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THE ORIGINS OF CHILDREN'S SPATIAL SEMANTIC CATEGORIES: COGNITIVE VERSUS LINGUISTIC DETERMINANTS

MELISSA BOWERMAN

When we observe the motion or location of an object in space, we are not aware of imposing categorical distinctions on the scene: "phenomenally, space seems to be completely continuous and homogeneous, stretching without seam in three open-ended dimensions" (Bialystok & Olson 1987: 511). Yet, to talk about motion and location, we must partition space into a discrete number of basic spatial categories. For example, to describe a cookie in contact with the upper surface of a dish, we must decide whether it is 'on' or 'in' the dish. The shape of the dish may be intermediate between a flat plate and a clearcut bowl, but in everyday English we cannot represent the relationship as intermediate between 'on' and 'in.'

Where do the semantic categories associated with words like *on*, *off*, *in*, *out*, *up*, *down*, *over*, and *under* come from? Is non-linguistic spatial perception and conceptualization implicitly categorical, perhaps organized around focal exemplars or perceptual primitives? Or do we divide up space in a particular way because of the language we learn? Obviously no simple appeal to either non-linguistic cognition or the influence of language can provide a complete answer to this complex question. However, in the literature on how children learn locative prepositions non-linguistic spatial development is seen as vastly more important than experience with language. Children are portrayed as acquiring morphemes to express spatial concepts they already have, rather than creating spatial meanings in response to language.

In this chapter I argue that this widespread view of spatial semantic development seriously underestimates the role of language. Languages differ widely in their organization of spatial meanings – for example, in the criteria they use to categorize two situations as instances of "the same" or "different" spatial relations. Although non-linguistic spatial development clearly paves the way for children to acquire spatial morphemes, learners must attend to the linguistic input to discover the particular way space is organized in their language. Little is known about how this language-specific learning takes place, but it begins

very early: I present evidence that children's semantic categories for spatial terms may already be profoundly language-specific even before the age of two.

1 The "cognitive" approach to spatial semantic development

Over the last twenty years, many researchers have argued that the process of language acquisition builds critically on children's prelinguistic cognitive achievements. This approach, often called the "cognitive" hypothesis, is embedded in a fundamental change in attitudes towards the relationship between language and cognition.

In the 1950s and 1960s, researchers generally assumed that children construct semantic categories by noticing which properties of referents remain constant across successive uses of a form by fluent speakers. Whorf (1956) claimed that language shapes children's understanding of the world and that learners of different languages end up with different systems of thought. Inspired by Whorf, Roger Brown (1958) described lexical development as "The Original Word Game," a pastime in which the child makes guesses about how to classify referents according to local custom and the adult helps by modeling appropriate lexical usage and correcting the learner.

By the early 1970s, the tide began to turn against the idea that children's categorization of the world is guided by language. Explicit attempts to test the Whorfian hypothesis had yielded mixed or disappointing results. Interest was growing in the work of Piaget (e.g. 1954), who showed that considerable cognitive development takes place in the prelinguistic period. Rosch's work on prototype structure and "basic level categories" (Rosch 1973; Rosch, Mervis, Gray, Johnson, & Boyes-Braem 1976) suggested that natural language categories are less arbitrary than had been thought – more "given" in the correlational structure of reality. This meant that reliable clues to categorization were available to children independently of language. Indeed, as Rosch & Mervis (1977) demonstrated, children can categorize objects at the "basic level" before they learn names for them. At the same time, crosslinguistic research showed that some semantic domains are conceptualized more uniformly across cultures than had previously been supposed (e.g. Berlin & Kay 1969, on color; E. V. Clark 1977, and Allan 1979, on classifiers). For color, there was also evidence linking crosslinguistic similarities to properties of human visual physiology. Infant research demonstrated that babies come "prewired" to perceive changes along certain physical continua in a discontinuous or "categorical" way (see Bornstein 1979, and Quinn & Eimas 1986, for reviews). It began to seem as though the semantic organization of language, far from influencing or determining

speakers' categories, was itself simply a reflection of deep-seated properties of human perceptual and cognitive organization.

Among students of language development, this *Zeitgeist* led to a reversal in the way questions about semantic development were formulated: rather than asking how children figure out meanings for the words they hear, researchers began to ask how children find words for meanings they already know (e.g. Nelson 1974, Slobin 1973). Prelinguistic children were pictured as busy building up concepts for understanding and interpreting their experiences. As they begin to want to communicate, they look for linguistic devices – words, inflections, word order patterns, etc. – for expressing their ideas. In this approach, then, the initial stages of language acquisition are seen as a process of learning how to translate from one representational system to another. (See Bowerman 1976, Cromer 1974, Johnston 1985, for general discussions of this position.)

Children's acquisition of locative morphemes is often cited as a paradigm example of how language is mapped onto pre-existing concepts. Three broad lines of evidence are relevant. First, children undeniably learn a great deal about space before they begin to talk (e.g. Gibson & Spelke 1983, Needham & Baillargeon 1993, Piaget & Inhelder 1956; see Van Geert 1985/6, for a useful review). Because of this, R. Brown (1958) in fact excepted space from linguistic shaping in his description of "The Original Word Game": "conceptions of space, time, causality, and of the enduring object..., so brilliantly studied by Piaget...are the basic referent categories and they are formed with little assistance from language" (p. 195).

Second, there seemed to be a close relationship between the non-linguistic and linguistic structuring of space. In an influential paper H. Clark (1973) argued that the way people perceive and conceptualize the locations of objects ("P-space") is heavily constrained by their biology (e.g. top–bottom and front–back asymmetry, lateral symmetry, upright posture) and their physical environment (e.g. the workings of gravity). He proposed further that the properties of spatial language ("L-space") are conditioned by and isomorphic to those of P-space. This correspondence between the two systems means that "the perceptual features in the child's early cognitive development (his P-space) are reflected directly in the semantics of his language (his L-space)" (p. 30), which in turn allows the child to acquire spatial expressions "by learning how to apply them to his prior knowledge about space" (p. 62).[1]

Third and most important, a variety of studies has shown that the acquisition of spatial words is preceded, guided, and paced by the unfolding of non-linguistic spatial knowledge. It is worthwhile reviewing

a few of these, since they support the claim that children's spatial semantic concepts originate in non-linguistic development.

(a) Children often show signs of wanting to communicate about the location of objects before they know spatial morphemes; for instance, they may combine two nouns or a verb and a noun with what seems to be a locative intention, as in "towel bed" for a towel ON a bed and "sit pool" for an event of sitting IN a pool (Bowerman 1973: 242). R. Brown (1973) noted that the prepositions most often called for but usually missing in the speech of his three English-speaking subjects were *in* and *on*. At a later stage, these were the first two prepositions reliably supplied. Citing similar data from a variety of languages, Slobin (1973) proposed that the emergence of a given locative concept sets the lower bound on when the form for expressing that concept will be acquired. After the concept is available, the time the form is actually acquired depends on its formal linguistic properties (its "linguistic complexity" for children). For example, if a locative notion is expressed with a postnominal marker in language-A and a prenominal marker in language B, children learning A will tend to master the marker earlier than those learning B (Slobin 1973: 191).

(b) Within a language, locative forms like the English prepositions are often similar in linguistic complexity, but they do not all come in at once. Rather, they emerge over a long period of time, in an order that is roughly the same across children learning different languages. This order is consistent with the sequence established by Piaget & Inhelder (1956) for the emergence of different kinds of non-linguistic spatial knowledge, which supports the hypothesis that time of acquisition is guided by the maturation of the relevant spatial notions (Johnston 1985, Johnston & Slobin 1979, Slobin 1985). The first locatives to come in express functional and topological notions of containment (*in*), support and contiguity (*on*), and occlusion (*under*), then come notions of proximity (*next to, beside, between, behind, in front of* (in connection with objects with inherent backs and fronts), and finally projective order relationships (*behind, in front of* in connection with nonfeatured objects).

(c) When researchers have compared children's non-linguistic grasp of a spatial concept directly with their knowledge of the word that encodes this meaning, they have invariably found an asymmetry in favor of non-linguistic knowledge. For example, Levine & Carey (1982) tested two- and three-year-old children's non-linguistic grasp of the concepts 'front' and 'back' by having them line up (toy) objects such as a doll, a car, a chair, and a stove in a "parade" and, in a second task, asking them to place these objects so they could have a conversation with a doll held by

the experimenter. They then asked the children to point to the 'front' and 'back' of these and other objects. They found that children could distinguish the fronts and backs of objects non-linguistically well before they knew the words *front* and *back*. Similar results have been obtained for the Hebrew equivalents of *in*, *on*, and *under* (Corrigan, Halpern, Aviezer, & Goldblatt 1981; Halpern, Corrigan, & Aviezer 1981), and for the use of *in back of* and *in front of* with featured and nonfeatured objects (Johnston 1979, 1985).

(d) E. Clark (1973) showed that young children often play with objects in ways that show understanding of the spatial notions 'containment' and 'support' before they learn the words *in* and *on* (see also Freeman, Lloyd, & Sinha 1980 for further evidence, but Caron, Caron, & Antell 1988, for some qualifications), and they make systematic use of this knowledge in trying to comply with instructions containing unknown locatives. For example, when told to place object A *in*, *on*, or *under* object B, Clark's youngest subjects typically put A 'in' if B was container-shaped and 'on' if B provided a flat, supporting surface, regardless of the preposition mentioned. This meant that they were almost always correct with *in*, correct with *on* unless B was a container, and never correct with *under*. Clark hypothesized that prepositions whose meanings accord with children's non-linguistic spatial strategies are acquired earlier than prepositions whose meanings do not: hence, *in* is easier than *on*, which in turn is easier than *under*.

To summarize, the hypothesis that children map spatial morphemes onto their non-linguistic concepts of space has rested on three foundations: (i) evidence that prelinguistic children know a lot about space; (ii) arguments for a close correspondence between the perceptual and the linguistic organization of space; and (iii) evidence that spatial morphemes emerge only after the relevant non-linguistic spatial knowledge is in place. All three foundations seem sound: any adequate theory of spatial semantic development will have to take into account both children's non-linguistic spatial cognition and biological or environmental constraints on the meanings of possible spatial morphemes. However, in all the emphasis on what children do NOT have to learn in acquiring spatial morphemes, what they DO have to learn has been neglected. In the next section, let us look at the basic problem presented by differences in the way languages partition space.

2 Crosslinguistic variation in spatial categorization

All languages make categorical distinctions among spatial configurations for the purpose of referring to them with relatively few expressions, such

as the spatial prepositions of English.[2] However, they do not all do so in the same way; that is, what "counts" as an instance of a particular spatial relationship varies from one language to another. This is not a problem *per se* for the view that there is a close correspondence between spatial perception and spatial language. "Correspondence" does not mean that all languages have to have identical spatial meanings, but only that their meanings must be "consistent with" hypothesized spatial primitives (H. H. Clark 1973, Miller & Johnson-Laird 1976, Olson & Bialystok 1983). Still, stress on the way perception conditions the semantic organization of space inevitably leads to overestimation of how closely the spatial morphemes of, say, English map onto hypothesized perceptual primitives.[3] This in turn has reconfirmed the assumption that "having a non-linguistic understanding" of spatial relationships is more or less the same as having spatial concepts that are similar in meaning to the English locative prepositions. This assumption needs close examination.

As an exercise, let us investigate the gap between non-linguistic understanding and knowledge of linguistic categories by looking at

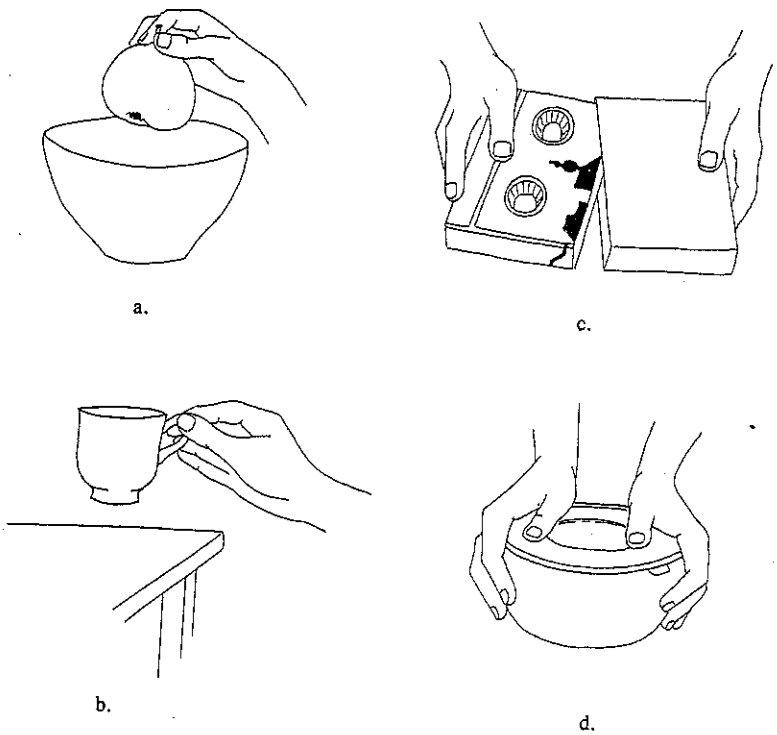

Fig. 6.1 *Four spatial actions*

alternative ways of partitioning topological relationships that all can be described with *in* or *on* in English. Relations of other kinds would serve as well, but 'in' and 'on' relations are especially revealing because investigators have so often assumed that the basic meanings of the words *in* and *on* could be acquired non-linguistically.[4] My argument is consistent with that of cognitively oriented linguists (e.g., Croft 1991, Herskovits 1986, Lakoff 1987, Langacker 1987, and Talmy 1975, 1983, 1985) who have argued that the lexicon and grammar of a language provide conventionalized ways of conceptualizing scenes for given purposes.[5]

Imagine yourself as a child who, like R. Brown's (1973: 327ff.) subject Eve, knows that she can say *in* connection with, for example, putting an apple into a bowl (example [a] in figure 6.1) or *on* for putting a cup on the table (example [b]), and is now faced with deciding which novel situations also qualify as instances of the same spatial relation.

If you associate *in* with 'containment' and *on* with 'support' (see R. Brown 1973: 330), your choice is clear: you will extend *in* from (a) putting an apple in a bowl to (c) putting a video cassette in its case, and *on* from (b) putting a cup on the table to (d) putting a fitted lid on a container. And you would be right – in English. However, if you are learning Korean your reliance on 'containment' and 'support' would lead you astray. In this language, putting a video cassette into its case and a fitted lid on a container are typically distinguished from putting an apple in a bowl and a cup on the table, respectively, and grouped together into the SAME spatial category on the grounds that they both involve bringing an object together with another object in relationship of three-dimensional meshing or fit (Bowerman 1989, Choi & Bowerman 1991). We will return to these differences in the next section; for now the way these events are typically classified in the two languages is simply diagrammed in figures 6.2A and 6.2B.

Now consider figure 6.3, which gives 'apple in bowl' and 'cup on table' as anchor points, along with a set of new spatial configurations, this time static ones rather than motions. In English, *on* applies not only to 'cup on table' but to all the new examples as well: 'handle *on* pan,' 'bandaid *on* leg,' 'ring *on* finger,' 'fly *on* door,' and 'picture *on* wall.' This makes perfect sense to speakers of English: these spatial configurations are all similar to 'cup on table' in that the located object is IN CONTACT with an exterior surface of the reference object and SUPPORTED (but not CONTAINED) by it. (Following Talmy 1975, 1985, I will use the term "figure" for the moving or located object and "ground" for the reference object; these are called "theme" and "relatum" or "trajector" and "landmark" in other treatments.)

Dutch,[6] like English, distinguishes 'apple *in* bowl' from the other configurations shown (using the cognate preposition *in*). However, it

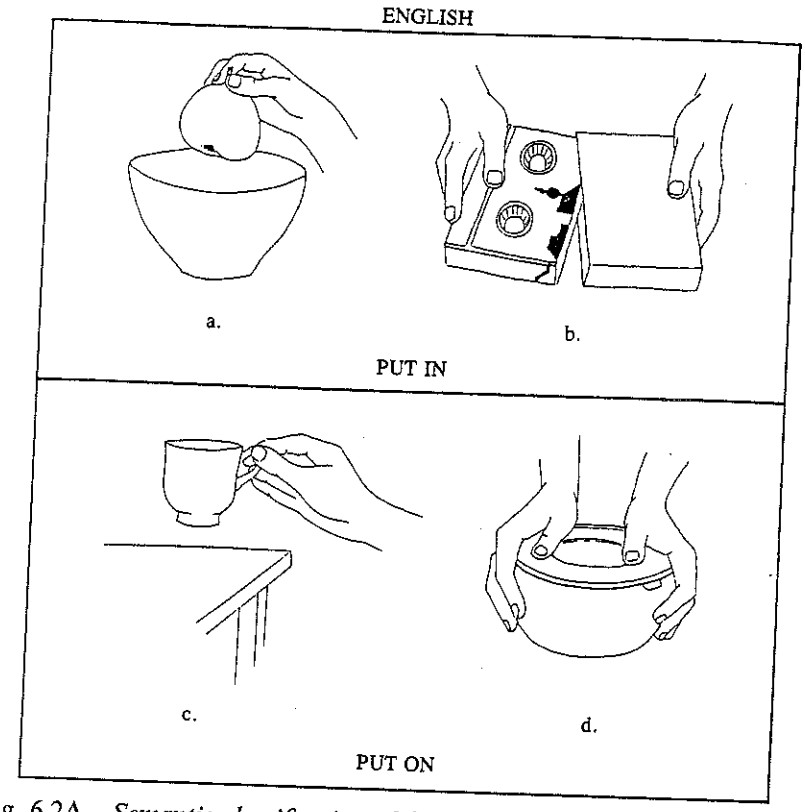

Fig. 6.2A *Semantic classification of four actions in English*

breaks down the English *on* relations into three different categories, expressed by the prepositions *op*, *aan*, and *om*, as shown in figure 6.4.

Om is like English *around* in specifying a relationship of 'encirclement,' but it is used much more consistently for encirclement than *around* is. English speakers prefer or even insist on *on* for encirclement relations involving contact with and support by the ground object; cf. 'ring *on*/*??around* finger,' 'diaper *on*/*??around* baby,' 'pillowcase *on*/*??around* pillow,' while Dutch speakers typically use *om* for these configurations.

Op and *aan*, in many of their uses, divide up one of the basic "use types" described by Herskovits (1986: 140–3) for the English preposition *on*: 'spatial entity supported by physical object.' The difference between them for topological relations like those in figures 6.3/6.4 has to do with how the figure stays in contact with the ground. *Aan* is used when the figure maintains its position – e.g., resists separation from the ground by the pull of gravity or other force, including lateral or upward forces – by being attached, typically hanging or projecting, by one or more fixed

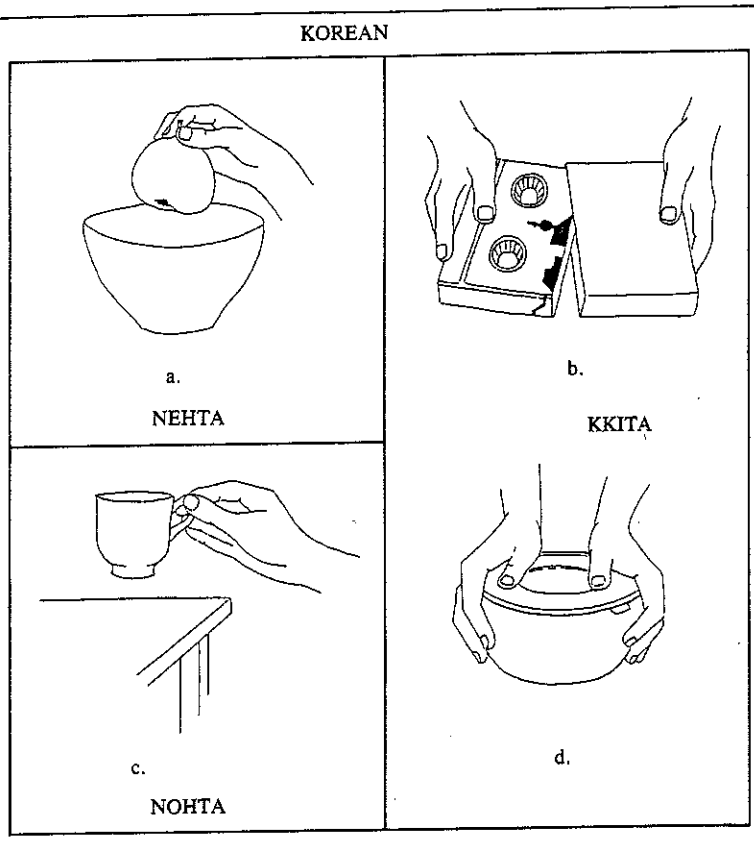

Fig. 6.2B *Semantic classification of four actions in Korean*

points; the ground may, but need not, actually support the figure. Examples include 'clothes on line,' 'picture on wall' (hanging from nail), 'apple on twig,' 'icicles on roof,' 'handle on pan,' 'handle on suitcase,' 'dog on leash,' 'pull-toy on string,' and 'balloon (either helium or ordinary) on string.' *Op* is used for relationships in which the figure is supported by the ground from underneath (e.g. 'cup on table'), or in which a living figure finds support in any orientation ('fly on door,' 'spider on ceiling,' 'snail on wall'), or in which an "adhesive" figure sticks tightly over a broad surface of itself to a ground in any orientation ('bandaid on leg,' 'poster on wall' [glued tight], 'sticker on cupboard,' 'paint on door,' 'raindrops on window'). What seems to unite these seemingly diverse uses of *op* and distinguish them from uses of *aan* is that a figure *op* a ground is perceived as stable, i.e., not in any salient way resisting an underlying force that pulls it away from the ground, while a figure *aan* a ground is seen as being prevented from manifesting a tendency towards separation.[7] It is plausible that underlying "force

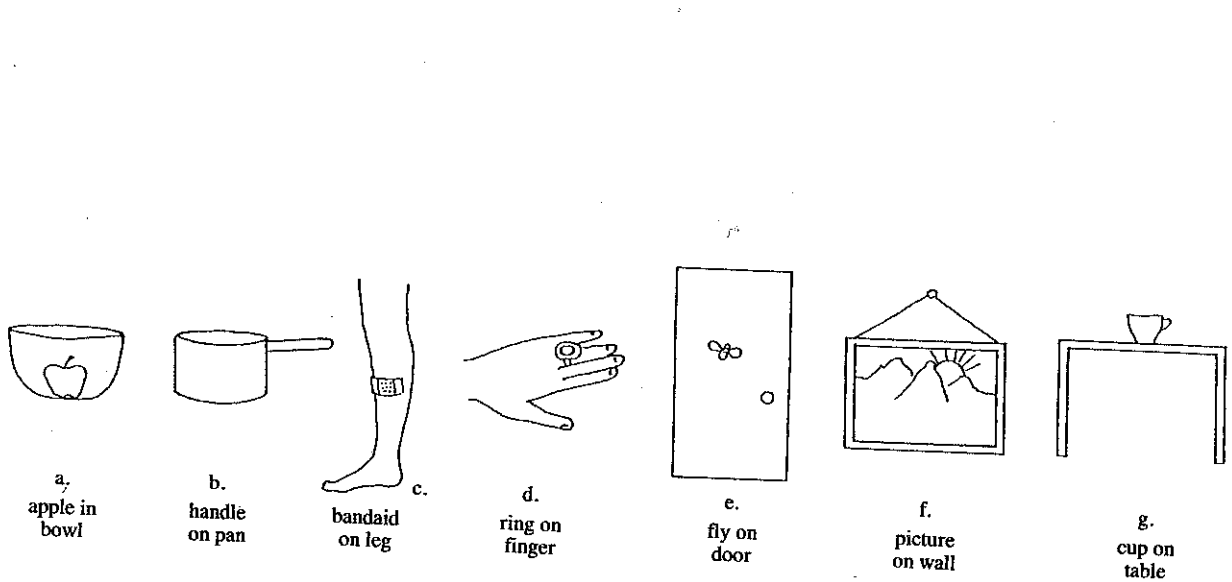

Fig. 6.3 *Some static spatial configurations*

bowl on pan on leg finger door on wall table

Fig. 6.3 *Some static spatial configurations*

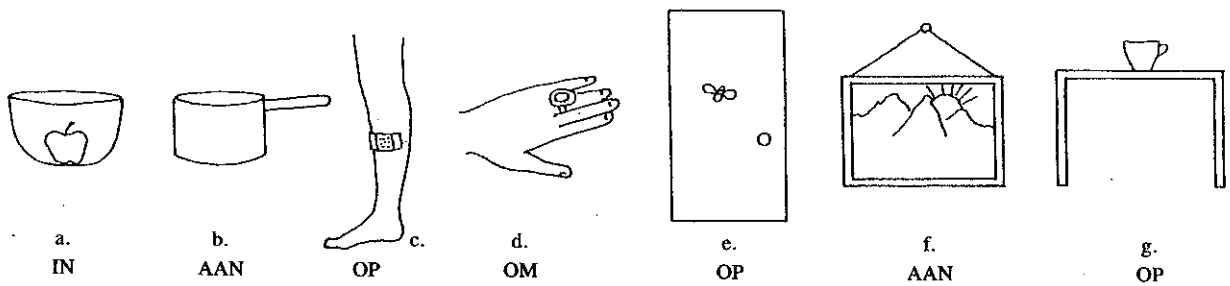

Fig. 6.4 *Semantic classification of static spacial configurations in Dutch*

dynamic" considerations like these are relevant to the semantics of preposition choice even in seemingly static situations, given both their pervasive importance in other domains of language (Talmy 1988) and experimental evidence that people perceive static situations in terms of "forces in equilibrium" (Freyd, Pantzer, & Cheng 1988).

In Finnish the examples shown in figures 6.3/6.4 are broken down in still a different way. Finnish expresses most locative relations with a case ending on the ground nominal. The three so-called "internal" cases are usually translated as *in*, *into*, and *out of*, and the three "external" cases as *on*, *onto*, and *off* (or *from*). These translations are somewhat misleading, however. Only (f) and (g) in figure 6.3 are encoded with the "external" case corresponding to *on* in English, the adessive (*-lla/-llä*). All the rest are encoded with the "internal" case corresponding to *in*, the inessive (*-ssa/-ssä*). These differences between English and Finnish are shown in figure 6.5.

To speakers of English, this classification seems strange. Surely the handle is not 'in' the pan, the bandaid 'in' the leg, or the fly 'in' the door! And surely it is the finger that is 'in' the ring, not the ring that is 'in' the finger! In accounting for these differences, it is helpful to invoke a dimension of "relative distance" proposed by Landau & Jackendoff (1993) to explain the difference between locatives such as *in*, *on*, *near*, and *far*. "Relative distance" specifies how close the figure is to the ground: the figure is maximally close when it is located in the interior of the ground (*in, inside*), somewhat more distant when it is exterior to the ground but in contact with it (*on, against*), still more distant when it is close to the round but not touching it (*near*), and so on. In figures 6.3–6.5, the examples are arranged from left to right roughly in order of increasing "distance," starting with (a) apple in bowl (far left) as the "closest" (located in the interior). A relationship of "exterior to the ground but in contact with it" is represented by several examples, ranging from "fixed attachment" ([b]: handle on pan) through "easily broken attachment" ([c]–[e]: bandaid on leg, ring on finger, fly on door), to "loose contact; no attachment" ([f]–[g]: picture on wall,[8] cup on table).

As figure 6.5 shows, English makes a cut between examples (a) and (b)–(g): it uses *in* for a figure interior to a ground, and *on* for a figure in contact with an outer surface. Finnish, in contrast, puts a cut much further along the continuum, distinguishing (a)–(e) from (f)–(g): *-ssa* (inessive) applies to a figure that is EITHER interior to a ground OR "intimately" in contact with its outside surface (e.g., because it is attached), whereas *-lla* (adessive) is used for a figure "loosely" in contact with the outside surface of a ground.[9] These two partitionings reverse the markedness relations in the two languages. For English, being located in the interior of an object merits special encoding whereas being on the outer surface is undifferentiated (*on* is indifferent to whether the figure is

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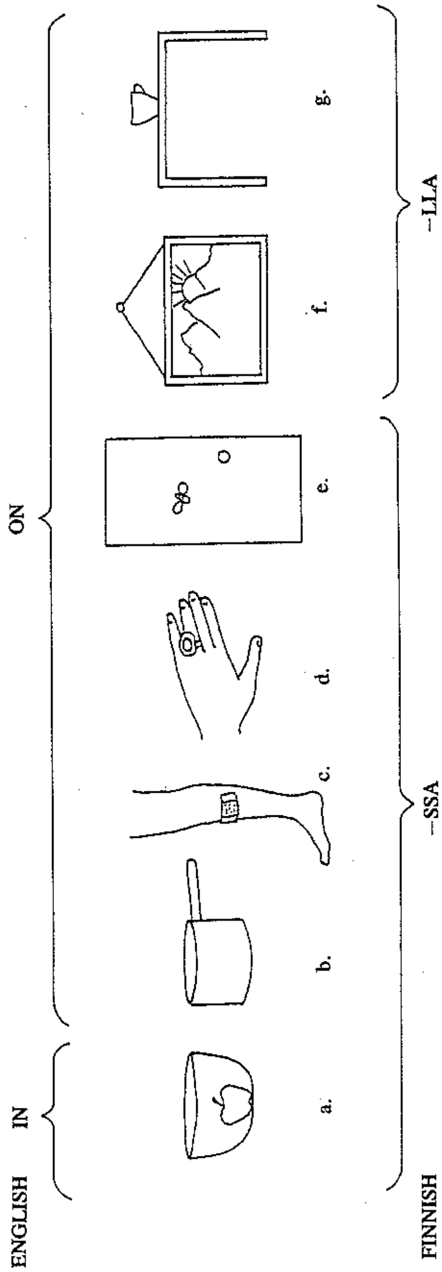


Fig. 6.5 *Semantic classification of static spatial configurations in English and Finnish*

intimately or loosely in contact with a surface). For Finnish, in contrast, being loosely in contact with an outside surface is special, while being "intimately" in contact is undifferentiated (the inessive is indifferent to whether the figure is contained by the ground or "close" to it on its outside surface) (see also Alhoniemi 1979). Independent evidence that the Finnish inessive is unmarked relative to the adessive is that the word *missä*, 'where,' is composed of the morpheme *mi-*, 'what,' suffixed with the inessive case.

These examples show that if you are a child learning Dutch or Finnish you will have to learn to attend to rather different aspects of topological relationships than if you are a child learning English. However, these languages agree with English in one important way: their spatial morphemes are not very sensitive to the shape or identity of figure and ground objects. If you are learning certain other languages, however, you will have to learn to take these properties into account as well in selecting locative forms.

Consider, for example, the spatial configurations shown in figures 6.6A and 6.6B; which all involve a roughly horizontal supporting surface of the kind associated with prototypical uses of *on* in English. For speakers of Mixtec, a language of Mexico, the examples of 6.6A fall into four spatial semantic categories on the basis of the shape of the ground object (Brugman 1984, Brugman & Macaulay 1986, see also Lakoff 1987). Mixtec has no prepositions or other morphemes dedicated to spatial relations. Instead, it expresses locations by metaphorically viewing the ground as an animal or a person and assigning a body part to the region in which the figure is located.[10] Examples (in loose translation): (a) 'the man is-located the house's ANIMAL-BACK'; (b) 'the cat is-located the mat's FACE'; (c) 'the tree is-located the mountain's HEAD'; and (d) 'the man is-located the tree's ARM.' These distinctions do not simply subdivide English *on* relations more finely, but cross-cut them to some extent. For example, the use of English *on* for situations like those in 6.6A requires CONTACT between figure and ground, but many Mixtec locative expressions permit both a contact and an "adjacent space" reading; e.g., 'X is-located the mountain's HEAD' could be said regardless of whether X – a bird, say – is touching the mountain or hovering in the air above it.[11]

Speakers of Tzeltal, a Mayan language, can also use body-part metaphors to locate a figure with respect to a ground if they want to be precise about the region of the ground involved. However, the ground is more typically introduced only with a general preposition *ta* ('at, in, on, to, from,' etc.), and spatial relationships are mostly expressed with closed-class "positional" verbs that subdivide spatial relationships on the basis of the properties of the FIGURE (P. Brown, 1994; Levinson 1990).

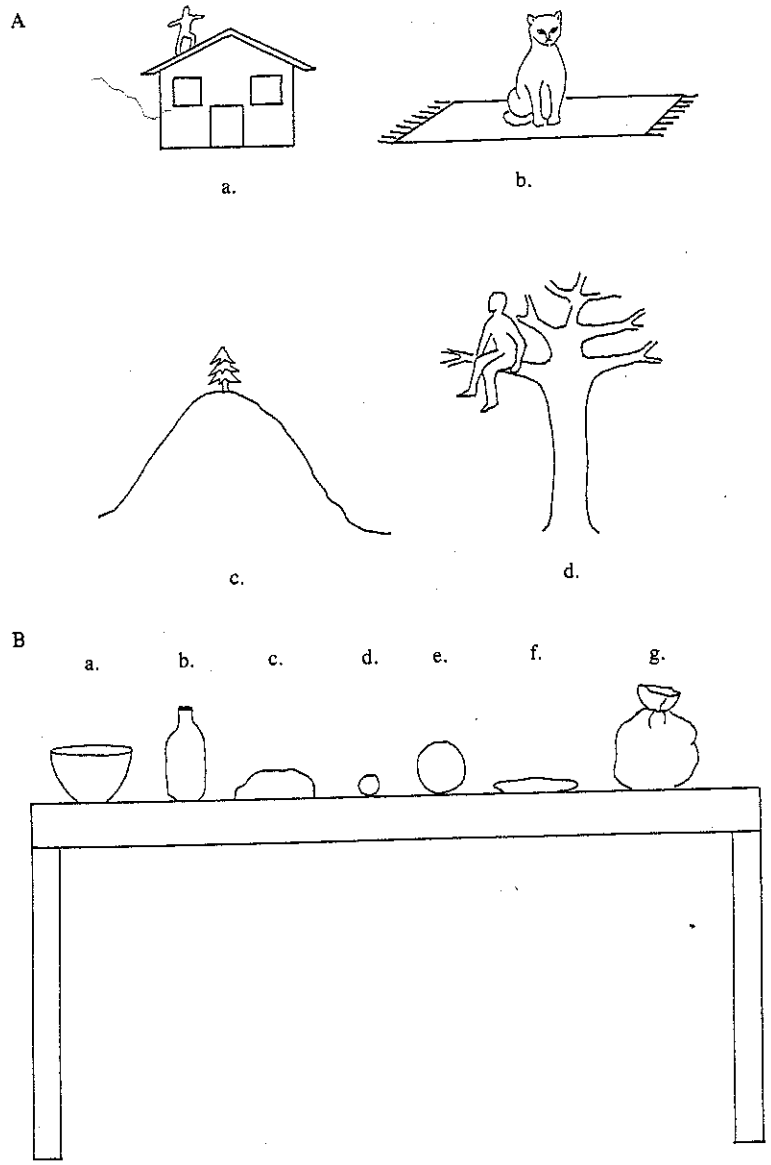


Fig. 6.6 *Some horizontal support relationships*

The objects on a table in figure 6.6B, for example, fall into seven different spatial categories: (a) *pachal* 'to be located' (said of a bowl-shaped figure in upright, canonical position); (b) *waxal* (said of a narrow-mouthed container in upright position); (c) *pakal* (said of an inverted object with flat surface down); (d) *wolol* (said of a small sphere); (e) *k'olol* (said of a large sphere); (f) *lechel* (said of a smallish flat thing); and (g) *chepel* (said of things sitting bulging in a bag). Again, this classification cross-cuts that of English: these descriptions are indifferent to whether a figure is 'on' a table or 'in' some container, as long as it has the relevant shape and orientation.

Let us stop now and take stock of the situation. Languages use surprisingly different criteria to calculate similarities and differences among spatial configurations, and this means that their spatial categories cross-cut and intersect each other in complex ways.[12] When children contemplate spatial configurations like an apple in a bowl or a cup on the table, they may well notice the shape of the figure and the ground, the nature of the contact between the two objects, and so on. However, they cannot know ahead of time which of these properties will be critical for assigning the scene to a spatial category of their language; this is something that can only be learned through attention to how linguistic forms are distributed across referent situations in the speech of fluent speakers.

When does this learning take place? Researchers concerned with cross-linguistic differences have typically assumed that learning from language is a drawn-out process (e.g. Schlesinger 1977, Slobin 1985). This is, of course, consistent with the idea that children initially rely on their own meanings. According to Slobin (1985: 1174), for example, "children discover principles of grammatical marking according to their own categories – categories that are not yet tuned to the distinctions that are grammaticized in the parental language." Later, however, "the language-specific use of particular functors will train the child to conceive of grammaticizable notions in conformity with the speech community." Although this scenario is plausible, I find it sobering that the "non-linguistic spatial concepts" often hypothesized to underlie spatial prepositions – e.g. "containment" and "support" – lend themselves much more readily to shaping into the spatial categories of English than, say, of Tzeltal. In other words, our ideas about plausible "primitives" in the language of thought may themselves be conditioned by the language we have learned.

A different possibility is that children are sensitive virtually from the beginning to the classification patterns displayed in their language. Differences in how languages partition a conceptual domain presumably signal a flexibility in human sensitivity to similarities and differences of

various kinds among to-be-classified referents. Children may have fewer options in classification than adults, but there is no reason to assume that they are predisposed to construe things in only one way. To the extent that children are flexible, they may be open from an early age to linguistic guidance (Bowerman 1985, R. Brown 1965: 317, Gentner 1982). Of course, some conceptual domains may be more susceptible to linguistic influence than others; for instance, Gentner (1982) argues that object concepts are cognitively more "given" whereas relational concepts are more imposed by the structure of language. And within a given domain some principles of classification may be easier for children than others – in particular, principles that are used frequently in languages of the world may be cognitively more "natural," hence easier for children to identify, than those that are used infrequently (Bowerman 1993).

One way to compare the roles of cognition and language in structuring children's early spatial semantic categories is to determine how early the meanings of their words are language-specific. If language-specificity is early, then children must have relatively weak language-independent preferences for classifying space and they must pay careful attention to language. Conversely, if there is a period of universal or idiosyncratic meanings followed only later by language-specificity, then children have strong language-independent preferences and less sensitivity to language. In the following section, I describe research Soonja Choi and I have conducted comparing spatial semantic categories in very young children learning English and Korean (Bowerman 1989, Choi & Bowerman 1991).

3 Talking about spatial events in English and Korean

In this research, we have been concerned with spatial events like putting an apple into a bowl or a cap on a pen, taking a cassette out of a case or a hat off the head, and climbing up on a lap or sliding down from a chair. These are the situations in which English-speaking children first use words like *in*, *out*, *on*, *off*, *up*, and *down*, often still during the one-word period. Several researchers have suggested that these uses reflect previously established dynamic spatial concepts (e.g. Bloom 1973, McCune-Nicolich 1981, Nelson 1974). According to McCune-Nicolich, for example, they encode operative knowledge (knowledge of transformations) attained in the late sensorimotor period (Piaget 1954). She predicts that "since operative intelligence is a universal aspect of cognition, the same categories of meaning would be expected for all children, although various lexical items might be used to encode these" (1981: 18).

English and Korean classify spatial events quite differently. Yet if children learning English use universal sensorimotor concepts to guide

their uses of *in*, *down*, etc., they should produce these words in much the same situations in which children learning Korean say some Korean word.

3.1 Adult English and Korean

In adult English, spatial prepositions and particles (e.g. *in*, *out*, *up*, *down*) form a closed-class system for expressing the notion of Path: the location or trajectory of a figure with respect to a ground (Talmy 1975, 1983, 1985). These morphemes are used together with main verbs that express the manner or cause of a motion (or location); e.g., *float/walk/swim/push IN/OUT/UP/DOWN*. Comparable Path-marking systems are found in most Indo-European languages and Chinese.

In a typologically different approach to path-marking, exemplified by Romance and Semitic languages, Path is conflated with motion in the main verb, and manner or cause is expressed optionally as a separate adverbial; for example: (Spanish) *la botella ENTRÓ a /SALIÓ de la cueva (flotando)*, 'the bottle went INTO/OUT OF the cove (floating)/floated into-out of...'; similarly, *subir*, 'go UP,' *bajar*, 'go DOWN,' *meter*, 'put IN,' and *sacar*, 'take OUT.'

Korean presents a mixed picture (Choi & Bowerman 1991). In transitive clauses expressing caused motion, Path is conflated with motion in the main verb, as in Spanish. However, in intransitive clauses expressing spontaneous motion, motion and Path and (optionally) manner or cause are encoded as separate constituents, a pattern not described by Talmy. In both transitive and intransitive clauses, most Path information is expressed with verbs. There are only three locative affixes, -EY, 'at/to,' -LO, 'toward,' and -EYSE, 'from.' These are suffixed to an (optional) nominal specifying the ground, and function like the Spanish prepositions *a*, 'to,' and *de*, 'from,' in the examples above.

Two differences between English and Korean are particularly important for present purposes. First, English Path markers are indifferent to whether a motion is presented as spontaneous or caused; for example, the prepositions are constant in the following sentence pairs: *the mouse went IN the box/John put the mouse IN the box; the mouse went OUT of the box/John took the mouse OUT of the box*. Korean, in contrast, marks most Path meanings with distinct verb roots in intransitive and transitive sentences; for instance, the verbs corresponding to *go IN* and *put IN* these examples are *tule kata*, 'enter go,' (=go in) and *nehta*, 'put-in,' and the verbs corresponding to *go OUT* and *take OUT* are *naylye kata*, 'exit go,' (=go out) and *kkenayta*, 'take-out.'[13]

A second important difference between the two languages is that Korean Path verbs and English prepositions often carve out different categories of Path meanings. For example, there are no transitive Korean

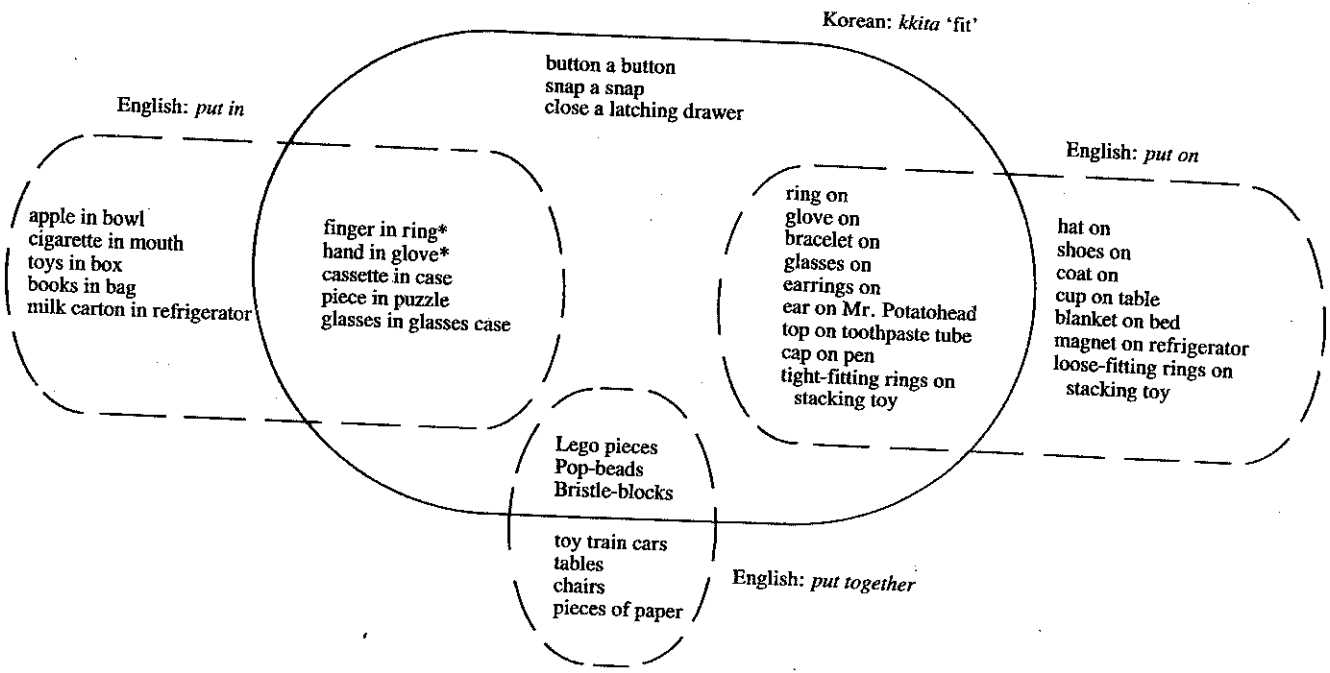
verbs directly equivalent to English *put IN* and *take OUT*, or *put ON* and *take OFF*. Instead, there is an extensive set of verbs that specify the joining or separation of figures and grounds as a function of the properties of these objects; some examples are listed under A of table 6.1. Notice that one of these verbs, KKITA, loosely glossable as 'fit,' was responsible for the differences between English and Korean shown earlier in figure 6.2B. A more detailed look at how KKITA cross-cuts the territory of English Path particles is given in figure 6.7. Two more differences in the structure of Path categories are shown in table 6.1: B, where English uses *put ON* for donning clothing of all types, Korean has different verbs for putting clothing on different body parts; C, where English uses *up* and *down* very broadly for motion along the vertical axis,

Table 6.1. *Some Korean Path verbs*

A Join/separate	
kkita/ppayta	Cause one 3-dimensional object to 'fit'/'unfit' from another (e.g. Lego pieces, ear plugs–ears, cassette–cassette case, top–pen, ring–finger).
nehta/kkenayta	Put something into/take something out of a loose container (wallet–handbag, ball–box, furniture–room).
pwuthita/tteyta	Join/separate flat surface of an object to/from another flat surface (sticker–book, poster–wall, two table sides).
kkotta	Put a solid object elongated in one dimension into/onto a base. (flower–vase, book–shelf, dart–dartboard, hairpin–hair). Separation: *ppayta* when the base holds the figure tightly, but *kkenayta* when it holds it loosely.
nohta	Put something loosely on a surface (pen–table, chair–floor). Separation: *tulta* when focusing on taking the object into the hand, *cipta* for picking it up.
pwusta/phwuta	Pour liquid or a large quantity of tiny objects into/out of a container (milk–cup, sand–pail).
tamta/kkenayta	Put multiple objects into/take out of container that one can carry (fruits–basket, candies–bowl, toys–box).

B Putting clothing onto one's own body	
ipta	Put clothing onto trunk (dress, shirt, pants).
ssuta	Put clothing onto the head (hat, scarf, umbrella)
sinta	Put clothing on the feet (socks, shoes).
chata	Put clothing on the waist or wrist (belt, watch, diaper).

C Motion 'up' and 'down'		
naylye kata	'descend go'	go DOWN
ancta	'sit-down'	sit DOWN
nwupta	'lie-down'	lie DOWN
olla kata	'ascend go'	go UP
ileseta	'stand-up'	stand UP



*Canonically, rings are put on fingers and gloves on hands, but envision here a situation in which the ring or glove is held stable and the finger or hand moves towards it.

Fig. 6.7 *Comparison of the Korean verb* kkita *with English* put in, put on, put together, *and other verbs*

including posture changes, Korean distinguishes "going up/down" from posture changes.

As this sketch should make clear, English- and Korean-speaking children receive different "instructions" about what spatial actions they should regard as similar. For example, English tells them that putting a video cassette IN its case is similar to putting an apple IN a bowl but different from putting a tight-fitting lid ON a container; Korean, however, reverses these judgments. Further, English says that putting a hat ON is in some ways like putting a coat ON, that sitting DOWN on the floor is like climbing DOWN from a chair, and that the trajectory of a ball is the same whether it rolls INTO or is put INTO a box. Korean, however, disagrees.

If children are guided in their early use of spatial morphemes purely by non-linguistic ideas about similarities among events, these linguistic differences should have no effect: children learning the two languages should either associate spatial words with the same underlying concepts, or differ only idiosyncratically. To see whether this is so, Choi and I examined early spontaneous speech data from English- and Korean-speaking children.[14]

3.2 Child English and Korean

In both languages, the children began to produce spatial morphemes at 14–16 months and to use them productively between 16 and 20 months. They also talked about similar events; for example, they commented on their own changes of posture or location, such as sitting down, standing up, and climbing up onto chairs or laps; they appealed to adults for help in changing location or to go outside; they asked to be picked up or carried; and they referred to donning and doffing clothing and to object manipulations of many kinds. These shared preoccupations apparently reflect similarities in the cognitive development and daily activities of children of this age. Underlying the surface look of sameness, however, there were important linguistic differences.

(a) Spontaneous versus caused motion along a Path. By 16–20 months the English-speaking children used words like *up*, *down*, *in*, *out*, *on*, and *off* freely for both spontaneous and caused motions. For example, they said *out* when they climbed out of the bathtub or took something out of a pan, and they said *in* when they climbed into a box or put something into a bag. In contrast, the Korean children made a strict distinction between spontaneous and caused motions: e.g., they said *kkenayta*, 'take out of loose container,' for taking blocks out of a box but not for getting out of the bathtub, and they said *kkita*, 'fit,' while putting plastic shapes into the holes of a shape box but not when they crept into a small space. The

*Canonically, rings are put on fingers and gloves on hands, but envision here a situation in which the ring or glove is held stable and the finger or hand moves towards it.

Fig. 6.7 *Comparison of the Korean verb* kkita *with English* put in, put on, put together, *and other verbs*

Korean children never violated the distinction between spontaneous and caused motion along a Path throughout the entire period investigated.

(b) Containment and support. For the English-speaking children the distinction between *in* and *on* (and their opposites *out* and *off*) was in place by 18–20 months. Like adults, they used *in* and *out* for Paths into and out of both "tight" and "loose" containers, for example, for putting tiny books into a fitted container and removing them and for putting toys into a pan and taking them out. They used *on* and *off* both for surface attachment (e.g. joining and separating Lego pieces and Pop-beads, caps on pens, lids on jars, magnets and tape stuck on surfaces) and for "looser" surface contact such as climbing on or off a lap or stool and for donning and doffing clothing of all kinds (see also Gopnik 1980, Gopnik & Meltzoff 1986).

The Korean children, in contrast, used no global semantic categories of "containment" and "surface contact and support." They used *kkita*, 'fit,' and its opposite *ppayta*, 'unfit' – their earliest spatial words – both for putting objects INTO/OUT OF tight spaces and for surface-attachment (ON/OFF) manipulations involving caps on pens, lids on jars, Pop-beads, and Lego pieces. By 18–20 months they learned other transitive Path verbs that intersect the domains of English *in/out* and *on/off*, and used them generally appropriately, e.g., *nehta* and *kkenayta*, 'put into/take out of a loose container,' *nohta*, 'put loosely on a surface,' *pwuthita*, 'put one flat surface to another,' *kkotta*, 'put elongated object to base,' *ipta/ssuta/sinta*, 'put clothing on trunk/head/feet.' These differences between the English- and Korean-speaking children are shown schematically in figure 6.8.

(c) Motion 'up' and 'down.' Like other English-speaking children, our learners of English used *up* and *down* between 16 and 20 months for a wide range of spontaneous and caused motions along the vertical axis (e.g. going up or down stairs, getting up on or climbing down from raised surfaces like chairs, riding toys, and laps, falling, sitting or lying down, standing up, picking up objects off the floor or putting them on raised surfaces, putting objects down on the floor or low surfaces, and as a request to be picked up and held or put down). To account for the early acquisition and broad extension of these words, several investigators have proposed that *up* and *down* are mapped directly to core spatial concepts of "vertical motion" (e.g. Bloom 1973, Gruendel 1977, McCune-Nicholich 1981). If this is so, Korean children – presumably equipped with similar concepts – should seize on Korean words heard often for events involving vertical motion and extend them freely to other such events. For example, they might select *ancta*, 'sit down,' or *naylita*, 'cause to go down,' to mean 'down' in general, or *anta*, 'pick up and carry,' or *ollita*, 'cause to go up,' to mean 'up' in general.

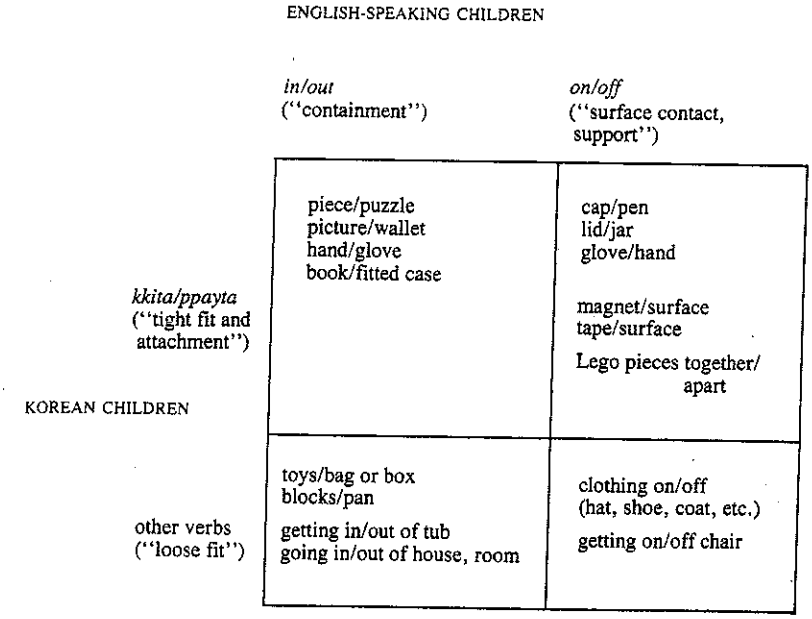


Fig. 6.8 *Cross-cutting classification of acts of "separation" and "joining" by young English- and Korean-speaking children*

This does not occur. Some of our subjects used *ancta*, 'sit down,' and *anta*, 'pick up and carry,' starting at about 17 months, but they never overextended these words to other situations involving motion 'down' or 'up'. They acquired intransitive and transitive causative forms of *nayl-*, 'descend,' and *oll-*, 'ascend,' very late compared to *up* and *down* in children learning English. The Korean children talked about upward and downward motion just as much as the English-speaking children, but they did so with verbs that classify these events by criteria other than shared vertical motion, e.g. *ancta*, 'sit down,' *nwupta*, 'lie down,' *nohta*, 'put X (down or up) on surface.'

To summarize, children learning English and Korean use the Path morphemes of their language with surprising accuracy well before the age of two. Learners of English extend the same words freely to both spontaneous and caused motions, and they concentrate on notions of containment (*in/out*), support and surface contact, especially attachment (*on/off*), and vertical motion (*up/down*). Korean children use different

words for spontaneous and caused motion, they focus on a "tight fit" notion that is orthogonal to containment and support, they distinguish putting clothing onto various parts of the body from other kinds of surface contact, and they distinguish among different kinds of vertical motions.

How significant is this language specificity? Perhaps children simply imitate the words they hear adults use in certain contexts, and have figured out no broader patterns. Yet this is not so. All the children used Path morphemes creatively for novel referents. Their extensions were often quite appropriate; e.g., *on* while holding up yarn against a doll's head (15 months), *down* as the child pushed a cat's head down (17 months), *up* and *down* as the child "walked" her fingers up her body to her neck and back down, *off* while peeling a sticker off a toy bell and while pushing the mother's hand off the page she was drawing on (all 19 months). Some extensions were errors from the adult point of view; e.g., *off* while separating stacked Dixie cups (16 months) (adults would say *[take] apart*), *open* for pulling Pop-beads *apart* (16 months), *in* for putting a pingpong ball *between* the knees (20 months). Errors like these have in the past been interpreted (also by me; cf. Bowerman 1980) as signs that the child is relying on her own non-linguistic concepts instead of being guided by the input. Seen against the backdrop of children acquiring a completely different system, however, it seems that many of these errors are better interpreted as signs of difficulty in working out the details of a system that in broad outline is already quite language-specific (Bowerman 1989, Choi & Bowerman 1991).

4 Discussion

The English and Korean acquisition patterns I have described testify to the contribution of both non-linguistic spatial cognition and the categorization system of the input language to the process of acquiring spatial words. On the one hand, children are not simply mapping morphemes directly onto non-linguistic concepts of containment, support, vertical motion, and the like. From the beginning, they are paying close attention to the way adults use spatial words: across contexts, the word serves as a "lure to cognition," in R. Brown's (1958) felicitous phrase, which draws the learner's attention to properties the referents share. On the other hand, children must be equipped to make sensible guesses about what might be relevant – about what recurrent properties to look for. For example, they do not seem to waste time on the idea that a spatial morpheme could refer only to the location of blue objects, or only to the location of objects in the morning. And some aspects of spatial situations seem to be more salient to them than others – for instance, the distinctions between "containment" and

"support" and between "tight fit" and "loose fit" seem to be easy, but other distinctions are not: e.g., children learning English have trouble with "asymmetrical" vs. "symmetrical" joining and separation (e.g., *on/off* vs. *together/apart*), and children learning Korean tend to overextend words for three-dimensional meshing (*kkita*, 'fit'/*ppayta*, 'unfit') to two-dimensional attachments involving magnets and stickers, which require other words.

As Langacker (1987: 148) notes, "our ability to conceive of spatial relationships presupposes some kind of representational space creating the potential for such relationships." However, the representational space children use in judging the properties of spatial referents remains mysterious. One critical question is this: from all the things people can notice about spatial situations, do the spatial morphemes of language draw on a "privileged" subset (Talmy 1983, Landau & Jackendoff 1993)? If so, this would help children enormously in hypothesizing spatial properties of the "right kind" as meanings for the words they hear (Landau & Stecker 1990). Yet it is harder than it first seemed to pin down this privileged subset.

Talmy (1983) and Landau & Jackendoff (1993) proposed that closed-class spatial morphemes encode highly schematic information about topological regions, main axes, and trajectories, but not Euclidean information about angles and distances or about the exact shape or nature of the ground and especially the figural objects. Levinson (1990), however, argues that this is incorrect: the closed-class positional verbs of Tzeltal, for example, pick out a number of Euclidean properties of figures (see also figure 6.6B). Of course, children may give priority to schematic topological information and so find many of Tzeltal's positional verbs difficult to learn, but this remains to be seen. It is troubling for the hypothesized developmental priority of abstract information about topology and trajectory that Choi's and my Korean subjects learned everyday verbs that express schematic Path meanings like 'enter,' 'exit,' 'ascend,' and 'descend' more slowly than verbs with strong restrictions on figure and ground – e.g. clothing and carrying verbs, for which ground objects must be particular body parts (Choi & Bowerman 1991: 117).

In closing, let us raise the Whorfian question: does learning the spatial categories of their language influence the way children conceptualize space non-linguistically? In principle, of course, it need not: the principles of categorization needed for language may be relevant ONLY for language and play no other role (as argued by Slobin 1991, and in this volume). That is, non-linguistic spatial cognition may be uniform across cultures, drawing entirely on language-neutral organizing principles. However, in the research I have presented here, it is striking how quickly and easily children adopted language-specific principles of semantic

categorization. There was little evidence that they had strong prelinguistic biases for classifying space differently from the way introduced by their language. This leaves the door open to the possibility that, after all, spatial thought – undeniably one of our most basic cognitive capacities – bears the imprint of language.

Acknowledgments

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Notes

1 Related claims about the correspondence between spatial perception and the meanings of spatial morphemes have been made by Bierwisch (1967), Miller & Johnson-Laird (1976), and Olson & Bialystok (1983).
2 Of course, finer distinctions can be made if necessary by combining or modifying these expressions.
3 For example, in arguing that non-linguistic spatial representation is couched in an internal mental vocabulary of spatial "predicates," Olson & Bialystok (1983) propose that "ordinary language yields a relatively full expression of the basic spatial predicates," and that "lexical items express particular spatial predicates and hence have the same structure that mental predicates do" (p. 236).
4 Recall that *in* and *on*, and their counterparts in other languages, are typically among the first spatial morphemes learned by children, often before the age of two. In general, researchers have assumed that morphemes learned very early are especially likely to be mapped to meanings the child has established non-linguistically. Consistent with this, the meanings of *in* and *on* are usually analyzed in terms of functional or topological notions that seem like good candidates for semantic primitives, such as 'containment' or 'inclusion' versus 'support' and 'contact' (see H. H. Clark & Clark 1977, Herskovits 1986, Miller & Johnson-Laird 1976).
5 Languages usually offer alternative ways to encode any given spatial situation, e.g. "the vase is *on* the cupboard" versus "the vase is *on top of* the cupboard." These offer somewhat different perspectives on the scene and are useful for different communicative purposes. In this discussion I will focus on the categories associated with a language's most "neutral" or "pragmatically unmarked" way of describing 'in' and 'on' relations of the kinds considered. I do not attempt to provide a full account of all the ways in which the spatial morphemes at issue can be used, but only to show what kinds of distinctions children have to attend to in order to generalize the morphemes to spatial scenes that are similar in the appropriate way to the ones for which they have heard the forms used.
6 The informal analyses presented here of the way Dutch and Finnish classify spatial configurations like those shown in figure 6.3 are my own. For Dutch I rely on innumerable judgments graciously rendered over the years by native-speaker colleagues and friends (see also Bowerman 1989), and I have also consulted Heestermans (1979), Weijnen (1964), and especially Cuyckens (1991); thanks also to David Wilkins for helpful feedback on my analysis. For

Finnish I am grateful to Riikka Alanen, Olli Nuutinen, Håkan Ringbom, Saskia Stoessel, Jorma Toivainen, and Erling Wande for their judgments and discussion; I have also consulted Alhoniemi (1979) and Leino (1989).

7 For some situations, such as 'glue on scissors,' either *op* or *aan* may be used, reflecting somewhat different construals of the situation.

8 Although the picture hangs from a nail and so might seem to qualify as "attached," its surface is apparently what counts for this calculation, and this is "loosely" in contact with the wall. In Dutch, in contrast, the attached/hanging relationship of the picture to the nail is critical.

9 The characterization given in figure 6.5 of "what speakers say" for various spatial scenes is inevitably somewhat idealized. In Finnish, as in other languages, some spatial situations are routinely described by a specific spatial morpheme while others allow a choice. Which morpheme is selected in case of a choice is influenced both by overall communicative goals (see note 5) and by how speakers construe the specific situation (cf. note 7) – in this case, by hypothesis, how they construe the "relative distance" between figure and ground. Construal is in turn influenced by factors like the relative size and sometimes the specific identity of the figure and ground entities involved.

10 Body-part spatial systems are widespread among Meso-American and African languages (e.g. Heine 1989, MacLaury 1989). Another language requiring close attention to the properties of ground objects is Atsugewi (Talmy 1975, 1985). This language has about fourteen verb suffixes that are equivalent to English *into* for different kinds of ground objects: e.g. 'into a liquid,' 'into a fire,' 'into an aggregate' (e.g. buses, a crowd), 'down into a gravitic container' (e.g. a basket, a pocket), '(horizontally) into a volume enclosure' (e.g. a house, an oven), 'over the rim into a volume enclosure' (e.g. a gopher hole, a mouth), 'down into or onto an object above the ground.'

11 Indifference to whether a figure above a ground is in contact with it is widespread in spatial semantic systems: e.g., Korean, Chinese, and Japanese all routinely use the same morpheme for situations that English distinguishes as *on* versus *over* or *above*.

12 For other interesting examples of crosslinguistic differences in spatial classification, see Anderson & Keenan (1985), Bavin (1990), Casad (1977), Casad & Langacker (1985), Cienki (1989), Denny (1978), Foster (1969), Friederich (1971), Hill (1978), Talmy (1975, 1983, 1985), Taylor (1988), Zubin & Choi (1984), and Zubin & Svorou (1984).

13 The final *-ta* of these forms marks the citation form of the verb and is not part of the root.

14 Our English data come from detailed diary records of my two daughters from the start of the one-word stage, supplemented by an extensive literature on the early use of English Path particles. Two sets of Korean data were used: (i) from four children whom Choi videotaped every 3–4 weeks from 14 to 24–28 months; (ii) from four additional children taped by Choi, Pat Clancy, and Youngjoo Kim every 2 to 4 weeks from 19–20 months to 25–34 months.

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