perform well in a video version of the task [37–39]. A video image is much less physically salient than a model, so it is easier to achieve dual representation. Two-year-old children, however, perform relatively poorly in the video task, even if they watch on a monitor as the experimenter models finding the toy in the room [40]. However, this age group does succeed in an analogue of the shrinking room. If they are led to believe that they are looking through a window at a person hiding a toy in the room next door (they are actually watching the event on video), they can find the toy [38]. Thus, 2-year-olds can learn from an event when they directly observe it or think they are directly observing it, but not when they knowingly view the same event via a symbolic medium.

Box 2. Dual representation in symbol understanding and use

A unique aspect of symbolic objects is their inherently dual nature. A symbolic artifact such as a picture or a model is both a concrete object and a representation of something other than itself. To use such objects effectively, one must achieve dual representation, that is, one must mentally represent the concrete object itself *and* its abstract relation to what it stands for. One has to perceive the symbol and interpret its relation to its referent. The need for dual representation constitutes a challenge for young children, who have difficulty considering both the symbolic object itself and its referent [2,46].

Our research has established that the more salient or appealing the physical aspects of a symbolic object are, the more difficult it is for young children to achieve dual representation. Focusing too much on the symbolic object underlies their difficulty using scale models, which are very salient and attractive as objects. As described in the text, emphasizing the physical model itself makes it more difficult for children to use it symbolically, whereas diminishing its physical salience makes it easier. Similarly, children below the age of 2 years can interpret symbolic gestures more easily than replica objects, which are interesting in and of themselves and hence pose more of a challenge for dual representation [47]. When an experimenter made a hammering motion to designate that the correct target object was a hammer, children made more correct choices than when the experimenter held up a small toy hammer.

Other recent research provides evidence of the opposite problem—focusing almost exclusively on the referent of a symbol, ignoring characteristics of the symbolic object itself. In studies of children’s understanding of the nature of photographs and photography [48], 3-, 5-, and 7-year-old children were shown pairs of photographs of the same scene that had been taken from different viewing angles. Asked to explain why they looked different, many of the younger children denied that the pictures did differ, justifying their answer solely on the basis of referential content. According to one 3-year-old, ‘They’re both the same... [they have] the same stuff’ ([48] p. 15). All that mattered to this child was that both photographs contained tulips; the fact that the tulips were viewed from above in one but straight on in the other was irrelevant.

The ability to readily achieve dual representation of symbolic objects gradually improves over several years. Many factors contribute to this development, but cumulative experience with a variety of symbols presumably plays a prominent role.

Box 3. Questions for future research

- What is the relation between the development of symbolic competence in different symbolic domains, including the role of language development in the mastery of various symbolic artifacts?
- What is the role of experience in hearing infants’ gradual focus on spoken words as names? Could their initial acceptance of a variety of entities as labels be prolonged with continued exposure to non-linguistic labels?
- How does infants’ manual exploration of depicted objects relate to their symbolic interpretation of pictures?
- To what extent can infants and young children acquire new information via symbolic media?
- How can the concept of dual representation inform the design of more effective teaching materials for young children?

Conclusion

The youngest members of the symbolic species rapidly master many different types of symbols. Their progress is initially aided by their acceptance of a wide variety of entities as representations and by their sensitivity to the intentions of other people. Important milestones of

symbolic development that are achieved in the first few years of life include figuring out the nature of the relation between symbolic objects and their referents and using those relations to acquire information. What we have been learning about symbolic development in the first years of life has important practical implications, such as how to tailor educational materials to children's fledgling symbolic skills [41]. Future research will help us to further our understanding of the development of symbolic competence within different symbolic domains and how development in different domains is related (see Box 3).

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