

# Where Do Children's Word Meanings Come From?

## Rethinking the Role of Cognition in Early Semantic Development

Melissa Bowerman

*Max Planck Institute for Psycholinguistics*

Acquiring a first language is a feat of astonishing complexity and speed. By 2 years of age children have learned many words and can put them together to form simple sentences, and by 4 years they have mastered most of the grammatical machinery of their language. For any theory of language acquisition, the central problem is to explain how this is possible.

Opinions about the underlying mechanisms of language development diverge widely, with some scholars urging that children come equipped with innate, domain-specific knowledge of language structure and others arguing for the power of general-purpose learning procedures. But until recently there has been widespread agreement on one important claim: that in the early stages of language development, children link linguistic forms directly to concepts and categories that they have already established in the course of their nonlinguistic cognitive development.

In this chapter I first sketch how this widely shared view has come about. Then I discuss how it is being challenged by contemporary crosslinguistic research on semantic structure and semantic development. This work suggests that although nonlinguistic cognitive development provides an indispensable foundation for semantic development, its role is less direct than has often been envisioned. Different languages organize meanings in different ways. This means that the semantic organization of a particular language is as much a part of the structure to be mastered as are the language's syntax and morphology. Instead of simply matching words to preexisting concepts, learners draw on their conceptual resources to help them deter-

mine how their local language structures the content to be expressed. Children's skill at building semantic categories is in fact remarkable: from their earliest productive language use and at least in some cases even before, the semantic categories children associate with the forms of their language are already language specific.

## THE RISE OF THE COGNITIVE APPROACH

The hypothesis that children's nonlinguistic cognitive categories play a central role in language acquisition emerged in the 1970s. Before then, the study of language development was for some time dominated by approaches that paid little attention to meaning; these included behaviorism, with its emphasis on direct modeling, imitation, and reinforcement, and distributional analyses, which focused on the positioning of linguistic forms and restrictions on their co-occurrence.

There were several reasons for the new attention to cognition in language acquisition studies. One was the outcome of the first modern studies comparing children learning different languages. Researchers had initiated these crosslinguistic studies inspired in part by Chomsky's (1959, 1965) arguments that in acquiring a language children are constructing an abstract rule system, and that in doing so they are guided by innate knowledge about the possible form of a human language. At that time, students of language acquisition were beginning to develop a detailed picture of the early speech of children learning English and—drawing on a handful of evidence from other languages—were starting to make proposals about possible universals of language development. By establishing universals, they hoped to make inferences about the nature of the underlying capacity for language acquisition.

Firm crosslinguistic evidence was essential to this enterprise. Without this evidence, it was unclear whether children's observed speech patterns reflected acquisition mechanisms common to all learners, or resulted from exposure to a language with a particular structure. For example, children learning English were found to observe a relatively fixed word order in their early word combinations. But was this because of a bias in the universal capacity for language acquisition (e.g., Slobin, 1966) or because English is a language in which word order is in fact relatively rigid? To untangle what is universal from what is language specific, researchers began to compare children learning structurally diverse languages (cf. Bowerman, 1973 on Finnish; Blount, 1969 on Luo; Kernan, 1969 on Samoan; see R. Brown, 1973 and Slobin, 1973 for overviews).

The most important outcome of these early crosslinguistic comparisons was not—contrary to expectations—a finding about invariants of early syn-

tax, but a finding about meaning. All around the world, children's first sentences were seen to revolve around a restricted set of meanings to do with agency, action, location, possession, and the existence, recurrence, nonexistence, and disappearance of objects (Bowerman, 1976; Braine, 1976; R. Brown, 1973; Slobin, 1970, 1973). As Slobin put it, "If you ignore word order, and read through transcriptions of two-word utterances in the various languages we have studied, the utterances read like direct translations of one another. There is a great similarity of basic vocabulary and basic meanings conveyed by the word combinations" (1970, p. 177).

Where did this surprising convergence on a handful of meanings come from? Piaget's work provided a critical clue. At that time—in the waning days of behaviorism—Piaget's research was only beginning to become widely familiar to U.S. developmentalists. Imagine the click of things falling into place when language acquisition researchers realized that the meanings that figure so heavily in children's early speech were precisely the kinds of meanings that Piaget (e.g., 1954) had stressed in his account of conceptual development in the first 2 years of life. An influential statement of this insight came from R. Brown (1973):

I think that the first sentences express the construction of reality which is the terminal achievement of sensori-motor intelligence. What has been acquired on the plane of motor intelligence (the permanence of form and substance of immediate objects) and the structure of immediate space and time does not need to be formed all over again on the plan of representation. Representation starts with just those meanings that are most available to it, propositions about action schemas involving agents and objects, assertions of nonexistence, recurrence, location, and so on. . . . (p. 200)

The observed correspondence between nonlinguistic and linguistic meanings gave rise to an important new vision of the nature of language acquisition. According to this view, first language development can be understood as a process of mapping the forms and combinatorial patterns of language onto concepts that have already been established in the course of nonlinguistic cognitive development (L. Bloom, 1970, 1973; Bowerman, 1973; Braine, 1976; R. Brown, 1973; Nelson, 1974; Slobin, 1973; Schlesinger, 1971). For example, constructions like *more X* and *X all-gone* could be linked to nonlinguistic notions of the recurrence or disappearance of an object or event, and word order patterns could be used to express categories of relationships; for example, *mommy hug* or *daddy go* would specify a relation of actor to action, *hug mommy* a relation of action to patient, and *sweater chair* a relation of entity to location.

This view of language acquisition—dubbed the "Cognition Hypothesis" by Cromer (1974)—took hold and spread rapidly during the 1970s.

Its success can be attributed to its incorporation of several attractive features:

1. It provided a plausible account of the apparent universality of the meanings expressed in children's early utterances. The meanings would be universal because they would arise from processes of cognitive development hypothesized to be common to all children.

2. It provided an explanation of productivity—how children go beyond the sentences they have heard to produce and understand an infinite number of novel sentences. Productivity was on researchers' minds because of Chomsky's stress on this important feature of natural languages. Productivity would follow—so the thinking went—from children's reliance on their nonlinguistic concepts to guide their application of words and word order rules. For instance, if children have formulated a simple rule like "first name the actor and then the action," they can use it to produce not only unremarkable strings like *daddy go* but also unusual ones like *spider move* (cf. Braine, 1976, p. 15).

3. The learning procedure posited by the Cognition Hypothesis could easily be hooked up to an appealing developmental "motor": children's presumed desire to communicate their emerging ideas. Many developmentalists had been persuaded by Chomsky's argument that in learning a language, children are mastering an abstract rule system. But they were less willing to accept his proposal that language acquisition is guided by the workings of an innate mental module devoted to grammar. For them, an attractive alternative was that children make progress in language by trying to identify the conventional linguistic devices—words, inflections, word order patterns, and so forth—with which they can communicate their unfolding thoughts about the world. Children would not necessarily be able to express a particular meaning in a conventional way from the moment it emerges, since rate of acquisition also is affected demonstrably by linguistic factors like the formal complexity of the device needed (Slobin, 1973). But the onset of the communicative intent would set the search process in motion.

4. Finally and perhaps most important, the Cognition Hypothesis conformed with the theoretical Zeitgeist of the 1970s, which featured a growing emphasis on universality and constraints in studies of human mental processes. A critical initial impulse for this orientation was Chomsky's (1965) argument that structural variation among languages is more superficial than many had believed, with variation held in check by inborn constraints on the possible structure of language. Initial interest in language universals focused on syntax, but there soon followed studies of semantic structure emphasizing universality and possible biological

determination (e.g., Berlin & Kay, 1969 on color terminology; Allan, 1979 and E. Clark, 1976 on object categorization in numeral classifier systems). Such findings suggested that the semantic categories of language reflect fundamental properties of human perceptual and cognitive organization. If semantic structure follows the contours of nonlinguistic human thought, then the concepts children form on the basis of their nonlinguistic experiences would seem to provide an ideal basis for language learning.

Research on semantic universals was particularly central to Slobin's seminal work on the acquisition of the "grammaticized" portion of language—inflections, case endings, prepositions and postpositions, connectives, negative markers, and other closed-class forms. Drawing on Talmy (1983, 1985), Slobin (1985) proposed that the meanings of closed-class forms are constrained across languages in ways that children are highly sensitive to. After surveying crosslinguistic evidence on the meanings children initially associate with such forms, he concluded that children approach language acquisition with a prestructured "semantic space" in which meanings and clusters of meanings constitute a "privileged set of grammaticizable notions" onto which grammatical forms are initially mapped. The particular forms that are mapped vary of course across languages, but the basic meanings are constant. A similar conclusion was reached by Bickerton (1981) in his work on the meanings that become grammaticized when new languages undergo a process of creolization.

Few theorists have supposed, of course, that grammatical development can be adequately described only as a process of discovering the mapping between preestablished concepts and linguistic forms. Even researchers generally sympathetic to the Cognition Hypothesis pointed to aspects of language that are difficult to reduce to matters of meaning (e.g., Cromer, 1974). More fundamentally, many investigators argued that the fit between meaning and grammar is too imperfect for children to be able to arrive at an adult knowledge of syntax starting only with meanings and general-purpose learning mechanisms that analyze the distribution of linguistic forms (e.g., Pinker, 1984). Children must be helped—just as Chomsky had claimed—by inborn knowledge of grammatical categories and relationships.

The appeal to innate grammatical knowledge did not, however, supplant the need to invoke nonlinguistic cognition: concepts established independently of language were now recruited to solve a new problem. Assume that children do come with inborn knowledge of the abstract properties of nouns, verbs, subjects, direct objects, and so on. To benefit from this knowledge, they have to be able to identify a given segment

in the speech they hear as an instantiation of one or another of these constructs. How do they do this? If children have foreknowledge not only of syntactic categories and relations but also of canonical mappings between syntax and meaning, they could use the meaning expressed by a form as a guide to its likely syntactic status ("Semantic Bootstrapping," Pinker, 1984; see also Grimshaw, 1981). For instance, they could assume that words specifying concrete objects are nouns and words specifying actions are verbs; similarly, the word in a sentence that names the agent of an action is likely to be the sentence subject and the word naming an object acted on the direct object. In this scenario, children's nonlinguistic concepts and categories play just as important a role in language acquisition as in the Cognition Hypothesis. The difference is in whether the concepts are seen as serving directly as building blocks for the child's early grammar, or indirectly as cues to already known syntactic categories.

Since the 1970s the appeal to prelinguistic concepts has been basic to research not only on morphological and grammatical development but also on early lexical development. In an influential early study of the "cognitive" era, Nelson (1974, p. 268) argued that prior researchers were mistaken in assuming that "the child learns meaning from his encounters with the language rather than from encounters with the physical and social world." It is posing the question backward, urged Nelson, to ask "How does the child form a concept to fit the word?" The right approach, in her view, was to ask "How does the child match words to his concepts?" (see also Huttenlocher, 1974, p. 356 for a similar view). Much of the contemporary work on early lexical development asks "How do language learners determine the intended referent of a novel word?" ("Quine's problem"; cf. Quine, 1960). Although at first glance this may seem like a return to the formulation of the question that Nelson rejected, proposed solutions (e.g., P. Bloom, *in press*; Gleitman, 1990; Markman, 1990; Tomasello, 1995) take for granted what Nelson was arguing to establish: that the needed referent concept itself—for example, 'ball,' 'throw,' 'give,' 'see'—is already part of the child's cognitive repertoire. That is, learners are seen as needing to identify the referent concept from among the set of possibilities compatible with the context, not to construct the concept in the first place.

In summary, although students of language acquisition have had different opinions about many issues since the 1970s, they have agreed widely on the view that language learners are highly structured and constrained in their cognitive development and that they rely on nonlinguistically established concepts and categories to help them acquire grammar and lexicon. For the study of language development, the legacy of the cognitive revolution has been the pervasive assumption that the meanings associated with the basic vocabulary and grammatical structure

of a language arise in language learners independently of the linguistic input.<sup>1</sup>

### **THE CHALLENGE OF CROSSLINGUISTIC VARIATION IN SEMANTIC STRUCTURE**

After a particular intellectual framework has been firmly in place for a while, problems that were swept aside in the initial enthusiasm begin to reassert themselves, at first tentatively and then more insistently. And there is indeed a major difficulty in the vision of language acquisition I have just sketched—a problem that is stimulating a rethinking of the role of nonlinguistic cognition in language development. What is this problem? Put simply, it is the conflation of semantics with cognition: the assumption that the semantic categories of a language can be equated directly with the concepts that human beings everywhere formulate spontaneously in the course of their nonlinguistic cognitive development.

This equation would be plausible if languages everywhere partitioned conceptual content in just the same way. And indeed the identification of semantics with cognition arose, as I mentioned earlier, in an intellectual climate of stress on semantic universality. It is undoubtedly true that the patterning of meaning in language is constrained, perhaps even strongly constrained. But “constrained” does not mean uniform. In virtually every conceptual domain, languages display a striking range of crosscutting options for structuring and combining the categories of meanings with which words, grammatical morphemes, and construction patterns are associated.

Semantic variation commanded considerable interest earlier in the 20th century, as attested especially in work on North American Native American languages by linguists and anthropologists such as Boas, Sapir, and Whorf. But attention to differences in the structuring of meaning was associated with the controversial idea that patterns of language determine patterns of thought (the Whorfian hypothesis; cf. Whorf, 1956). Attempts to test this hypothesis in the 1950s and 1960s yielded mixed or negative results. As enthusiasm for cognitive and linguistic universalism bloomed in the 1970s, the Whorfian hypothesis was widely dismissed, and the differences in semantic structure that had given rise to it were downplayed or forgotten.

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<sup>1</sup>In reviewing the development of the cognitivist position I have necessarily simplified somewhat. Even those who strongly rely on the view that meanings are established first have sometimes acknowledged problems for this view (e.g., Gleitman, 1990, fn. 1), and crosslinguistic challenges of the kind I will discuss in the next section have been foreshadowed in earlier studies, for example, Bowerman (1985), Gentner (1982), Pinker (1989), and Schlesinger (1977).

In the rejection of the Whorfian hypothesis, the baby was thrown out with the bath water. Whether or not the semantic categories of a language influence the way its speakers think, we must still account for how children acquire them—how they master language-specific ways of organizing meaning. The equation of semantic development with nonlinguistic cognitive development has led to neglect of a whole chapter in the story of language acquisition: how children end up controlling the semantic patterns of their own language, as distinct from those of other languages.

Significant variation in semantic structuring has been documented for a variety of conceptual domains, including, for example, notions of agency and causality, temporality, modality, animacy, criteria for individuating entities, and criteria for determining what will be treated as an "event." In this chapter, I focus on the domain of space. Space may seem like a surprising content area with which to explore crosslinguistic semantic variation and its effects on children. The ability to perceive and mentally represent spatial relationships is fundamental to human life, and it is supported and constrained not only by vision and other biological systems but also by universal physiological and environmental factors like upright posture, front-back asymmetry, and the workings of gravity (H. Clark, 1973). In linguistics, spatial concepts are often taken as basic because they provide structuring principles not only for spatial language per se, but also for other semantic domains like time, state change, and causality (e.g., Talmy, 1976; Jackendoff, 1976; E. Clark, in press).

Children clearly know a great deal about spatial relations before they begin to talk about them. Piaget and Inhelder (1956) showed this early on for toddlers, and it has been demonstrated since in ever more sophisticated ways for ever younger infants (e.g., Antell & Caron, 1985; Bailargeon, 1995; Behl-Chadha & Eimas, 1995; Needham & Bailargeon, 1993; Quinn, 1994; Sitskoorn & Smitsman, 1995; Spelke, Breinlinger, Macomber, & Jacobson, 1992; see Bowerman, 1996a for a review). Consistent with these findings, space has long served as a paradigm case for the claim that language maps to children's nonlinguistic concepts, and with good reason. Consider findings like these:

1. Both within and across languages, children acquire locative markers (prepositions, postpositions, case endings) in a relatively consistent order: first morphemes for notions of containment (*in*), contiguity and support (*on*), and occlusion (*under*); then for proximity (*next to*, *beside*, *between*); and finally for projective relationships (*in front of*, *behind*; Johnston, 1985; Johnston & Slobin, 1979; Sinha, Thorseng, Hayashi, & Plunkett, 1994). This sequence is consistent with the order of emergence of spatial concepts as established through nonlinguistic testing by Piaget and Inhelder (1956). This has suggested that cognitive development is the pacesetter for spatial semantic



development (Johnston & Slobin, 1979): as new concepts mature, children look for linguistic forms to express them with.

2. Early spatial words often generalize rapidly from familiar to novel situations. For example, by as early as the one-word stage, forms like *in*, *out*, *up*, *down*, *off*, and *open* are extended to a wide variety of events that are similar in trajectory of movement or salient outcome state, abstracted across entities of different kinds (McCune-Nicolich, 1981; Smiley & Huttenlocher, 1995). Rapid generalization has suggested to researchers that the child's use of the words is guided not by concepts that are in the process of being formulated, perhaps under guidance from language, but by concepts that are already in place when the words are acquired.

3. Children often use spatial words somewhat idiosyncratically from the adult point of view. For example, children learning English tend to apply the verb *open* too broadly, using it not only for actions on doors, boxes, and drawers, but also for separating two Frisbees, taking a piece out of a jigsaw puzzle, and pulling the stem off an apple (Bowerman, 1978; see also E. Clark, 1993). Conversely, English-speaking toddlers initially restrict words like *up*, *down*, *in*, and *on* to situations in which an object moves (e.g., [put the] *ball in*), and extend them only later to situations of static position ([There's a] *ball in* [there]; Smiley & Huttenlocher, 1995). Overextensions, underextensions, and other deviations from adult usage have been taken to show that children initially link spatial words to their own spontaneously generated spatial concepts (Bowerman, 1978, 1980; E. Clark, in press; Griffiths & Atkinson, 1978; Johnston, 1985; Smiley & Huttenlocher, 1995).

The conviction that first spatial words express nonlinguistic spatial concepts has rested not only on empirical findings but also, more implicitly, on the sense shared by native speakers of a language that the meanings of everyday vocabulary items reflect the obvious way to conceptualize things. The first spatial words in English and closely related languages are particles like *in*, *out*, *on*, *off*, *up*, *down*, and *back* and verbs like *fall*, *come*, *go*, *give*, *open*, and *break*. It is easy for researchers who speak these languages to assume that the meanings of such words reflect an inevitable conceptual parsing of space into such seemingly basic concepts as *containment*, *support*, *verticality*, and motion *toward* or *away from* the speaker. But none of the semantic categories associated with these words is, in fact, universal.<sup>2</sup>

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<sup>2</sup>For crosslinguistic differences in the categorization of 'in - out' and 'on - off' - type relations see Bowerman (1989, 1996a, 1996b); Bowerman & Choi (in press); Brugman (1984); Choi & Bowerman (1991); and P. Brown (1994); for 'up - down' and 'fall' relations, see P. Brown (in press); Choi & Bowerman (1991); and de León (in press); for 'give' see Margetts (1998), Newman (1998), and Talmy (1982, 1985; cf. Bowerman 1994, p. 39 for implications of Talmy' analysis for acquisition); for 'come - go' see Wilkins & Hill 1995; for 'open' see Bowerman (1996a); and for 'break' see Pye (1996).

Consider, for example, the linguistic classification of the following actions: (a) putting a block into a pan, (b) putting a small book into a fitted case, (c) putting a Lego piece on a stack of Legos, (d) putting a ring on a finger, (e) putting a cup on a table, (f) putting a hat on someone's head, and (g) putting a towel on a towel rack. In events (a) and (b), the moving object (the Figure) ends up contained by the reference-point object (the Ground; these terms are Talmy's, 1985). English speakers describe such actions with a verb-particle construction that includes the particle *in*, for example, *put in*. In (c) through (g), the Figure ends up in contact with and supported by an external surface of the Ground; events of this kind are typically called (*put*) *on*. This way of grouping and distinguishing the events is shown in Fig. 9.1.

In Dutch, as in English, the main work of encoding spatial relationships is carried out by prepositions/particles. One of these forms—*in* 'in'—picks out the same two containment situations distinguished in English (a, b; see Fig. 9.2). But Dutch makes a finer breakdown among the contact-and-support relationships: actions (c), (d), and (e) are typically described with *op* 'on1,' action (f) with *om* 'around,' and action (g) with *aan* 'on2.'

*Om* 'around' has a meaning similar to English *around*, so in itself this category is familiar, but its application is more insistent: in many situations where English speakers prefer *on*, stressing the contact-and-support aspect of the situation over the encirclement aspect, Dutch speakers routinely select *om*, for example, "put your safety belt *om*," "put the ring *om* your finger," or "put the diaper *om* the baby."

The difference between *op* 'on1' and *aan* 'on2' is more exotic to English speakers (see Bowerman, 1996b for analysis). When used for concrete spatial situations, *aan* applies to relations in which the Figure is construed as acted on by an external force—most typically gravity—that would pull it away from the Ground if it were not held in place, for example, by attachment at a fixed point. *Aan* is thus the preposition of choice for situations of less attachment by hanging (e.g., 'picture *aan* wall,' 'coat on hook') and by screws, string, and the like ('side-view mirror *aan* car,' 'handle *aan* cupboard door,' 'kite *aan* string,' 'dog *aan* leash'). *Op*, in contrast, picks out relations in which the Figure is construed as "at rest"—not pulled away from the Ground by any salient external force. This conceptualization applies most obviously to things supported from below ('cup *op* table,' 'child *op* stool'), but also to living creatures who seem to rest as naturally on a vertical or underneath surface as we do on the floor ('spider *op* wall,' 'fly *op* ceiling')<sup>3</sup> and to lightweight, relatively flat

<sup>3</sup>A contrast can be made between, for example, 'spider *op* wall' and 'spider *aan* wall': the former indicates that the spider is living and stays in contact with the wall in the way that is natural for spiders, whereas the latter suggests that the spider is dead and so could be expected to drop off the wall, but somehow remains stuck in place.

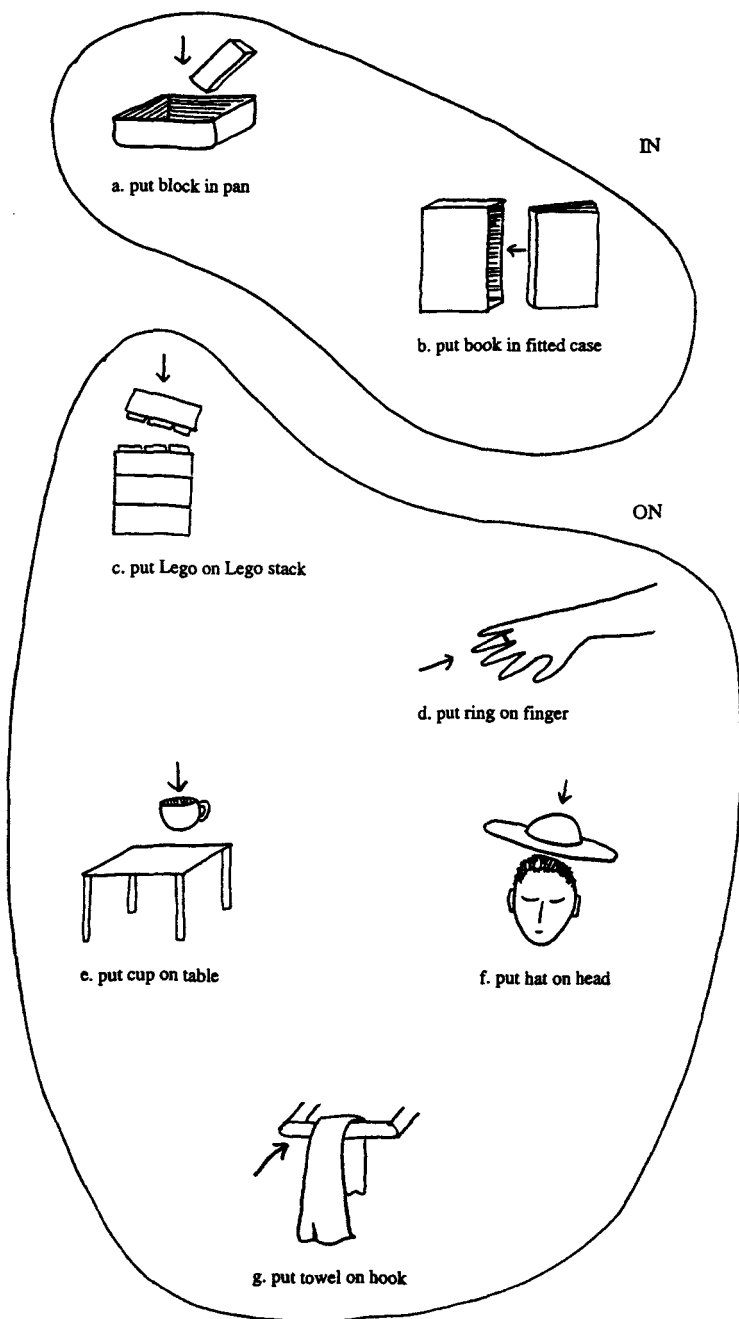


FIG. 9.1. Classification of some actions in English.

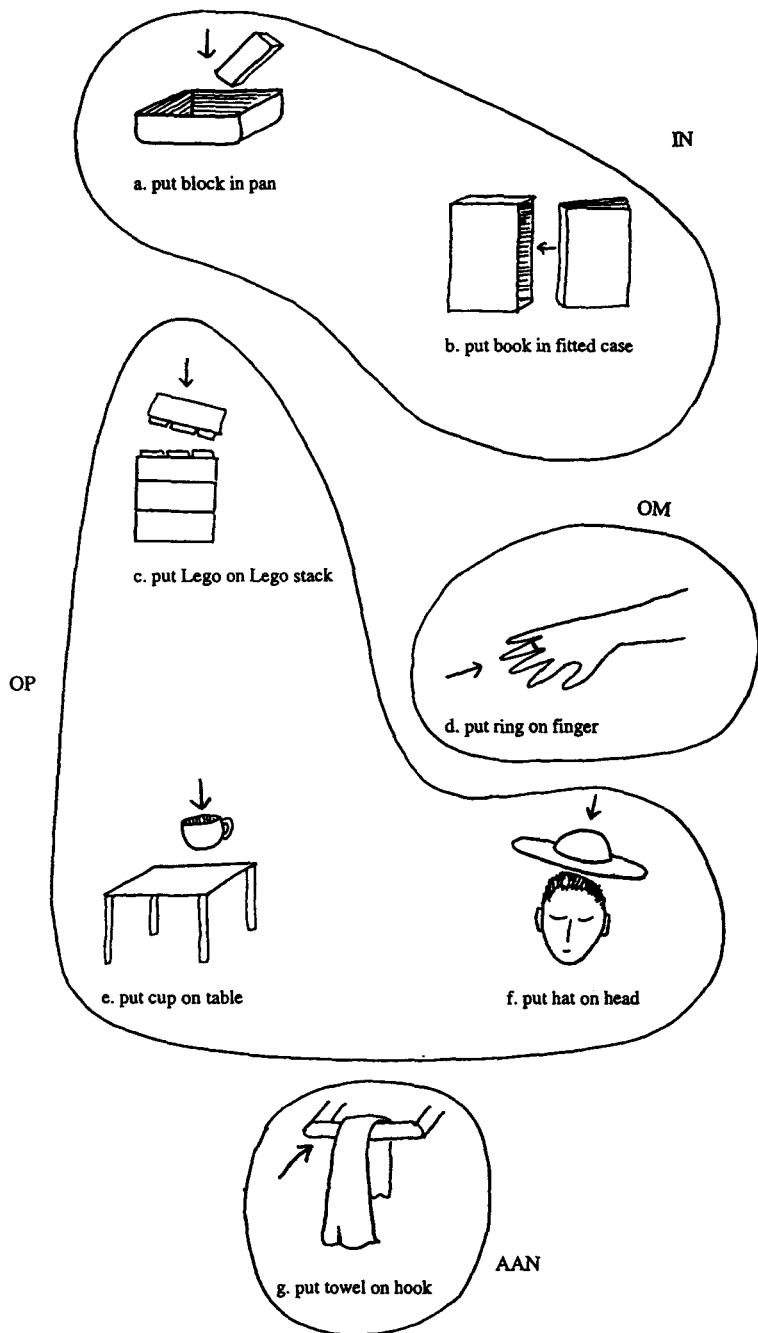


FIG. 9.2. Classification of some actions in Dutch.

Figures that stay in place by adhesion or surface tension ('bandaid *op* leg,' 'raindrops *op* window,' 'dust *op* wall').

In Korean, the classification is again different. Korean has no forms comparable to the spatial prepositions/particles of English and Dutch; most of the work of expressing spontaneous or caused motion along a path is done by verbs.<sup>4</sup> The semantic categories associated with path verbs often differ strikingly from the path categories of English, especially for caused motions of putting something somewhere (Choi & Bowerman, 1991). This is illustrated for the current set of actions in Fig. 9.3.

Notice first that the containment category—so fundamental in English and Dutch—is absent. Instead there is a new, crosscutting category that treats one of the containment actions—(b) 'put book in fitted case'—as similar to two of the support actions ((c) 'put Lego on Lego stack' and (d) 'put ring on finger'), and different from the other containment action ((a) 'put block in pan'). This category is labeled by the high-frequency verb *kkita*. What do the actions called *kkita* have in common? They all involve the joining of three-dimensional objects whose shapes are complementary and fit together snugly. English has no word for this topological spatial concept.<sup>5</sup> Other examples include putting an earplug *in* an ear, glasses *in* a glasses case, and one nesting cup *in* another; putting a tight-fitting lid *on* a pan, a cap *on* a pen, a ring *on* the pole of a stacking toy; putting two paper cups or two Lego blocks *together*, and even buttoning a button, snapping a snap, and closing a latching cupboard door.

The four other manipulations shown in Fig. 9.3 fall into distinct semantic categories of Korean. Action (a) is described with *nehta*, which applies most prototypically to putting something into a loosely fitting container, but also to putting an object loosely around another object, such as a loosely fitting ring on a pole. Action (e) is encoded by *nohta* 'put loosely down on a surface'; (f) by *ssuta* 'put clothing or related item on the head or face' (e.g., hat, glasses, mask; put up umbrella). Other common cloth-

<sup>4</sup>In Talmy's (1985, 1991) typological classification of the characteristic way in which languages express path meanings, Korean is a "verb-framed" language, that is, a language that expresses path primarily through verbs (Choi & Bowerman, 1991). In contrast, English and Dutch are "satellite-framed" languages—languages that express path primarily through particles, prefixes, and so forth. English does have some verbs that express path—for example, *enter*, *exit*, *ascend*, *descend*, *insert*, and *extract*—but these were borrowed from French, a verb-framed language, and belong to a somewhat higher register than everyday expressions such as *go in / out / up / down*, and *put in*, *take out / off*.

<sup>5</sup>For example, *fit* is too general because it is not sensitive to the criteria that the shapes be complementary before the action is carried out (cf. "Does this belt fit?") and that they fit in a three-dimensional sort of way ("This bandaid is too small, it won't fit over the wound."). *Interlock* or *mesh* come a bit closer, but these suggest the engagement of more than one projecting part from each object, so it seems absurd to use them for putting, for example, a book in a case or a cap on a pen.

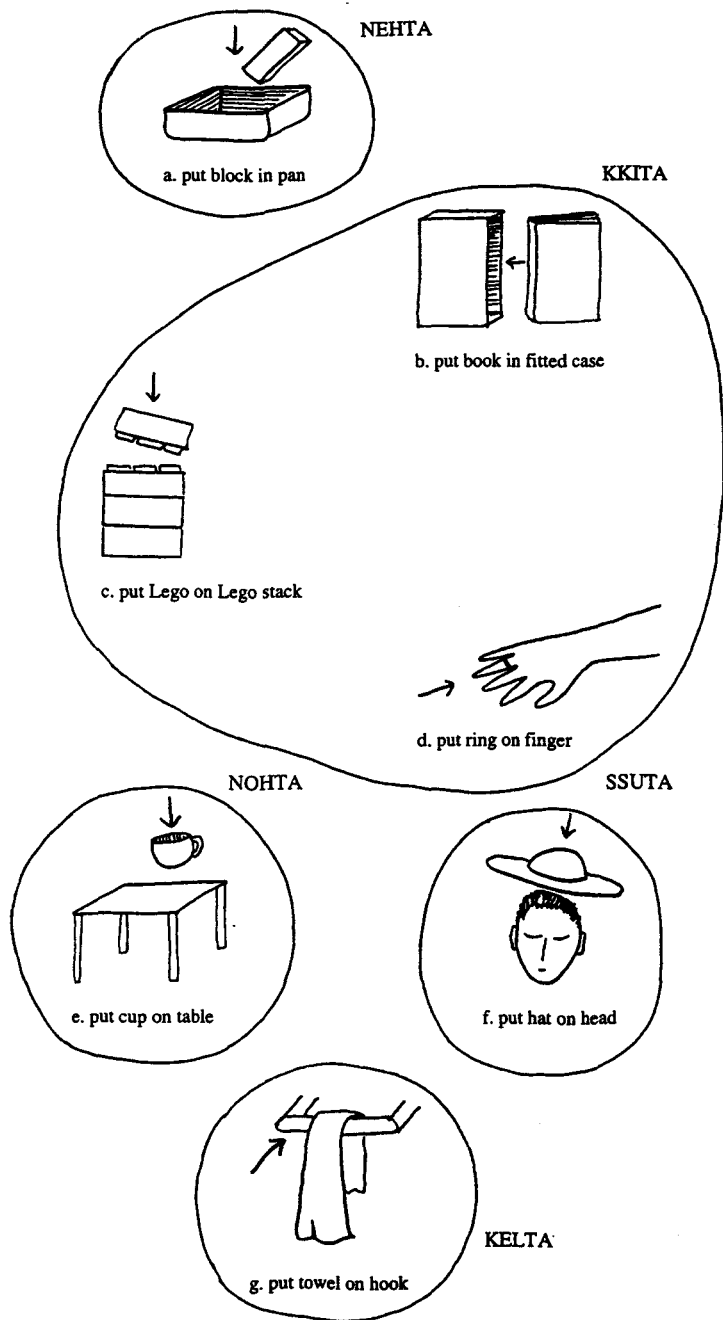


FIG. 9.3. Classification of some actions in Korean.

ing verbs include *ipta* 'put clothing on the trunk' and *sinta* 'put clothing on the feet'. Finally, (g) is specified by *kelta* 'attach with hook, peg, or the like' (e.g., hanging a Christmas tree ornament on a tree; hooking two train cars together).

As these examples suggest, spatial situations are characterized by a multitude of properties that can be used to distinguish them from or class them together with other situations. In learning to talk about space, children must learn to attend to different things to decide what spatial relationship is at stake. For the English and Dutch speaker, what is relevant for talking about putting a book into a fitted case is that the book comes to be contained, but for the Korean speaker, it is that the book and the case have snugly fitting complementary shapes. The Dutch speaker must assess the force dynamics of how a Figure stays in contact with an external surface of a Ground to select a preposition (cf. 'picture *aan* wall' but 'fly *op* wall'), whereas for the English speaker this is irrelevant—*on* works fine across a wide range of contact-and-support situations.<sup>6</sup>

Crosslinguistic variation in semantic categorization raises questions for the view that children's early uses of spatial morphemes are guided directly by their nonlinguistic conceptualizations of spatial situations. Which of all the various overlapping conceptualizations that could be applied to any given situation will children home in on spontaneously? Notice that reliance on containment and support—conceptualizations that seem so obvious to English speakers—would lead to rapid and correct generalization for children learning English, but to many errors for children learning, for example, Korean. But children do of course make errors. Recall Slobin's (1985) conclusion, based on crosslinguistic analyses of children's under- and overextensions of grammatical morphemes, that all children initially rely on the same set of meanings. According to this view, learners are at first insensitive to the way meanings are structured in the language they hear. It is their own meanings that they first try to express—sensitivity to language-specific categories develops only gradually. This is a testable hypothesis, so let us see whether it is correct for space.

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<sup>6</sup>In still another scenario, children learning Tzeltal and Tzotzil, Mayan languages of Mexico, must learn to select among different verbs to specify the location of objects of different shapes and orientations (P. Brown, 1994; de León, in press). For instance, in Tzeltal, *pachal* 'to be located' is said of a bowl-shaped object in upright position (e.g., 'bowl *pachal* at table'; but also of things located *inside* such an object 'apple *pachal* at bowl'). *Waxal* works similarly, but for a narrow-mouthed container in upright position (e.g., bottle on table), or its contents (e.g., water in bottle). *Pakal* is said of an inverted object lying with its flat surface down, *wolol* of a small sphere, *k'olol* of a large sphere, *lechel* of a smallish flat thing, *chepel* of things sitting bulging in a bag, and so on.

## LEARNING TO CATEGORIZE SPACE FOR LANGUAGE

Together with colleagues, I have investigated the early development of spatial semantic categories in children learning English, Korean, Dutch, and Tzotzil Mayan. I first summarize results of an elicited production study in which the youngest subjects were 2 to 2½ years old, and then move to still earlier developmental stages—first to the emergence of spatial words in spontaneous speech and then to a comprehension study with children who often did not yet actually produce the critical words.

### Joining and Separating Objects in Elicited Speech

Exploiting crosslinguistic differences of the sort just discussed, Soonja Choi and I examined how speakers of English, Korean, and Dutch describe actions that involve joining and separating objects (Bowerman, 1996a; Choi, 1997). In a play-like situation, we elicited descriptions of a wide range of actions from ten adults for each language, and ten children in each of three age groups from 2;0 (years; months) to 3;6. The actions included putting things into tight and loose containers (e.g., piece into puzzle, Legos into pan) and taking them out, putting objects down on surfaces, attaching and detaching things in various ways (e.g., Band-Aid, train cars joined with hooks or magnets, suction cup, rubber band, lid on pan, Legos, Pop-beads), opening and closing things (e.g., suitcase, box), hanging things up and taking them down (towel on hook), buttoning and unbuttoning, and donning and doffing various clothing items.

Speakers were tested individually. We encouraged them to talk about each action by presenting the relevant objects—for example, a ring poised over a pole—and almost but not quite performing the action to be described, pausing to say things like “What should I do? Tell me what to do.” This technique worked well: even in the youngest age group, 87% of the responses were attempts to label the intended action.<sup>7</sup>

To explore and compare speakers’ classification systems, we constructed for each speaker a similarity matrix that represents all the actions taken pairwise. If the speaker used the same expression for both members of a given pair (e.g., [*put*] *in* for putting both a piece into a puzzle and a Lego into a pan), the corresponding cell of the matrix was assigned a score of

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<sup>7</sup>The responses of children learning English and Dutch typically consisted of a particle, sometimes accompanied—especially among the older children—by a verb, for example, (*put it*) *on!* The responses of the children learning Korean were usually verbs, for example, *kki-e* (stem of *kkita* ‘interlock complementary shapes’ - MODAL).



1; if he or she used different expressions (e.g., *kkita* for putting a piece into a puzzle and *nehla* for putting a Lego into a pan), the cell was assigned a 0.<sup>8</sup> Similarity matrices—which are more familiar from studies in which subjects are explicitly asked to sort items—can be used to assess the overall degree of similarity in the classification patterns of different respondents independent of the actual words they used, and the structure in the matrices can be further explored with techniques like multidimensional scaling and cluster analysis.<sup>9</sup>

Our most basic question was straightforward: do young children classify more like same-age children learning other languages or adult speakers of their own language? If children proceed by mapping their first spatial words to a small set of putatively universal nonlinguistic concepts like containment and support, as these become available through cognitive development, they should initially classify very similarly to each other, even though the actual words they use will of course differ, depending on the language being learned. But if early word use is based on learners' analyses of the spatial categories of the input language, they should classify more like adult speakers of their own language.

To assess overall degree of similarity among different groups of speakers, we treated each cell in the similarity matrix as a variable and correlated every individual with every other individual. A high correlation between two speakers indicates high agreement in which actions they treated as similar (i.e., described with the same words, regardless of what words these were) or as different (described with different words). With paired *t* tests, we then compared the average correlations among speakers of different groups.

The outcome was clear: even the children of the youngest age group grouped and distinguished the actions significantly more like adult speakers of their own language than like same-age children learning the other two languages. There was no evidence for a uniform starting set of spatial categories across children learning different languages. Some of the differences we found between the youngest speakers of English and Korean (2;0 to 2;5 years) are shown in Figs. 9.4 and 9.5. These figures indicate how the two sets of children classified a subset of the "joining" actions—those actions for which at least 4 of the 10 speakers of at least one of the languages used the same word (the actual number is indicated next to the action), and there was no other equally frequent response (for more detail, see Figures 3 and 4 in Bowerman, 1996a).

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<sup>8</sup>In some analyses we graded similarity more finely; for example, the score assigned to *put in* versus *push in* would fall between 0 and 1, reflecting a partial but not complete correspondence in the speaker's responses.

<sup>9</sup>In analyzing these data, Choi and I were joined in our collaboration by Jim Boster.

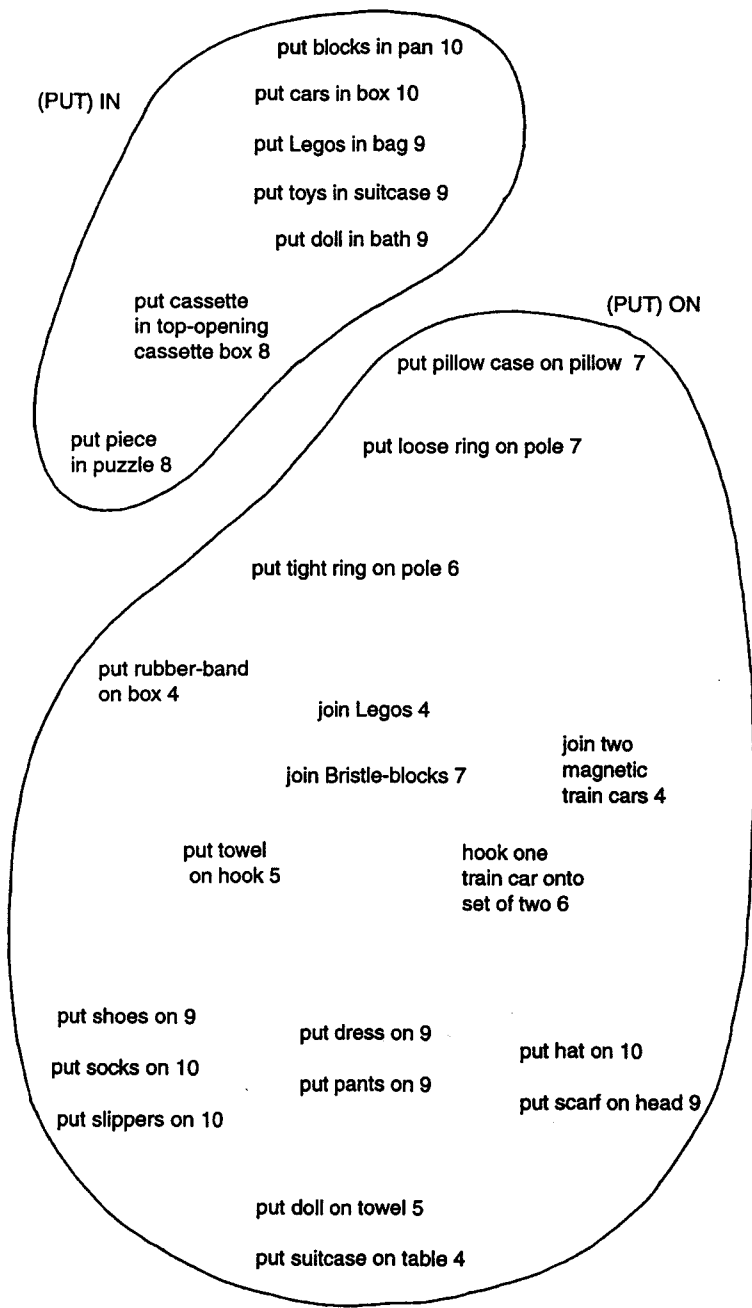


FIG. 9.4. Classification of some joining actions by children age 2;0 to 2;5 learning English.

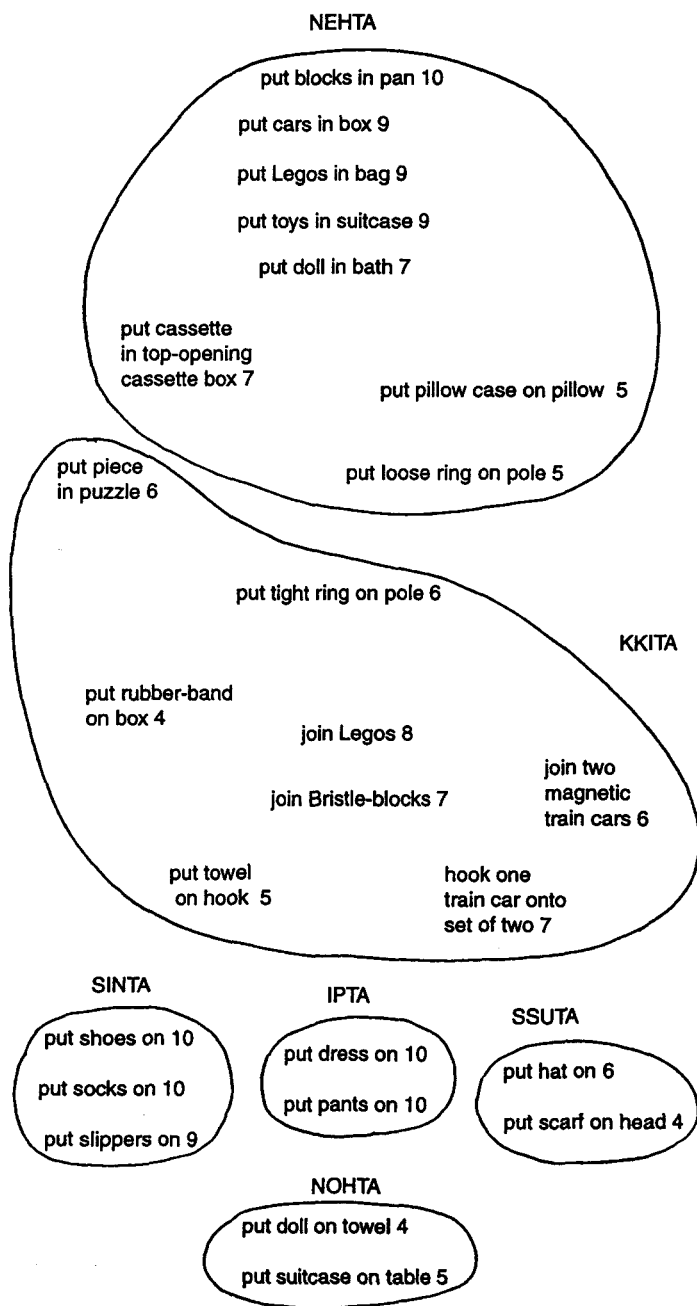


FIG. 9.5. Classification of some joining actions by children age 2;0 to 2;5 learning Korean.

## Spatial Categories in Early Spontaneous Speech

The study just described shows that at least by 2;0 to 2;5 years, children learning different languages classify spatial situations differently for purposes of talking about them. There is no evidence, for example, that all children initially draw directly on concepts of containment or support. But although these children are young, they are beyond the very first phase of language acquisition. Perhaps we must look to still younger children to find evidence for a uniform way of classifying space. To explore earlier stages, Choi and I charted the emergence and early use of spatial words in longitudinal spontaneous speech samples collected from English- and Korean-speaking children between the ages of about 1 and 3 years (Choi & Bowerman, 1991).

In some ways both sets of children were very similar: they first began to use spatial words at about 14 to 16 months, and by 20 months or earlier they used these words productively, extending them to novel situations and sometimes making errors. The kinds of situations they talked about were also similar. But language-related differences, including those illustrated in Figs. 9.4 and 9.5, were strongly present from the beginning.

For example, the English-speaking toddlers distinguished systematically between containment and surface contact/support regardless of fit, saying *in* for putting, e.g., a book into a fitted case (*snug*) and a toy into a bag (*loose*) and *out* for the reverse of these actions; and *on* for snapping a rein back onto the side of a rocking-horse's mouth and joining Lego pieces (*snug*), for climbing on a stool and putting on clothing (both *snug* and *loose*), and *off* for the reverse of these actions. The Korean children, in contrast, ignored the containment-support distinction in favor of a "snug-loose" distinction. For snugly fitted relations, they said *khita* 'interlock complementary shapes' and its opposite, *ppayta* 'separate interlocked shapes' (e.g., putting a peg doll into a perfectly fitting niche in a toy chair and taking it out; putting one Lego piece on another and taking it off). For loose relations they used a variety of words, including *nehta* 'put loosely in or around' and its opposite *kkenayta* 'take out / off . . .' (e.g., blocks into and out of a pan, a loose ring on and off a pole), *nohta* 'put down on surface,' and the clothing verbs *ssuta* 'put clothing on head,' *ipta* 'put clothing on trunk,' *sinta* 'put clothing on feet,' and *pesta* 'remove clothing item.'

The two sets of children also talked differently about vertical motion. In the speech of children learning English, the words *up* and *down* are among the first spatial words to appear—sometimes by as early as 12 to 14 months (e.g., Greenfield & Smith, 1976; Nelson, 1974) and typically by 16 to 17 months (L. Bloom, 1973; Gopnik, 1980). The words are at first often restricted to movements of the child's own body, although within that context they are used for many different kinds of movement, including posture changes like standing up and sitting or lying down, spontaneous motions like going

up and down stairs and climbing on and off furniture or laps, and caused motions like being picked up and put down, being put into a high chair and taken down. Soon the words are also extended to movements of many other kinds of objects, including the spontaneous motions of other animate beings and caused motions like picking objects up off the floor, moving objects to a higher surface, moving them lower, or putting them down on the floor. Researchers have often interpreted the rapid extension of *up* and *down* as evidence for the operation of core concepts of vertical movement (Nelson, 1974; L. Bloom, 1973; McCune-Nicolich, 1981).

The English-speaking children in Choi's and my study also said *up* and *down* across a wide range of situations by 18 months or earlier, depending on the child and the word. Our Korean-speaking children, in contrast, used no uniform expressions for events involving motion *up* or *down*, and their various words for such events came in slowly over a long period of time. The earliest such words (17–20 months) included *antia* 'hold/carry in arms' and *epta* 'hold/carry on back' as requests to be picked up, and *ancta* 'assume a sitting posture' (up or down), *nwnupta* 'lie down,' and *ileseta* 'stand up' for posture changes. Somewhat later (21–22 months), expressions like *ollita* 'cause to ascend' and *naylita* 'cause to descend' began to be applied to caused motions of putting an object (e.g., book, child) on a raised surface or taking it down. Becoming productive still later were the intransitive expressions *olla kata* 'ascend go' (= go up) and *naybye kata* 'descend go' (= go down), used for spontaneous vertical motions like climbing up on a couch, getting down from a step or a high chair, and going up and down stairs.<sup>10</sup>

A special case of vertical motion is falling. Like other learners of English, our English-speaking children said *fall* or *fall down* early and often for a broad range of uncontrolled motions downward, for example, when they themselves tripped and fell, when a toy toppled over, or when an object fell off a table or chair. Korean-speaking children, in contrast, distinguished, as Korean requires, between falls from a higher to a lower place (e.g., pencil falls from table, magnet falls from refrigerator: *ttelecita*) and falls onto the same surface (e.g., child falls on floor, tower is knocked over: *nemecita*).

Children learning Tzotzil, a Mayan language spoken in the Chiapas highlands of Mexico, encode still other spatial semantic categories in their

<sup>10</sup>As these examples illustrate, the English- and Korean-speaking children also differed in their treatment of caused versus spontaneous motion along a path. The English speakers used some path particles for both caused and spontaneous motion by 14 to 16 months and many by 20 months, for example, *down* both when pushing a cat's head downward and when climbing down from a doll's crib (17 months). The Korean speakers, in contrast, distinguished scrupulously between caused and spontaneous motion, using only transitive verbs for the former and—somewhat later to emerge—intransitive verbs for the later; for example, *naylita* 'cause to descend' for taking an object down from a counter and *naybye kata* 'descend go' for getting down from a counter. (See Choi & Bowerman, 1991, for discussion.)

early spontaneous speech (Bowerman, de León, & Choi, 1995; de León, 1999, in press). Like learners of Korean, these children initially express spatial meanings with verbs. One of their earliest productive spatial words—comparable in frequency and productivity to *in* in English and *kkita* 'interlock complementary shapes' in Korean—is *xoj*. In adult speech this verb specifies actions that cause an elongated object to end up encircled by a ring- or tube-shaped object (there is no comparable word in either English or Korean). Children use it appropriately to specify, for example, putting a ring *on* a pole or a pole *through* a ring, a coil of rope *over* a peg, and an arm, leg, or head *into* a sleeve, pant-leg, or opening in a shawl.

Tzotzil toddlers are also quick to master several different verbs that distinguish language-specific categories of position: *nuj* 'be located face down/upside down,' *kot* 'be located standing on all fours,' *pak* 'be located on the ground,' and *kaj* 'be located on a high surface.' They use no all-purpose words for vertical motion, but—like Korean children—distinguish between various posture changes, being picked up and carried on different body parts, and falling in different ways, for example, *p'aj* 'fall straight down from height,' *lom* 'topple over,' of a vertical figure like a tree or lamp post, *jach* 'animate being in motion slips and falls on base (e.g., mud, ice)' (de León, in press).

Although the children approximated the semantic spatial categories of the input language remarkably well, they did make certain kinds of errors. For instance, the English speakers sometimes overextended *in* to 'between' situations like putting a ping-pong ball in the space between the knees and looking for coins between the cushions on a couch. The Korean children sometimes used *kkita* for snug fit events in which the joined objects did not have complementary shapes before the action was performed, as the verb requires, but only afterward (e.g., plunging a fork into an apple). Such errors are important because—along with correct use for novel referents—they show that children's good conformity to the semantic classes of the input language cannot be dismissed as due simply to learning what to say in specific situations, but rather is guided by productive principles of categorization (see Choi & Bowerman, 1991, for discussion of this issue). But the errors did not converge on a uniform set of spatial concepts such as containment or support. Rather, they pointed to learners' problems in identifying the boundary conditions of categories that, at least in broad outline, were already language specific.

### Still Earlier Evidence for Language-Specific Categories?

The evidence just reviewed suggests that there is no period during which children's use of spatial words is guided directly by a universally shared set of spatial conceptualizations. Already from earliest productivity, spatial

words are associated with language-specific categories of events. But when, then, does this sensitivity develop? Presumably it must already begin to emerge sometime during the period from about 9 months to 2 years of age, when children understand far more words than they can produce (Benedict, 1979; Goldin-Meadow, Seligman, & Gelman, 1976; Huttenlocher, 1974).

Most studies of very early comprehension have used rather minimal evidence to credit children with understanding a word; for example, children are asked to look at or pick up an object referred to by a noun (e.g., *doll*) or point to or perform an instance of an action specified by a verb (e.g., *dance*). With rare exceptions (e.g., Huttenlocher, Smiley, & Charney, 1983), researchers have not worried in detail about the structure of the category the child associates with the word. And crosslinguistic work on category structure in early comprehension is virtually nonexistent. To address this gap, Choi, McDonough, Bowerman, and Mandler (1999) designed a preferential looking study to compare young children's comprehension of the category structure of two overlapping language-specific categories: (*put*) *in* for learners of English and *kkita* 'interlock complementary shapes' for learners of Korean.

The basic preferential looking technique was pioneered for use in studies of language development by Golinkoff, Hirsh-Pasek, Cauley, and Gordon (1987) and further adapted by Naigles (1990).<sup>11</sup> The child sits on a parent's lap in front of two TV monitors, mounted side by side. The monitors show different scenes. These are first introduced one by one, while an audio from a loudspeaker between the monitors encourages the child in general terms to examine them. Then the two scenes are shown simultaneously, along with an audio input that "matches" (describes) only one of the scenes. If children understand the auditory input, they gaze longer overall at the matching scene.

Our crosslinguistic experiment was composed of four pairs of videotaped actions of putting objects somewhere.<sup>12</sup> For two of the pairs, the matching scene was the same in both languages: the Figure ended up both contained by and tightly fitted with the Ground (e.g., 'putting books into a tightly fitted case'), so the action qualified as an instance of both *put in* and *kkita* (in this pair the other scene was 'putting books on top of each other'). These two pairs were termed *conflated pairs*, because the properties of containment and

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<sup>11</sup>We modeled our lab on that of Letty Naigles, whom we thank for her generous sharing of software and expertise.

<sup>12</sup>Each action was performed three times in succession. To avoid unnecessary distractions only the actor's hands and arms were shown, and within each pair of scenes care was taken to equate colors and the rhythm with which the actions were performed, and other factors that might influence the relative salience of the two scenes. For half the children the side on which the matching screen was shown was left, right, right, left across the four pairs, and for the other half it was right, left, left, right.

tight-fit/interlocking—critical for *in* and *kkita*, respectively—were combined in the same scene. In the two other pairs (*split pairs*), these two properties were split and assigned to different scenes, so the matching scene was different for the two languages. For example, one of the split pairs showed ‘putting plastic rings into a basket’ (containment, the match for English) versus ‘putting rings on tapered plastic poles’ (tight fit, the match for Korean). The target word intended to direct the child’s attention was embedded in a carrier sentence such as “Where’s she putting it *IN*?” for English or “Eti-ey *KKI*-e?” (roughly, “Where’s (she) tight-fitting it?”) for Korean.

Thirty children between 18 and 23 months were tested, 20 learning English and 10 learning Korean. Only 6 of the English learners and 2 of the Korean learners were producing the target word for their language, according to parental report, so the majority did not yet use the word. If the English-speaking children understood *in*, they should look longer at scenes showing putting an object into a container, regardless of whether the container fit tightly or loosely. And if the Korean-speaking children understood *kkita*, they should look longer at scenes showing putting an object into a tight-fitting relation, regardless of whether the fit involved containment or surface attachment. So on the conflated pairs the two groups should look at the same scene (e.g., ‘putting books into fitted cases’), but for different reasons—the English-speaking group because it depicts containment and the Korean-speaking group because it depicts tight fit. Which property children were attending to on the conflated pairs is revealed by where they looked on the split pairs.

The predictions were borne out. Under the influence of the target word, the children from both groups looked significantly longer overall at the matching scenes for their language than at the nonmatching scenes.<sup>13</sup> Between 18 and 23 months, then, children learning English and Korean already assign language-specific semantic categories to their target words: English learners know that containment is relevant for *in* but degree of fit is not, whereas Korean learners know that fit is relevant for *kkita* but containment is not. When both properties are present in a situation at once, the target word directs the learners’ attention to the property of the situation that is relevant to its semantic classification in the language being learned.

Recall that most of the children were not yet producing the target word for their language. Evidence for sensitivity to language-specific spatial cat-

<sup>13</sup>To control for the possibility that the children’s gaze behavior was guided not by the target word they heard but by a nonlinguistic preference for one scene over the other, we compared whether the children’s preference for the matching scene over the nonmatching scene was significantly greater on trials when they heard the target word (test trials) than when they did not (control trial). On the control trials the children showed no overall preference for either the matching or nonmatching scene, so we can conclude that their significant preference for the matching scenes on the test trials was indeed due to the presence of the target word.



egories in comprehension, before production begins, allows us to make sense of two observations that otherwise seem to conflict. On the one hand, children often generalize spatial words rapidly to a wide range of referents in their production—a finding that, as noted earlier, has been interpreted to mean that the words are being used to express meanings that originate in nonlinguistic cognition. On the other hand, children's spatial words pick out language-specific categories from the beginning of productive use, which suggests that the meanings are influenced by the input language. If children are able to get a sense of the contours of semantic categories in comprehension, before production begins, we need not be surprised by generalization in production that is both rapid and language specific.

## DISCUSSION

Previous work had suggested that early spatial semantic development follows a universal course, with children mapping morphemes like *in*, *on*, *up*, and *down* to such presumably basic concepts of space as containment, support, and vertical motion as these become available through nonlinguistic cognitive development. The crosslinguistic studies reviewed here concur with these studies in some respects, but disagree critically in others.

It is true that terms like *containment*, *support*, and *vertical motion* capture kinds of spatial configurations and events that are highly salient to language learners—for instance, children talk about object placements involving containers and surfaces long before those involving relationships “in front of” or “behind.” This initial focus on certain kinds of relations is presumably due to children's cognitive biases. But within these bounds, cognition appears to constrain children's early word meanings less than has often been supposed: the specific meanings learners associate with their early spatial words vary strikingly as a function of the input language. For instance, in the speech of young learners of English, *in* and *on* are indeed associated with a fundamental distinction between containment and surface contact/support. But the speech of toddlers learning Korean is insensitive to this distinction: what is critical in their spatial semantics is a crosscutting distinction between interlocking relations (*kkita*), loose containment-or-encircling relations (*nehta*), and various other kinds of surface-contact relations.

Early steps in acquiring the meanings of spatial words are, then, less uniform than has often been supposed. There is no reason, of course, to suppose that this is true only for space. There is significant crosslinguistic variation in the acquisition of other domains as well, including modality (Choi, 1991, 1996), temporality (Behrens, in press), and object reference (Imai & Gentner, 1997). Nonlinguistic cognitive development provides a

critical foundation on which children can build to work out the meanings needed for the local language, but it does not strongly channel them to a universal starting set of meanings. Rather, early meanings vary in alignment with differences in the semantic structure of the adult languages being learned. The existence of this language-conditioned semantic variation means that semantic development can no longer be viewed as a process of simply mapping forms onto concepts that have arisen nonlinguistically and that the child now wants to express. The relationship between linguistic and cognitive development is more complex than this.

The mechanisms underlying this relationship are still far from clear. One possibility is that spatial words are mapped directly to nonlinguistic concepts, just as the Cognition Hypothesis posited, but that the toddler's repertoire comprises many more such concepts than has previously been envisioned (Mandler, 1992). And these concepts would overlap and cross-cut each other in complex ways; for example, every child would develop concepts suitable for mapping to English *in* and *on*, to Korean *kkita* 'interlock complementary three-dimensional shapes' and *nehta* 'put loosely in or around,' and to Tzotzil Mayan *xoj* 'bring about a ring-around-pole-shaped configuration'—all words used appropriately at a very young age, often for similar referents. The language learner's task on encountering a new word—for example, (*put*) *in* or *kkita* in the context of play with nesting cups—would be to determine which of the candidate concepts is the one the word denotes. A wrong guess might be corrected later if the child sees that it does not adequately account for adult uses of the word.

There is some evidence for this scenario: in particular, learners sometimes seem to fleetingly associate a word or bound morpheme with a meaning that is wrong for the language being learned, but that is commonly used in other languages (Bowerman, 1980; Clark, 1976, in press). Such wrong hypotheses might be particularly likely when the language the child is learning categorizes the erred-on domain in a crosslinguistically unusual way. (The child might have a tendency first to try those concepts that, across languages, are more often relevant; Bowerman, 1985, 1993.) An experimental study comparing spatial prepositions in early English versus Dutch found support for this proposal (Bowerman, 1993; Bowerman & Gentner, in preparation; Gentner, 1996). The Dutch categorization of surface contact and support situations (described briefly on p. 208) is crosslinguistically rare, whereas the English classification is common (Bowerman & Pederson, 1992, in preparation; see Bowerman & Choi, in press, for a summary). Children learning Dutch indeed have more trouble with their system than those learning English, and their errors reflect a crosslinguistically more common classification pattern.

But do we do full justice to children's early semantic abilities if we assume that learners are capable *only* of sorting through preexisting con-

cepts to find a plausible match to a word? Or might they also have a more creative skill: the ability to flexibly construct *new* semantic categories (i.e., meanings that do not correspond directly to any preexisting concepts) by observing how forms are distributed across contexts in fluent speech?<sup>14</sup>

There is indeed evidence for such an ability. Consider words that can be applied to actions of separating objects. Children often make errors with such words—recall, for instance (p. 207), overextensions of the verb *open*. Children's anomalous extension patterns in this domain have often been interpreted as direct reflections of nonlinguistic concepts (Bowerman, 1978; McCune & Vihman, 1997). But detailed crosslinguistic comparisons of these patterns show that category contours differ in ways that are closely related to statistical and other properties of the linguistic input, such as the frequency with which given words are used, the consistency of their range of application, the presence or absence of polysemy, and the number of words that populate a given corner of semantic space (see Bowerman, 1996a; Bowerman & Choi, in press, for examples and discussion).

Such findings suggest that even very young children can build categories on the basis of the way words are used in the input. Factors that are likely to influence this process are suggested by "usage-based" approaches to language that stress the dynamic properties of linguistic knowledge—for example, the effect of type vs. token frequency on the ability to induce and restructure schemas, and the role of competition among forms (Bybee, 1985, 1991; MacWhinney, 1987). Such an approach lends itself well to computational modeling of category induction (see Regier, 1997, for a computational model of some of the English vs. Dutch learning patterns documented for "separation" by Bowerman and Choi). And it also provides a way to understand how children could draw on form–meaning mappings they have already acquired to project language-appropriate meanings for new forms, and so get quickly into the typological semantic patterns of their language ("typological bootstrapping"—Slobin, in press; see Choi & Bowerman, 1991; Brown, in press; de León, in press, for specific proposals).

It is unlikely that all early words are learned in the same way—for some words a fairly direct mapping of a preexisting meaning may be sufficient, while others may require the construction and fine-tuning of a new concept under guidance of language (Gentner, 1982; Gentner & Boroditsky,

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<sup>14</sup>To build categories they must draw of course on the perceptual and conceptual sensitivities provided by nonlinguistic cognition, but we can consider a category "new" either if these sensitivities have been combined in a new way or if the child's attention has been drawn to a way of grouping and distinguishing referents that was previously only implicit or potential. Whether such categories, once formed, are used only for producing and comprehending language—"thinking for speaking" (Slobin, 1996)—or have deeper consequences for thought goes beyond the scope of this chapter, but see Gopnik (in press), Levinson (in press), and Lucy and Gaskins (in press) for new perspectives on this perennially controversial Whorfian issue.

in press). A detailed picture of how children's cognitive sensitivities are applied to the discovery of semantic structure will require intensive further study. But it is clear that in sharpening and testing our hypotheses about this process, we have much to gain from comparisons of children learning different languages.

## REFERENCES

- Allan, K. (1979). Classifiers. *Language*, 53, 285-311.
- Antell, S. E. G., & Caron, A. J. (1985). Neonatal perception of spatial relationships. *Infant Behavior and Development*, 8, 15-23.
- Baillargeon, R. (1995). A model of physical reasoning in infancy. In C. Rovee-Collier & L. P. Lipsitt (Eds.), *Advances in infancy research* (Vol. 9, pp. 305-371). Norwood, NJ: Ablex.
- Behl-Chadha, G., & Eimas, P. D. (1995). Infant categorization of left-right spatial relations. *British Journal of Developmental Psychology*, 13, 69-79.
- Behrens, H. (in press). Cognitive-conceptual development and the acquisition of grammatical morphemes: The development of time concepts and verb tense. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Benedict, H. (1979). Early lexical development: Comprehension and production. *Journal of Child Language*, 7, 183-200.
- Berlin, B., & Kay, P. (1969). *Basic color terms*. Berkeley: University of California Press.
- Bickerton, D. (1981). *Roots of language*. Ann Arbor, MI: Karoma Publishers.
- Bloom, L. (1970). *Language development: Form and function in emerging grammars*. Cambridge, MA: MIT Press.
- Bloom, L. (1973). *One word at a time: The use of single word utterances before syntax*. The Hague: Mouton.
- Bloom, P. (in press). Roots of word learning. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Blount, B. G. (1969). *Acquisition of language by Luo children*. Unpublished doctoral dissertation, University of California, Berkeley.
- Bowerman, M. (1973). *Early syntactic development: A cross-linguistic study with special reference to Finnish*. Cambridge, England: Cambridge University Press.
- Bowerman, M. (1976). Semantic factors in the acquisition of rules for word use and sentence construction. In D. Morehead & A. Morehead (Eds.), *Directions in normal and deficient child language* (pp. 99-179). Baltimore: University Park Press.
- Bowerman, M. (1978). The acquisition of word meaning: An investigation into some current conflicts. In N. Waterson & C. Snow (Eds.), *The development of communication* (pp. 263-287). New York: Wiley.
- Bowerman, M. (1980). The structure and origin of semantic categories in the language-learning child. In M. L. Foster & S. H. Brandes (Eds.), *Symbol as sense: New approaches to the analysis of meaning* (pp. 277-299). New York: Academic Press.
- Bowerman, M. (1985). What shapes children's grammars? In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition: Vol. 2. Theoretical issues* (pp. 1257-1319). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Bowerman, M. (1989). Learning a semantic system: What role do cognitive dispositions play? In M. L. Rice & R. L. Schiefelbusch (Eds.), *The teachability of language* (pp. 133-168). Baltimore: Paul H. Brookes.

- Bowerman, M. (1993). Typological perspectives on language acquisition: Do crosslinguistic patterns predict development? In E. V. Clark (Ed.), *The proceedings of the twenty-fifth annual Child Language Research Forum* (pp. 7–15). Stanford, CA: Center for the Study of Language and Information.
- Bowerman, M. (1994). From universal to language-specific in early grammatical development. *Philosophical Transactions of the Royal Society of London B*, 346, 37–45.
- Bowerman, M. (1996a). Learning how to structure space for language: A crosslinguistic perspective. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp. 385–436). Cambridge, MA: MIT Press.
- Bowerman, M. (1996b). The origins of children's spatial semantic categories: Cognitive vs. linguistic determinants. In J. J. Gumperz & S. C. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 145–176). Cambridge, England: Cambridge University Press.
- Bowerman, M., & Choi, S. (in press). Shaping meanings for language: Universal and language specific in the acquisition of spatial semantic categories. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Bowerman, M., & Gentner, D. (in preparation). *Are some ways to partition space more natural than others? Learning to categorize 'in' and 'on' relations in Dutch and English*.
- Bowerman, M., de León, L., & Choi, S. (1995). Verbs, particles, and spatial semantics: Learning to talk about spatial actions in typologically different languages. In E. V. Clark (Ed.), *Proceedings of the twenty-seventh Annual Child Language Research Forum* (pp. 101–110). Stanford, CA: Center for the Study of Language and Information.
- Bowerman, M., & Pederson, E. (1992, December). *Cross-linguistic perspectives on topological spatial relationships*. Paper presented at the annual meeting of the American Anthropological Association, San Francisco.
- Bowerman, M., & Pederson, E. (in preparation). *Cross-linguistic perspectives on topological spatial relationships*.
- Braine, M. D. S. (1976). First word combinations. *Monographs of the Society for Research in Child Development*, 41(1, Serial No. 164).
- Brown, P. (1994). The INs and ONs of Tzeltal locative expressions: The semantics of static descriptions of location. *Linguistics*, 32, 743–90.
- Brown, P. (in press). Learning to talk about motion UP and DOWN in Tzeltal: Is there a language-specific bias for verb learning? In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Brown, R. (1973). *A first language: The early stages*. Cambridge, MA: Harvard University Press.
- Brugman, C. (1983). *Metaphor in the elaboration of grammatical categories in Mixtec*. Unpublished manuscript, University of California, Berkeley.
- Bybee, J. L. (1985). *Morphology: A study of the relation between meaning and form*. Amsterdam: John Benjamins.
- Bybee, J. L. (1991). Natural morphology: The organization of paradigms and language acquisition. In T. Huebner & C. A. Ferguson (Eds.), *Crosscurrents in second language and linguistic theories* (pp. 67–91). Amsterdam: John Benjamins.
- Choi, S. (1991). Early acquisition of epistemic meanings in Korean: A study of sentence-ending suffixes in the spontaneous speech of three children. *First Language*, 11, 93–119.
- Choi, S. (1996, July). *Development of modality in Korean and a crosslinguistic comparison with Turkish*. Paper presented at the Seventh International Congress for the Study of Child Language, Istanbul.
- Choi, S. (1997). Language-specific input and early semantic development: Evidence from children learning Korean. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition: Vol. 5. Expanding the contexts* (pp. 41–133). Mahwah, NJ: Lawrence Erlbaum Associates.
- Choi, S., & Bowerman, M. (1991). Learning to express motion events in English and Korean: The influence of language-specific lexicalization patterns. *Cognition*, 41, 83–121.

- Choi, S., McDonough, L., Bowerman, M., & Mandler, J. (1999). Early sensitivity to language-specific spatial categories in English and Korean. *Cognitive Development*, 14, 241-268.
- Chomsky, N. (1959). [Review of the book *Verbal Behavior* by B. F. Skinner]. *Language*, 35, 26-58.
- Chomsky, N. (1965). *Aspects of the theory of syntax*. Cambridge, MA: MIT Press.
- Clark, E. V. (1976). Universal categories: On the semantics of classifiers and children's early word meanings. In A. Juilland (Ed.), *Linguistic studies offered to Joseph Greenberg on the occasion of his sixtieth birthday: Vol. 3. Syntax* (pp. 449-462). Saratoga, CA: Anna Libri.
- Clark, E. V. (1993). *The lexicon in acquisition*. Cambridge, England: Cambridge University Press.
- Clark, E. V. (in press). Emergent categories in first language acquisition. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Clark, H. H. (1973). Space, time, semantics, and the child. In T. E. Moore (Ed.), *Cognitive development and the acquisition of language* (pp. 27-63). New York: Academic Press.
- Cromer, R. F. (1974). The development of language and cognition: The cognition hypothesis. In B. Foss (Ed.), *New perspectives in child development* (pp. 184-252). Harmondsworth, Middlesex, England: Penguin.
- de León, L. (1999). Verbs in Tzotzil early syntactic development. *International Journal of Bilingualism*, 3, 219-240.
- de León, L. (in press). Finding the richest path: Language and cognition in the acquisition of verticality in Tzotzil (Mayan). In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In S. A. Kuczaj II (Ed.), *Language development: Vol. 2. Language, thought, and culture* (pp. 301-334). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Gentner, D. (1996, July). *Crosslinguistic differences in the lexicalization of spatial relations, and effects on acquisition*. Paper presented at the Seventh International Congress for the Study of Child Language, Istanbul.
- Gentner, D., & Boroditsky, L. (in press). Individuation, relativity, and early word learning. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Gleitman, L. (1990). The structural sources of verb meanings. *Language Acquisition*, 1, 3-55.
- Goldin-Meadow, S., Seligman, M. E. P., & Gelman, R. (1976). Language in the two-year-old. *Cognition*, 4, 189-202.
- Golinkoff, R. M., Hirsh-Pasek, K., Cauley, K. M., & Gordon, L. (1987). The eyes have it: Lexical and syntactic comprehension in a new paradigm. *Journal of Child Language*, 14, 23-45.
- Gopnik, A. (1980). *The development of non-nominal expressions in 12-24 month old children*. Unpublished doctoral dissertation, Oxford University.
- Gopnik, A. (in press). Theories, language, and culture: Whorf without wincing. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Greenfield, P., & Smith, J. (1976). *The structure of communication in early language development*. New York: Academic Press.
- Griffiths, P., & Atkinson, M. (1978). A 'door' to verbs. In N. Waterson & C. Snow (Eds.), *The development of communication* (pp. 311-319). New York: Wiley.
- Grimshaw, J. (1981). Form, function, and the language acquisition device. In C. L. Baker & J. J. McCarthy (Eds.), *The logical problem of language acquisition* (pp. 165-182). Cambridge, MA: MIT Press.
- Huttenlocher, J. (1974). The origins of language comprehension. In R. L. Solso (Ed.), *Theories in cognitive psychology: The Loyola symposium* (pp. 331-368). Potomac, MD: Lawrence Erlbaum Associates.

- Huttenlocher, J., Smiley, P., & Charney, R. (1983). Emergence of action categories in the child: Evidence from verb meanings. *Psychological Review*, 90, 72-93.
- Imai, M., & Gentner, D. (1997). A crosslinguistic study of early word meaning: Universal ontology and linguistic influence. *Cognition*, 62, 169-200.
- Jackendoff, R. (1976). Toward an explanatory semantic representation. *Linguistic Inquiry*, 7, 89-150.
- Johnston, J. R. (1985). Cognitive prerequisites: The evidence from children learning English. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition: Vol. 2. Theoretical issues* (pp. 961-1004). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Johnston, J. R., & Slobin, D. I. (1979). The development of locative expressions in English, Italian, Serbo-Croatian and Turkish. *Journal of Child Language*, 6, 529-545.
- Kernan, K. T. (1969). *The acquisition of language by Samoan children*. Unpublished doctoral dissertation, University of California, Berkeley.
- Levinson, S. C. (in press). Covariation between spatial language and cognition, and its implications for language learning. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Lucy, J. A., & Gaskins, S. (in press). Grammatical categories and the development of classification preferences: A comparative approach. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- MacWhinney, B. (1987). The competition model. In B. MacWhinney (Ed.), *Mechanisms of language acquisition* (pp. 249-308). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Mandler, J. (1992). How to build a baby: II. Conceptual primitives. *Psychological Review*, 99, 587-604.
- Margetts, A. (1998, June). 'Give' verbs in Saliba. Paper presented at the Workshop on Crosslinguistic Perspectives on Argument Structure: Implications for Learnability, Nijmegen, The Netherlands.
- Markman, E. (1990). Constraints children place on word meanings. *Cognitive Science*, 14, 55-77.
- McCune, L., & Vihman, M. (1997). *The transition to reference in infancy*. ms.
- McCune-Nicolich, L. (1981). The cognitive bases of relational words in the single-word period. *Journal of Child Language*, 8, 15-34.
- Naigles, L. (1990). Children use syntax to learn verb meanings. *Journal of Child Language*, 17, 357-374.
- Needham, A., & Baillargeon, R. (1993). Intuitions about support in 4.5-month-old infants. *Cognition*, 47, 121-148.
- Nelson, K. (1974). Concept, word, and sentence: Interrelations in acquisition and development. *Psychological Review*, 81, 267-285.
- Newman, J. (Ed.). (1998). *The linguistics of giving*. Amsterdam: John Benjamins.
- Piaget, J. (1954). *The construction of reality in the child*. New York: Basic Books.
- Piaget, J., & Inhelder, B. (1956). *The child's conception of space*. London: Routledge & Kegan Paul.
- Pinker, S. (1984). *Language learnability and language development*. Cambridge, MA: Harvard University Press.
- Pinker, S. (1989). *Learnability and cognition: The acquisition of argument structure*. Cambridge, MA: MIT Press.
- Pye, C. (1996). K'iche' Maya verbs of breaking and cutting. *Kansas Working Papers in Linguistics*, 21, 87-98.
- Quine, W. V. (1960). *Word and object*. Cambridge, MA: MIT Press.
- Quinn, P. C. (1994). The categorization of above and below spatial relations by young infants. *Child Development*, 65, 58-69.
- Regier, T. (1997). Constraints on the learning of spatial terms: A computational investigation. In R. L. Goldstone, P. G. Schyns, & D. L. Medin (Eds.), *Psychology of learning and motivation* (Vol. 36, pp. 171-217). San Diego, CA: Academic Press.

- Schlesinger, I. M. (1971). Production of utterances and language acquisition. In D. I. Slobin (Ed.), *The ontogenesis of grammar* (pp. 63–101). New York: Academic Press.
- Schlesinger, I. M. (1977). The role of cognitive development and linguistic input in language acquisition. *Journal of Child Language*, 4, 153–169.
- Sinha, C., Thorseng, L. A., Hayashi, M., & Plunkett, K. (1994). Comparative spatial semantics and language acquisition: Evidence from Danish, English, and Japanese. *Journal of Semantics*, 11, 253–287.
- Sitskoorn, M. M., & Smitsman, A. W. (1995). Infants' perception of dynamic relations between objects: Passing through or support? *Developmental Psychology*, 31, 437–447.
- Slobin, D. I. (1966). The acquisition of Russian as a native language. In F. Smith & G. A. Miller (Eds.), *The genesis of language: A psycholinguistic approach* (pp. 129–148). Cambridge, MA: MIT Press.
- Slobin, D. I. (1970). Universals of grammatical development in children. In G. B. Flores D'Arcais & W. J. M. Levelt (Eds.), *Advances in psycholinguistics* (pp. 174–186). Amsterdam: North-Holland.
- Slobin, D. I. (1973). Cognitive prerequisites for the development of grammar. In C. A. Ferguson & D. I. Slobin (Eds.), *Studies of child language development* (pp. 175–208). New York: Holt, Rinehart & Winston.
- Slobin, D. I. (1985). Crosslinguistic evidence for the Language-Making Capacity. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition: Vol. 2. Theoretical issues* (pp. 1157–1256). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Slobin, D. I. (1996). Learning to think for speaking: Native language, cognition, and rhetorical style. In J. J. Gumperz & S. C. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 70–86). Cambridge, England: Cambridge University Press.
- Slobin, D. I. (in press). Form/function relations: How do children find out what they are? In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.
- Smiley, P., & Huttenlocher, J. (1995). Conceptual development and the child's early words for events, objects, and persons. In M. Tomasello & W. Merriman (Eds.), *Beyond names for things: Young children's acquisition of verbs* (pp. 21–61). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Spelke, E. S., Breinlinger, K., Macomber, J., & Jacobson, K. (1992). Origins of knowledge. *Psychological Review*, 99, 605–632.
- Talmy, L. (1976). Semantic causative types. In M. Shibatani (Ed.), *Syntax and semantics: Vol. 6. The grammar of causative constructions* (pp. 43–116). New York: Academic Press.
- Talmy, L. (1982). Borrowing semantic space: Yiddish verb prefixes between Germanic and Slavic. *Berkeley Linguistics Society*, 8, 231–250.
- Talmy, L. (1983). How language structures space. In H. Pick & L. Acredolo (Eds.), *Spatial orientation: Theory, research, and application* (pp. 225–282). New York: Plenum.
- Talmy, L. (1985). Lexicalization patterns: Semantic structure in lexical form. In T. Shopen (Ed.), *Language typology and syntactic description: Vol. 3. Grammatical categories and the lexicon* (pp. 57–149). Cambridge, England: Cambridge University Press.
- Talmy, L. (1991). Path to realization: A typology of event conflation. *Berkeley Linguistics Society*, 17, 480–519.
- Tomasello, M. (1995). Pragmatic contexts for early verb learning. In M. Tomasello & W. Merriman (Eds.), *Beyond names for things: Young children's acquisition of verbs* (pp. 115–146). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Whorf, B. L. (1956). *Language, thought, and reality* (J. B. Carroll, Ed.). Cambridge, MA: MIT Press.
- Wilkins, D. P., & Hill, D. (1995). When GO means COME: Questioning the basicness of basic motion verbs. *Cognitive Linguistics*, 6, 209–259.