The Symbol-Mindedness of Young Children

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A symbol is something that someone intends to stand for or represent something other than itself.

There are two reasons why it is important to start this chapter on the early development of symbolic understanding and use with this definition of a symbol. The first is to make it clear exactly how I am using the term, given the wide historical variation in its usage; the second is to review what some others have had to say about symbolization and its development.

With respect to the first point, it is very important to specify both how the term symbol is and is not being used. Much confusion has arisen from the unfortunate fact that many different people in many different disciplines have used both symbol and representation in many different ways.

To begin with, symbol has been used by many psychologists to refer to purely internal, mental representations—the encoding of experience in memory (e.g., Newell & Simon, 1972). It is also used for language and some gestures; indeed, most writers on the topic of symbolization—from Peirce (1897, 1903/1955) to Langer (1942) to Deacon (1997)—have been primarily interested in language. Finally, symbol is also used to refer to a variety of external representations, artifacts created to serve as vehicles of thought (Vygotsky, 1978).

Representation is sometimes used as the superordinate category to which symbols belong. For example, Piaget (1951) distinguished between two senses of representation: “In its broader sense representation is iden-
tical with thought. . . . In its narrower sense, representation is restricted to the mental or memory image, i.e., the symbolic evocation of absent realities” (p. 67). Mandler (1983) also distinguished between broad and narrow senses of representation. The former refers to “knowledge and the way it is structured,” whereas the latter is specifically symbolic representation—“words, artifacts, or other symbolic productions that people use to represent (to stand for, to refer to) some aspect of the world or some aspect of their knowledge of the world” (p. 420).

Dividing the representational pie somewhat differently, Bruner, Olver, and Greenfield (1966) argued: “There are two senses in which representation can be understood: in terms of the medium employed and in terms of its objective” (p. 6). The medium includes three pieces: enactive (motoric), iconic (e.g., pictures, images), and symbolic (language) representations. These three forms of representation develop in sequence, culminating in “representation in words and language. Its hallmark is that it is symbolic in nature” (Bruner, 1965, p. 11).

In stark contrast to the equation of symbol and language is Sigel’s (1970) position: “My definition of representation does not include language since language is considered as a system of signs that can function to evoke representations” (p. 111). Yet another take on the relation between symbol and representation comes from Wolf and Gardner (1981). Representation is “the ability to reconstruct or recall information to guide behavior,” whereas symbolization is “the ability to convert such information into observable forms that refer to, rather than simply guide, experience” (p. 295).

Noting that “Representation and its derivatives have many other uses . . . ,” philosopher Nelson Goodman (1976) attempted to clarify his own view with respect to pictures: “Some writers use ‘representation’ as the general term for all varieties of what I call symbolization or reference, and use ‘symbolic’ for the verbal and other nonpictorial signs I call nonrepresentational” (p. 4). I leave it to the reader to judge how much clarification was achieved.

Further confusion is introduced by the fact that different theorists distinguish in different ways among terms such as symbol, sign, signal, index, and icon. In one of the most influential efforts to chart the representational landscape, the philosopher Charles S. Peirce (1897, 1903/1955) proposed three categories of sign relations: icon, index, and symbol. An icon is linked to its object through similarity or resemblance, whereas an index is related to something via temporal or spatial association. A good example of an icon is a picture, and an example of an index is a weathervane indicating the direction of wind. Symbols, for Peirce, involve purely arbitrary, formal, conventional relations to what they stand for. The prototypical case of symbols is language.

Although Peirce, Bruner, and other theorists reserved symbol for arbitrary, noniconic relations between entities, others have argued strongly that iconicity per se is irrelevant to whether something serves a symbolic function (Goodman, 1976). The relation between signs and symbols also differs from one writer to another: For example, unlike Peirce, Werner and Kaplan (1963) took signs to be lower level representations than symbols.

Perhaps of most importance, however, is the simple fact that, in spite of this great variability and confusion in how we talk about symbolization, we do talk about it. We talk about it a lot, because it is so important. Indeed, more “philosophic ink has been spilt over attempts to explain the basis for symbolic reference than over any other problem” (Deacon, 1997, p. 43).

Here I spill some more metaphorical ink in an effort to reach a better understanding of the very early development of symbolization. I focus primarily on very young children’s understanding and use of symbolic artifacts.

FOUR COMPONENTS OF SYMBOL

The definition with which I started—“a symbol is something that someone intends to stand for or represent something other than itself”—contains four elements, each of which is worth considering closely:

1. Someone: First and foremost is the component someone. Humans are “the symbolic species” (Deacon, 1997). Our remarkably creative and flexible use of a vast array of symbols is a unique and distinctively human talent. As the philosopher Suzanne Langer (1942) noted, “It is the power of using symbols . . . that makes [humans] lord of the earth” (p. 26). Symbolization is the “most characteristic mental trait of mankind” (p. 72). Our symbolic capacity vastly expands our intellectual horizons, liberating us from the constraints of time and space. Unlike any other creature, we can mentally exist in the present moment, the past, or the future, in this place or some other. We collect an enormous amount of information about reality without directly experiencing it, adding “the experiences of other people to [our] own” (Langer, 1942, p. 29).

The emergence of the symbolic capacity irrevocably transformed our species in the course of evolution (Deacon, 1997). It eventually made possible the historical development of culture and the preservation and transmission of knowledge from one generation to succeeding ones (Vygotsky, 1978). So too does the emergence of symbolization transform children in the course of their individual development. The early German psychologist Wilhelm Stern identified as “the greatest discovery in the child’s life”
the recognition of the fact that words have meaning (cited in Vygotsky, 1978, p. 23). Vygotsky concurred: Symbols are vital cognitive tools, and “the most significant moment in the course of intellectual development...occurs when speech and practical activity...converge” (p. 24).

Becoming symbol-minded is thus a universal developmental task. All children growing up anywhere in the world must master the symbols and symbol systems that are crucial for full participation in their society.

2. Something: The very indefinite term something is used quite deliberately to accord with Goodman's (1976) assertion that “almost anything may stand for almost anything else” (p. 5). Virtually any entity can serve as a symbol. Spoken words, printed words, pictures, video images, numbers, graphs, a block of wood, a chair in a store window, maps—the list is infinite. Similarly, virtually anything can be symbolized, that is, can serve as the referent of a symbol. However, several authors have emphasized that it is anything for which one has a concept that can serve as a referent. Puttenlocher and Higgin's (1978) statement that “A symbol brings to mind something other than itself...” (p. 109) presupposes the existence of a mental representation that is activated by the symbol. Potter (1979) explicitly stated that a symbol refers to or represents a “mental concept of an object, rather than the real-world object” (p. 56).

3. Represents or stands for: Symbols represent; they refer to, they denote, they are about something. “[Symbols are] entities which subserve a novel and unique function, the function of representation.” The function of representation is a constitutive mark of a symbol...” (Werner & Kaplan, 1963, p. 13). “Symbolization is the representing of an object or event by something other than itself” (Potter, 1979, p. 41). “Denotation is the core of representation” (Goodman, 1976, p. 5).

It probably goes without saying that symbol and referent are always different entities; the referent is always something “other than” the symbol itself. It is probably worth saying, however, that a necessary element of symbolization is being able to distinguish between symbol and referent. Indeed, if for some reason one cannot tell two entities apart, one cannot be a symbol for the other.

A distinctive feature of symbol-referent relations is that they are inherently asymmetrical. It is typically the referent to which the symbol is designed to draw attention. This asymmetry holds even when symbol and referent resemble one another. As Goodman (1976) noted, “while a painting may represent the Duke of Wellington, the Duke doesn’t represent the painting” (p. 4). A scale model of the White House is always the symbol, the real structure always the referent. An important source of this asymmetry is the fact that symbols and their referents typically have different affordances: One can shake the hand of the real Duke, but not his representation; celebrities can spend the night in the real Lincoln’s Bedroom, but not in its model.

We can reason in either direction. Driving in an unfamiliar town, we can consult a map to try to figure out where in the world we are; and we can also look around at our surroundings to try to figure out where on the map we are. However, the map–world relation is invariant. The “designative function [of symbols] involves a fixed functional relation...regardless of the direction of activation” (Puttenlocher & Higgin, 1978, p. 105). Indeed, it may be this ineluctable asymmetry that accounts for the charm of comedian Steven Wright’s concept of a “life-size map of the world.”

4. Intends: The human element comes back into the definition with respect to intention: A symbolic relation exists only if some person intends for that relation to exist. The necessary and sufficient condition is that someone has stipulated a referential relation between two entities. “In order for a symbolic relationship to be established, an intentional act of denotive reference is required” (Werner & Kaplan, 1963, p. 21). Further, “when a symbolic vehicle is taken to ‘represent’ a referent, . . . [it] functions to ‘depict’ or ‘reveal,’ through some sort of correspondence or analogy, the connotational structure of the referent. It should, however, be emphasized . . . that correspondence or analogy is not . . . ‘given objectively’ in and by itself, but is established through an intentional act...” (Werner & Kaplan, 1963, p. 15). Thus, human action is at the heart of symbolization. Nothing is inherently a symbol; only as a result of someone using it to denote or refer does anything become a symbol. “Psychologically, any item that is to have meaning must be employed as a sign or a symbol; that is to say, it must be a sign or a symbol to someone” (Langer, 1942, p. 53).

The centrality of intention has recently been emphasized in other domains as well. For example, Tomasello (1999) believed that crucial to early language learning is the child’s appreciation of the intention of the other person. He claimed that: “joint attentional scenes are defined intentionally; that is, they gain their identity and coherence from the child’s and the adult’s understandings of ‘what we are doing’” (p. 98). Bloom (1996) made the case that artifacts in general, including pictures, are defined by the intention of their creator: “In general, we construe the extension of the kind picture of an X as all and only those pictures created with the intention to represent an X” (p. 6).

The pivotal role of intention in symbolization is nicely illustrated by a photograph of a Holstein (black-and-white spotted) cow named “Miss USA” that appeared in National Geographic. The reason for the unusual (for a bovine) appellation is clear from the picture: Sprawling across the left side of the cow is a large white spot in the shape of the United States. The spot looks, to a truly remarkable degree, like a map of the United States. (The authors of the article were unable to restrain themselves—as am I—from referring to this as an outstanding example of “cowsography.”) The
presumed reluctance of anyone to call this shape a symbol testifies to the
critical status of intention in symbolization.

THE DUALITY OF SYMBOLS

As the preceding discussion shows, symbols are unique entities. An
important aspect of their uniqueness is their inherently dual or double
nature, a fact upon which many have commented (Kennedy, 1974; Potter,
1979; Sigel, 1978). "The distinctive mark of the concept [symbol] . . . is its
inherent duality: . . . a symbol entails a 'vehicle' which, through its particu-
lar formal and qualitative properties, represents a 'referent,' that is, an
object, a concept, or a thought . . ." (Werner & Kaplan, 1963, p. 16). The
paradoxical, dual nature of pictures has often been noted: "A picture is
both a surface in its own right and a display of information about some-
thing else" (J. J. Gibson, 1979, p. 282). "Pictures are unique among objects;
for they are seen both as themselves and as something, entirely dif-
ferent from the paper or canvas of the picture" (Gregory, 1970, p. 32). Ittel-
son (1996) made the case particularly clearly:

A picture, no matter how "realistic" or "representational," always presents
two broad classes of visual information: (1) information that would be pro-
vided by viewing the pictured real-world scene . . . and (2) information that
is unrelated to the pictured scene but comes from the real-world surface on
which the picture appears . . . These two types of information can be ana-
alyzed separately by the psychologist, and they can be decoupled by the ob-
server, but they are always encountered together. (pp. 175–176)

DUAL REPRESENTATION OF SYMBOLS

The dual nature of symbolic objects themselves requires that both aspects
be represented for the object to function as a symbol. I have proposed the
necessity for dual representation: To understand and use a symbol, one must
represent both facets of its dual reality, both its concrete characteristics
and its abstract relation to what it stands for. Very similar ideas were pre-
viously put forth by Sigel (1978), as well as by Potter (1979), who cited the
need to "apprehend the identity of the symbolic medium at the same time
as the identity of the referent" (p. 60). With respect to pictures, J. J. Gibson
(1979) mentioned "two kinds of apprehension that go on at the same
time" (p. 283).

The need for dual representation is the source of a great deal of the dif-
culty that very young children have understanding and using a variety
of symbolic artifacts. According to Potter (1979), "A child's limited ability
to hold two or more things in mind simultaneously may prevent him
from realizing the relation between the properties of the symbol and those
of the referent. Either he focuses on the conceptual referent, or he looks at
the symbol as an object . . ." (p. 60).

It follows from the concept of dual representation that some symbolic
artifacts would be more difficult than others for young children. The more
an object draws attention to itself, to its inherent physical characteristics,
the more difficult it is to appreciate its abstract function as a representa-
tion of something other than itself. A good symbol, according to Potter
(1979), is "deliberately self-effacing; one reads the message and ignores the
medium" (p. 59). This idea was expressed in an especially compelling way
by Langer (1942): "A symbol which interests us also as an object is distrac-
ting. It does not convey its meaning without obstruction . . . the more bar-
ren and indifferent the symbol, the greater is its semantic power. Peaches
are too good to act as words; we are too much interested in peaches them-
selves" (p. 75).

To achieve dual representation, children must avoid becoming "cap-
tured" by the symbolic object itself; they must psychologically distance
themselves from it. The idea of psychological distancing was originally
proposed by Werner and Kaplan (1963) and substantially elaborated by

DUAL REPRESENTATION AND DEVELOPMENT

The challenge that dual representation poses is rarely evident in modern
adults: We have all had such extensive experience with such a vast array
of symbols that most seem transparent to us. But the importance of dual
representation, and the challenge involved in achieving it, become much
more obvious when examined in the context of development. It is reveal-
ing to look both at the historical development of symbol use and at the
development of early symbolization in young children.

Dual Representation in Mesopotamia

According to archaeologist Denise Schmandt-Besserat (1978), the ancient
Sumerians, around 8500 BC, started keeping track of agricultural trades
with small tokens fashioned out of clay. Each shape stood for one of a par-
ticular category of agricultural product (sheep, sacks of grain, jars of olive
oil, etc.), so three spheres might mean that three goats had changed hands.
After a few thousand years, the Sumerians were trading more broadly
and needed more permanent and transportable records than a pile of to-
kens, so they began sealing the tokens up in clay containers. They would
take a sheet of damp clay, put the tokens on top, and then fold it up to
make a container for the tokens. This practice resulted in a permanent,
transportable record, but there was one obvious problem—the record
could be inspected only by destroying it, by breaking open the container.
After a few decades, they solved this problem; they pressed each token
into the sheet of clay before folding it, leaving the imprint of the tokens on
the outside of the container. Now one could tell what tokens were inside
the container—and hence what goods had been traded—just by inspecting
the marks on the outside. The next insight took another hundred
years, when the Sumerians realized they could dispense with the tokens
altogether and just incise marks on the clay. Eventually, according to
Schmand-Besserat, both number representations and writing evolved
from these clay tablets.

This archaeological account provides a wonderful illustration of the
difficulty inherent in the dual nature of symbolic artifacts. Long after the
Sumerians had taken the giant leap of creating a set of symbols, they still
had trouble realizing how fully abstract their system could be. Their
thought remained tied to the original symbolic objects. Thus, in our cul-
tural history, the development of symbolic artifacts was a long and com-
plex process characterized by difficulty coping with the dual nature of
symbols. We turn now to young children’s understanding and use of
symbolic artifacts, where we also find that development is slow, complex,
and characterized by difficulty coping with the dual nature of symbols.

Dual Representation in the Modern World

Perhaps one reason the Sumerians had so much difficulty achieving psy-
chological distance from their original symbolic creations is that they had
relatively little experience with symbolic artifacts in general, a situation
extremely different from that in which modern people find themselves. In
industrialized, technologically advanced societies, we are immersed in
symbols all our waking hours. This point was made forcefully by Litelson
(1996) with respect to visual representations:

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. . . . (p. 171, emphasis added).

3. THE SYMBOL-MINDEDNESS OF YOUNG CHILDREN

The same massive exposure to symbolic artifacts is true for young chil-
dren in our society as well. Young children, and increasingly even infants,
are exposed to picturebooks in frequent parent-child reading sessions,
and pictures adorn the walls and other surfaces of most homes. Television
and representational toys are nearly ubiquitous. Given children’s en-
ormous exposure to symbolic artifacts in their daily lives and the crucial role
of symbolization in modern societies, it is important to understand how
children initially respond to this unique class of objects and how they de-
velop a mature understanding of them. The course of development turns
out to be very complex—and very interesting.

The complexity of symbolic understanding stems in large part from a va-
riety of factors that make it more or less difficult to achieve dual represen-
tation. In addition, there is a substantial amount of conceptual knowledge
about symbols that must be acquired—knowledge we might characterize
as the that, what, how, and who of symbols. Mature symbolic understand-
ing with respect to any particular symbolic artifact involves realizing that it
stands for something other than itself, that it is supposed to be interpreted
with respect to its referent. Adults in modern societies immediately and
automatically categorize any picture they encounter as merely a represen-
tation, so a highly realistic photograph of a charging elephant—some-
thing that in real life would be terrifying—is not for a moment frighten-
ing. One must also know what the content of the symbol is; one has to
recognize and interpret that content. Our exemplar picture is immediately
interpreted as an elephant. One must also appreciate how the symbol is rel-
ated to its referent, the nature of the symbol–referent relation. Most
adults know a great deal about the relation between color photographs
and reality. They could readily infer that the photograph is of a real ele-
phant that exists or once existed, that a person with a camera stood at
some unknown distance in front of the elephant, and so on. Finally, ma-
ture understanding also includes some appreciation of who—recognizing
that someone has some intention or purpose in using a symbol.

It might seem that the developmental course of understanding these
four components would be straightforward, but it is not. Which compo-
nents are understood at any given time depends not only on the age of
the child, but also on the symbolic medium and how the symbol is used. This
point is illustrated by research I and my colleagues have done on infants’
and young children’s understanding and use of two kinds of symbolic ar-

tifacts: one kind—pictures—is prominent in the everyday environment
and highly familiar to most young children; the second—scale models—
is relatively unfamiliar and uncommon outside the psychological labora-
tory. In all this research, the symbols—pictures and models—are highly
iconic. The pictures are highly realistic color photographs, and the models
are constructed to be as similar as possible, except for size, to the larger
spaces they represent. As a result, understanding *what*—the content of these symbols—is easy, even for infants and very young children. However, a high level of similarity between symbol and referent may simplify the child’s task of detecting the relation between them, but definitely does not remove the challenge involved in achieving dual representation. The research I review helps us understand more about how infants and young children master the *that, how,* and *who* of symbolic objects. It focuses particularly on how and when the dual nature of symbols and the role of human intention is gradually understood.

**GRASPING THE NATURE OF PICTURES**

Imagine that as you are sitting in a lecture hall, the image of a charging elephant suddenly appears in front of you. Would you leap up and flee? That’s supposedly what the residents of a remote village in Uganda did around the turn of the century when a visiting Scottish missionary showed a lantern slide of a charging elephant (Deregowski, 1989). I’m fully confident that you would remain firmly rooted in your seat for three reasons. One is perceptual—specifically, the absence of many of the cues for three-dimensionality, as well as movement, that would indicate the presence of a real elephant. The second is conceptual—your extensive knowledge about pictures; you would automatically categorize this as a *picture of an elephant,* not a real one, and you would immediately conclude that this elephant has absolutely nothing to do with the immediately present world. Third, you have extensive pragmatic knowledge about the reasonably small likelihood of elephants in lecture halls, as well as the high likelihood of a slide accompanying a lecture. So, because of your knowledge, and in spite of some aspects of your perception, you would not for one moment entertain the hypothesis that a huge elephant was actually bearing down on you.

Why would you, and any other adult with pictorial experience, so readily interpret appropriately the charging elephant picture? That was the subject of a long-standing debate about the role of experience in the perception and interpretation of pictures. According to J. Gibson (1971, 1979), pictures provide much of the same information available from the three-dimensional world, and an observer “picks up” stimulus information from a picture in much the same way he or she picks up information from the environment. As a result, no special picture-perceiving abilities are necessary to recognize a picture. In contrast, Goodman (1976) argued that, “Pictures in perspective, *like any others* [italics added], have to be read; and the ability to read has to be acquired” (p. 14). Art historian Ernst Gombrich (1974) agreed that picture perception requires learning a code to interpret the somewhat arbitrary correspondence between pictures and the world. Some psychologists agree: “It requires practice to see the meanings and the spatial relations in two-dimensional representations and displays” (Stone & Church, 1957, p. 329).

We thus have a classic debate of the “It’s learned,” “is not,” “is so” variety. The truth is, as usual, both more complex and more interesting. There is clear evidence supporting the Gibson view that picture perception is unlearned, starting with the classic study by Hochberg and Brooks (1962) of their own son. The child was prevented from seeing any pictures until 19 months of age, at which point he was presented with a series of photographs and line drawings of familiar objects. In spite of his lack of experience with pictures, he had no difficulty identifying most of the items. Further evidence comes from several studies that showed that much younger infants can perceive and recognize pictures of people (Barrera & Maurer, 1981; Dirks & E. Gibson, 1977) and objects (DeLoache, Strauss, & Maynard, 1979). Even newborns are able to recognize pictures of simple shapes (Slater, Rose, & Morison, 1984).

At the same time, other evidence supported the learning view espoused by Goodman and Gombrich. From the turn of the century on, anthropologists recorded a variety of confusions experienced by pictorially inexperienced adults on their first encounters with pictures (see Deregowski, 1989). One of the most vivid and frequently cited (although possibly apocryphal) accounts was of the reaction of residents of a remote Ugandan village to the lantern slide show presented by a visiting Scottish missionary: “When all the people were quietly seated, the first picture flashed on the sheet was that of an elephant. The wildest excitement immediately prevailed, many of the people jumping up and shouting, fearing the beast must be alive, while those nearest to the sheet sprang up and fled . . .” (Deregowski, 1989, p. 58).

A resolution to the “is learned/is not” debate was proposed by Sigel (1978, 1990), who argued that previous researchers had confused the *recognition* and *comprehension* of pictures. As the infant research revealed, pictorial experience is not necessary to identify or recognize pictures of familiar entities. However, as the cross-cultural work and Sigel’s own research revealed, older children and even adults do not necessarily understand the nature and use of pictures. Kennedy (1974) argued forcefully that the cross-cultural results often interpreted as a failure of picture perception were simply an investigative response to a very unfamiliar kind of object: “Photographs are clearly special objects. Would not anyone meeting a photograph for the first time be puzzled, not know quite what to say, but certainly deny that it was, physically, the represented object?” (p. 67)
Sigel (1990) later observed, “I felt very much alone in arguing that picture comprehension is an important cognitive achievement for all children and not one to be taken for granted” (p. 91). He has had a presumably gratifying amount of company in recent years, as researchers have provided further evidence of incomplete understanding by young children of the nature of pictures, particularly the relation between pictures and reality. Preschoolers sometimes say, for example, that a picture of ice cream would feel cold to the touch (Beilin & Pearlman, 1991) or that a photograph of a display of objects would change if the objects themselves were changed (Robinson, Nye, & Thomas, 1994; Zaitchik, 1990). Thus, young children have a very tenuous grasp on the ways that pictures are and are not like their referents.

At the same time, young children display fairly sophisticated understanding of one important aspect of pictures—their intentional basis. For example, Gelman and Ebeling (1998) showed that very young children think something is a picture only if it was intentionally created. They showed 2½- to 3½-year-old children simple line drawings and told them either that someone had worked very hard to make it or that it had come about as the result of an accident, such as someone spilling some paint. When the children were asked, “What’s that,” they named the depiction (“That’s a bear”) when it had been described as intentionally created. When it was described as the result of an accident, however, they usually did not attach a name to the shape, often referring to it in other ways, such as, “some paint.”

Bloom and Markson (1998) provided another example of young children using intention to judge pictures. Three- and 4-year-old children were asked to draw four pictures—a balloon, a lollipop, themselves, and the experimenter. Children of this age are not very skilled at drawing, so their drawings of the balloon and lollipop were pretty much indistinguishable, as were their renditions of the two people. However, when later asked to name the drawings they had produced, the children reliably applied the correct labels. Whatever they had intended to be a balloon was a balloon, even though it looked just as much like a lollipop.

Back to Babies

This resolution to the historical debate—that learning is not required for the perception of pictures (at least relatively simple pictures) but is required to understand the nature and use of pictures—turns out to be the resolution to another mystery. For a long time, anecdotes and informal accounts appeared here and there of infants or young children confusing a picture with its referent. For example, Church (1961) described this striking sight:

Ninio and Bruner (1978) described one infant’s efforts to grasp depicted objects, and Murphy (1978) reported that, in a study of mother–child picturebook interactions, 9-month-olds sometimes “hit the pictures in the book and scratched at the pages as if trying to lift the picture from the page” (p. 379). More recently, Perner (1991) recounted his 16-month-old son’s efforts to fit his foot into the picture of a shoe. A colleague described her 20-month-old daughter’s reaction to seeing a snapshot of her father that had been put under glass on the top of a play table in her preschool: “Chloe became distraught, pointing to her father and crying: ‘Daddy out. Open. Open. Daddy out.’ When she could not be soothed, the teacher removed the picture from the table and handed it to her. At first, she tried to liberate her father from the photograph with her fingers. Giving up, she hugged the picture to her face” (DeLoache, Pierroutsakos, & Troseth, 1996, p. 12).

Such anecdotes sound like they could be related to Werner and Kaplan’s (1963) notion of symbol realism—“the tendency to treat entities which are patently symbolic . . . as if they possessed the properties and the causal efficacy of the objects which they denoted” (p. 35). However, in the absence of any systematic investigation of infants’ response to pictures, it was always hard to know what to make of these accounts.

Accordingly, I and my colleagues (DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb, 1998) began studying infants’ reactions to pictures to see whether infants commonly react to depicted objects as if they were real or whether the various anecdotes and informal reports of such behavior represent unusual occurrences. We presented 9-month-olds with a book composed of highly realistic color photographs of single objects. To our surprise, every single one of the infants in our original study behaved like Perner’s son, except that they used their hands instead of their feet. (See Fig. 3.1.) They felt, rubbed, patted, and stuck at the pictures, and often they even grasped at the image as if trying to lift it off the page. Over the course of several studies, two infants have actually leaned over the picture of a baby bottle of milk to put their mouths on the nipple. Some infants were remarkably persistent in these behaviors, some made only tentative, fleeting efforts; but our results clearly established that infants’ manual (and occasionally oral) exploration of depicted objects is a very real, very common phenomenon.
patted, and rubbed the depicted objects and tried to pluck them off the page, even when, like the little girl in the figure, they were otherwise engaged.

Our results thus provide evidence that the behaviors casually observed long ago by Church (1961) are a common and easily elicited response of infants to highly realistic pictures. We disagree, however, with his belief that infants do not recognize pictured objects or distinguish between pictures and what they represent. Not only do the infant visual attention data argue against this view, but so do our results for manual exploration of pictures. Clearly, the infants who applied their lips to the nipple of the depicted bottle recognized it. Further, when offered a choice between a real object and a picture of that object, infants overwhelmingly choose the real thing.

We think the phenomenon of manual exploration of objects that we have documented reflects a conceptual, not a perceptual, deficit. Although infants have no problem perceiving pictures, and can discriminate between pictures and objects, they do not know what kind of thing a picture is. Not understanding the significance of two-dimensionality, infants respond to realistic pictures as if they were three-dimensional.

This idea is supported by a study (Pierroutsakos & DeLoache, 2000) showing that the extent of manual exploration by 9-month-olds is a direct function of the degree of realism in the pictures. Most exploration occurred to color photographs and least to black-and-white line drawings. Thus, the more a depicted object looks like a real object, the more infants treat it like a real object.

The infants in our research apparently do not share Goodman's (1976) view that, even when looking at highly realistic pictures, "I seldom suppose that I can literally reach into the distance, slice the tomato, or beat the drum” (p. 35). Our subjects' behavior belies Huttonlocher and Higgins' (1978) assumption that “...a person does not react similarly to icon and instance; he does not eat the picture of an apple...” (p. 106). Some persons do, although only when they are very young.

Infants gradually figure out the nature of pictures. By 19 months, manual exploration occurs only rarely. Instead of trying to feel or pick up depicted objects, older infants point to them, sometimes naming the object (DeLoache et al., 1998). They have thus learned something about the nature of pictures; they've figured out what pictures are not, and something about their intended function. In the terms of Werner and Kaplan (1963), for these children pictures have undergone "a most significant transformation from things-of-action to objects-of-contemplation" (p. 18). I need to qualify the aforementioned. Infants in picture-rich societies like ours figure out the limitations of pictures during their 2nd year. It seems unlikely, however, that learning would be so rapid in societies—such as the Beng of Ivory Coast—in which infants have little or no exposure to pictures.

Just how common became clear when the anthropologist in our group presented our books to some infants living in an almost picture-free society—an impoverished, rural village in Ivory Coast of West Africa. There were dramatic differences in the experimental setting from our lab in Urbana; for one thing, chickens and goats wandered through the testing site. Nevertheless, the Beng babies behaved just like the Americans. They felt,
After American children, presumably as a function of spending hours and hours looking at picturebooks on their parents’ laps, stop manually exploring pictures, they are still ignorant of one of the most basic pictorial conventions. Eighteen-month-old children simply do not care whether the picture they’re looking at is right-side-up or upside-down (DeLoache, Uttal, & Pierroutsakos, 2000). Although they typically reorient an object that is handed to them upside-down, they are content to leave an upside-down picture as it is.

To return to the four components of mature knowledge of symbols, we can conclude that there is an innate ability to identify what is in a realistic picture. Infants gradually come to understand that depicted objects are not real, that pictures stand for something else. By around 3 years of age, children grasp the importance of who; they heavily weight intention in naming pictures. Coming to a full understanding of how pictures are related to their referents takes several more years.

THE MODEL BEHAVIOR OF YOUNG CHILDREN

We turn now to another line of investigation into the early development of symbolization in which children’s mastery of the four components of symbolic knowledge takes a very different path. In this line of work, my colleagues and I have extensively studied very young children’s use of symbolic artifacts as a source of information for solving a problem. We use a symbol—most often a scale model—to communicate the location of a toy hidden in the room. The model is highly iconic: It contains miniature versions of all the items of furniture in the room that look as much as possible like the corresponding larger ones and are in the same spatial positions.

First, we tell our young participants everything about the task. We go to great lengths to explain and demonstrate the relation between the two spaces. For example, we carry each miniature item of furniture from the model into the room, hold it up against its larger counterpart, and comment on the similarity between them. We explain that we will hide a miniature toy in the model and that a larger toy will then be hidden in the same place in the room.

After this extensive orientation, the child watches as the experimenter hides the miniature toy somewhere in the model (e.g., behind the couch, under a pillow). Next, out of the child’s sight, she hides the larger toy in the corresponding place in the room. The child is then reminded that the larger toy is hidden in the same place in the room and is asked to go find it. After searching for the larger toy in the room, the child returns to search for the miniature toy in the model. Children of all ages are always highly successful at finding the toy in the model. In other words, they have excellent memory for the hiding event they observe directly. The same procedure is repeated for multiple trials, with the toy hidden in a different place each time.

We have repeatedly found that 3-year-old children readily appreciate the relation between the model and room (DeLoache, 1987; see DeLoache, 1995a, 1995b). They use their memory for where the miniature toy is hidden in the model to infer where to find the larger toy in the room. In contrast, 2½-year-old children seem almost completely unaware of the relation between the two spaces. They do remember the location of the small toy in the model, but they do not realize that it tells them where the larger one is in the room. This basic pattern of performance for these age groups has been replicated many times.

The younger children’s failure in the standard task is so predictable that we learned to warn parents of 2½-year-olds that their children would probably not do well. The task looks so simple, the relation between model and room so obvious that parents are typically shocked when their child fails to find the toy. Indeed, it was even surprising to a former participant. I recently received a testimonial e-mail from 12-year-old Charlotte who had seen a PBS rebroadcast of a program in which she had appeared as a 2½-year-old failing the model task: “I can’t believe I couldn’t find the Snoopy. I think even my dog could of found him.”

The fact that performance in the standard model task is so reliable and replicable does not mean that it is immutable. By manipulating the degree of iconicity, or similarity, between the model and room, we can easily make the standard task either easier or harder; enabling 2½-year-olds to succeed or causing 3-year-olds to fail (DeLoache, Kolstad, & Anderson, 1991). Giving children prior experience with a symbolic task that they understand produces dramatic improvement in their subsequent performance in more difficult tasks that they normally fail (Marzolf & DeLoache, 1994).

An important question to ask is, when children succeed in the model task, what is the basis for their success? It is clear that children must detect the lower order object correspondences; they have to recognize that the miniature chair is related to the larger chair, the little couch to the big one, and so forth. Mental representations of these lower order relations could, in principle, be adequate for success. However, several aspects of our results make it clear that representation of these lower order object correspondences is necessary, but not sufficient, for success in this task.

In one study that makes this point, the experimenter pointed to objects in the model and asked 2½-year-olds to “show me the one just like this” in the room. They were highly successful at doing so; when we pointed to the table in the model, they ran in and indicated the table in the room. Immediately afterward, we gave these children the standard model task. In spite of having just demonstrated their ability to detect the similarity between
all the objects in the two spaces, they failed. Although they knew that the small couch in the model was like the large couch in the room, they did not know that the fact that the miniature toy was behind the couch in the model meant that the large toy was behind the couch in the room.

Dual Representation and the Model Task

Thus, similarity does not make a symbol. Why not? I think the problem is largely due to the difficulty young children have achieving dual representation. Young, inexperienced symbol users are inclined to respond to novel entities primarily—and often exclusively—in terms of their physical reality. The more salient a symbol is as an interesting, attractive object—like a scale model—the more difficult it is for young children to achieve dual representation; that is, the more difficult it is for them to appreciate its higher order relation to what it stands for. They see the object—the model—but fail to see through to the room it represents.

The dual representation hypothesis has received strong support from several studies. In the most dramatic one, we showed that 2½-year-old children could reason between two spaces when we eliminated the need for dual representation (DeLoache, Miller, & Rosengren, 1997). We did this by convincing 2½-year-olds that we had a machine that could shrink a room; that is, the machine could transform a room into a model. The basic idea is that if children believed us, then there would no longer be a symbolic relation between the two spaces and hence no need for dual representation. Believing the model to be the room, these young children (who would fail the standard model task) should be able to reason between the two spaces.

In the orientation to the task, each child was first shown “Terry the Troll” and “Terry’s room” (a tentlike portable room used in many previous model studies). Then we told the children we had a machine that could shrink things. The troll was placed in front of the 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 sat in place of the original one. The child was then shown that the machine could also make the troll “get big again.” We next demonstrated that the machine could also shrink and enlarge Terry’s room. The machine was pointed at the room, and the child and experimenter waited in the adjoining area again listening to the sounds the machine made while shrinking the room. When they returned to the room, the small model sat in the middle of the large space previously occupied by the portable room. It was a very dramatic sight. We then demonstrated that the machine could also enlarge both the troll and the model. The children gave many signs of believing us, and their accompanying parents judged that they did. Finally, we were ready for the actual experiment.

For the retrieval task, the child 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. On the next trial, the miniature toy was hidden in the model, and after it was enlarged, the child searched 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 than that of a control group in the standard model task. Thus, when there is no symbolic relation between two spaces and hence no need for dual representation, 2½-year-old children can reason from one to the other.

Intention and the Model Task

Given the pivotal role of intention in the definition of a symbol, it is important to analyze the model task, and children’s performance in it, in that context. The scale models that we use in our research are clearly designed by people to stand for a particular larger space. Although the model typically resembles the larger space it represents, it is the intentions and actions of the people using it that establish the symbolic relation between the two spaces. In other words, it is the fact that I intend that the model stand for the room that establishes that relation. Similarly, it is my intention alone that establishes the correspondence between the hiding events in the two spaces. Only because I intend that observed events in the room have significance for unseen events in the room is that the case. I make it so.

This suggests that part of a mature understanding of the model–room relation is recognition of the intention of the adult using the model as a representation of the room. Several questions follow: First, could we improve the performance of young children who typically fail the model task by emphasizing the intentional nature of the model–room relation? Second, at what age could children detect the nature of that relation on their own, that is, without the extensive explanation of the model–room relation that we typically provide? Third, to what extent are children who succeed in the task explicitly aware of the experimenter’s intentions to make the events in the two spaces correspond?

**Emphasizing the Intentional Nature of the Model–Room Relation.** We have recently tried to improve the performance of two age groups of young children by highlighting the intentional nature of the model–room relation (Sharon & DeLoache, 2001a). To do so, we modified the standard task...
in several ways: First, the children were given a "blind" trial in which they were told that Snoopy was hidden in the room and they should try to find him. The point was to make them realize they had no way of knowing where the toy was. Next a "helpful" assistant to the experimenter indicated that she could help the child know how to find the toy. She then proceeded to assemble the model of the room, commenting on the similarity between the two spaces and explaining how the model would help the child know where Snoopy was hidden. On the first hiding trial, after the experimenter entered the room to hide the larger toy, the friendly assistant assumed a conspiratorial stance, peeking through the door as the experimenter was hiding the toy. She then hid the miniature toy in the model, telling the child this would help her know where Snoopy was hiding in the room. Finally, the child searched in the room.

A group of 3-year-old children received this assistance in the context of the low-similarity task. We found that their age group typically fails. They clearly benefited from the "helpful" experimenter’s efforts to clue them in to the model–room relation. However, a group of 2½-year-olds, who were given the standard task that their age group typically fails, did not benefit from the helpful assistant’s conspiratorial behavior. Thus, we find that emphasizing the intentional nature of the adults’ actions in the task can assist 3-year-olds to appreciate the model–room relation, but, at least in this initial study, 2½-year-olds were less receptive to the intervention.

Children's Ability to Detect the Model–Room Relation on Their Own. We have discovered that it is not until 5 to 7 years of age that children can figure out the model–room relation on their own (DeLoache, DeMendoza, & Anderson, 1999). In this case, we simply showed them the model and the room, and they watched a hiding event in the model. They were then told to find a larger toy that was hidden in the room. Unlike younger children, these children did not have to be told the purpose of the model to appreciate the symbolic relation between it and the room.

The children's comments were highly informative. Upon first seeing the model and room, some children commented on the resemblance:

"This looks the same. Everything’s the same!"
"How do you make the same thing?"
"Hey, these rooms look the same."

Some seemed to catch on after the first retrieval trial:

"I think I know how it’s done. I know the secret!"
"He’s in the same place! Always in the same place. . . . That’s funny!"

A few children voiced an explicit, full understanding of the situation:

"I know where you hide him, because the place you hide him is the same as the other place . . . sorta the same room."
"I better remember where Little Snoopy is hiding because she might hide Big Snoopy in the same place."

One child was clearly thinking ahead; after watching the experimenter lift the miniature table to hide the toy under it, he worried: "I can’t carry that when it’s big." This child was clearly seeing through the model, thinking about searching in the room while observing the hiding event in the model.

This study shows that by 5 to 7 years of age, the model–room relation is relatively transparent to children, just as it is to adults. From simply seeing the two spaces and observing a hiding event in one of them, they infer the nature of the symbolic relation that the experimenter has established. They assume that the adult’s actions that they observe in one space have implications for her unseen actions in a different space.

Children’s Explicit Awareness of the Model–Room Relation. In another recent study, we asked whether young children’s understanding of the intentional nature of the model–room relation is explicit enough to enable them to ignore irrelevant information (Sharon & DeLoache, 2001b). A group of 3½-year-olds participated in the standard model task, with two very nonstandard trials interpolated among four regular ones. On the two “accidental hiding” trials, the children watched as the experimenter hid the miniature toy in the model as usual and then went into the room to hide the larger toy. At this point, a second, “clumsy” experimenter “accidentally” kicked the model, dislodging its contents. She replaced all the furniture in the correct locations. Then, picking up the miniature toy, she said, “Hmm, I don’t know where this was; I’ll just put it here.” She proceeded to put the toy in a different place from where the experimenter had hidden it.

The question was whether the children would realize that the “accidental” hiding was irrelevant to where the larger toy was hidden in the room. In other words, would they realize that the intention of the first experimenter determined its location, not the last hiding event they had actually observed in the model.

The results were quite clear. Of the eight participants, six clearly understood that the appropriate guide to the location of the toy in the room was where the experimenter had originally hidden the miniature toy in the model, not where her clumsy sidekick had subsequently placed it. The children ignored the “accidental” hiding to the extent that their retrieval performance did not suffer at all. Thus, these children recognized the importance—and information value—of the experimenter’s intentions in
THE DEVELOPMENTAL STORY

The research we have reviewed here reveals that progress in young children's use of symbolic artifacts as a source of information is relatively rapid. For example, 2-year-old children fail miserably at our basic picture task, but 2½-year-olds are very successful in it. Similarly, 2½-year-olds generally perform extremely badly in the basic model task, whereas 3-year-olds perform extremely well. What accounts for the fact that children who find a task impossibly difficult at one age find it trivially simple only 6 months later?

Age changes in our symbolic object-retrieval tasks are not all that must be explained. What accounts for the fact that children who find a task impossibly difficult at one age find that same task trivially simple after experience with a related one? Or how can children of a given age who find a task trivially simple find a very similar task impossibly difficult?

The research reviewed here makes it clear that there is substantial complexity involved in the understanding and use of simple symbol--referent relations. Therefore, it should not be surprising if the developmental story is similarly complex, involving change in numerous domains. We think this is exactly the case. It is unlikely that any one or two factors are by themselves responsible for the rapid development we have documented.

One factor that we know improves performance over time is prior symbolic experience, as shown by our transfer studies. We assume that general symbolic experience also contributes to more successful performance with age in our tasks. Most of the children who have participated in this program of research receive an enormous amount of exposure to a variety of symbolic artifacts in the first years of life: Among other things, most middle-class American toddlers enjoy numerous picturebook interactions with their parents and others, watch television, engage in pretend with representational toys, and begin drawing (although their representational intent is not usually obvious). None of these experiences involves using symbolic objects to solve a problem based in current reality, but we assume that their increasing understanding of and facility with such entities makes children more flexible when they come into our laboratory and are asked, for the first time, to use a symbolic artifact as a source of information about current reality.

Understanding intentionality is also likely to be a key contributor to developmental progress. An increasing body of research is establishing substantial understanding of intention by young children and even in-fants, but such understanding no doubt expands dramatically in the 3rd year of life and for years to come. This probably makes it easier for children to figure out the basic nature of the symbolic object-retrieval task.

Another likely source of developmental progress is in the ease of achieving dual representation. Increasing inhibitory control may be very important. To achieve dual representation, a child has to inhibit responding to a symbolic artifact exclusively or primarily as an object. The more a young child responds to a scale model as an interesting toy, the less likely he or she is to appreciate its role as a representation of something else. General inhibitory control is known to increase during the first several years (Harnishfeger & Bjorklund, 1993). Basic brain development could be making an important contribution in this regard: Frontal lobe development is known to be important in inhibitory control, and it is also known to be proceeding rapidly throughout this period (Diamond, 1991; Welsh & Pennington, 1991).

Another important aspect of early development is a large increase in the basic amount of information that children can represent. Their steadily increasing speed of information processing and resulting growth in working memory (Kail, 1995) no doubt help young children cope with the cognitive demands of symbolic tasks. Both Case (1992) and Halford (1993) stressed the growing ability to represent multiple relations simultaneously. Any symbolic-retrieval task has, at a minimum, one more relation—the relation between symbol and referent—to represent than does any memory-based retrieval task (Marzolf & DeLoache, 1997; Troth & DeLoache, 2001).

In addition, between the ages of 2 and 3, children undergo extensive language development. At a minimum, their increased language skills should make it easier for them to apprehend our instructions. Also, increasing linguistic capability should facilitate the achievement of psychological distance (Sigel, 1990) and hence of dual representation. The well-documented increases in analogical reasoning skills that occur in the early years of life (Chen, 1996; Gentner, Ratterman, Markman, & Kotovsky, 1995; Goswami, 1992) should be another source of developmental progress in symbolic retrieval tasks.

This list is by no means intended to be complete; rather, it serves to illustrate the assumption that the rapid developmental improvement that occurs in our symbolic object-retrieval tasks is almost certainly attributable to several converging lines of development. The account will not be simple.

PRACTICAL APPLICATIONS

I turn now to some practical implications of what we have learned about early symbolic development. Because adults assume that symbol–referent relations are more transparent than they actually are, many well-intended
efforts to assist young children miss the mark. One example is the anatomically detailed dolls that have often been used to interview young children when sexual abuse is suspected. It has simply been taken for granted that children would easily be able to use a doll to represent themselves, and the further assumption is made that the doll would help them provide a more complete and accurate memory report. Everything in this account of early symbolic development suggests that this assumption should be questioned, and indeed there is accumulating evidence from my own lab and several other investigators that children younger than 5 have substantial difficulty understanding and using a doll as a self-representation.

A second case concerns the manipulatives that are a staple of early math education. These are objects such as rods, blocks, counters, and so forth that young children are encouraged to use to help them solve problems and understand concepts. However, teachers too often assume that the relation between the manipulatives and what they are supposed to represent is transparent. As a consequence, teachers often provide little or no instruction about the relation between them. And as a consequence of that, their pupils often totally miss the point (Uttal, Liu, & DeLoache, 1999; Uttal, Scudder, & DeLoache, 1997).

This was vividly illustrated by 7-year-old Michael whose mother gave him a stock of candies to use to solve the arithmetic problem of $3 + 1 = ?$. Michael obediently used the candies, but not precisely in the way his mother had in mind. He made a group of three, then constructed a plus sign out of five more, put a single candy after that, then used two more to form an equals sign, and finally made a group of four for the answer. He then proceeded to count on his fingers before giving his answer. Michael understood part, but only part, of what he was supposed to do with the candies, and it is almost certain that the arrangement he created did nothing either to help him solve this particular problem or to acquire a better understanding of addition.

We have thus come full circle, from the ancient Sumerians and their failure to fully appreciate the abstract nature of their tokens to a thoroughly modern child having a similar problem.

FUTURE DIRECTIONS

It seems likely that research into the development of symbolization will increase in the future, with respect both to issues of current interest in developmental psychology and to issues of more general concern to society. One particular area within developmental psychology that is ripe for further investigation is the role of children's understanding of intentionality in their understanding of symbolic artifacts. Intention is fundamental to symbolization. As discussed here, I and my colleagues have recently begun examining this issue in the context of symbolic object-retrieval tasks, and others have been studying children's sensitivity to the role of intention in the interpretation of pictures. As increasing attention is paid to children's developing understanding of intentionality across a wide array of domains, it will be worthwhile to examine it further in the context of early symbolic development.

More generally, children in Western societies today are exposed to a wider variety of media and symbolic artifacts at younger ages than ever before. Some television programming is now directed specifically to toddlers, and preschool children are expected to begin learning numbers and letters. Computers are becoming increasingly common throughout society, and children are being exposed to them increasingly early. Full participation in society thus requires that children begin to develop several kinds of literacy quite early in life.

The fact that very young children receive more exposure to symbolic media than ever before means that it is more important than ever to know more about the processes involved in understanding and interpreting symbols. It would be valuable to have better information about how very young children can be helped to correctly interpret symbolically mediated information. Research designed to improve the instructional materials used in classrooms could be particularly beneficial.

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3. THE SYMBOL-MINDEDNESS OF YOUNG CHILDREN


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