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8 Individuation, relativity, and early word learning

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Which words do children learn earliest, and why? These questions bear on how humans organize the world into semantic concepts, and how children acquire this parsing. A useful perspective is to think of how bits of experience are conflated into the same concept. One possibility is that children are born with the set of conceptual conflations that figures in human language. But assuming (as we will) that most semantic concepts are learned, not innate, there remain two possibilities. First, aspects of perceptual experience could form inevitable conflations that are conceptualized and lexicalized as unified concepts. In this case, we would have *cognitive dominance*: concepts arise from the cognitive–perceptual sphere and are simply named by language. A second possibility is *linguistic dominance*: the world presents perceptual bits whose clumping is not pre-ordained, and language has a say in how the bits get conflated into concepts.

We propose that *both* cognitive and linguistic dominance apply, but to different degrees for different kinds of words (Gentner 1981, 1982). Some bits of experience naturally form themselves into inevitable (preindividuated) concepts, while other bits are able to enter into several different possible combinations.

1 Relational relativity and the division of dominance

Embracing both cognitive and linguistic dominance may seem to be a vague middle-of-the-road position. But we can make the distinction sharper by asking *which* applies *when*. We suggest a larger pattern, a *division of dominance* (Gentner 1988). This distinction takes off from the classic distinction between open- and closed-class words whereby an *open class* is a large lexical category that readily accepts new members – e.g. noun, verb, and adjective in English – and a *closed class* is a (typically small) lexical category to which new members are rarely added – for example, preposition, determiner, and conjunction in English. Whereas open-class words have denotational functions, closed-class words[1] serve grammatical or relational functions; their role is to provide linguistic connections among the more

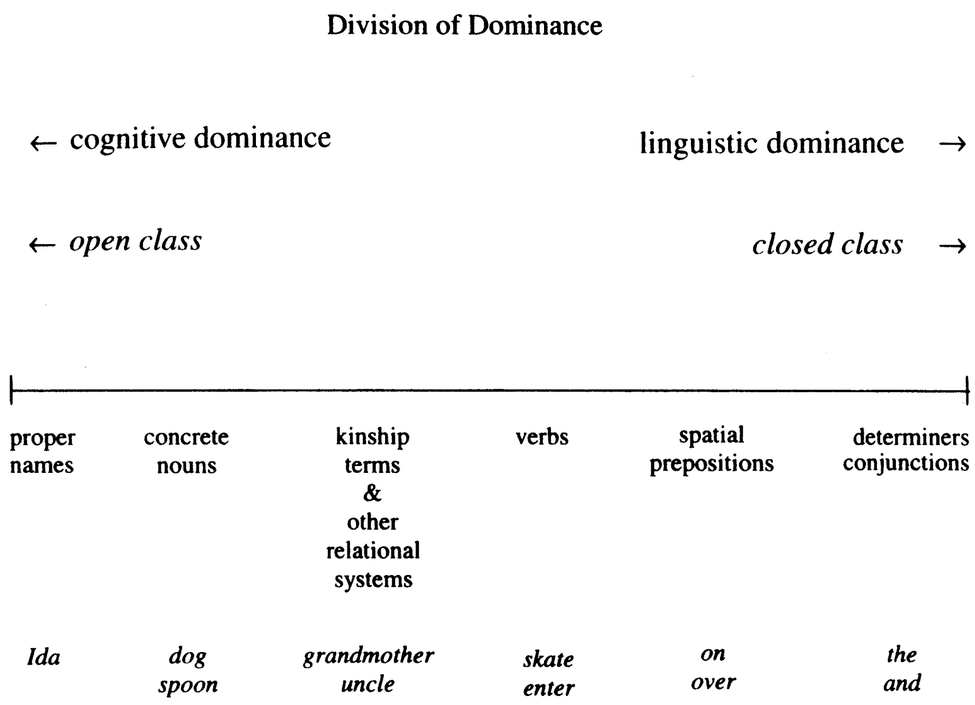

Fig. 8.1 The Division of Dominance.

referential open-class terms. Closed-class words have a number of interesting properties relative to open-class words: they are mostly of high frequency, they are not easily translated, they are rarely borrowed in language contact, their interpretation is context-sensitive, and they are often polysemous and even syncategorematic.

This distinction has traditionally been considered a dichotomy in English, with nouns, verbs, and other contentives in the open class. But, as Gentner (1981, 1988) reviewed, this division is better viewed as a continuum, with verbs and prepositions ranged between nouns and closed-class terms. Like closed-class terms, verbs and prepositions perform relational functions. Further, to return to our main issue, they are linguistically embedded: their meanings are invented or shaped by language to a greater degree than is the case for concrete nouns.

The Division of Dominance continuum is shown in figure 8.1. At one extreme, concrete nouns – terms for objects and animate beings – follow cognitive–perceptual dominance. They denote entities that can be individuated on the basis of perceptual experience. At the other extreme, closed-class terms – such as conjunctions and determiners – follow linguistic dominance. Their meanings do not exist independent of language. Verbs and prepositions – even "concrete" motion verbs and spatial prepositions – lie between. Unlike closed-class terms, they have a denotational function, but the composition of the events and relations they denote is negotiated via language.

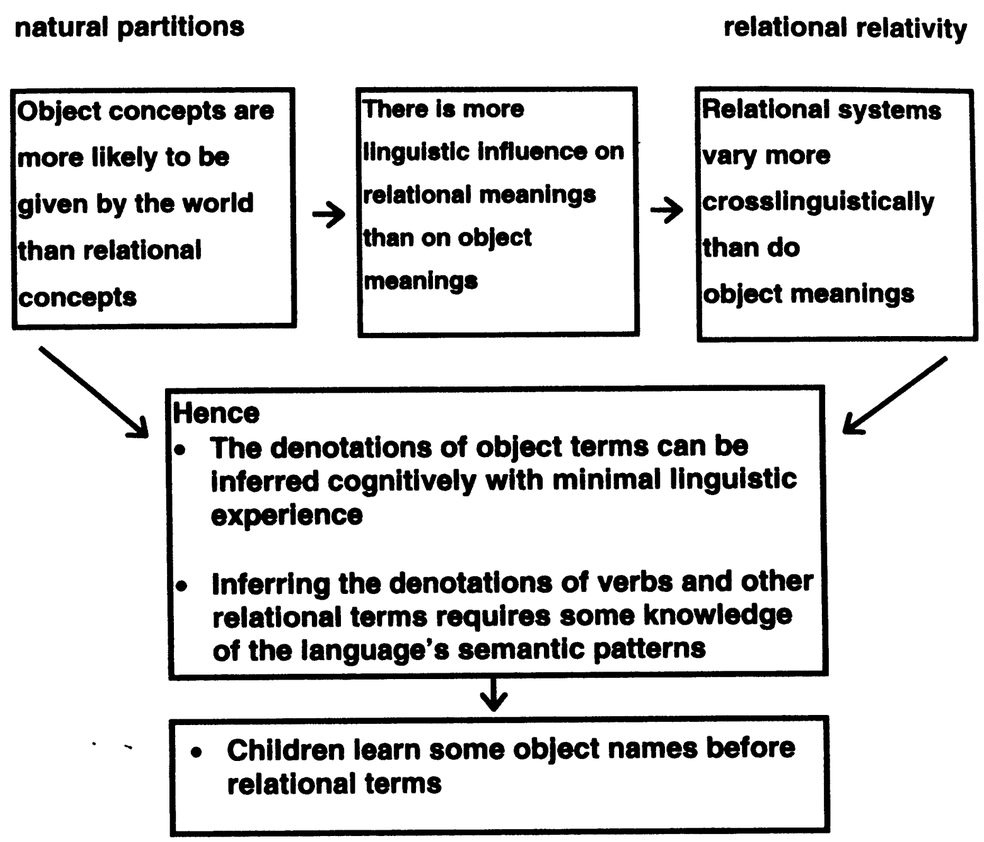

Fig. 8.2 Natural partitions and relational relativity.

1.1 Language acquisition and the Division of Dominance

How does all this connect with early word learning? Gentner's (1982) prediction that nouns should enter the vocabulary before verbs rests on two corollaries of the Division of Dominance: natural partitions and relational relativity (figure 8.2). Although the first has received more attention, the second is, to our thinking, more interesting:

1. *Natural partitions*: "there are in the experiential flow certain highly cohesive collections of percepts that are universally conceptualized as objects, and . . . these tend to be lexicalized as nouns across languages. Children learning language have already isolated these cohesive packages – the concrete objects and individuals – from their surroundings" (Gentner 1982: 324).

2. *Relational relativity*: "when we lexicalize the perceptual world, the assignment of relational terms is more variable crosslinguistically than that of nominal terms . . . Predicates show a more variable mapping from concepts to words. A language has more degrees of freedom in lexicalizing relations between coherent objects than in lexicalizing the objects themselves . . . Thus, for verbs and other relational terms, children must discover how their language combines and lexicalizes the elements of the perceptual field" (Gentner, 1982: 323–325).

According to the natural partitions hypothesis, the first concepts to be lexicalized are cognitively preindividuated natural conflations – concepts whose representations are densely internally connected (Gentner 1981). The relational relativity hypothesis states that the meanings of relational terms – even "concrete" relational terms such as motion verbs and spatial prepositions – exist in linguistically defined systems and are therefore more variable crosslinguistically than those of concrete nouns. Thus cognitive dominance prevails at the first referential connection. Later, as the child enters the language, linguistic dominance becomes more important.

The relational relativity hypothesis drew on research by Talmy (1975), Bowerman (1976), Maratsos & Chalkley (1980), and Langacker (1987) showing crosslinguistic differences in characteristic patterns of meanings for verbs and other predicate terms.[2] Recent research has further demonstrated the crosslinguistic variability of relational terms (e.g. Choi & Bowerman 1991, ch. 16 of this volume; Bowerman & Pederson 1992; Levinson 1996, ch. 19 of this volume; Sinha, Thorseng, Hayashi, & Plunkett 1994; Slobin 1996; Waxman, Senghas, & Benveniste 1997). For example, in his classic treatise on motion verbs, Talmy (1975) noted differences in conflation patterns between English and the Romance languages. English verbs readily conflate manner of motion with change of location, leaving path as a separate element: e.g. *fly away*, *tiptoe across*. In contrast, French and Spanish motion verbs[3] tend to include path, with manner optionally added separately: e.g. *partir en volant*, *traverser sur la pointe des pieds*. The infant must learn which of these conflationary patterns applies in her language.

At one end of the Division of Dominance lie concrete nouns, whose referents are highly likely to be clumped into single units. These are likely to have crosslinguistically stable denotations (because all cultures can perceive them as wholes) and to be easily learned by children (because their referents are easy for a child to individuate). Verbs and prepositions lie further towards the linguistic pole, where semantic conflation patterns are linguistically specified. Learning the denotations of these terms requires some understanding of the language. Thus they will be acquired later, in part through bootstrapping from previously learned noun–object pairs.

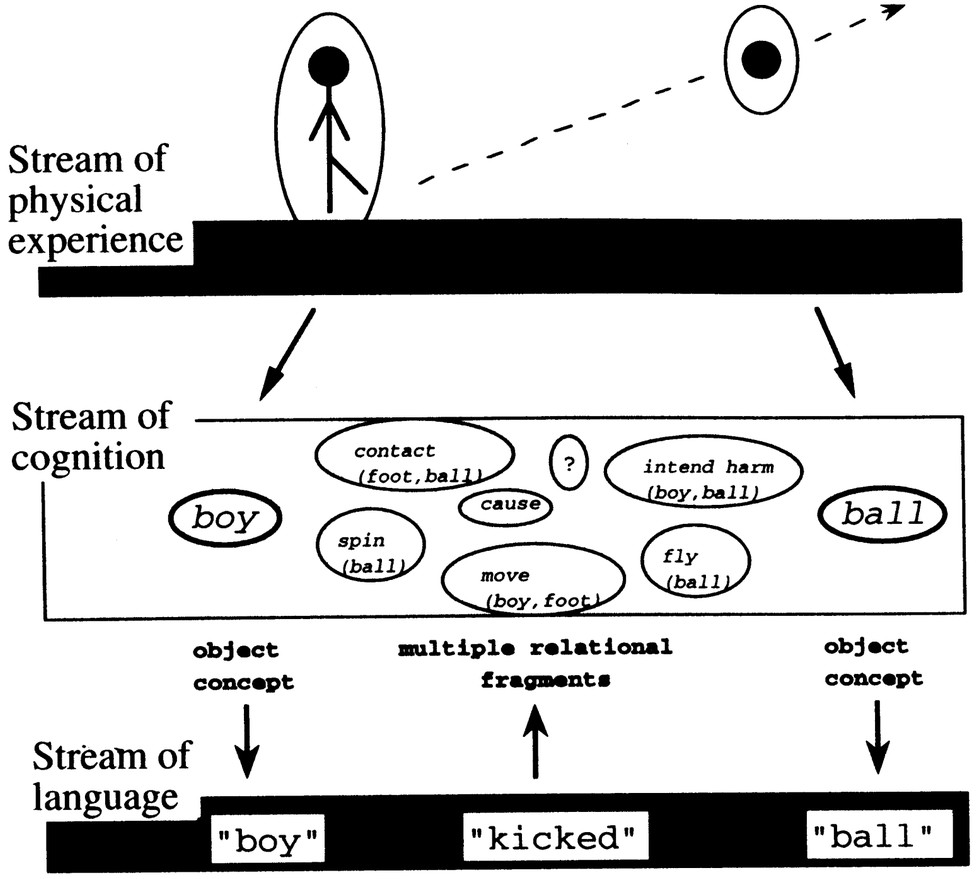

Fig. 8.3 Early interactions of language and experience.

We suggest that different word classes behave very differently in language acquisition. Consider the child's initial task in its simplest terms, as one of attaching words in the stream of speech to their referents in the stream of experience (figure 8.3). Concrete objects and entities have already been individuated prelinguistically (Spelke 1985, 1990; Baillargeon 1993). Given a salient potential referent, part of the child's task of finding word–referent connections is already solved; it remains only to find the correct linguistic label. In contrast, for verbs and other relational terms,[4] isolating the word is only part of the job. The child must also discover which conflation of the available conceptual elements serves as the verb's referent in her language. Not only the intensions but even the extensions of relational terms must be learned in part from language. This is not to suggest that young children fail to perceive relations, or that they are not interested in them. On the contrary, movement, change, agency, and causality are fascinating to infants. But although relational fragments are perceived from early on, there is no one best way in which they cohere into referential units.

There are other reasons to expect particular classes of verbs and prepositions to be learned late relative to nouns. Many concrete verbs have referents that exist only briefly; concrete nouns typically have referents that persist over time. There is also evidence that the instantiation of relational terms depends on their arguments (Gentner & France 1988). For example, in "The goose rode the horse" *goose* and *horse* can be imaged independently of the rest of the terms, but *rode* cannot.

Research by Gillette, Gleitman, Gleitman, & Lederer (1998) demonstrates the difficulty of picking out possible verb referents (see also Gleitman & Gleitman 1992; Gleitman 1994; Fisher, Hall, Rakowitz, & Gleitman 1994). These investigators showed adult subjects silent videos of mothers talking to young children, with beeps marking the instance of a particular noun or verb. The subject's task was to guess the word uttered at the beeps. After six different instances of a given word, subjects were able to guess correctly only 15% of the time for verbs (as compared to 45% of the time for nouns). If subjects were also given the nouns used by the mother, they were about twice as accurate, at 29%. Interestingly, if nonsense syntactic frames – e.g. "Gorp the fendex" – were also given, the percentage rose to 90% – evidence for the role of syntactic frames in selecting among possible verbs (but see also Pinker 1994).

Another line of evidence attesting to children's difficulties in learning relational meanings comes from their semantic errors during verb learning. For example, in Bowerman's (1974, 1976, 1978) studies of children's spontaneous semantic errors for verbs, she found that two- to four-year-olds, having previously used verbs like *eat* and *fall* correctly, began making errors like "But I can't eat her!" (meaning "I can't make her eat") and "I'm gonna just fall this on her" (meaning "make fall, drop"; Bowerman 1974). She suggested that the children were overextending a common English conflationary pattern by which a word denoting a state – e.g. "The door is *open*" – can also be used as a causative, as in "*Open* the door" (i.e. *Cause* the door to *become open*). These late errors suggest that children take a fair bit of time to discover the patterns of conflation in their language. L. Bloom's (1973) observations of children's speech also illustrate their difficulties in expressing relations between objects. For example, 3-year-old Gia, wishing to put a disc into her pocket, says "Button. Button. Button. Button" and "Pocket. Pocket," but "cannot express the relationship she wants to exist between the two objects she can name separately" (1973: 13). To say "*Put* the button *into* the pocket" seems trivial to an adult, but the child must learn that *put* does not contain a path element, that English uses *put* for inanimate destinations and *give* for animate destinations, and so on.

Of course, lexical acquisition should also be influenced by the input, as Gentner (1982) noted – both by typological factors like word order and morphology and by interactional factors such as patterns of child-directed speech. We suggest that when all the input factors are taken into account, there will remain a contribution from conceptual preindividuation. A full test of this prediction requires calibrating the various input factors across languages, and comparing them with observed patterns of vocabulary acquisition. Although this kind of research can and should be done, there is a "quick and dirty" shortcut that may be informative. If words with highly individuable referents – such as names for entities and objects – predominate in early vocabularies across a wide range of input variation, this would constitute evidence for conceptual factors in early word learning.

There is evidence in English for an early predominance of names for objects and individuals and a later increase in the proportion of relational terms (Woodward & Markman 1998). Nouns predominate in early production and comprehension (Macnamara 1972; Nelson 1973; Huttenlocher 1974; Goldin-Meadow, Seligman, & Gelman 1976; Gentner 1982; Huttenlocher & Smiley 1987). Further, children appear to take novel words as names for objects (Markman 1989, 1990; Waxman 1991; Waxman & Hall 1993; Landau, Smith, & Jones 1998), even as early as 13 months of age (Waxman & Markow 1995) and to learn object reference readily (Goldin-Meadow, Butcher, Mylander, & Dodge 1994).

Yet despite this support, the claim of an early noun bias has recently become the focus of intense controversy. A number of challenges have emerged, some of them based on new crosslinguistic findings. In section 3 of this chapter, we respond to these challenges in detail. First, however, we take a new tack. We explore a new prediction of the Division of Dominance framework that escapes certain difficulties by staying within one form class. In the next section we present this extension, which we call the *Individuability continuum*, and give new evidence.

2 Individuability and early word learning: predictions within the object class

We have argued that ease of individuation is a strong predictor of early naming, and that this is a factor in the advantage of concrete nouns over concrete verbs. But comparing across form classes risks confounding other differences along with individuability. We now look within the noun class as another way of testing this claim. If the conceptual naturalness of individuation is the source of the noun advantage, then there should be differential acquisition *within* the noun class, as well as between nouns and relational words. Specifically, (1) relational nouns that are acquired early should initially be taken as object reference terms; and (2) the names of

highly individuable objects and entities should be acquired before those of less easily individuated objects.

There is evidence for the first prediction in the acquisition of relational nouns like *uncle* and *passenger*. Children at first tend to interpret these as object-reference terms and to extend them according to common object properties. For example, Keil (1989) found that preschoolers initially interpreted *uncle* as "a friendly man with a pipe" and later shifted to an interpretation in terms of kinship relations. Likewise, Waxman & Hall (1993) found that preschool children taught new relational terms, such as *passenger*, tended to interpret them as object-reference terms.

The second prediction, that ease of individuation is a strong predictor of initial learning, requires deciding which kinds of objects are highly individuable. One route is to ask what contributes to infants' sense of objecthood. Spelke's (1985, 1990) findings suggest that from a very early age children expect continued "objecthood" when they perceive a stable perceptual structure moving against a background (the Gestaltists' *common fate* principle). Later they come to use the perceptual *well-formedness* of an object as a predictor of its continued stability. If individuability is predictive of early word learning, then these patterns imply that the first words should include words for moving entities – animate beings and small movable objects – and words for objects that are perceptually coherent and well-formed.

We begin with perceptual coherence and return to animacy below. We suggest two related criteria for "perceptual coherence," both of which assume that objects can be represented in term of interrelated components such as geons (Biederman 1987) or object parts (Palmer 1978; Tversky & Hemenway 1984). The first is internal connectivity. Highly coherent objects have densely interconnected representations, in which the number of internal links between components is large relative to the number of components (Palmer 1978; Gentner 1981). The second contributor to perceived coherence is well-formed structure. Higher-order relations such as symmetry or monotonicity promote coherence (Garner 1978; Palmer 1978; Prasada 1996; Kotovsky & Gentner 1996).

Does object coherence affect early word learning? Research on Japanese and English conducted in collaboration with Mutsumi Imai suggests that the answer is "yes."

2.1 Individuation and the mass/count distinction

One way to approach the issue of early individuation is to ask what makes children treat something as an object rather than a substance in word learning. Object terms and substance terms have fundamentally different patterns of reference. While object terms like *chair* have discrete reference, substance terms like *flour* have "scattered" reference and can refer cumulatively. Any portion of flour is also flour, but the legs of a chair are not a chair. A child must realize that a term like *chair* can be extended to similarly shaped objects regardless of material, while a term like *flour* projects to stuff of the same material regardless of shape.

How might children learn the object–substance distinction? As before, there are three possibilities: the distinction could be innate; learned from experience of the world; or learned from language. The latter possibility was suggested by Quine (1969), who noted that in English the object–substance distinction is correlated with the grammatical distinction between count nouns and mass nouns. (See Gordon 1985; Gathercole 1986). Count and mass nouns take different determiners: *a chair* vs. *some flour*. Count nouns can be pluralized directly (as in *several chairs*), but mass nouns cannot (**several flours*). Finally, count nouns can be directly counted, but mass nouns require a unitizer before they can be counted (e.g. *two chairs* vs. *two cups of flour*).

Soja, Carey, & Spelke (1991) investigated children's understanding with an ingenious technique. They taught young children new words for either solid objects or nonsolid substances and then asked the children to extend the word, using phrasing that was neutral with respect to the count/mass distinction (e.g. "This is my blicket – show me your blicket"). They found that even 2-year-olds distinguished between objects and substances in their word extensions. When shown an object, they extended on the basis of common shape, indicating an object interpretation; when shown a substance, they extended on the basis of common material, indicating a substance interpretation. Soja *et al.* concluded that there is a prelinguistic, possibly innate ontological distinction between objects and substances that children use to constrain possible meanings of new words.

Despite the elegance of this reasoning, the conclusion rests on the problematic issue of when linguistic influences begin. English 2-year-olds lack productive competence in the count/mass distinction, but may nonetheless have been influenced by the syntactic distinction. Therefore, Imai & Gentner (1997) decided to undertake a stronger test by taking advantage of crosslinguistic differences. Many numeral classifier languages, such as Yucatec Maya and Japanese, lack a syntactic count/mass distinction (Lucy 1992b). All inanimate nouns, even nouns referring to concrete objects, are treated like English mass nouns: they cannot be pluralized and they require classifiers in order to be enumerated (much as in the English *three sheets of paper*). Since classifier languages provide no linguistic support for the

object–substance distinction, they provide a natural arena in which to investigate the distinction in young children.

Imai & Gentner therefore replicated Soja *et al.*'s study, using monolingual Japanese children living in Tokyo and American children living near Chicago. These two groups receive highly comparable experience with the world, but differ in linguistic input. Following Soja *et al.*, the investigators used three types of standards: *substances*, *simple objects* (simple rigid entities such as a kidney-shaped piece of paraffin) and *complex objects*[5] (artifacts such as wire whisks with relatively complex, perceptually coherent, shapes). On each trial they were given a novel label for the standard, in syntax that was neutral as to count/mass: e.g. "This is my dax" in English or "This is dax" in Japanese[6] (the normal pattern in that language). They were then asked which of two alternatives – one alike in shape but not material, and the other alike in material but not shape – could also be called *dax*. (See figure 8.4.) Children (aged 2, 2½, and 4) and adults received four trials for each type of standard.

For our purposes, the key question concerns the youngest children, the 2-year-olds. If there is an innate ontological distinction, then both language groups will show it from the start. If the object–substance distinction is learned in part from count/mass syntax, then English children should show the distinction to a greater degree than Japanese children. Finally, if the individuation continuum is correct, then children should be more likely to show object-extension patterns for complex coherent objects than for simple objects.

The results, shown in figure 8.5, show two commonalities and one striking difference. In both languages, complex objects were treated as objects from the beginning. Regardless of language, children as young as 2 years extended words applied to complex objects according to shape. This finding accords with Soja *et al.*'s finding of 93% shape-responding in young American children and suggests that the complex, perceptually coherent objects were readily individuated regardless of language. The second commonality was that in both languages, words applied to substances tended to be extended according to material. Despite their language's lacking a count/mass distinction, Japanese infants nevertheless distinguish (complex) objects from substances. This is evidence for a prelinguistic conceptual distinction between objects and non-objects.

Where the languages differed was on the simple object trials. English children, whose grammar groups simple objects together with complex objects as individuated entities, showed a fairly pronounced shape bias even at 2 years old. In contrast, young Japanese children, whose language provides no guidance as to whether simple objects should be seen as objects or as substances, responded at the level of chance.

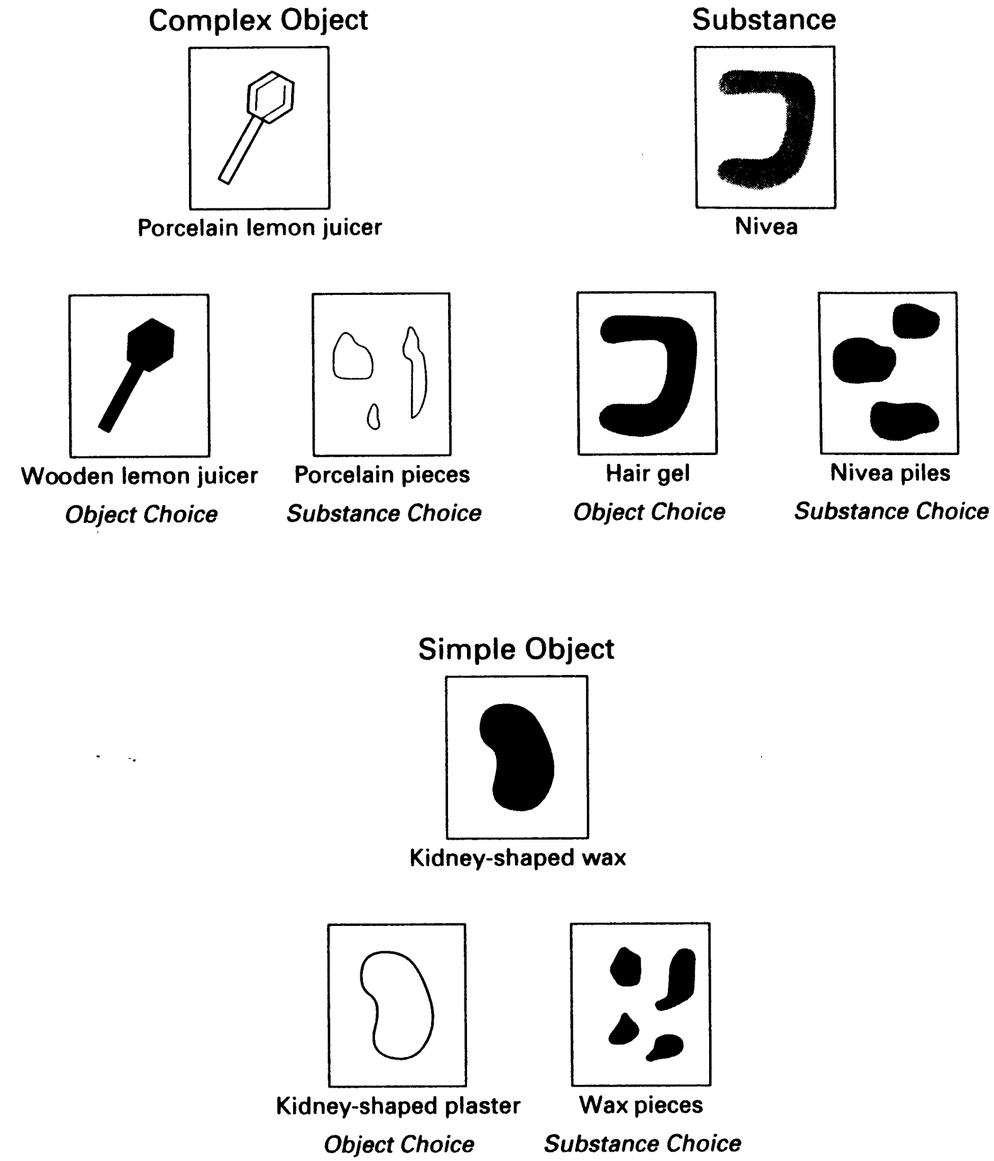

Fig. 8.4 Materials used in the Imai & Gentner experiment.

2.2 *Object complexity, individuation, and the object-naming bias*

The pattern of results is support for the individuation continuum. Irrespective of language, all children in our study treated complex objects as individual entities. The privileged status of complex objects was particularly striking for Japanese 2-year-olds: they consistently extended terms applied to complex objects according to shape, even though they performed at chance for simple objects and substances. Thus even among children

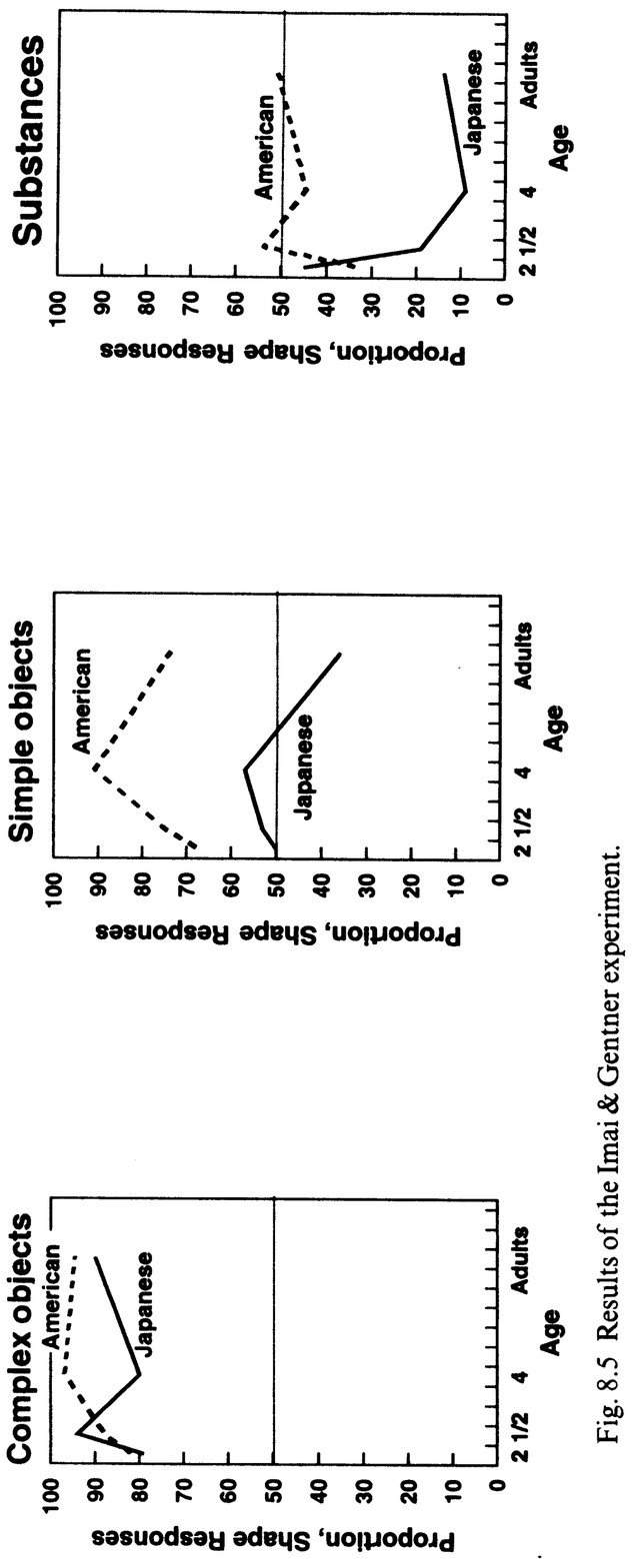

Fig. 8.5 Results of the Imai & Gentner experiment.

whose grammar provides no support for an object–substance distinction, complex objects were treated as individuals. This is consistent with the claim that perceptual coherence[7] contributes to the individuability of entities in the world, and that this in turn influences early word learning.

These findings have implications for theories of the early noun–object connection such as Markman's (1989, 1990) whole-object constraint, by which infants take a word applied to an object to apply to the whole object, not to any of its parts or qualities, and Waxman's (1991) noun-category linkage. The findings of Imai & Gentner suggest that the whole-object constraint may need to be graded to take account of differences in the coherence or individuability of objects. Further, the scope of these constraints may be learned from language.

2.3 *Effects of language*

The pattern for simple objects suggests very early effects of language. American 2-year-olds – whose language cuts the continuum into objects and substances – projected new words by shape for both simple and complex objects, showing an object-naming pattern for all solid bounded entities. In contrast, 2-year-old Japanese children treated the three categories as a continuum, from complex objects to simple objects to substances (see figure 8.6 below). It appears that even something as basic as the scope of early object naming is influenced very early by the language learned (see Smith 1996, ch. 4 of this volume). These findings accord with other reports suggesting that children learn some semantic patterns very early (e.g. Slobin 1987; Choi & Bowerman 1991, ch. 16 of this volume; but see Gentner & Bowerman 1996; Bowerman & Gentner, in preparation).

2.4 *Entrainment*

When asked to extend words for substances, the two language groups diverged with age. Japanese children shifted from chance responding (55% material responding) in 2-year-olds to a strong material bias (81%–91%) among older groups. American children started with a slight material bias which never increased; in fact, older groups showed chance responding. Japanese speakers became more likely to interpret novel terms for substances as referring to the material; English speakers did not.

These findings are consistent with Lucy's (1992) speculation that, whereas the grammar of languages like English invites attention to shape, the grammar of Yucatec Maya and other numeral-classifier languages invites attention to material. For example, Lucy (1992b: 74) notes that in Yucatec Maya, a single noun (*ha'as*, which we might translate as 'banana-stuff') is

used to denote what in English are three different nouns: *banana* (i.e. the fruit), *banana leaf*, and *banana bunch*. The distinction is conveyed by the shape classifier used to unitize banana-stuff for individuation and enumeration: one-dimensional, two-dimensional, and three-dimensional, respectively. Lucy suggests that this linguistic pattern leads its speakers to focus on material even in nonlinguistic cognition.[8] He found that when given the same stimuli to sort or remember, English adults give extra weight to shape, and Mayans to material.

2.5 *Early ontology vs. individuality*

Our evidence is consistent with parts of Soja, Carey, & Spelke's proposal in suggesting a prelinguistic distinction between objects (at least, complex, cohesive objects) and substances. However, the results do not support a strong version of the universal early ontology view. First, the fact that complex objects are privileged but simple objects are not is difficult to reconcile with an ontological dichotomy between objects and substances. Second, the link between complex objects and an object interpretation is far stronger than the link between substances and a material interpretation. Japanese 2-year-olds were at chance on the substance trials, and American 2-year-olds showed only 66% material responses. In contrast, both groups showed about 80% shape responses for complex objects. Soja *et al.*'s American 2-year-olds showed a similar pattern. These findings don't appear consistent with the idea that infants possess an innate ontology commensurate with that of adults. Rather, they suggest that extremely clear cases of preindividuated objects – namely, complex objects – are prelinguistically distinguished from substances, but that the middle ground – simple objects – is malleable by language.[9] A sense of ontology may emerge out of the child's cognitive and linguistic experience, rather than predating it.

2.6 *The individuation continuum*

In the preceding sections, we invoked classifier languages to separate linguistic from experiential explanations. Now we propose to use these contrasts as typological clues to individuability. As noted above, classifier languages like Yucatec or Japanese differ from English in that they do not grammatically treat objects as naturally preindividuated. In English, substances must be unitized before they can be counted – e.g. "four teaspoons of sand." In Yucatan Maya, the same goes for concrete objects. One counts banana leaves by saying roughly "three sheets of banana" and bananas by saying "four rods of banana." English speakers may find it remarkable that

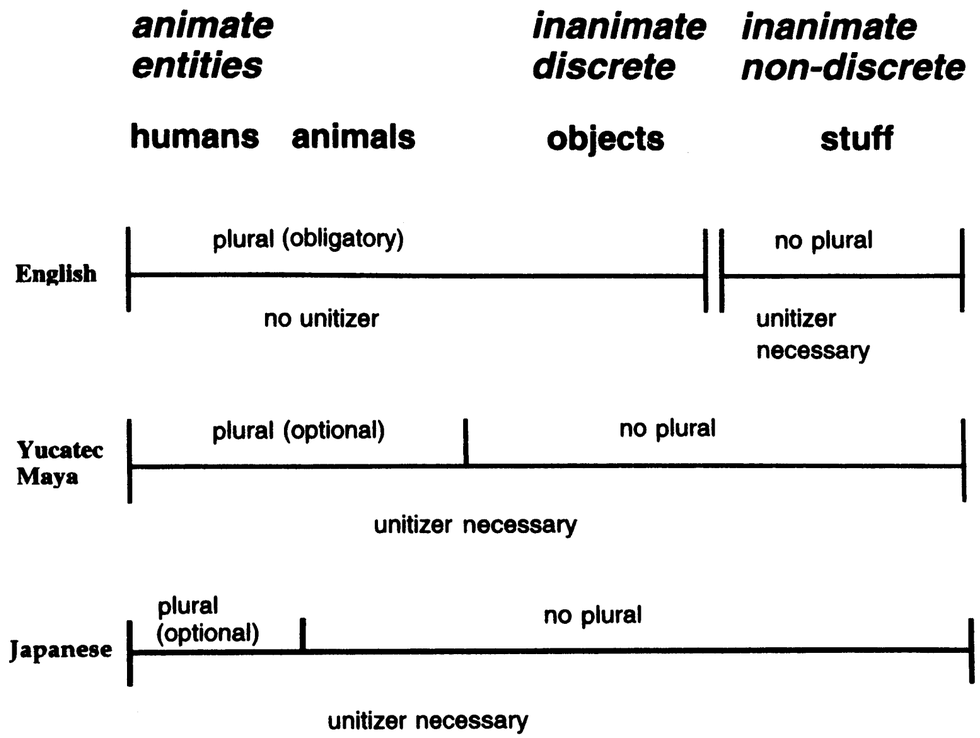

Fig. 8.6 The Animacy continuum (adapted from Lucy 1992b).

all languages do not take cups and bananas as automatically preindividuated, yet languages are clearly free to differ on this point.

Although languages differ in where they set the count/mass division, the pattern is not random. A useful way to compare languages is to use what is sometimes called the *Animacy continuum* (Allan 1980; Comrie 1981; Croft 1990; Lucy 1992b). A simplified version, shown in figure 8.6, extends from human to animal to concrete object to substance. It can be used to characterize where a given language draws the line between things that it considers to be preindividuated and those that must be unitized before being counted or pluralized.[10] As figure 8.6 shows, English has a generous individuation assumption – it grants individual status to concrete objects, whereas Yucatec Maya and Japanese reserve it for animate beings (or, even more exclusively, for humans).

This fundamental point – that languages differ in what they are willing to treat as automatically individuated in the grammar – suggests another clue to individuability. We suggest that patterns of grammatical individuation across languages can inform us about what constitutes a natural individual. Suppose those entities most likely to be treated as individuated across languages are just those that are most individuable in human

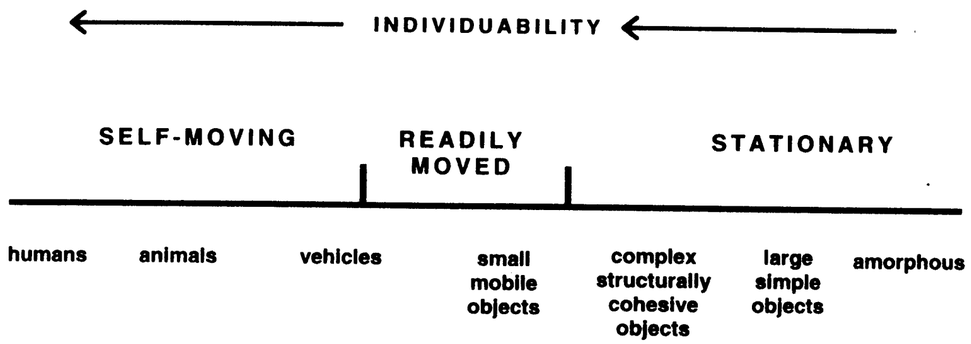

Fig. 8.7 The Individuation continuum: range of individuability across types.

cognitive–perceptual experience. On this assumption, animate beings are most likely to be inevitably individuated, followed by concrete objects.

We propose an Individuation continuum, inspired by the Animacy continuum, from animate beings through coherent, well-structured, and/or movable objects through simple objects to substances. The further we move rightward along the continuum, the more experience with language is necessary to individuate semantic entities. The Individuation continuum, shown in figure 8.7, is primarily a perceptual continuum. It both adds and omits distinctions found in the Animacy continuum. It adds a differentiation between complex, structurally coherent objects and simple objects. As Lucy (personal communication, approx. June 1994) points out, there is no linguistic justification for separating complex coherent objects from simple objects, nor for separating small movable objects from large immovable objects. Yet these distinctions, we suggest, are important to perceptual individuation. In the other direction, the Individuation continuum omits some differentiations that are relevant in the Animacy continuum (though not depicted here – see note 10): namely, differences in status, gender, etc., that seem unlikely to be reflected in young children's individuation patterns.

If perceptual ease of preindividuation influences the kinds of meanings that children learn first, then names for animate beings, which are self-individuating by virtue of their spontaneous motion, should be among the first words acquired. Applying this order to infant word learning, we would expect that animate beings would be the earliest preindividuated entities, and hence that their names would figure largely among children's first word meanings. Thus, words like *Mommy*, *Rover*, *Auntie*, and *kitty* are expected to be among the frequent early names. Many of these will be proper names,[11] the inclusion of which is thus essential to testing the natural partitions hypothesis.

There is evidence to support the claim of early learning of names for animate beings. Caselli, Bates, Casadio *et al.* (1995) used the MacArthur checklist to assess the early vocabularies of 659 English-speaking and 195 Italian-speaking infants. Words for animate beings constituted on average two of the first five words produced in English (*Daddy* and *Mommy*) and four of the first five in Italian (*Mamma*, *Papa*, *bau-bau* (for dogs), and *Nonna* (grandmother)). In Nelson's (1973) study of the first eight to ten words acquired by eight English-speaking infants, names for animate beings made up an average of 62% of the nominals and 41% of the total vocabulary. Nelson also noted names for moving vehicles and small manipulable objects whose motion against a background can be used to individuate them.

For the six children of six different languages whose early vocabularies are given in Gentner's (1982: table 5) corpus, names for animate beings – including both proper and common nouns – accounted for from 33% to 100% of the first nominals. Furthermore, as expected, the proportion of animates to total nouns drops as vocabulary size increases. Interestingly, the makeup of the early animates may differ cross-culturally. Children whose cultures emphasize extended sets of relatives tended to have large numbers of person names (proper names and kin terms). For example, a Kaluli girl at 1;8 (with 16 recorded words) had as her first 8 nominals 7 names for people and 1 animal term. Thus names for animate beings constituted 100% of her early nominals, with person names dominating. For Xiao-Jing, a Mandarin girl aged 1;6 with 37 recorded words (discussed below), animates constituted 50% of the early nominals and 30% of her total vocabulary, and most of these were person names. An English girl (age 1;2, vocabulary 39) and a German boy (age 1;8, vocabulary 33) also showed a fair proportion of animates (about 36%), but for these children, animal names were as prominent as person names.

3 The controversy: are object names learned before relational terms?

Over the last decade, a number of challenges to the natural partitions hypothesis have been lodged. Some – the first three listed below – question the noun dominance pattern in general. Others accept the pattern in English but question its cognitive basis, using crosslinguistic evidence to suggest that noun dominance, when it exists, can be traced to nonsemantic input factors. We present the challenges in boldface italics, followed by our replies.

(1) Children's early nouns may conceptually be verbs: that is, a child may say "door" meaning "open," so that scoring "door" as an object term is inaccurate.

Dromi (1987) investigated this question using her child's first words in Hebrew. She found remarkable stability: roughly 90% of her child's first nouns (by adult classification) were used for objects, and 87% of the first verbs were used for actions. Huttenlocher & Smiley (1987) carried out a detailed analysis of whether early object words co-occur with particular actions in children's early vocabularies. They found that early object words tended to be used for objects of a particular kind, but with a varied set of actions. They concluded that these object words refer to classes of objects, not to actions nor to object–action complexes. It appears that although object words may be pragmatically used to accomplish various goals, they retain a sturdy basis of object reference.

(2) Counts of early nominals should include only common nouns; the inclusion of proper nouns gives an inflated estimate of the noun advantage.

Many researchers who have argued against early noun dominance have counted only common nouns, omitting proper nouns (e.g. Gopnik & Choi 1990, 1995; Nelson, Hampson, & Shaw 1993; Bloom, Tinker, & Margulis 1993; Choi & Gopnik 1995; Tardif 1996). Tardif (1996) explicitly raised this concern and recounted Gentner's (1982) data omitting the proper nouns. But which terms should be counted depends on the theory under consideration. To test the natural partitions hypothesis, it is essential to include proper nouns.

(3) The noun advantage in English simply reflects the adult pattern: there are more noun types than verb types in the input language.

It is true that there are more nouns than verbs in English, as in most languages; in fact, nouns and verbs have altogether different patterns of occurrence (Gentner 1981). A large number of noun types is used, mostly with low frequency; and a small number of verb types is used, often with very high frequency. In this respect, as in many others, verbs behave more like closed-class terms than do nouns. Young English-speaking children show this same pattern: they use a greater variety of object names than relational words, but they use each of their relational words more often on average than their object names (Gopnik & Meltzoff 1982).

One might suggest, then, that there is nothing to explain: children's word distributions simply match those of adults, with many nouns and a few highly frequent relational words. But to say the patterns match does not provide a *mechanism* of learning. Although animals can match their response frequencies to the relative payoffs of two keys, we know of no learning mechanism that allows learners to match category frequency when – as is the case for nouns and verbs – the categories consist of distinct exemplar types. Indeed, classical learning theory would predict that the determining factor should be the relative numbers of *tokens* of each type: that is, children should learn those types experienced most frequently. But in this

case verbs would be far more predominant in early vocabularies than they are. Gentner (1982) estimated that verbs compose about 20% of the 100 most frequent words used in English, while nouns compose only 6%. If input frequency were the sole governing factor, then many verbs would be learned before most nouns.

(4) There is a noun advantage in English, but it results purely from linguistic input features that make nouns more salient to young children, rather than from semantic and conceptual factors (Choi & Gopnik 1995; Gopnik & Choi 1995; Tardif 1996).

This issue is crucial in evaluating the natural partitions hypothesis, and since fresh evidence is available, we will delve into the issues a bit here. Gentner (1982) noted a number of linguistic input features of English that could account for the noun advantage without invoking semantic–conceptual factors: namely, *word frequency*, *word order*, *morphological transparency*, and *patterns of language teaching*. To these could be added *stress* and the presence of *verb-only utterances* (i.e., pro-drop sentences).

In considering these possibilities we must distinguish the claim that certain input factors *influence* children's rate of word acquisition from the stronger claim that these factors entirely *account for* the early noun advantage. To preview our conclusions, we will suggest (as in Gentner 1982) that the data support the first claim but not the second.

3.1 Word frequency

Could word frequency determine acquisition rate? Aside from the point mentioned above, that children fail to learn frequent verbs, evidence against word frequency as the sole determinant of acquisition rate comes from studies that have controlled the input to children. In a series of elegant studies, Leonard, Schwartz, Camerata, and their colleagues found that English-speaking infants were faster to learn and produce new names for objects than new names for actions, even when there were strict controls for number of exposures (frequency), position in the sentence (Schwartz & Leonard 1980), stress, and phonology (Camerata & Schwartz 1985; Camerata & Leonard 1986). Rice & Woodsmall (1988) found that 3- and 5-year-olds learned fewer action words than object and property words after viewing videotaped stories that included all three word types. Golinkoff and her colleagues found that children could fluently extend new verbs to new exemplars (using pictorial depictions) at 34 months (Golinkoff, Jacquet, Hirsh-Pasek, & Nandakumar 1996), 6 months after they could extend nouns to further exemplars in a similar task (at 28 months; Golinkoff, Hirsh-Pasek, Bailey, & Wenger 1992). Merriman, Marazita, & Jarvis (1993) found that 4-year-olds were faster to map new object words onto referents

than new action words. Thus, word frequency must play a role, but it does not by itself account for the noun advantage.

3.2 Nature of the input language

The above studies have found that factors such as frequency and position do not account for the noun advantage. But they were conducted within English. Perhaps there are features of English that make nouns salient, and once this salience is established children can find nouns even in more difficult surroundings. Gentner (1982) suggested several input factors that could lead to a noun advantage in English acquisition, including word order, relative morphological transparency, and language teaching patterns. English SVO (subject–verb–object) word order places nouns in sentence-final position, known to be advantageous for word learning (Slobin 1973). Verbs typically occur in the least advantaged middle position. Morphological transparency – that is, how easily a root can be perceived within the surrounding word – is also a possibility. English verbs can take a greater variety of inflections than nouns; hence the sound–meaning relation may be more difficult to perceive for verbs. Finally, practices of linguistic interaction with infants, such as the object-naming routines used in American families, might lead to faster noun learning than, for example, the kinds of social-interaction routines practiced among the Kaluli (Schiefflin 1979). Gentner (1982) compared early vocabularies in English with those of five languages – Mandarin, Turkish, Kaluli, Japanese, and German – that varied in these key parameters in ways that should make them more "verb-friendly." While the *degree* of noun advantage varied with input factors, nouns (common and proper) were the most dominant class in all the studied languages. Gentner concluded that (1) input factors are important but (2) there is a persistent early noun advantage, supporting the natural partitions hypothesis.

However, these conclusions must be regarded as provisional, owing to the variability of the language samples. Recent studies of acquisition in languages that provide verb-oriented input to the child, such as Korean, Italian, and Mandarin Chinese have led some researchers to conclude that nouns are not always learned before verbs (Gopnik & Choi 1995; Tardif 1996).

3.3 Mandarin

Tardif (1996) studied acquisition in Mandarin Chinese. Mandarin is verb-friendly in that verbs and nouns have equivalent morphological transparency: neither nouns nor verbs are inflected. Mandarin is also a pro-drop language: the subject of a sentence can often be omitted. Since word order is SVO, subject-dropping creates verb-initial (VO) sentences, in which the verb occupies a more salient position than in the English SVO sentence (Slobin 1973). Tardif tabulated the vocabularies of ten Mandarin-speaking infants using transcriptions of hour-long tapes of their spontaneous interactions with caregivers. She reported a mean of 13.8 common nouns and 19.1 main verbs. With proper names included, the mean number of nouns rose to 19, making nouns and verbs roughly equal. Tardif concluded that the early noun advantage is not universal, and that the relative rates of acquisition of object and relational terms depend on linguistic factors.

However, a later more comprehensive study of Mandarin revealed a clear noun advantage (Gelman & Tardif 1998; Tardif, Gelman, & Xu 1999). Parents were asked for their children's full production vocabularies, using a Mandarin-adapted MacArthur checklist, for 24 Mandarin and 24 English children of about 20 months old. The results showed 2.4 times as many nouns as verbs for Mandarin children and 6.1 times as many for English children. To correct for the fact that the Mandarin children had larger vocabularies (with a mean of 316 types) than the English children (160 types),[12] Tardif *et al.* (1999) compared pairs of subjects with similar vocabularies. The noun–verb ratio remained significantly greater for English (4.6) than for Mandarin (2.8), supporting the prediction that verb-friendly features of the input language can make verbs easier to acquire. However, consistent with the natural partitions hypothesis, both groups showed a solid noun advantage.

The Tardif *et al.* study used rather advanced children. What about early acquisition? In both Mandarin and English, mothers reported that their children's first object word had preceded their first action word (Gelman & Tardif 1998). Gentner (1982) reported first vocabularies for 2 Mandarin-speaking children with vocabularies of under 50 words, using parental data collected by Mary Erbaugh (1980, personal communication) in Taiwan.[13] For both children, nominals (including proper nouns) were the dominant class (.65 and .59 of the total). For example, at age 1;6, the child Xiao-Jing had 37 words, of which 22 (.59) were nouns, 7 were relational terms (e.g. *go*, *come*, *pick-up*), and 2 were modifiers. Half the nominals referred to animate beings, including 8 (73%) person names – e.g. *Mommy*, *Grandfather*, *Cousin*, *Uncle*.

3.4 Korean

Another verb-friendly language is Korean (Gopnik & Choi 1990; Au, Dapretto, & Song 1994; Choi & Gopnik 1995). Korean follows SOV word order and is a pro-drop language, so verbs often appear alone or in the

salient utterance-final position. Choi & Gopnik verified that in a sample of Korean adult speech to children, there were almost twice as many verbs as nouns (19.8 verbs vs. 11.9 nouns per 100 utterances). Thus if input factors dominate, Korean children should learn verbs earlier than nouns. Choi & Gopnik asked Korean parents to report on their children's vocabularies, using a modified version of Gopnik's relational inventory questionnaire and encouraging parents to list other words their children said. They found that the proportions of nouns and verbs in the first 50 words were 44% and 31% respectively. This proportion for nouns is substantially lower than the 60–70% range found in English.

However, other studies of Korean have reached different conclusions. Au *et al.* (1994) studied early vocabulary acquisition in Korean using a checklist method. They first confirmed Choi & Gopnik's finding that Korean input to children is verb-favored. Verbs were four times more likely than nouns to appear in the salient final position in Korean language to children (46% vs. 10%). In English, the reverse was found: verbs occupied 9% of the utterance-final positions, and nouns 30%. But despite this verb advantage in input, when Au and her colleagues examined early vocabularies of Korean children (using an adapted MacArthur CDI parental checklist) they found a sizable noun advantage. The median noun-to-verb ratio in very early Korean acquisition was about 4:1. This is a striking finding: children produced four times as many nouns as verbs despite hearing four times as many verbs in the final position.

Other findings on Korean have corroborated Au *et al.*'s results. Pae (1993) used a MacArthur checklist adapted for Korean to assess the vocabularies of 90 children living in Seoul between the ages of 12 and 23 months. She found a strong noun advantage throughout, comparable to that for English. Most children (87 of the 90) used a noun as their first word, and none had a verb as first word. Nouns increased rapidly from the stage of 1–5 words on; verbs did not appear until the 11–20-word stage. At 51–100 words, children's vocabularies contained 50–60% nouns and about 5% verbs.

3.5 *Italian*

Caselli *et al.* (1995) suggested that Italian has several verb-friendly features relative to English (but see Tardif, Shatz, & Naigles 1997). Italian has variable word order, including many verb-final constructions in speech to children; subject omission (pro-drop) constructions are common (e.g. *Piove* 'It is raining'); and unstressed (clitic) pronouns are often used for established referents, so that the child hears many sentences in which the verb is the only content word (as well as the final word in the sentence; e.g. *Lo voglio* 'It

(I) want'). Caselli *et al.* used parental MacArthur CDI checklist data to assess the early vocabularies of 195 Italian infants. They found that "verbs, adjectives, and grammatical function words are extremely rare until children have vocabularies of at least 100 words." Common nouns made up 28.8% of the early vocabulary, over ten times the proportion of verbs (2.3%). Caselli *et al.* concluded that "nouns predominate and grow sharply (in proportion to other items) across the first stages of lexical development."

3.6 *Comparing methods of assessment*

There is a striking convergence between the methodology used to assess vocabulary and the findings obtained. Studies that have used checklist data have found that nouns predominate in early vocabulary (e.g. Au *et al.* 1994; Caselli *et al.* 1995) while studies using taped sessions or interview tasks have often found that they do not (Bloom *et al.* 1993; Choi & Gopnik 1995; Tardif 1996).

The comparison of methods discussed above (Gelman & Tardif 1998; Tardif *et al.* 1999) bears on two important methodological issues: (1) how stable are vocabulary estimates derived from transcript data; and (2) how well do these estimates agree with vocabulary data obtained by the checklist method? As discussed above, parents were asked to provide vocabularies for 24 Mandarin and 24 English children aged about 20 months. The same children were also tape-recorded in naturalistic interactions with caregivers in three controlled contexts, which were designed to be either noun-favorable (reading a picture book together), verb-favorable (playing with a mechanical toy that offered several different activities), or neutral (playing with various toys). The findings are striking. First, the transcript results showed high variability across contexts. The noun–verb (N/V) ratios are 2.2, .62, and .51 for Mandarin and 3.3, 1.0, and .7 for English for noun-friendly, neutral, and verb-friendly contexts, respectively (Tardif *et al.* 1999). Depending on context, one could conclude that the Mandarin children had twice as many nouns as verbs, or half as many.[14] Even for English, two of the transcript findings would lead us to conclude that children know as many or more verbs as nouns.

The second striking methodological finding is that the checklist revealed higher ratios of nouns to verbs than did any of the transcripts. The N/V ratios revealed on the checklist were 6.1 and 2.4 for English and Mandarin children, respectively, as compared with N/V ratios of 2.1 for English and 1.4 for Mandarin across the transcribed sessions.[15] Pine, Lieven, & Rowland (1996) also found that checklists revealed a higher proportion of nouns than did transcribed sessions.

The third important finding concerns completeness. Apart from their extreme variability, the transcript results were also less comprehensive than the checklist results. The total number of words in the transcripts ranged from 13 to 38 types. The checklist revealed many times this number: 316 types (Mandarin) and 160 types (English). Of course, longer recording sessions could increase transcript coverage. But these figures make it clear that we cannot in general equate transcript results with the child's vocabulary.

The underestimate may be especially severe for nouns. As noted above, nouns are used in a more referentially specific manner than are verbs (Bates, Bretherton, & Snyder 1988). People use a large variety of noun types, each fairly infrequently, and a small number of relational types, each fairly frequently (Gentner 1981). For example, Gopnik & Meltzoff (1984) compared the results of multiple taped sessions of nine 1–2-year-olds and found that children used a small number of relational terms across multiple sessions, but used nominals in a more context-specific manner: 75% of the relational terms occurred in more than one session, compared to only 25% of the nominals. Thus the results of any given transcript session are likely to underestimate nouns relative to verbs.

This is not to say that checklists are perfect. Tardif *et al.* (1999) found that some words (more verbs than nouns) were spoken but not reported on the checklist (interestingly, this imbalance was stronger in English than in Mandarin). Further research is needed to assess the extent of this kind of underreporting. The checklist method may be the best single method, but its limitations need to be kept in mind: (1) it can discourage proper nouns, unless parents are encouraged to provide them; (2) its success depends on having an inclusive, language-appropriate list; (3) it asks first for nouns, possibly leading to fatigue factors in reporting verbs (this could be remedied); (4) it may underestimate phrases used as wholes; (5) for heavily morphologized languages it may be difficult to decide how to count words; and (6) the context of use is not provided. The best method, apart from exhaustive diaries, may be to combine checklist and observational lists (Pine, Lieven, & Rowland 1996).

3.7 Navajo

Along with Bill Nichols, we studied the acquisition of Navajo, another language that might be considered verb-friendly (Gentner, Boroditsky, & Nichols, in preparation). Navajo is a polysynthetic language of the Athapaskan family. It uses SOV word order (Young, Morgan, & Midgette 1992). Thus verbs occur in the salient utterance-final position, and because nouns are often omitted, verbs can stand as complete utterances. Another

consideration is relative morphological transparency. Navajo verbs are heavily inflected – they can include up to 14–16 bound morphemes (as prefixes), and 11 is fairly typical – whereas nouns rarely have more than about 4–5 affixes and/or inflections. However, the verb morphology is considerably more transparent than the noun morphology. Navajo verbal affixes appear as prefixes before the verb stem, so that the verb stem itself appears in the salient word-final position. In contrast, nouns take affixes both before and after the noun stem. Thus the verb stem has the favored word-final position (in addition to its sentence-final position). Navajo forms a useful further point in our exploration of the determinants of early verb learning.

The study was conducted in the Navajo reservation near Shiprock, New Mexico. We first developed a checklist for Navajo, by translating, adapting, and augmenting the MacArthur CDI for Infants.[16] We tape-recorded this list for use with nonliterate families and interviewed the caretakers (all mothers or grandmothers) of 5 Navajo-speaking infants aged 18–26 months, with vocabulary sizes ranging from 31 to 187 words. The families were selected to be in remote parts of the reservation, where Navajo is likely to be the dominant or only language spoken in the homes.

We categorized the children's productive vocabularies according to the following categories: *nominals* (terms referring to concrete objects and entities, including proper names); *relational terms* (terms referring to spatial, temporal, or quantity relations – as in 'down,' 'later,' 'more' – or causal events – 'break'); *modifiers* (e.g. 'pretty'); *indeterminate terms* that are ambiguous as to noun–verb status (e.g. 'pee-pee'); *sound effects* (e.g. 'moo-moo'); and words associated with social games and routines (e.g. 'bye-bye').

Table 8.1 summarizes the results. Both predictions of the Division of Dominance hypothesis were supported. First, all 5 infants produced many more nominals than relational terms. Object terms made up an average of 44.8% of early Navajo vocabulary, compared to 17.1% for relational terms. The mean ratio of object terms to relational terms was 3.2. Consistent with the predictions of the Individuation continuum, the proportion of names for animate beings (including both concrete and proper nouns) was high in early vocabularies and declined as vocabulary increased. The average proportion of animates among nominals was 73% for the three children with the smallest vocabularies (31, 32, and 47), and 40.5% for the two children with the largest vocabularies (131 and 187).[17]

These findings also support the relational relativity claim that acquiring the meanings of verbs and other relational terms requires specific experience with the particular language being learned. With one exception, the proportion of relational terms increased with vocabulary size.

Table 8.1. *Early vocabularies of five Navajo children: mean percentages of nominals, relational words, and other classes*

Child Gender/ Age (mths.)	1 M/23	2[b] F/18	3 F/25	4[b] F/19	5 M/26	Mean percent	Mean number
Total nominals	51.6 (16)[a]	21.9 (7)	55.3 (26)	51.1 (67)	43.9 (82)	44.8	(39.6)
Animate beings	35.5 (11)	18.8 (6)	36.2 (17)	15.2 (20)	22.5 (42)	25.6	(19.2)
Other objects	16.1 (5)	3.1 (1)	19.1 (9)	35.9 (47)	21.4 (40)	19.1	(20.4)
Relations	9.7 (3)	15.6 (5)	10.6 (5)	20.6 (27)	28.9 (54)	17.1	(18.8)
Modifiers	1.0 (1)	0.0 (0)	2.1 (1)	5.3 (7)	4.3 (8)	2.5	(3.4)
Sounds/routines	35.5 (11)	40.6 (13)	27.7 (13)	16.0 (21)	12.3 (23)	26.4	(16.2)
Other	0.0 (0)	21.9 (7)	4.3 (2)	6.9 (9)	10.7 (20)	8.8	(7.7)
Total vocabulary[c]	**31.0 [5]**	**32.0**	**47.0**	**131.0 [7]**	**187.0 [43]**		
N/V	**5.3**	**1.4**	**5.2**	**2.48**	**1.52**	**3.2**	

Notes:

[a] Numbers in the table represent the percentages of total vocabulary. Numbers in parentheses represent the actual numbers of words.

[b] Proper names were not obtained for these two children's vocabularies, so their totals for animates and total nominals are probably underestimates.

[c] The entries for Total Vocabulary are the total number of Navajo words for each child, including both checklist counts and words added by parents. Numbers in square brackets represent words added by parents.

3.8 Tzeltal

Brown (1998) discusses another way a language can be verb-friendly. She notes that Tzeltal (along with other Mayan languages such as Tzotzil) has "heavy" verbs – that is, verbs that are specified as to the object properties of their arguments.[18] For example, the early verb *eat-tortilla* specifies both the event 'eating' and the object 'tortilla.' Brown studied Tzeltal acquisition in two children. Both started at around 15–17 months with a small set of nouns, mostly animates (caregivers), as well as deictics. This early noun advantage is also apparent in the early vocabulary of a child called X'anton, as recorded by the child's father (Brown, personal communication, November 1995). Nine of the child's eleven words are nominals, and, of those nine, four (36% of total vocabulary) are animates and a fifth, *car*, is another mobile object (see table 8.2).

However, later acquisition of verbs was rapid. For example, Xan[19] at 25 months had 52 words, of which 31 were nouns (including proper nouns) and 20 were verbs (Brown 1998: table 1). This is a comparatively high number of verbs: most studies have reported 10 or fewer verbs at the 50-word vocabulary level.[20] Likewise, de León (1999a, b, c) reports a large

Table 8.2. *First words of a Tzeltal child, according to her father (Reported by P. Brown)*

At 15 months, 5 days:
Mother
Father
At 15 months, 15 days:
cow [baby word for cow, used to mean 'dog']
car
tree/wood
At 15 months, 23 days:
tortilla
eat-tortilla (verb for eating tortillas)
At 16 months:
cat
At 17 months:
chili
potato
breast/suck

number of verbs in a 19-month-old Tzotzil child. We consider below the possibility that "heavy" verbs might be particularly easy to acquire.[21]

Taken together, the new crosslinguistic findings point to two conclusions. First, there is an early noun advantage across languages. Even in verb-friendly languages like Korean, Mandarin, and Italian, concrete nouns – especially names for animate beings – seem to serve as the entry-points to referential language. Second, there are clear effects of the input language. The accessibility of verbs in the input influences how early they are acquired.

4 Summary and implications

Are denotations formed nonlinguistically and simply named by language, or does language shape or even determine the denotations themselves? Both extremes are clearly wrong, and a bland compromise is unsatisfying. Our aim has been to present a specific proposal by which some parts of the semantic system are cognitively driven and others linguistically driven. Building on Gentner's (1982) proposal, we laid out a Division of Dominance continuum, according to which verbs, prepositions, and other relational predicates have denotations that are linguistically influenced, whereas concrete nouns are in many cases simply names for preexisting cognitively natural referents.

According to this framework, the denotations of concrete nouns tend to follow natural partitions – naturally preindividuated perceptual groupings.

For these noun-to-referent bindings, the cognitive parsing of the world is pre-solved, leaving only the linguistic parsing to be done. Relational terms, even concrete verbs and prepositions, are more linguistically influenced – the relational relativity claim. Their acquisition requires entry into the system of semantic distinctions that their language uses.

Our review of the current "nouns vs. verbs" debate leads us to conclude that the claim of an early noun advantage holds up well cross-linguistically.[22] The results indicate a strong early noun advantage even in languages with verb-friendly input characteristics, such as Mandarin and Korean. Even Tzeltal, which as a heavy-verb/light-noun language poses a strong contrast to English, seems to show an early noun advantage; however, further exploration of languages like Tzeltal and Tzotzil will be valuable. The evidence also suggests that input structure matters. The referential insight may be first established through a noun–object connection, but the subsequent rate of verb acquisition is affected by the input structure.[23]

4.1 *The nature of the early noun advantage*

The natural partitions hypothesis shares assumptions with other theories that have postulated an early noun–object link (Macnamara 1972; Maratsos 1991; Golinkoff *et al.* 1992), such as Markman's (1989, 1990) whole-object and taxonomic constraints and Waxman's (1991) early noun–category linkage. Although these constraints have sometimes been taken to be innate, the natural partitions hypothesis derives the noun–object connection from general learning principles (see also Smiley & Huttenlocher 1995; Bloom, ch. 6 of this volume; Smith, ch. 4 of this volume) and assumes that it is sensitive to the degree of preindividuation of the referent object.

4.2 *Noun dominance as counterintuitive*

The idea of early noun dominance runs contrary to the intuition that children, being interested in dynamic changes, motion, and causality, should want to talk about things usually conveyed by verbs (Nelson 1973; Gopnik & Meltzoff 1993). But children's word meanings are not a simple reflection of what is most interesting to them; they are also influenced by what is understandable within their system. For example, in Gentner's (1978b) *jiggy-zimbo* study of form vs. function in early noun meaning, young children labeled a new object according to its form, even though it shared an enthralling function – that of giving candy – with a different previously named object. Their language labeling was based not only on their interests

– which were clearly focused on the candy function – but also on their current understanding of how word meanings work. We suggest that the idea that "children's word learning is based on what they are interested in" is seriously incomplete. It misses the fact that language is a *system* of ways to codify experience and that children are learning that system. Children's propensity to learn nouns in no way impugns their interest in events and relations – merely their knowledge of how to lexicalize them.

4.3 *The paradox of verb centrality*

Another source of resistance to the idea of early noun dominance is that it seems to challenge the centrality of verbs in language processing. This is actually the tip of a much larger paradox. Linguistically and cognitively, the verb can be said to be the core of a sentence: it conveys the central set of events and relations in which the nouns participate. Chafe (1970: 97–98) analogized the verb and nouns to the sun and planets: "anything which happens to the sun affects the entire solar system," whereas "a noun is like a planet whose internal modifications affect it alone, and not the solar system as a whole." Yet verbs are harder to remember, both in recognition and in recall; more mutable in meaning under semantic strain; less prone to be borrowed in language contact; and less stable in translation between languages than nouns (Gentner 1981). How can verbs be so central and yet so elusive?

Such a paradox signals the need for a finer-grained analysis. We cannot simply assume that the verb's centrality confers some kind of generalized potency. For example, the verb's role as central connector requires it not only to link its noun arguments in the specified syntactic manner but to provide a set of relations that might meaningfully connect those objects, and this sometimes requires compromising the verb's default meaning (Gentner & France 1988). Thus the very centrality of verbs may contribute to their mutability under semantic strain and hence to their polysemy and fragility in sentence memory.

4.4 *The Individuation continuum in early acquisition*

Within the nominal class, we proposed an Individuation continuum and showed evidence for two implications. First, words applied to complex, well-structured objects are taken as object names (as evidenced by their being extended according to shape rather than substance) even very early in acquisition, and even by Japanese children who lack a syntactic marker for the object–substance distinction. Second, names for animate beings are learned early in many languages, as evidenced by findings from English, Italian, Navajo, and Tzeltal.

Crosslinguistically, words for animates are the most likely category to be treated linguistically as individuated (i.e. to be pluralizable and to be quantifiable without a unitizer – Croft 1990; Lucy 1992b). Developmentally, the extremely good cases of preindividuation within the nominal class – animate beings and complex movable objects – are already individuated either before or just at the onset of word learning. They thus provide natural candidates for the child's first forays into symbol–referent bindings.

These early referential bindings may provide natural entry points into language – "an initial set of fixed hooks with which children can bootstrap themselves into a position to learn the less transparent aspects of language" (Gentner 1982: 329; see also Maratsos 1990; Naigles 1990; Gleitman 1994). Noun–object bindings could provide a basis for working out the more variable aspects of language, including the binding of semantic relations to verb structures (Fisher 1996, 1999).

The early connection between nouns and highly individuable concrete referents may also lay the ground for the interpretation of other, more abstract nominals (but see P. Bloom 1994, ch. 6 of this volume). For example, as noted above, relational nouns like *uncle* or *passenger* are typically interpreted first as object-reference terms, and only later relationally (Keil 1989; Waxman & Hall 1993). We suggest that early referential concepts are highly concrete, and that the notion of an abstract individual arises as a later abstraction.

4.5 *An Individuation continuum for relational terms?*

Are there naturally cohesive relational concepts, analogous to preindividuated objects and animate beings, that children discover on their own and bring to language? One possibility is that the child's own goals could provide cohesion (Tomasello 1992; Gopnik & Meltzoff 1993). Indeed, Huttenlocher, Smiley, & Charney (1983) found that change-of-state verbs like *give* and *open* were more frequent in early production than action verbs like *run* and *jump*, and that they were produced initially only with the child as agent. However, a case could also be made for intransitive verbs denoting actions with distinctive motion patterns, such as *jump* and *bounce*. These might be individuated early for the same reasons as well-structured objects: they denote actions with high perceptual coherence and distinctiveness. Consistent with this possibility, Huttenlocher *et al.* (1983) found earlier *comprehension* of action verbs than of change-of-state verbs. (See also Gentner 1978a.)

Going further in the direction of coherence, we come to "heavy" verbs that specify object–action conflations. These form additional candidates for natural early verbs. We've suggested that one difficulty in learning verb denotation is learning what to extract, and in particular extracting relational elements away from the participants. As Brown (1998) notes, the rapid acquisition of verbs in Tzeltal suggests that heavy verbs, which allow a child to retain a cohesive event schema, are easier to learn than light verbs like English *make* and *go*.

Even in English, children may initially learn some relational terms in an overly conflationary manner, retaining the objects as well as the relational elements.[24] For example, in Gentner's (1982: 305–307) longitudinal vocabulary study, Tad's first relational words were *up* and *down*, at 19 months (8–9 months after his first nominals). He initially used *down* only when in his high chair, as a request to be taken out, and *up* while raising his arms, as a request to be picked up.[25] Olguin & Tomasello (1993) found that 25-month-olds who had been taught new verbs used them initially only with a highly restricted argument set.[26] As noted above, Huttenlocher *et al.* (1983) found that early verbs are understood first with the child as agent.

These patterns suggest that there may be something analogous to an Individuation continuum for verbs. Is the degree of cognitive preindividuation for heavy verbs comparable to that for "heavy nouns," such as names for animate beings? We suspect not. Brown's finding that names for animates are acquired before heavy verbs in Tzeltal suggests that more linguistic experience is required to learn verb meanings – even for heavy verbs – than to learn the meanings of nouns denoting animate beings.

4.6 *Relational relativity*

Relational relativity is, to us, the most interesting (and most overlooked) aspect of verb acquisition: "There is . . . variation in the way in which languages conflate relational components into the meanings of verbs and other predicates. Loosely speaking, noun meanings are given to us by the world; verb meanings are more free to vary across languages" (Gentner 1981: 169). The fact that languages vary widely in what constitutes the referents of their "concrete" verbs – far more so than for concrete nouns – has inescapable implications for word learning. No matter how important children find relations, they still must *learn* how to conflate them into word meanings.

For example, an English child and a French child standing side by side watching a duck float past a tree would need to lexicalize the event differently – *The duck floats past the tree* vs. *Le canard passe l'arbre en flottant*. The distribution of semantic components across the verb and satellite is different between the two languages (Talmy 1975, 1985). In contrast, *duck* (*le canard*) and *tree* (*l'arbre*) have essentially the same denotations. Examples like this show that children cannot possibly learn the denotations of verbs solely from perceptual experience. Some knowledge of linguistically influenced semantic

systems is required to learn verb meanings. We suggest that this knowledge is typically bootstrapped by the noun–object referential connection.

4.7 *Language and thought*

The question of whether linguistic categories affect general cognitive categories has been (to put it mildly) relegated to the fringe for some time (although see Lucy & Shweder 1979; Kay & Kempton 1984). However, recently the issue of linguistic influences on cognition has returned to the research foreground in three ways. First, recent theorizing has explored subtler versions of the linguistic influence hypothesis (as did Whorf himself – 1956), such as Slobin's (1987) "thinking for speaking" and Hunt & Agnoli's (1991) review of evidence that language may make certain habitual distinctions extremely fluent. Second, recent research suggests influences of language on conceptual development (e.g. Gopnik & Meltzoff 1984, 1986; Gopnik & Choi 1990; Byrnes & Gelman 1991; Shatz 1991; Gentner & Medina 1997). For example, when given object labels, children shift their attention from thematic relations to likeness relations, promoting the formation of categories (Markman 1989; Waxman 1991). Third, as discussed below, recent research has explored domains that appear more likely to reveal linguistic influences than the color domain on which much prior work centered (e.g. Bowerman 1985, 1993, 1996; Shatz 1991; Gentner & Rattermann 1991; Lucy 1992a, b; Brown 1994; Levinson & Brown 1994; Levinson 1994, 1996, ch. 19 of this volume; Pederson 1995; but see Li, Gleitman, Landau, & Gleitman 1997). From what has been said, two promising arenas are the object–substance distinction and the linguistic partitioning of spatial relations.

As discussed above, Imai & Gentner (1997) found crosslinguistic differences between English and Japanese speakers in their patterns of extension for object words and substance words. First, while both language groups showed a shape focus (i.e. an object interpretation) for complex objects, Americans were far more likely throughout development to extend by shape for simple objects. Second, the two groups diverged across age on substances, with Japanese becoming more likely to make material-based extensions and Americans remaining neutral across development. These findings fit with Lucy's (1992b) analysis, which would suggest that Japanese should promote a substance focus and English a shape focus.

However, as noted above, these entrainment effects show only that grammar influences speakers' assumptions about word meanings, not that they influence the cognitive categories associated with the words. To investigate conceptual influences, Imai & Mazuka (1997) conducted a nonlinguistic similarity task. American and Japanese adults were shown the same

triads used in Imai & Gentner's word-extension task, but were simply asked which of the two alternatives was most similar to the standard. For both languages, the similarity judgments closely mimicked the corresponding word-extension patterns[27] in Imai & Gentner's study, with English speakers focusing on common shape and Japanese speakers on common substance. These results parallel Lucy's (1992b) finding of shape-oriented classification for English speakers and substance-oriented classification for Yucatec Maya speakers.

Interestingly, the results for 4-year-olds on this similarity task did not mimic their patterns in the word-extension task. For example, the English 4-year-olds were less shape-oriented in the similarity task than in the word-extension task. This could suggest that such cognitive effects are manifest only after considerable experience with language. This interpretation fits with Lucy & Gaskin's (ch. 9, this volume) finding that Mayan semantic patterns find their way only rather late into perceptual classification patterns. Likewise, Smith & Sera (1992) found in their investigation of the development of dimensional terms that carrying out a correct polarity mapping between dimensions (e.g. *big/small* → *loud/soft*) occurs first in the context of word usage and only later in a purely perceptual context, suggesting that the linguistic distinction leads the perceptual distinction developmentally.

4.8 *Relational relativity and the linguistic partitioning of space*

Spatial relations are a promising arena in which to investigate possible effects of language on cognition, for three reasons. First, Whorfian effects are possible only for those aspects of language that are malleable crosslinguistically. Thus, returning to the Division of Dominance continuum (figure 8.1), we suggest that linguistic influences on thought are most likely to be found for relational terms. (Of course, purely grammatical terms are also highly malleable crosslinguistically, but since they operate chiefly at the grammatical level, their cognitive consequences are hard to test.) Second, verbs and other relational terms – including those concerned with spatial relations – provide framing structures for the encoding of events and experience; hence a linguistic effect on these categories could reasonably be expected to have cognitive consequences. Finally, *spatial* relations in particular offer the possibility of specific tests of the Whorfian claims, as in the work of Levinson and his colleagues (Pederson 1995). For example, Levinson (1996) found that Tzeltal speakers, whose language makes heavy use of absolute spatial terms (analogous to *North/South*), behave differently in a nonlinguistic spatial task from Dutch speakers, whose language uses a speaker-relative system of *right/left/front/back*. When shown a scene and asked to turn around and reconstruct it on a table behind them,

Dutch speakers preserve the left–right order of objects, but Tzeltal speakers preserve the north–south order.

In summary, we suggest that the relation between language and cognition is far more intricate than a one-way path. At one end of the Division of Dominance continuum, cognition calls the shots; language must adapt itself to cognitive–perceptual concepts. In the other direction, language influences our semantic categories. Children can most easily enter the lexicon at the cognitive end of the continuum. Once into the language, powerful mechanisms for learning regularities can come to grasp the semantic patterns that hold at the linguistically determined end of the continuum. This is the most interesting reason that children learn nouns before verbs.

NOTES

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1 The closed class is often extended to include grammatical morphemes such as plural *-s*. Also, although we have emphasized grammatical terms as purely linguistic terms, conveying relations internal to the language, they can also denote abstract conceptual relations (Talmy 1985).
2 Although these researchers have argued for the crosslinguistic variability of certain relational terms, they would not necessarily agree with the claim that relational terms are *more* crosslinguistically variable than object terms.
3 This difference holds for sentences with destination frames or boundary crossings (Slobin, 1996).
4 For brevity, we will often refer to this contrast as between nouns and verbs; however, many of the points made for verbs apply in varying degrees to prepositions and other relational predicate terms. As discussed below, there are also some relational systems that are lexicalized as nouns – e.g. kinship and cardinal directions in English.
5 Soja *et al.* compared simple objects and complex objects with substances in separate experiments, and found substantially the same results for both in English.
6 The instructions in Japanese were "Kono osara-wo mite. Kore-wa dax to iimasu. Dewa, kondowa kochirano osara-wo mite. Dochirano osara ni dax ga notte-imasuka?"
7 There is also the possibility that the complex objects were advantaged because children perceived their functional affordances (e.g. lemon-squeezing). However, we consider it unlikely that 2-year-olds knew these functions.
8 In contrast, Imai & Gentner's results do not entitle us to conclude an effect of language on thought. They only show an influence of grammar on the child's assumptions about word meaning. We return to this issue in section 4.

9 Another possibility, pointed out by Sue Carey and Liz Spelke (personal communication, November 1995), is that children are universally endowed with an ontological distinction between objects and substances, but that (1) this distinction manifests itself more readily with complex objects than with simple objects, which are more ambiguous as to their ontological status, and (2) learning the English count/mass distinction may superimpose attention to shape over this ontological distinction.
10 This discussion is necessarily broad and omits many subtleties of classifier systems that are unlikely to bear on infants' perceptual individuation. Animacy distinctions enter into many other aspects of the grammar besides pluralization, including case markings; and they draw on other conceptual distinctions besides those discussed here, such as person (in pronouns), gender, and status (Comrie 1981: 187–193).
11 Comrie (1981: 179) notes that some languages treat proper names as being "higher in animacy" than common noun phrases: e.g. "William Shakespeare" vs. "the author of Hamlet."
12 Because any early noun advantage should diminish as vocabulary increases, language effects must be assessed on children of matched vocabulary size.
13 The data are based both on transcriptions of natural interaction sessions and on a parental vocabulary list.
14 The proportion of noun types to totals ranged from .44 to .21 to .16 in English and from .46 to .18 to .16 in Mandarin for the noun-favorable, neutral, and verb-favorable contexts, respectively.
15 Tardif *et al.* (1999) give their results in terms of N/N + V ratios; we have converted these to N/V ratios for comparability with other findings.
16 We thank Oswald Werner for his invaluable help and guidance. We also thank Ed Shorty, Anthony Yazzi, Larry King, and Begaye, and especially William Morgan, for assistance in preparing Navajo materials. Finally, we thank Terry Au, Mirella Dapretto, & Y. Song for giving us their Korean checklist, which helped to augment our starting list.
17 These figures are probably underestimates. For two of the children (child 2 and child 4) the experimenter failed to elicit terms beyond the checklist, and this resulted in a lack of proper nouns. If these two children are omitted, the figures become 27.5% for the two smallest vocabularies and 22.5% for the child with the largest vocabulary.
18 Tzeltal has other verb-friendly features: it uses VOS word order and allows noun-dropping, so that children hear sentences consisting of a verb with its associated morphology.
19 Xan's vocabulary was assessed with a combination of transcripts and parental lists.
20 For example, Pae's (1993) Korean children had a mean of 2 verbs (and 17 nouns) at 21–50 words and a mean of 4 verbs (and 49 nouns) at 51–100 words, comparable to English.
21 Another factor here may be the relative "lightness" of nonanimate nouns. As in Yucatec Maya, these specify substance and require a classifier to specify shape (Lucy 1992b).

22 There remain questions as to whether this framework will hold for languages in which the noun–verb distinction is disputed, such as Salish or Tagalog (Evans, in press). However, Croft (1990) offers encouragement for the claim that the categories of nouns and verbs have semantic/pragmatic correlates. In his universal-typological theory, the category *noun* expresses "reference to an object" in the typologically unmarked case.

23 We speculate that the more linguistically embedded a term is, the more its acquisition will be sensitive to frequency.

24 A possibly related point is the prevalence of bathroom terms like *pee-pee* in early language. These events are characterized by a nearly perfect correlation of action and associated object context.

25 However, Bowerman (personal communication, November 1995) noted rapid generalization of some early relational terms in her children.

26 In contrast, Tomasello & Olguin (1993) found that 23-month-olds readily generalize new nouns across different verb frames.

27 Using the neutral syntax version of the word task in English, which is the form most comparable to the Japanese word extension task.

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9 Grammatical categories and the development of classification preferences: a comparative approach

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1 Introduction

The defining characteristic of the human species is its culture-bearing capacity whereby very similar biological organisms develop and sustain extraordinarily diverse behavioral repertoires. Research on human behavior, then, must necessarily concern itself with the scope and significance of this diversity and the process of its development in childhood. However, contemporary psychological research often assumes instead a homogeneity of repertoire and of underlying psychological function – coupled with a concomitant assimilation of the psychological to the biological – and neglects the process of culture acquisition. Theories and methods developed from such a perspective neither incline their proponents to developmentally oriented comparative research nor provide a set of concepts and tools adequate to undertake it.

The reality of cultural diversity requires us to adopt a comparative perspective from the beginning as part of a coherent effort to account for the actual range of human psychological functioning and the process of its formation. Such a coherent effort demands more than simply testing whether our local findings generalize to other cultures or looking for a specific, naturally occurring equivalent for some odd manipulation we cannot perform within our own culture for one reason or another. Rather, it requires taking seriously the proposal that the human developmental process is designed to support diversity in behavioral outcome and that psychological research programs must take account of this from the outset if they are to produce adequate methods and theories. Taking a comparative perspective from the outset involves the following general steps: documenting ethnographically the range and patterning of behavioral diversity, formulating and testing for tangible psychological implications of the diversity manifest in various cultures, and then exploiting the diversity itself in order to uncover the nature of the psychological mechanisms and developmental processes at work. The ultimate objective is a body of psychological theory and method