Chapter 9

Preverbal Representation and Language

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Although my interests lie in the character of the preverbal conceptual system rather than of language itself, the preverbal system forms the foundation on which language rests, and it constrains what is learnable. I shall argue that preverbal conceptual representation is largely spatial in nature and that the relationship between space and language is therefore far-reaching and pervasive. It is not just that spatial terms tell us something about spatial meanings, or that spatial meanings place constraints on spatial terms. It is that many of the most basic meanings that language expresses—both semantic and syntactic—are based on spatial representations. Such a point of view will hardly be news to cognitive linguists such as Ronald Langacker or Leonard Talmy. What I hope to contribute are a few suggestions as to *why* language should be so structured. I will suggest that language is structured in spatially relevant ways because the meaning system of the preverbal language learner is spatially structured. So with apologies to Leonard Talmy for twisting his words, the subtitle of this chapter should read: "How Space Structures Language."

One further introductory comment. To say that the preverbal meaning system is spatially structured is not to say that it is the same as spatial perception. Rather, spatial information has been redescribed into "meaning packages," and these meaning packages retain some spatial characteristics. I will argue that some of the categorical or packaging characteristics often ascribed to language itself are actually due to the prepackaging that is accomplished during the preverbal period. Babies do not wait until the onset of language to start thinking; the problem of packaging meanings into workable units is thus a prelinguistic one.

Gesture: visual packages

9.1 Sensorimotor Schemas Are Not Concepts

The more I delve into cognition in the first year of life the more it becomes apparent that many of the most basic foundations on which adult concepts rest are laid down during this period. Pace Piaget, the first year of life is far from being an exclusively sensorimotor stage. Instead, the higher cognitive functions that (among other things) will support language acquisition are being formed in parallel with the sensorimotor learning that is going on. The research that Laraine McDonough and I have been conducting indicates that the foundations of the major conceptual domains are being laid down during this period (Mandler and McDonough 1993). Fundamental concepts of animals and vehicles are learned by around six to seven months (perhaps resting on an even earlier conceptual distinction between animate and inanimate things), and the domains of plants, furniture, and utensils follow soon after. These conceptual domains in turn are used to control inferential reasoning processes (Mandler and McDonough in press). In addition, the episodic memory system has become operational and long-term recall processes have begun (Mandler and McDonough in press). All this is happening before children learn how to speak.

Such findings should give us pause. Where is the familiar sensorimotor infant we are used to hearing about, the creature who has not yet achieved conceptual representation? It seems to have disappeared. In its place we find a baby that has already developed a rich conceptual life. For many people working in language acquisition this will come as no surprise, if for no other reason than the need to account for the complexity of the concepts that newly verbal children express in language. But the current research does make evident a tension that has been lurking in the literature for many years. According to Piaget (1951), babies are not supposed to have a conceptual representational system, yet according to linguists, to learn language requires mapping onto a conceptual base. As a result, we pay lip service to the idea that to learn language requires a preexisting conceptual system, but have avoided specifying what that system is like.

The neglect seems to be due in part to a conflict within Piagetian theory. On the one hand, Piaget (1967) said that conceptual thought is not created by language, but instead thought precedes language, which then transforms it in various ways. On the other hand, because language begins before the sensorimotor period ends, Piaget tended to characterize early verbalizations as just another kind of sensorimotor schema. He did devote a good deal of effort to describing how sensorimotor schemas might be transformed into conceptual (symbolic) representation, but he said little about how the new type of representation differed from the old. The result is a gap in his theory. Sensorimotor schemas are said to be transformed into concepts and concepts are mapped into language, but little is said about what the concepts themselves are like.

As best as I can tell, this dilemma was handled in different ways by people studying language acquisition and those studying cognitive development. Workers in language acquisition attempted to specify the various notions necessary for learning language and then, reasonably enough, left it to the developmental psychologists to explicate

the representational status of these notions. For example (with the exception of the nativist position that grammatical categories are innately given) there seems to be widespread agreement that the underlying concepts needed to learn grammatical categories are notions such as "actionality," "objecthood," "agent," "location," and "possession" (Maratsos 1983). But where the developmental psychologists were to take over, until the recent work on objects and agency began to appear (Baillargeon 1993; Leslie 1984; Spelke et al. 1992), there was largely a blank. Because Piagetian theory was silent about conceptual representation at the end of the sensorimotor period, it seems to have been assumed by default that the relevant conceptual categories were the same as the sensorimotor schemas themselves. Thus in many accounts the sensorimotor achievements were assumed to be the base onto which language is mapped. Typical examples of this approach were the various attempts to relate language acquisition to stage 6 sensorimotor accomplishments, such as object permanence, but these were not very successful (see Nelson and Lucariello 1985 for discussion).

For the most part, sensorimotor schemas are not the right sort of representation for learning language. Piaget provided some of the reasons why procedural forms of representation such as sensorimotor schemas cannot in themselves serve a semiotic function. A sensorimotor schema provides something like meaning in that it enables recognition of previously seen objects to take place, and thus for the world to seem familiar. It also allows each component of a familiar event to signal the next component to come. This kind of reaction is indexical; a conditioned stimulus predicts or "means" that some other event will follow. But a sensorimotor schema does not allow independent access to its parts for purposes of denotation or to enable the baby to think independently of the activation of the schema itself (Karmiloff-Smith 1986). In short, sensorimotor schemas are neither concepts nor symbols, which Piaget considered to be the sine qua non for both the development of the higher cognitive functions and language acquisition.

There are other ways in which sensorimotor knowledge also appears to be the wrong sort of base for learning language. Sensorimotor schemas structure perception and control action. These schemas consist of a large number of parameters that monitor continuously varying movements and rapidly shifting perceptual views. How are such schemas to be mapped into a discrete propositional system? Some kind of interface between perception (or action) and language is needed, something that will allow an analog-digital transformation. For example, consider putting a spoon into a bowl. This requires an intricate sequence of movements, but the conceptual system greatly simplifies it, forming a summary of the event that constitutes its meaning. In this case, the meaning might be a representation of one object containing another. It is this conceptual simplification onto which propositional language is mapped, rather than onto the sensorimotor schemas themselves.

9.2 Differences between Perceptual and Conceptual Categories

In addition to Piaget's view that at the end of infancy concepts are constructed out of sensorimotor schemas, there is an even older view of the onset of concept formation, namely, the traditional doctrine of the British empiricists, espoused in modern times by philosophers such as Quine (1977). In this view, which Keil (1991) has called the doctrine of "original sim," before children develop abstract concepts about the world they categorize objects on the basis of their physical appearance according to the laws of perceptual similarity. Once these perceptual categories are formed, various types of information become associated with them, and in so doing these perceptual categories become conceptual in nature.

+ function !

This associative doctrine of the creation of concepts is exemplified in current theory by the view that the first concepts to be formed are at the basic level (Mervis and Rosch 1981). In this view, babies first form concepts such as dog and cat on the basis of the similarity of the exemplars to each other, and only much later generalize from these concepts to form a superordinate concept of animal. The details of this process have never been worked out, but it would seem to be a process along the lines of the doctrine of original sim. This view is given support by the recent findings of Eimas and Quinn and their colleagues (Eimas and Quinn 1994; Quinn, Eimas, and Rosenkrantz 1993) showing that as young as three months, babies form perceptual categories of animals after a very few exposures to pictures of contrasting classes. For example, both three-olds and six-month-olds quickly learn to distinguish horses from zebras, dogs from cats, and cats from both dogs and lions. It is agreed that these are purely perceptual accomplishments, but Quinn and Eimas (in press) believe, as I assume do many others, that these perceptual categories form the kernel around which the first concepts will develop.

Nevertheless, there are both theoretical and empirical difficulties with this view that have never been resolved. Theoretically, it does not specify in what form the information to be associated with the perceptual categories is itself couched. A property such as barking might be a perceptual category in its own right, and one could imagine how it might become associated with the perceptual category of dog. But it is difficult to understand how properties that are less clearly perceptual are represented, such as "animate" or "interacts with me." More importantly, in my opinion, this approach does not explain how the transition from perceptually based categorization to more abstract or theory-laden concept formation takes place. Indeed, Quinn and Eimas (1986), among others (e.g., Keil 1991), have pointed out that no one taking the traditional empiricist view has ever satisfactorily explained how abstract or superordinate concepts are derived from the perceptual concepts of infants, or how theory-based associations begin to supplant perceptually based ones (see also Fodor 1981).

As long as it was assumed that superordinate concepts such as animal, vehicle, and plant were late acquisitions, this difficulty might be finessed. For example, perhaps language acquisition itself contributes to superordinate concept formation (e.g., Nelson 1985). However, research in our laboratory has shown that infants have formed concepts of animal and vehicle as early as seven months of age (Mandler and McDonough 1993), and other global concepts such as plant are in place at least by eleven months (we have not yet tested younger children on this concept). This research shows that on some tasks infants distinguish global categories *before* they distinguish the basic-level categories nested within the animal class.[1] For example, on our tasks infants differentiate animals and vehicles from seven months onward. But even by eleven months, they do not differentiate dogs and rabbits or dogs and fish.[2] Furthermore, differentiation among various basic-level classes of mammals, such as dogs and rabbits (and also basic-level classes of land vehicles, such as cars and trucks) is still not well established at eighteen months (Mandler, Bauer, and McDonough 1991).

The details of the development on these conceptual domains is not my main concern here. Rather, I want to emphasize that the development of perceptual categories (which are sensorimotor accomplishments) does not look like the development of conceptual ones. Because most aspects of these two developments have not yet been investigated, specifying the differences between them is still problematic. Nevertheless, several reasons to make the distinction are already known. First, if there were only perceptually based categories in infancy, it would be difficult to explain how infants could manage on any kind of task to categorize two superordinate domains, whose exemplars do not look alike, while failing to categorize the basic-level classes within them, whose exemplars do look alike. The quintessential example of this dilemma is shown by infants in our experiments distinguishing between little models of birds and airplanes, all of which have outstretched wings and therefore very similar overall shapes, while at the same time not distinguishing between dogs and fish or dogs and rabbits, whose shapes are quite different (Mandler and McDonough 1993).[3]

Second, a purely perceptual account of categorization cannot explain why three- to six-month-old infants are apparently so much more advanced than seven- to eleven-month-olds, in particular, why the younger infants make fine discriminations among basic-level classes that the older infants do not. McDonough and I have suggested that the infants at these different ages are actually engaged in different kinds of processing, even though superficially there seem to be similar task demands in the various experiments that have been conducted. The experiments for both age ranges have used a habituation-dishabituation paradigm. However, the studies of categorization in young infants have measured times to look at pictures, whereas in our work we have measured times to manually explore objects. Apparently, the traditional looking-time habituation-dishabituation experiments do not engage infants very deeply (Mandler and McDonough 1993); for example, there is often high subject loss in these experiments even when the infants are given something to suck on to keep them awake and happy. On the other hand, when infants are given objects to explore, they show intense interest and concentration and subject loss is virtually nil. Although this issue needs further study, our findings suggest that very young infants begin to perceptually categorize the world in the absence of meaning, but that when they are older and are given a task that engages their interest, a different process is brought to bear. This different process consists of treating objects as kinds of things, that is, as having meaning, not just as things of differing appearance.

This early conceptual processing is crude in comparison to the fine perceptual discriminations that infants make. They appear not yet to have divided the world into very many different kinds, although the kinds they have conceptualized are fundamental cuts that give meaning to the perceptual categories they are also making. That is, the primary meaning to accrue to a basic-level category such as dog is that it is an animal; it is secondary (not only for infants, but adults as well) that dogs are four-legged or bark, or are man's best friend.[4]

I am suggesting that the babies in our experiments can see that dogs look different from fish or rabbits, but do not find these differences important enough to treat them differentially. This situation is essentially the same as when an older child or adult sees the differences in the appearance of poodles and collies, but for most purposes treats them as the same kind of thing, namely, dogs. Babies see the differences in the appearance of dogs and rabbits, but having constructed fewer concepts about the world, for most purposes treat them as the same kind of thing, namely, animals. The question then becomes, exactly what does this initial concept of animal consist of and how is it learned?

Unless one wants to posit that the concept of animal consists of a set of innate ideas, the meanings that make up this concept need to be derived from information that babies can learn from observation alone. By seven months, babies are not yet independently locomoting; they have just begun to handle objects and are still unskilled at doing so. It is also unlikely that most seven-month-olds have held any kind of real animal in their hands. So what kind of information is at their disposal? The first that seems likely to be relevant is biological motion. Bertenthal (1993) has shown that three-month-olds already differentiate biological from nonbiological motion, insofar as the parameters of people's motion are concerned. It seems likely that they do the same for other animals as well because the parameters governing animate motion are quite general. Thus perception of biological versus nonbiological motion is one early source of knowledge that could be used to divide the world into classes of things that move in animate and inanimate ways.

Once these categories of motion are formed they must be characterized in some way, if the difference is not just to remain a sensorimotor distinction but to represent a meaning. One of the ways to do this is to notice that the things that move in the biological way start up on their own, whereas the things that move in the mechanical way start only when another object contacts them. Another characteristic to be noticed is that the things that move in the biological way and start on their own also interact with other objects from a distance, whereas those things that move mechanically and get pushed never interact from a distance. Notice that each of these properties is available even to very young babies. Indeed, these are some of the major properties that babies can pick up when their acuity is still not well developed. Responsivity to these characteristics of motion can explain why babies as young as two months of age respond differentially to people and to dolls (Legerstee 1992). People interact with them; dolls do not. Similarly, it can explain why, by four months, babies differentiate caused motion from self-motion (Leslie 1984).

There are, of course, many other properties of objects that babies observe as well. By four months, babies know that objects are solid, that other objects cannot pass through them, and that objects still exist when they move out of sight (Baillargeon 1993). By six months, babies have learned something about containment; they know that containers must have bottoms if they are to hold things (Kolstad 1991). As young as three months, infants have begun to learn about the properties of object support. They expect an object that loses contact with a surface to fall, unless it is supported by a hand (Baillargeon in press). Slightly older infants expect that any contact implies support, so that various insubstantial objects such as a horizontal finger touching a large box are expected to be sufficient to provide support. By seven months, babies have learned enough about contact and support to predict that something seen to overlap its supporting surface by only about 15% of its base will fall. There are undoubtedly other properties babies learn about before they begin to handle objects themselves, but these are some of the main ones that have been studied to date.

9.3 How Meanings Are Created

Self-starting, biologically moving, mechanically moving, interactive, causing-to-move, caused-to-be-moved, contacting a surface, containing—these are all observable spatial and/or kinetic properties. This is one of the reasons why I have proposed that it is spatial properties (including motion) babies analyze and abstract from perceptual displays to form meanings. I have suggested that as infants are learning to parse the world into objects, a process of perceptual analysis begins to take place (Mandler 1988, 1992). This is an attentive process that occurs when an object is being thoroughly examined and/or is being compared with something else, unlike the usual sensorimotor processing, which occurs automatically and is typically not under the attentive control of the perceiver. This attentive analysis results in a redescription of the perceptual information being processed. Thus babies have a mechanism that enables them to abstract spatial regularities and to use these abstractions to form the beginnings of a conceptual system. The contents of this new conceptual system are sets of simplified spatial invariants. It is these invariants that form the earliest represented meanings. I claim that these spatial abstractions are sufficient in themselves to represent the initial meanings of such concepts as animate thing, inanimate thing, cause, agent, support, and container. It is not necessary to interact with objects (pick them up, hold them, move them around, or move around them) for meaning to begin to be created, although as infants mature these newfound skills will provide different kinds of information than they received before. But to begin the process, it may take no more than an intelligent eye and a mechanism to transform what the eye observes.[5]

I want to add an aside here, which I hope will clarify the position I have taken with respect to the creation of meaning (Mandler 1992). It is not a nativist position; on the contrary, it is a constructivist account. The mechanism of perceptual analysis I have described makes it unnecessary to posit inmate ideas or concepts; perceptual analysis alone can build up meanings and can do so continuously throughout infancy (and for that matter, throughout life). The mechanism itself must be innate, and presumably also the basic aspects of the spatial representations that result from the analysis, but the concepts our minds conceive do not have to be carried on our genes. Thus babies can create a beginning concept of animal even though it is crude compared to the biological theory they will eventually espouse (Carey 1985). New analyses can provide new information at any time, and of course, with the onset of language, a whole new source of accumulating conceptual information arrives on the scene.

Even if we agree that the earliest meanings, such as animal or container, are derived from spatial information, their representational format need not be spatial. After all, I have just described them using language. On the other hand, because the meanings themselves result from spatial analyses, there does not seem to be any good reason to translate them into propositional form. Language will be coming along shortly and babies may not need propositional representations in the interim. Once language is learned, they will be in the advantageous position of having two kinds of representation, one of which is useful for representing continuous and dynamic analog information and the other which provides a way of representing information in a discrete compositional system. Is there any advantage in the meantime to translate spatial representations of something starting up on its own or interacting with

something else from a distance into a list of propositions such as [selfmove (thing)] or [afar (thing1, thing2) + interact (thing1, thing2)]? And how would this be accomplished? Is there a list of empty slots waiting in the mind to be appointed to each successive spatial analysis, so that, say, slot 32a becomes a symbol meaning self-moving, and slot 32b becomes a symbol meaning distant interaction? This is what Harnad (1990) called the symbol-grounding problem. People usually try to solve this problem by saying that the external world provides the meaning for symbols. But neither the external world nor perception of it can provide meaning in and of themselves. The three-month-old who categorizes dog patterns or horse patterns can do so in the absence of meaning, just as an industrial robot can categorize nuts and bolts on the assembly line without meaning entering into its programs at all. Substituting perception for meaning is no different from substituting sensorimotor schemas for concepts. Instead, meaning must come from an analysis of what is perceived. Nothing about such analysis suggests it need consist of propositions composed of discrete symbols.

One reason to translate spatial representations into another format would be if it were needed to learn language. If existing spatial representations were themselves adequate for this purpose then a preverbal propositional representational system would be superfluous. At first glance, spatial representations seem unlikely candidates for the base on which to construct language. Their continuous analog character appears to be subject to some of the same difficulties I described for sensorimotor schemas. How do they get broken down into components that allow language to be mapped onto them? Here is where image-schemas come in. These are the type of spatial representations that I have described as resulting from perceptual analysis (Mandler 1992). They are spatial abstractions of a special kind (Lakoff 1987; Mandler 1992). Image-schemas retain their continuous analog character while at the same time providing some of the desirable characteristics of propositional representations. Although they are not unitary symbols, image-schemas form discrete meaning packages. In addition, they can be combined both sequentially and recursively with other image-schemas. Thus they provide an excellent medium to bridge the transition from prelinguistic to linguistic representation.

9.4 Spatial Representation in the Form of Image-Schemas

path

Because of the attention that babies give to moving objects, the first image-schemas they form are apt to be those involving movement. The simplest meaning that can be taken from such movement is the image-schema path. This schema represents any object moving on any trajectory through space, without regard to detail either of the object or type of movement. But paths can themselves be analyzed, and as I discussed earlier, these analyses lead to the concept of animal. For example, focus on the shape of the path itself leads to schemas of animate and inanimate motion. Focus on ways that trajectories begin leads to image-schemas of self-motion and caused-motion, associated with animate and inanimate objects respectively. (This is an example of the embedding nature of image-schemas: beginning-of-path and end-of-path are embedded in path itself). Although I originally called these image-schemas "dynamic" because they can represent continuous change in location, it would have been more accurate to call them "kinetic." As I have defined them, path and its parts are spatial, rather than forceful.

Other types of paths that attract babies' attention are those that go into or out of things, and onto or off surfaces, leading to image-schemas of containment, contact, and support. I have also suggested that perception of contingent motion, or interactions among objects at a distance, can be represented by the notion of coupled paths, or a family of link image-schemas. The link schemas are interesting, not only because they capture one of the ways in which animate objects behave but also because they illustrate how what at first glance seems to be a nonspatial meaning (if A, then B) has an underlying spatial base. In Mandler 1992, I discussed how the link schema that represents the meaning of one animal following another can, by a slight change in its structure, also represent two objects taking turns. This is an example of how a spatial representation can also represent time. It requires mentally following a path, which takes time but which does not require an independent representation of time. It is known, of course, that languages tend to represent time by borrowing spatial terms (e.g., Fillmore 1982; Traugott 1978). I think the reason is that it is easier to think about objects moving along paths than to think about time without any spatial aids.

Because babies are slow information processors and because they probably need a lot of comparisons to carry out any single piece of perceptual analysis, analyzing spatial relations should be easier for them than analyzing temporal relations. One can look back and forth at the various parts of an object or look back at the place where an object began to move. Temporal information is evanescent, and it may be difficult to analyze without the help of previously acquired meanings. If the infant's initial conceptual vocabulary is spatial, the easiest way to handle more difficult conceptualizations would be to use the spatial conceptions that have already been formed. In this view the *concept* of time is not a primitive notion but derived. Of course, to say that conceptualizing time is more difficult than conceptualizing space does not imply that babies are not sensitive to temporal relations; they obviously are. This discussion, however, is concerned with the ability to *think* about time and space and the representations we use to do so. All organisms are sensitive to temporal relations, but most get by without conceptualizing them. When we do think about time, we may

always do so in terms of following a path. Part of path following may include some ineffable sense of duration, but that in itself does not seem to qualify as conceptual.

It is not just time that is more difficult to analyze than space; so are dynamics and internal feelings. Talmy (1985) has suggested that image-schemas are derived from analyzing the forces acting on objects, and Johnson (1987) claims that they are derived from one's bodily experiences. For developmental reasons, however, I have stressed spatial analyses as their source. If image-schemas are to represent preverbal meanings, they must reflect the processing limitations of very young infants. Babies begin their perceptual analyses before they have yet learned to pick up and examine objects; thus many of the action schemas that might be used for purposes of image-schematic analysis have not yet been formed. The processes of image-schema analysis must be already well advanced by the time babies have become adept at manipulating the world, and long before they can move around in it.

In addition, humans are strongly visual creatures, and it should be easier for babies to analyze visual displays (or even for blind babies to analyze displays via touch) than to analyze their internal sensations. There is no evidence on this issue, but it may be noted that we are notoriously bad at introspection even as adults. It is not that babies are unaware of feelings of force or happenings within the container that is their body. But in terms of analysis, one can see the movements of objects, whereas one must typically infer the forces operating on them—and of course one cannot see internal activity at all. It simply has to be more likely that a baby will learn about containers from watching objects go in and out of other objects than from introspecting about the act of eating. This point of view is supported by the widespread phenomenon that the vocabularies of internal states are derived from the vocabularies used to describe external phenomena (e.g., Sweetser 1990). It may be that even as adults the concepts we call "internal states" are at heart spatial analyses, given their internal "flavor" by the gut sensations associated with them. Again, I am talking about *conceptions* of internal states, not the states themselves.

but feel it! do it! putting things into things

9.5 What is the Evidence That Spatial Analyses Structure Language Learning?

The spatial analyses I have been discussing are particularly important in learning the relational aspects of language, such as the meaning of verbs and grammatical relations. Object labels can and do get mapped ostensively onto the shapes of things, although that does not in itself give them meaning. But young children do have the global preverbal meanings of animal, plant, vehicle, furniture, kitchen utensils (and perhaps many more) at the time they begin to learn object names (Mandler, Bauer, and McDonough 1991). A good deal of what parents teach young children by the way they name things is to carve these domains into smaller meaning packages. For example, children have the preverbal meaning of animal, and as discussed earlier, they also see the perceptual difference between dogs and cats. Now they hear that this-shaped animal has a different name from that-shaped animal, and, at least in our culture, much is made of the fact that the two kinds of animals make different sounds as well. All this must suggest to children that the difference between cats and dogs may matter. In this way language can help the process of subdividing the initially global concept of animal into subclasses that carry meaning above and beyond their animalness. It is interesting in this regard that in the initial stages of noun learning, children do not particularly rely on shape. But as differential labeling increases over the next few months, they increasingly rely on shape to determine the reference of new nouns (Jones and Smith 1993). Such a finding suggests that children are making the connection between nouns and the perceptual-shape categories they have learned over the course of the first two years.

On the other hand, shape-based perceptual categories such as "dog" and "cat" cannot be used for learning grammar because relations cannot be pointed to in the way that objects can. But the global domain-level concepts such as animal and vehicle that were used to give meaning to these perceptual categories can be used instead. Thus the image-schemas that give the meaning "animate thing" to dog and cat can also be used to frame language overall, to provide the relational notions that allow propositions to be built up. For example, once the meanings are formed for animate objects as things that move themselves and cause other things to move, one has arrived at a simple concept of agent (Mandler 1991). Similarly, once the meanings are formed for inanimate objects as things that do not move by themselves but are caused to move, one has arrived at a simple concept of patient. It may be because the earliest meanings are themselves abstract and relational that abstract and relational notions such as agent and patient can be formed so easily.

Verb acquisition provides concrete examples of this kind of image-schematic underpinning. Golinkoff et al. (1995) discuss in detail how the kinds of image-schemas I have outlined underlie verb learning. The first verbs that children learn all describe paths of various sorts rather than states. The "shapes" of these paths are represented by image-schemas. These specific path schemas are more particular than the paths that differentiate animate from inanimate motion, but are otherwise similar in kind. A typical example is the verb *to fall*, which specifies the direction of the path of motion, but leaves other details aside. This kind of image-schema allows children to ignore the details of a given event and so to generalize from one instance to the next—in short to categorize types of motion.

At a more general level, notions such as animate object, cause-to-move, agent, inanimate object, and caused-to-be-moved are exactly the kind of meanings needed

to master the distinction between transitive and intransitive verb phrases. As Slobin (1985) has discussed, this distinction, abstract though it may be and marked in a variety of ways in different languages, is universally one of the earliest grammatical forms to be acquired. The reason for this is that the ideas expressed in the distinction are among those which preverbal children have universally mastered by the time language begins. English does not mark this distinction with grammatical morphemes, but many languages do and these should be easy for children to learn. For example, Choi and Bowerman (1992) point out that Korean uses different forms for intransitive verbs of self-motion and transitive verbs of caused motion (for example, a causative inflection must be added to "roll" in "He rolled the ball into the box," whereas it is not needed in "The ball rolled into the box"). Korean children respect this distinction as soon as they begin to use these verbs and do not make cross-category errors.

When errors are made in these kinds of grammatical morphemes, they often consist of underextensions. For example, Slobin (1985) found that children first use the morphemes marking transitive verb clauses in the prototypical transitive situation in which an animate agent physically acts on an inanimate object. Only later do they extend the marking to the less prototypical cases in which the agent is inanimate or the patient is animate. This kind of underextension suggests that children may try a fairly direct mapping of the language they hear onto their already-formed conceptualizations. Of course, languages do not always cooperate, and some distinctions seem likely to give language learners trouble.

This raises the old Whorfian issue of the extent to which language is mapped onto preexisting concepts or by its own structure leads children to create new ones. I will illustrate this issue with the case of learning spatial prepositions. Let me say at the outset that because we all agree that language is to some degree mapped onto existing concepts, we are only haggling over the details. But one of those important details is the following. Have preverbal children learned all the major spatial relations that various languages express? Or have they learned only a subset and do languages teach them to attend to new ones they have not analyzed on their own?

Melissa Bowerman and I have discussed this issue quite a bit, although I am not sure whether we have agreed, or merely agreed to disagree. The particular issue involves the notions of containment, contact, and support. As Bowerman (1989) has discussed, the languages of the world divide up these relations in various ways, and furthermore do so by a variety of constructions. English, for example, makes a single general distinction between containment and support by means of the prepositions *in* and *on*, with contact being ignored. I have claimed that containment and support are among the first image-schemas to be formed; because they match the English prepositional system in a straightforward fashion, it is not surprising they are the earliest grammatical morphemes to be learned, and are learned virtually without error (Mandler 1992).[6] These morphemes are very frequent in adult speech, they capture a well-understood conceptual distinction, they are easy to say, and so forth.

Although containment and support sound like universal spatial primitive, Bowerman (1989) suggests that this may be a somewhat provincial view. Some languages make no distinction at all (as in Spanish *en*), and others make a three-way distinction. Furthermore, various languages make the distinctions they do make by cutting the spatial pie up in different ways. For example, German divides support relations into two, depending on whether the support is horizontal or vertical. Dutch makes a similar split but apparently uses the method of attachment to categorize the support relation, rather than the horizontal and vertical. In either language, difficult cases can appear, such as how to express that a fly is on the ceiling. Upside-down support is an unusual support relation, and one might predict that it would give young language learners trouble.[7]

Developmental psychologists have only recently begun to explore in depth the development of concepts of containment, contact, and support in preverbal infants, but the work of Baillargeon and her colleagues described earlier (e.g., Baillargeon, 1995) tells us that a great deal of detailed knowledge is accumulating in the first year. Babies apparently start with quite simple image-schemas but rapidly learn conceptual variations on these, including containment with and without contact, horizontal versus vertical support, and so forth. The data suggest that a wide variety of these conceptual notions are well established before language begins. What remains to be done is to repackage these meanings *linguistically*. Perhaps because the conceptual notions are meanings and cannot be pointed to, or perhaps just because of their abstractness, different languages repackage them in various ways (Gentner 1982), ways babies must learn by listening to their native tongue.

If the native tongue is a prepositional one, it will express a quite limited subset of spatial distinctions (Landau and Jackendoff 1993), typically making binary or trinary distinctions in relations such as containment, contact, and support. The distinctions are few enough that they should pose few problems to the language learner who comes equipped with many such preverbal meanings. There are ways to express space that are limited by other principles, however. One way is to use body parts, as in Mixtec; for example, instead of saying, "The cat is under the table," in Mixtec one would say, "The cat be-located belly-table" (Brugman 1988). The system is still spatial but ignores one set of relationships (such as containment) and instead expresses a different set (relative locations vis à vis a human or animal body). Of course, body parts are well known to the young language learner; indeed, naming body parts is a common game among parents and newly verbal children, at least in our culture. This method of linguistically partitioning space should therefore not give children trouble.

Other languages use verbs to express some of the relationships that English describes by means of prepositions. In Korean, for example, entirely different morphemes are used to express relationships of *put into*, *take out*, *put onto*, and *take off*. Furthermore, the morphemes are different for *put into tightly* versus *put into loosely*, and for putting clothes on the trunk, putting clothes on limbs, and so forth. Essentially what Korean does is to distinguish between containment and support when these relations involve loose contact, but override containment and support when tight-fitting contact occurs. It is as if the language says that if the relationship is tight-fitting both containment and support apply in equal measure so that only the type of contact will be specified.

This set of semantic categories, combined with their expression in separate verb forms means that Korean children cannot get by in the early stages of communication by widespread use of a few all-purpose prepositions such as *in* or *out* to express these relations. On the other hand, they learn the morphemes just described early and effortlessly, just as English-speaking children learn a small set of prepositions to express similar meanings. English-speaking children, of course, do not say *fit together tightly* or *put in loosely* because those ideas are not expressed by single morphemes in English. The question is whether English-speaking children already understand these particular spatial distinctions and are silent about them because of a lack in their language, or whether they do not form the relevant image-schematic meanings until the language directs them to do so.

We are back to our Whorfian issue, but we have turned it into a manageable empirical question, and Bowerman, Choi, McDonough, and I are engaged in an experimental attempt to answer it. I am not sure if we have different predictions or not. I believe that babies have had ample experience of clothes fitting tightly or of the difficulty of separating pop beads to have formed a concept of tight-fitting. Therefore, I predict we will be able to show this distinction in preverbal children. The fact that Korean children sometimes overgeneralize the tight-fitting relation to the case of clothing (Korean uses a different word for putting on clothing), indicates to me the presence of a preverbal notion (as does the more general fact that the common errors children make in learning one language are often the correct expressions of another).

We still know relatively little about the age at which these various spatial analyses begin to be made. In addition, we do not yet have good estimates of the amount of language-specific learning that takes place before word production begins. If these two factors interact, it may be difficult to disentangle their relative importance. Nevertheless, a few simple principles can be surmised. First, if a language does not make a given distinction that a preverbal baby has conceptualized, this will not cause a language-learning problem. Babies will be willing to overlook this lack of sensitivity. Second, if the language makes a distinction that the baby has already learned, that will also not cause a problem, whether the distinction is expressed by a preposition or verb (given equal salience in the speech stream). Third, difficulty will occur only when the language makes a distinction that the baby has *not* made prelinguistically. If the baby has no conception at all of the meaning of such a morpheme or construction, it should be a very late acquisition indeed. A more common situation is likely to be one in which the morpheme excludes one of the possible and likely meanings in question. A possible example is an error Korean children sometimes make in expressing the tight-fittingness of a flat magnet on a refrigerator door (the verb for *fitting tightly* has to do with three-dimensional objects, and the status of a flat magnet is not entirely clear). The presence of such errors does not necessarily mean that the language is teaching a new relationship, only that the situations described are unusual or atypical vis à vis the particular semantic cut that the language has made.

One of the points I have made about image-schema representatons of space is that they have already been simplified and schematized; they have already filtered out a great deal of the information the perceptual system takes in. Language may do some of this kind of work, as Landau and Jackendoff (1993) have hypothesized, but it seems likely to me that much of it has already been done before language is learned. Infants have been analyzing spatial relations for many months. If these spatial relations are represented in terms of image-schemas a lot of the analog-to-digital transformation needed for language learning has already been done. The result is a set of meaning packages that language can put together in a variety of ways, ignoring some, emphasizing others. At the same time, no matter what the language, the number of distinctions needed to learn the spatial pronouns and/or verbs children acquire in their first year of language is quite small, involving such notions as inside-outside, contact–no contact, horizontal-vertical, up-down, tight-loose. The language itself can help children learn the more complex relationships they master at later stages by directing perceptual analysis to aspects of stimuli they may not yet have noticed.

I will close by reiterating the importance of the conceptual level of representation to understanding language acquisition. I worry that in too many accounts language is talked about as if it were mapped onto actions or onto perception. This is a common approach in connectionist paradigms, for example. Instead, language is mapped onto a meaning system that forms an interface between analog and digital forms. This interface, which shares some of the properties of both forms, is what enables a propositional representational system to be added to the baby's repertoire.

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Notes

1. We use the term *global* for these concepts because it does not seem correct to speak of a superordinate concept if it is not yet differentiated into subconcepts (Mandler, Bauer, and McDonough 1991).

2. Infants in our experiments do make more distinctions within the vehicle domain during this age range.

3. Domain-level categorization raises the issue of how infants identify as animals little models they have never seen before, such as a model elephant. We do not yet know which features seven-month-olds are using to identify the correct domain. We have suggested that once infants have begun to analyze object movement, it directs their attention to the parts associated with motion (Mandler and McDonough 1993). This may be why infants are sensitive to what seem (to us) like very small differences between the outstretched wings of the birds and airplanes in our experiments. They do not appear to be using face information because some of our planes are Flying Tigers with faces painted on them, and some of the bird faces do not show eyes. They might be using textural information, although texture cues are minimized in our plastic models. Whether shape or texture, however, a solely perceptual account has difficulty in explaining the shifts in use of one kind of perceptual cue to another when categorizing at the basic or global level.

4. It may be of interest that in various forms of meaning breakdown (semantic dementia), the most resilient aspect of knowledge about an object such as a dog is that it is an animal. Even when patients can no longer recognize the word *dog* or a picture of a dog or say anything specific about dog, they can often still say that it is an animal (Saffron and Schwartz 1994).

5. In the case of blind infants, an exploring hand is required instead (Landau 1988).

6. Only the present progressive, *-ing*, which expresses another preverbal image-schema, traversal of a path, is learned earlier; see Brown (1973).

7. We also must not forget the arbitrary aspects of language that arise from historical accident or for other reasons. These are more frequent than we sometimes realize. For example, in London one sees signs in the Underground saying "No Smoking Anywhere on This Station," which sounds distinctly odd to American ears, but of course perfectly fine to the British. I assume that the British expression can be traced to the fact that railway stations originally consisted of raised platforms, but the example is typical of the many arbitrary aspects of language that children must learn.

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Chapter 10

Learning How to Structure Space for Language: A Crosslinguistic Perspective

Melissa Bowerman

Space is an important preoccupation of young children. From birth on, infants explore the spatial properties of their environment, at first visually and proprioceptively, and then through action. With improved motor control during the second year of life, their spatial explorations become more complex, and they also begin to talk about space. Early comments on space revolve mostly around motions, with remarks about static position also beginning to appear in the second half of the second year. The following utterances from a nineteen-month-old girl learning English are typical:

(1) a. *In*. (About to climb from the grocery compartment of a shopping cart into the child seat.)
b. Monies. *In*. (Looking under couch cushions in search of coins she has just put down the crack between the cushions.)
c. Balls. *Out*. (Trying to push round porthole pieces out of a foam boat puzzle.)
d. Books. *Out*. Books. *Back*. (Taking tiny books out of a fitted case and putting them back in.)
e. Monkey *up*. (After seeing a live monkey on TV jump up on a couch.)
f. *Down*. *Drop!* (After a toy falls off the couch where she is sitting.)
g. *On*. (Fingering a piece of cellophane tape that she finds stuck on the back of her highchair.)
h. *Off*. (Pushing her mother's hand off the paper she is drawing on.)
i. *Open* mommy. (Wants adult to straighten out a tiny flexible mommy doll whose legs are bent up).[1]

Remarks like these attract little attention—the view of space they reflect is obvious to adult speakers of English. But their seeming simplicity is deceptive: on closer inspection, these little utterances raise fundamental and difficult questions about the relationship between the nonlinguistic development of spatial understanding and the acquisition of spatial language. How do children come to analyze complex events and relationships, often involving novel objects in novel configurations, into a set of