During the culture revolution of the 1960s and 1970s, the idea that children acquire language in a pre-existing world was revisited...

The idea that children learn how to structure meaningful linguistic expressions and word meanings through differentiation led to the proposal that language acquisition involves the implicit learning of the rules of a language. Through differentiation, children learn to use language in meaningful ways, and these meanings are then encoded in their long-term memory. This process is driven by the need to communicate with others and to understand their intentions. In this way, children learn to take the first steps into language usage, a process that involves both deliberate and unconscious encoding. The key to this process is the ability to recognize and encode the meanings of words in a way that allows them to be understood by others. This is achieved through the use of gestures, sounds, and other visual cues, which help children to develop their understanding of the world around them.

Melissa Bowman and Sona Choi

In this chapter, we will argue that early semantic development involves a prescriptive interaction between the input language and the way children process and use language. The semantic categories of the input language are not just a passive reflection of the world but are actively acquired and constructed by the child. This interaction is crucial for the development of language understanding and production.

The acquisition of language involves a complex interplay between the input language and the child's abilities, which are shaped by both the input and the child's cognitive processes. The child's ability to understand and use language is influenced by the structure of the input language and the child's cognitive capacity to process and organize information.

One of the key aspects of language development is the acquisition of word meanings. Children must learn to associate words with their meanings in order to communicate effectively. This process is not just a matter of memorization but involves a deep understanding of the world and how language represents it.

The study of language development in young children has shown that early language acquisition involves the construction of meaning in a way that is consistent with the child's cognitive development. This construction is not just a passive reflection of the input but involves active processing and interpretation of the input language.

The acquisition of language is a complex process that involves both the input language and the child's cognitive processes. The child's ability to understand and use language is influenced by the structure of the input language and the child's cognitive capacity to process and organize information.
Evidence for the role of nonlinguistic spatial development in the acquisition of spatial words.

One of the cornerstones of the assumption that children map spatial words on to preexisting spatial concepts is the evidence that they know a great deal about space before they begin to talk (Pitts & Inhelder, 1956; Slobin, 1971). For example, the first few months of life, infants can distinguish between left and right (Babić-Chadha & Emran, 1995) and above and below (Ané, T Перот, & Ruff, 1995).

Consistent with the idea that children acquire spatial concepts early, children generalize their knowledge of spatial concepts to novel situations. For example, Smiley & Huttenlocher (1995) found that children use language guided by knowledge that is already in place.

One important implication of this is that children are able to learn new concepts directly. For example, the acquisition of spatial words not only facilitates the acquisition of spatial words, but also enables children to learn something about the category of their language in comprehension before production begins.

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Shaping meanings for language

As figure 16.1a shows, English makes a fundamental distinction between a Ground figure, which then typically supports or contains an object (e.g., a piece of paper), and a Ground figure, which is a surface of the Ground on which the object (e.g., a piece of jewelry) sits. In English, the distinction between these two contexts is clear, as the object is either on or in the Ground. For example, in English, a piece of jewelry is either sitting on a table or in a box. In Korean, however, this distinction is not as clear, as the object can be on or in the Ground in different ways.

In English, children express such meanings through the use of prepositions and conjunctions. Prepositions like "on" and "in" are used to indicate the location of objects in relation to the Ground. For example, "a book on the table" or "a book in the box." These prepositions help to clarify the relationship between the object and the Ground. In contrast, in Korean, the distinction is less clear, as the object can be seen as being in contact with the Ground in different ways.

Figure 16.1b illustrates some differences between English and Korean in the categorization of actions involving objects. In English, the critical way of expressing Path is through the use of verbs such as "move," "go," and "come." These verbs are used to describe the movement of the object from one location to another. In Korean, however, the language is more focused on the characteristics of the object itself. For example, "a satellite-framed" language is used to describe the way in which the object is seen in relation to the Ground. In Korean, the object is seen as being a part of the Ground, while in English, the object is seen as being separate from the Ground.

2.1 Motion along a Path

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Fig. 16.1 Categorization of some object placements in English and Korean.
corresponding to the transitive verb *kkita* ‘interlock, fit tightly’ there is no intransitive verb meaning ‘move (physically) into an interlocking, tightfitting relationship’ (e.g. *crawl* into a narrow hole). Similarly, corresponding to *nehta* ‘put loosely in or around’ there is no intransitive verb meaning ‘move into a relationship of loose containment or encirclement’ (e.g. get in the bathtub). There is only an intransitive verb *tulta* ‘move/be in,’ which – like English *in* – is indifferent to the tight-fit/loose-fit distinction. Thus, children learning English must establish a uniform set of Path categories that abstract away from how the motion came about, while children learning Korean must distinguish meticulously between caused and spontaneous motion and master two sets of Path categories that often do not coincide.

2.2 Static spatial relationships

Continuing to focus on the kinds of situations covered by the English prepositions *on* and *in*, let us have a look at static spatial relations. In a crosslinguistic study, Bowerman & Pederson (1992, in preparation) investigated how speakers of thirty-eight languages from twenty-five different language families described situations of containment, support, encirclement, attachment, adhesion, piercing, hanging, and so on. Consider as examples the six spatial situations shown in figure 16.2. No language provided a distinct spatial term for all six. But which situations were grouped and which were distinguished varied across languages. Some of the attested patterns, as schematized in figure 16.2, were these:

1. One term for situations (a)–(e) and another for (f). This is a common pattern, followed by languages as diverse as English, Hebrew, Hungarian, and Mopan Mayan. In English, (a)–(e) are covered by *be* *on*, and (f) by *be* *in*.

2. One term for (a) and another for (f). Neither term is used for (b)–(e); these situations are covered instead by a general locative word or inflection – also applicable to (a) and (f) – that indicates only that there is *some* spatial relationship between the Figure and the Ground, normally understood as the most canonical one for the objects in question. This pattern, also common, is found for example in Japanese and Korean, in which the terms used to encode situations (a) and (f) are nominals: e.g. Japanese *te* ‘upper region, top, above,’ and *naka* ‘interior region.’

3. One term for (a)–(b), another for (c)–(e), and still another for (f). This pattern is rare in the languages Bowerman & Pederson looked at, occurring only in Dutch (German is similar but not identical). The three Dutch terms, all prepositions, are *op* (for a–b), *aan* (c–e), and *in* (f). *Op* and *aan* are both usually translated as *on* in English. The difference between them for situations like those shown in figure 16.2 has to do

![Diagram](image)

Fig. 16.2 Some crosslinguistic differences in categorizing static spatial relationships.

with the force dynamics of the situation (Bowerman 1996b). If the Figure is conceptualized as acted on by a salient force, usually gravity, that must be counteracted if the Figure is to stay in contact with the Ground, *aan* is selected (e.g. picture on wall). But if the Figure is seen as resting comfortably on the Ground with no “pull” towards separation, *op* is chosen (e.g. cup on table, banded on leg).

4. One term for (a)–(c) and another for (b)–(f). A language of this type is Berber, with the prepositions *x* and *di* (roughly ‘on’ and ‘in’); similar but not identical is Finnish, with the locative case endings *-lla* and *-ssa* (again, roughly ‘on’ and ‘in’). What is new and surprising here is the extension of an ‘*a*-type morpheme to many situations that English categorizes as ‘on’ relations; note also that there is some overlap in the range of the ‘on’–‘in’ terms.

5. One term for the whole range from (a) to (f), e.g. the Spanish preposition *en*, normally translated in English as either *in* or *on*. (Spanish speakers can, if they desire, be more explicit, distinguishing (a) as *encima* (*de*) ‘on top (of)’ and (f) as *dentro* (*de*) ‘inside (of)’.)

Despite all this variation, the languages Bowerman & Pederson investigated did not categorize spatial situations in arbitrarily different ways. All
3. How early are language-specific spatial semantic categories acquired?

What does cross-linguistic variation in spatial semantic categories entail for the question of where the meanings of children's early spatial words come from? Do children perhaps share an initial organization of semantic concepts, as proposed by Piaget (1961), and then diverge and specialize further in their native languages? Alternatively, do children’s early categories of space be organized in the input languages? How do children label different spatial categories with prepositions? Slobin (1985) argues, more generally, that language in children's early years is in an initial, unanalyzed state. Later, in the development of children's spatial language, the structures of their native languages play a role in the organization of their spatial categories.

In one study, we examined the spontaneous speech of children learning English and Korean between the ages of about 1 and 3 through analysis of longitudinal data (Choi & Bowern, 1992). Both sets of children began to talk about space between 14 and 16 months and to use space prepositions in a restricted way, with English children developing early language for abstract space and Korean children for concrete space. The early acquisition of language for abstract space has been associated with the development of more advanced spatial concepts, such as distance and direction, which are crucial for the development of more sophisticated spatial language.

3.1 Early spontaneous speech

In English, children begin to use prepositions such as in and on to label spatial locations at around 18 months of age. In Korean, children begin to use spatial terms such as 'giru' (inside) and 'hap' (on top of) at around 18 months of age. However, English children's use of prepositions is more varied and includes more abstract spatial concepts, such as 'up' and 'down', whereas Korean children's use of prepositions is more concrete and includes more physical spatial concepts, such as 'in' and 'on top of'. This suggests that the early acquisition of language for abstract space is crucial for the development of more advanced spatial concepts.
standing up and sitting down. These similarities presumably reflect the shared interests of young children. For our purposes, the critical question is whether learners of English and Korean semantically categorized these events in the same way, as inferred from the range of situations to which they applied their spatial words.

The words they used were of course different. As expected, our English speakers started out with particles like up, down, on, off, in, out, and back, and a few verbs like open and close. The Korean children used inclusively verbs (recall that Korean encodes motion along a Path with verbs; it lacks a system of Path markers equivalent to English particles and prepositions). Despite form-class differences, we can meaningfully compare the range of events for which each word was used. If the children had mapped the words to a shared set of spatial concepts arising from built-in perceptual biases or universal stages of nonlinguistic spatial cognition, they should use them to pick out similar sets of events. We would then find words over- or underextended from the adult perspective, given that the Path categories of adult English and Korean differ in many ways. But we can indeed expect over- and underextensions – recall that deviations from adult norms have been taken as prime evidence that early spatial words express nonlinguistic concepts.5

Our most important finding was that from their first productive uses of spatial words, the children categorized spatial events language-specifically – there was no evidence that they relied on the same set of basic spatial concepts.6 In both their routine and novel uses, our English-speaking subjects concentrated on notions of containment (in and out), support and surface contact, especially attachment (on and off), and vertical motion (up and down). The children’s initial use of these particles was mostly restricted to motion, so in this respect they made a selection from the range of uses modeled in adult speech (cf. also Smiley & Huttenlocher 1995). But within these limits they soon generalized the words across an English-style range of uses.

For instance, by 18–19 months they used spatial particles freely for both spontaneous and caused motion along a path (e.g. in for both getting into a bathtub and putting a picture into a wallet; up both when trying to climb onto a chair and as a request to be picked up). They respected the important English distinction between containment and contact-and-support, and they used in and out freely for both tight and loose containment (e.g. putting a book into a fitted case [tight] and a toy into a bag [loose]), and on and off for a variety of surface contact relations (e.g. taking Lego pieces apart [tight] and getting off a chair or taking off clothing [loose]). Viewed from the perspective offered by children learning another language, their overextensions were minor, suggesting difficulty in establishing the boundaries of categories that in overall contour were already language-specific, e.g. in for putting a pingpong ball between the knees (an enclosure of sorts), and off for pulling two Lego pieces apart (removal from surface contact).

The children learning Korean differed from those learning English in several important respects. First, like adults, they distinguished scrupulously between caused and spontaneous motions along a path (e.g. they applied the transitive verb nehta ‘put loosely in or around’ to putting toys in a box, but never to climbing into a bathtub). They made no general distinction between “containment” and “contact and support,” but followed instead the crosscutting Korean distinction between “interlocking, tight-fit” relations and “loose” relations. Thus, they used kkita ‘interlock, fit tightly,’ and its opposite ppayta ‘remove from an interlocking relation,’ for relations of both containment and contact-and-support, as long as there was a tight fit (e.g. kkita for both putting a peg doll into a perfectly fitting niche-seat and stacking Lego pieces on top of each other). For “loose” relations of containment and contact-and-support they used a variety of words more or less appropriately, e.g. nehta ‘put loosely in or around’ and its opposite kkenayta ‘remove from loosely in or around’ for putting toys into a box or bag and taking them out and for putting loose rings onto a pole and taking them off; nohta ‘put on horizontal surface’ for putting things down on table or floor; and three different clothing verbs: snuta ‘put clothing on head,’ ipta ‘. . . on trunk,’ and sinta ‘. . . on feet.’

The errors of the Korean learners, like those of the English learners, suggested difficulty in establishing the boundaries of categories that in broad outline were already language-specific. For example, kkita ‘interlock, fit tightly’ was used for sticking a fork into an apple and for attaching a metal fish to the magnetized beak of a toy duck. Both events are clearly similar to events that can be described as kkita, but for adults they fall outside the category, the fork example because the two objects did not have complementary shapes before the action took place (the holes in the apple were created by the action), and the magnet example because the surfaces, although tightly attached to each other, are flat and do not interlock.

Children learning Tzotzil are similar to those learning English and Korean in the kinds of situations they talk about at the one- and two-word stage, but their spatial words also pick out language-specific categories (Bowerman, de León, & Choi 1995; see de León, ch. 18 of this volume, on categories of motion “up” and “down”). For example, one of their favorite early words is the verb xo, which they use, like adults, for actions that cause an elongated object to end up encircled by a ring- or tube-shaped object (e.g. putting a ring on a pole or a pole through a ring, putting an arm into a sleeve or a leg into a trouser-leg, putting a coil of rope over a peg). Children exposed to English and Korean use no word for a comparable category:
3.2 Ellicited production of words for separating and joining objects

Spontaneous speech gives a good overview of the early stages of semantic development, and offers evidence of how children conceptualize objects and events. Despite certain under- and overextensions, the overall use of specific words and phrases shows that the basic concepts are well understood. To summarize, spontaneous speech data suggest that language-specific semantic distinctions and grouping principles of the target language play a significant role in the early stages of semantic development.

The actions described in the present study were open-ended and involved both familiar and novel objects. We observed that children choose to talk about different events for different reasons. For example, when asked to describe how they would put a toy car into a box, children might reply by saying, "I would put it in the box," or "I would put the car in the box." These responses indicate that children are beginning to understand the concept of containment and the relationship between objects and containers.

For each language, we identified key words for separating and joining objects, and compared them with the responses of the children. The results showed that children were able to use these words appropriately in a variety of contexts, indicating that they have developed a basic understanding of the concepts.

In conclusion, the findings of this study suggest that children begin to understand and use language-specific semantic distinctions and grouping principles at an early age. The use of specific words and phrases helps to establish the basic concepts of containment and the relationship between objects and containers, which are essential for the development of more complex language skills.
Fig. 16.3 Categorization of joining actions by children age 2;0–2;5 learning English and Korean.
istic design that allowed us to explore the comprehension of two overlapping semantic categories: \textit{(put) in} for learners of English, and \textit{kkita} 'interlock, fit tightly,' for learners of Korean (Choi, McDonough, Bowerman, & Mandler 1999).

Our subjects were thirty children between 18 and 23 months, twenty learning English and ten learning Korean. According to parental report, only six of the English learners and two of the Korean learners were producing the target word for their language, so the majority did not yet use the word. The child sat on a parent’s lap in front of two TV monitors mounted side by side, with a loudspeaker between them through which the auditory input could be presented. The child’s gaze behavior during the experiment was videotaped for offline coding and analysis.

The experiment was made up of four pairs of videotaped actions designed to test whether the children understood the properties of events that are relevant to the two target words: containment for \textit{(put) in} and tight fit or interlocking for \textit{kkita} (see figure 16.4). In the first and the third pairs, Pegs and Books, the matching scene was the same for both languages: the Figure ended up both contained by the Ground and in a tight-fitting relationship with it, so the action qualified as an instance of both \textit{(put) in} and \textit{kkita}. We will call these “conflated pairs,” since the properties of “containment” and “tight fit” were combined in the same scene. For Pegs, the matching scene was “putting pegs tightly into holes in a wooden block” and the nonmatching scene was “putting pegs on top of a solid block.” For Books, the matching scene was “putting books tightly into fitted box-covers” and the nonmatching scene was “stacking books on top of each other.”

In the second and fourth pairs, Legos and Rings, the properties of containment and tight fit were split up and assigned to different scenes, so the matching scenes were different for the two languages. We refer to these as “split pairs.” In the Legos pair, the two scenes were “putting Lego pieces into a large plastic container” (containment; this was the match for English) and “adding a Lego piece to the top of a stack of Lego pieces” (tight fit, the match for Korean). In the Rings pair, the scenes were “putting plastic rings into a basket” (containment, the match for English) and “putting rings onto tapered plastic poles” (tight fit, the match for Korean).8

If the English-speaking children understand \textit{in}, they should look longer at scenes showing “containment” regardless of whether it is tight or loose. And if Korean-speaking children understand \textit{kkita}, they should look longer at scenes showing a tight-fitting relation regardless of whether the fit involves containment or surface attachment. This means that on the conflated pairs, the two sets of children should look at the same scene (e.g. “putting books into fitted box-covers”) but for different reasons—the English group because it depicts “containment,” and the Korean group

1 The target word is shown above the scene that matches the word meaning.

Fig. 16.4 Four pairs of scenes used to test comprehension of English \textit{put in} and Korean \textit{kkita} in Choi, McDonough, Mandler, & Bowerman (1999).
because it depicts "tight fit." Which property children were attending to on the conflated pairs is revealed by their gaze direction on the split pairs.

For each of the four pairs, five trials were administered. First, two familiarization trials introduced each scene of the pair individually. Then a control trial presented both scenes simultaneously. The familiarization and control trials were accompanied by an audio that encouraged the child to look at the scenes, but did not contain the target word. The purpose of the control trial was to get a baseline measure of the child's relative interest in the two scenes in the absence of the target word. Then came two identical test trials. These again showed both scenes together, but now with the addition of the target word, embedded in a sentence like "Where's she putting it IN?" (English) or "Eti ey KKI-e?" (roughly, "Where's [she] tight-fitting it?"; Korean). A ring of flickering lights brought the child's gaze back to the midpoint between trials. The parent wore opaque glasses to prevent inadvertent cuing.

During the test trials, the children from both language groups looked significantly longer overall at the matching scenes than at the nonmatching scenes. This finding is not in itself conclusive, since the children might have preferred the matching scenes for purely nonlinguistic reasons (although recall that the matching scenes for the two languages were different on the two split pairs). To control for this possibility, we investigated whether the children's preference for the matching scene over the nonmatching scene was significantly greater when they heard the target word (test trials) than when they did not (control trial). It was. On the control trials the children showed no overall preference for either the matching or the nonmatching scene, so we can conclude that their overall preference for the matching scenes on the test trials was indeed due to the presence of the target word.

In summary, this study shows that between 18 and 23 months, children learning English and Korean already understand in and kkita - words that pick out overlapping sets of referents in adult speech - in language-specific ways. English learners know that "containment" is relevant for in but "tight fit" is not, while Korean learners know that "tight fit" is relevant for kkita but "containment" is not. Since most of the children were not yet producing the target word for their language, we conclude that sensitivity to language-specific spatial categories begins to develop in comprehension even before production begins.

This is an important finding, since it shows how we can reconcile two observations that otherwise seem to conflict. (1) From the moment spatial words first appear in children's spontaneous speech, they are often generalized rapidly to a wide range of referents. As noted earlier, this has been taken as strong evidence that children rely initially on their own spatial concepts, not those introduced by the input language. (2) Children extend their spatial words to language-specific categories from the beginning of productive use (as discussed in section 3.1). Rapid generalization along language-specific lines is not paradoxical if children are able to get a sense of the contours of the categories in comprehension before production begins.

4 How does spatial semantic learning take place?

Taken together, the studies we have discussed show that children are sensitive to language-specific principles of semantic categorization from their earliest productive uses of spatial words, and that this sensitivity begins to develop even before production begins. Spatial semantic development is, then, far more responsive to the properties of the input language than has been supposed. This outcome is particularly striking because, of all semantic domains, space is the one that has been cited most often in arguments for the critical role of children's autonomous concepts in early lexical development.

Evidence for early language specificity does not, of course, mean that children have no ideas of their own about spatial classification. The children we investigated, like those studied by others, used their early spatial words for a somewhat different range of situations than they heard them applied to; that is, they made systematic selections from among the uses modeled, and they extended words to situations for which adults would not use them. Clearly they were not merely passively awaiting the imprint of the input language.

What account of the acquisition process will do justice to both overall language specificity and evidence for language-independent spatial conceptualizations? We suggest that the story goes something like this.

Children construct spatial semantic categories over time on the basis of the way they hear words used in the input, and, in doing so, they draw on perceptual sensitivities and conceptual biases they bring with them to the task. Language input helps the learner decide which kinds of similarities and differences among referent situations are important for purposes of selecting a word, but the sensitivity to these properties must of course ultimately be supplied by the child. Some properties are undoubtedly more accessible or salient to learners than others, and categories that depend on these will, all else being equal, be learned earlier and with fewer errors than categories that depend on properties that are cognitively or perceptually more obscure (see also Clark, ch. 13 of this volume). Where the relevant properties are not obvious, because they are either low in salience or maturationally not yet available, children will make errors, either underextending or overextending words according to principles that are more readily available to them.
Throughout this process, learners’ built-in sensitivities to space are in constant interaction with a variety of characteristics of the language input. These include, for instance, the frequency with which given words are used (e.g., relevant spatial properties with relatively low initial salience might still be identified relatively quickly if the child has frequent learning opportunities), the consistency of the range of referents for which the words are used (e.g., polysemy in a word’s meaning might mislead the child to promote overextensions), the number of words that populate a given corner of semantic space (e.g., many words may help the child draw boundaries between categories, few may encourage overextensions), and the degree of overlap in the referents for which different words are used (low overlap may facilitate learning, high overlap—different words applied to the same referents on different occasions—may slow it down). We will illustrate some of these influences shortly.

This view of the process of acquiring spatial words can be placed within the framework of usage-based approaches to language that stress the dynamic properties of linguistic knowledge—i.e., the critical role played by input factors like type and token frequency and competition among forms in the input, and by learner capacities like the ability to induce categories and schemas to restructure them continually in response to both changes in the input and pressure exerted by the growth of other categories in the learner’s system (e.g., Bybee 1985, 1991; MacWhinney 1987). The view is also in accord with Slobin’s (ch. 14 of this volume) emphasis on the competing forces that shape language in use, and on children’s growing sensitivity to the specific properties that characterize the local language (“typological bootstrapping”); and with Smith’s (ch. 4 of this volume) claim that basic and domain-general processes of attentional learning can give rise to “smart,” seemingly domain-specific attentional biases. It is also compatible with computational approaches to modeling the acquisition of word meaning, especially those designed to be sensitive to cross-linguistic differences (e.g., Regier 1995, 1996, 1997).

4.1 Evidence for category-shaping processes

In our data, especially from the elicited production study described in section 3.2, there is ample evidence for the dynamic shaping of children’s spatial semantic categories by properties of the input language acting in concert with children’s inherent biases. Consider the domain of “separating objects.”

Among the overextensions often cited to support the claim that children map spatial words to their own concepts, it is striking that many have to do with “separation.” Recall, for instance the use of open in English for actions like separating Frisbees (Bowerman 1978; E. V. Clark 1993; see section 1). Related is the use of several different words for separation across a similar range of contexts (Griffiths & Atkinson 1978; McCune & Vihman 1997), and the blurring of words, such as Hildegard’s [bau], later [bax], which was apparently derived both from German auf ‘open’ (among other meanings) and aus ‘out,’ and from English off and out, and was used for acts of separation as diverse as clothing removal and opening a tin box (Leopold 1939, as discussed by McCune & Vihman 1997). McCune & Vihman suggest that “separation” (along with “attachment”) is a common early relational meaning that children will express even if the adult language lacks a well-suited word.

In our studies of spontaneous speech from children learning English, Korean, and Tzotzil Mayan, and our elicited production study with children learning English, Korean, and Dutch, we found a tendency for children to differentiate spatial events relative to the adult target language, and this was indeed especially marked in the domain of “separation”: in all the languages, children discriminated acts of separation less finely and accurately in their choice of words than acts of joining (Bowerman 1996a; Bowerman et al. 1995). But—critical for present purposes—the children did not overextend words for “separation” indiscriminately. Which words they overextended, and exactly how they used them, depended on how “separation” was semantically structured in the input language. Let us consider three examples.

4.1.1 Example 1: polysemy Our first example concerns the use of out and off, and their translation equivalents uit and af, by children learning English and Dutch (Bowerman 1996a). The youngest English-speaking children (age 2;0–2;5) in our elicited production study (see section 3.2) used out systematically for actions like those shown in (1) below and off for actions like those in (2). In contrast, Dutch children of the same age overextended uit ‘out’ massively, applying it to all the actions in both (1) and (2):

1. taking Legos out of a bag; a cassette out of a case; a doll and a toy boat out of a bathtub; cars out of a box; blocks out of a pan...
2. taking the lid off a pan; the top off a pen; a ring off a pole; a pillowcase off a pillow; a rubber-band off a box; taking off a dress, underpants, undershirt, shoes, socks, hat...

Why should the two groups of children differ in this way? A look at the use of the words by adults provides a clue. In adult speech, these words mark a systematic split between “removal from containment” (out, uit) and “removal from surface contact,” including incerclement and envelopment (off, af). But in Dutch there is an important class of exceptions: uit is used instead of the expected af for taking enveloping clothing items off the body.
e.g. trek je schoen, sok, trui, jas UIT ‘take your shoe, sock, sweater, jacket out [=off].’

When this incursion of uit into what is normally the territory of af – “removal from surface contact” – is brought to their attention, Dutch adults are surprised: they recognize that the foot after all comes out of the shoe, not the shoe out of the foot. Uit seems to be polysemous, with the clothing use stored as a separate, idiosyncratic sense. But for children in the early stages of language development, this polysemy creates a special learning problem. They have no a priori way of knowing that the use of uit for removing clothing (a high-frequency and salient event in their lives) is special – at odds with the more canonical uses of uit. So they try to construct a meaning that encompasses both. The only meaning consistent with both the canonical use and the idiosyncratic clothing use is “removal” itself – which immediately sanctions the extension of uit to all acts of removal, including taking objects off surfaces.

This example shows that while children are prone to overextend words for separation, whether they actually do so with a particular word is influenced by details of the word’s use in the linguistic input. If adults distinguish consistently between removal from containment and removal from surface contact, children can do so too. But if there is “noise” in the input – in this case a misleading polysemy in a word’s meaning – children may have trouble homing in on the relevant categorization principle.10

4.1.2 Example 2: “spacing” of words But what about English-speaking children’s overextensions of open – do these perhaps show that they have the same broad “separation” category as Dutch children, but just happen to encode it with open instead of out? Careful inspection of the data argues against this. The overextension of open – like the overextension of Dutch uit – is also conditioned by the semantic categories of the input language.

In our elicited production study, the learners of English often overextended open to actions for which the adults never used it (e.g. taking a shoe off, separating two Lego pieces). (This was also true of the children learning Dutch; the word for ‘open’ has the same form and a similar extension in the two adult languages.) There was only one such error in the elicited Korean data (yelta ‘open,’ used for unhooking two train cars), and we have found none in our spontaneous Korean data. To understand why there is this difference, compare the way actions of ‘opening’ are encoded in English vs. Korean (figure 16.5).

Korean breaks down the domain of English open into many categories, distinguishing opening doors and boxes, opening things that separate symmetrically (a mouth or a clamshell), opening paper things that involve tearing (an envelope), opening things that spread out flat (a book, hand, or fan), and so on. How might this affect learners? A possible answer is suggested by an ingeniously simple experiment conducted by Landsau & Shipley (in press) to test the effect on classification of the “spacing” of the words in the linguistic input.

These researchers placed two novel objects – the “standards” – in front of 2- and 3-year-old subjects. In the Same Label condition they gave both standards the same name (“This is a bicket... And this is a bicket”). In the Different Label condition they gave them different names (“This is a bicket... And this is a steb”). Then they showed, one by one, four test objects that were intermediate in shape along a continuum between the first and the
second standards, and asked about each one, "Is this a blicket?" In the Same Label condition, the children accepted the label at ceiling for all the test objects. But in the Different Label condition, there was a sharp dropoff in acceptance as the test object grew less like the first standard and more like the second standard. Landau & Shipley conclude that the presence of two identical labels can induce children to "fill in" the gap between even very different exemplars, "probably guided by the assumption that members lying on the hypothetical similarity line between standards are also members of the category." Conversely, the presence of different labels induces children to set up a boundary somewhere on the hypothetical similarity line between the first and second exemplars.

Applying these findings to the problem of 'open,' children learning English or Dutch are clearly in the Same Label condition: they are invited by the application of open to many different kinds of actions to fill in the gaps along a potential generalization gradient and create a very broad category. In doing so, they overshoot the mark. In contrast, children learning Korean are in the Different Label condition: at every turn they hear different verbs applied to actions to which they might have been inclined to generalize yelita 'open' (the "opening" verb they learn earliest and use appropriately for opening doors and containers). The impulse to generalize is checked before it can blossom.

4.1.3 Example 3: core members of a category  Although the Korean children in our elicited production study did not overextend yelita 'open,' they did overuse another word for separation: ppayta 'remove from an interlocking, tight-fit relation.' (Like overextensions of open by children learning English and Dutch, this may be encouraged by the broad range of the overextended word in adult speech: ppayta was used by at least one adult subject for twenty-four out of the thirty-six "separation" actions in our experiment.) We should ask, then, whether Korean children's ppayta category has the same shape as the overextended open category of children learning English and Dutch – if so, this could suggest the imprint of a nonlinguistic concept available to all children independently of language.

But although open and ppayta are often applied to similar situations, the two categories revolve around different cores in children's speech (Bowerman 1996a). For children learning English and Dutch, the core (the earliest and by far the most frequent and consistent) use of open is for actions of opening containers of various sorts. The word is only incidentally used for other acts of separation like separating Pop-beads or Lego pieces (out/uui or off are more frequent). In a different branch of overextensions, open is also used occasionally for actions in which there is no separation but something is made accessible, such as turning on TVs, electric lights, and water faucets. This latter use is motivated by a key feature of canonical acts of opening: when something is opened, something is often made accessible (Bowerman 1978). Korean children do not use ppayta for "making something accessible." Its core use, by children and adults alike, is for separating things that are stuck tightly together, like Lego pieces. "Making accessible" plays no role in these core uses, and children do not spontaneously supply the extension. (See Choi 1997 for an analogous analysis of different core meanings for English on and Korean kkita 'interlock, fit tightly'.)

As these three examples illustrate, children learning different languages may all have a tendency to overextend words for separation, but the focal point and exact extensions of their resulting categories are influenced by the contours of each word's category – and neighboring categories – in the adult linguistic input. What at first sight may seem like a universal child category resolves, on closer inspection, into a family of related, but different categories, each one shaped by the particular features of the input language.

4.2 What are spatial semantic categories constructed out of?

Up to now, we have skirted the critical problem of characterizing what we referred to as "perceptual sensitivities and conceptual biases" for space – the raw material out of which children construct the meanings of spatial words. This is a difficult issue for investigators of all theoretical persuasions.

One common proposal, which accords with the emphasis in the current literature on "constraints" in word learning, is that children come equipped with a set of domain-specific semantic primitives for space (e.g. Landau & Jackendoff 1993). In this view, learning involves figuring out how these primitives should be combined. Although we agree with the spirit of this proposal that children do not waste time on crazy possibilities and must have some sense of what properties of situations are likely to matter, there are a number of difficulties with crediting the child with a ready-made assembly kit of primitives, as discussed by Carey (1982), Choi & Bowerman (1991), Bowerman (1996a), Levinson (ch. 19 of this volume), and Slobin (ch. 14 of this volume).

A more fruitful approach, we believe, may be to conceive of the conceptual prerequisites to semantic learning not in terms of discrete components but in terms of gradients of perceived similarity between situations of different types.11 We have already drawn informally on the notion of similarity gradients in discussing the possible relevance of Landau & Shipley's (in press) study of novel object naming to overgeneralizations of open. And in section 2.2 we mentioned one candidate similarity gradient for space: the
continuum revealed by Bowerman & Pederson’s (1992, in preparation) study of ‘in’ and ‘on’-type words.

If children understand similarities and differences among static spatial situations in a way that is consistent with Bowerman & Pederson’s gradient, they could be expected to generalize spatial words in systematic ways. For example, on hearing the same form applied to both “cup on table” and “handle on door” (see, for instance, Pattern 1 in figure 16.2 [this amounts to the “Same Label” condition]), children could “fill in the gap” to predict that this form can also be used for “bandaid on leg” and “picture on wall.” The information that the form is not fuzzy about the orientation of the Ground object could be inferred directly from the input (horizontal table, vertical door), but the information that the form is also not fuzzy about the way the Figure is attached to a (nonhorizontal) Ground would be supplied indirectly: both adhesion and hanging against something fall between support from below and fixed attachment (e.g. with screws) on the gradient. If, on the other hand, children hear one form for “cup on table” and another for “handle on door” (cf. Pattern 3: Dutch op vs. aan [“Different Label” condition]), the impetus to generalize will be checked. More evidence will be needed before learners know what to do with pictures on walls (is it more like a cup on a table or a handle on door?), and they will have to pay close attention to details of orientation and attachment.

There is some limited evidence for this scenario from an elicited production study of how young learners of Dutch and English describe static spatial relationships (Bowerman 1993; Gentner 1996; Bowerman & Gentner, in preparation). English-speaking children aged 2;6 to 3;6 used on extensively for both familiar and novel situations similar to (a)–(e) in figure 16.2. Same-age Dutch children, in contrast, used only op frequently, and mostly only for familiar situations. Aan was rare. For situations like (b)–(e), the Dutch children often failed to produce a preposition at all. English-speaking children’s experience of the “wide-span” preposition on seems to have fostered a sense of a large, tolerant category. In contrast, Dutch-speaking children’s exposure to two, more restricted words in this corner of semantic space seems to have generated uncertainty about where one category leaves off and the next begins.

More research is clearly needed to determine whether it is sensible to credit children with an a priori shared sense of similarity gradients for space, and, if so, how such gradients can best be characterized. Also in need of study is whether some ways of partitioning a gradient are inherently easier for children than others. But research along these lines may ultimately yield a better picture than is currently available of children’s conceptual predispositions for spatial categorization.

5 Conclusions

In this chapter we have shown that the structuring of spatial categories differs strikingly across languages, and that children are sensitive to language-specific categorization principles from their earliest productive uses of spatial forms, and at least in some cases in comprehension even before production begins. This sensitivity does not, we stressed, mean that children are passive in the learning process. Learners clearly have an extensive practical understanding of space long before language acquisition begins, and they apply this knowledge actively to the task of figuring out what spatial words mean. In some cases they generalize too narrowly, restricting their use of a form to a subset of its everyday uses in adult speech. In other cases they generalize too broadly, using a form for spatial situations an adult would never apply it to. Both kinds of extension patterns testify to the influence of language-independent sources of spatial conceptualization.

In the past, deviations from adult speech have been interpreted as evidence that early spatial words are mapped directly to concepts of space that arise universally though nonlinguistic cognitive development. But crosslinguistic comparisons show that children’s extension patterns do not converge on a uniform set of categories, as they should if this hypothesis were correct. Some non-adultlike extension patterns look at first glance very similar across languages, but closer inspection shows that they have clearly been influenced by the categories of the input language.

Nonlinguistic perceptual and conceptual predispositions for space do not, then, shape children’s semantic categories directly, but only in interaction with the semantic structure of the language being acquired. Much remains to be learned about this interaction, but progress can be made, we have suggested, by viewing the process within a framework that stresses the usage-based, dynamic properties of language.

NOTES

We are grateful to Steve Levinson and Dan Slobin for their comments on an earlier draft of this chapter.

1 In English, Path satellites (which are spatial particles) overlap to some extent with prepositions, and in certain cases they fall together to produce a “merged form” that has properties of both (Talmy 1985:105).

2 Kkita can be used as an intransitive verb, but then it expresses an abstract sense of entering, as in joining a group or breaking into a queue.

3 Each example shown in figure 16.2 can be seen as representative of a larger class of situation types: (a) support from below (e.g. cup on table, pen on desk); (b) “clingy” attachment (adhesion or surface tension, e.g. bandaid on leg, rain drops on window); (c) hanging over/against (e.g. picture on wall, coat on bannister); (d) fixed attachment (handle on door, telephone on
wall); (c) point-to-point attachment (e.g., apple on twig, balloon on string); and (f) full inclusion (e.g., apple in bowl, rabbit in cage). With certain exceptions, spatial configurations falling into each of these situation types were encoded with the same spatial words within each language.

4 Even seemingly uncontroversial examples like (a) "cup on table" and (f) "apple in bowl" in figure 16.2 are not classified straightforwardly in terms of "support" and "containment" in all languages. For example, many languages (especially those following Pattern 2 above, like Japanese and Korean) use the same word for objects both "on" a supporting surface, as in (a), and "above" it (so contact and support are not critical). Australian languages often use the same term for both "being in," as in (f), and "being under" (Wilkins & Evans 1995). And Tzeltal Maya breaks down both "support" and "containment" quite finely; for example, "being in" a container is encoded with different morphemes depending on the shape of the container (P. Brown 1994).

5 Overextension was important in our analysis, as were appropriate uses of words for novel situations. This is because if children do not yet use spatial words productively, they might appear to follow language-specific principles of categorization when they are actually simply repeating what they have frequently heard adults say in particular situations. Only when children go beyond what they have heard is it possible to make inferences about the principles guiding their word extensions.

6 Productivity was sometimes preceded by a period of restricted use, e.g., one English-speaking child initially said out only for going outdoors; another said off only for taking clothes off the body (see Choi & Bowerman 1991). These uses were idiosyncratic—different for different children.

7 Our lab is modeled on that of Letty Naigles. We would like to thank her for her generous help in setting it up.

8 Each action was performed three times in succession. All scenes showed only the actor's hands and arms to avoid unnecessary distractions, and within each pair care was taken to equate colors, rhythm with which the actions were performed, and other factors that might influence overall salience. For half the children the side on which the matching screen was positioned was left, right, right, left across the four pairs, and for the other half it was right, left, left, right.

9 But this evidence for language sensitivity is congruent with other studies showing a very early influence of experience with a particular language, e.g., on infants' discrimination and categorization of speech sounds (Streeter 1976; Werker & Tees 1984; Kuhl, Williams, Lacerda, Stevens, & Lindblom 1992), on their preference for one stress pattern over another (Jusczyk, Cutler, & Redarz 1993), and on their relative emphasis on nouns vs. verbs (Choi & Gopnik 1995).

10 See Regier (1997) for a replication of English and Dutch children's learning patterns, using computational modeling in which the input to the "learner" reflected the above reasoning.

11 We use the term "perceived" here for lack of a better term. But we do not mean to suggest that only "perceptual" similarity, strictly defined, counts towards learners' construal of two situations as similar. For children as well as for adults, implicit similarity judgments are likely to be affected by "conceptual" considerations as well, such as - for spatial relations - assumptions about why an object stays in place and does not fail.

REFERENCES

Bloom, L. 1973. One word at a time: the use of single word utterances before syntax.
The Hague: Mouton.


