CHAPTER

14

Relations Between Language and Thought: Individuation and the Count/Mass Distinction

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OUTLINE

Abstract

What is the relationship between linguistic and nonlinguistic cognitive categories? How does language acquisition (specifically, the acquisition of grammatical categories) draw on prelinguistic concepts? Is it possible, as recent commentators have argued, that the acquisition of linguistic categories itself affects nonlinguistic

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conceptual categories? This paper addresses these questions by focusing on the grammatical distinction between count and mass nouns and its relation to the distinction between objects and stuff. We first ask whether learning count/mass syntax may help children think about objects and stuff in ways that were not antecedently available to them. We also ask whether cross-linguistic differences in marking count/mass status affect the nonlinguistic individuation criteria used by speakers of different languages. We review a number of recent findings that have been interpreted as showing such effects of count/mass syntax on nonlinguistic cognition and argue that they do not conclusively demonstrate language-specific influences on mental life.

14.1 INTRODUCTION

Several researchers within linguistics and developmental psychology hold that, in crucial respects, human concepts and mental architecture do not change throughout human development—in other words, there are fundamental similarities between the mental representations of children and those of adults (Fodor, 1975; Gleitman, 1990; Macnamara, 1982; Pinker 1984). These *continuity* theorists are impressed by the fact that prelinguistic infants already possess a rich inventory of conceptual categories that are presumably part of the universal human mental apparatus – including notions of space (Landau & Gleitman, 1985; Levine & Carey, 1982; Needham & Baillargeon, 1993), events (Baillargeon, Li, Gertner, & Wu, 2011; Gergely & Csibra, 2003; Woodward, 2004), quantity/number (Gallistel & Gelman, 1992), causality (Bullock & Gelman, 1979; Leslie & Keeble, 1987), and agency and animacy (Gelman & Spelke, 1981; Woodward, Phillips, & Spelke, 1993), among many others. Prelinguistic primitives such as these are assumed to form the basis for the acquisition of grammatical categories. As Chomsky (1982) has forcefully argued, without the existence of such primitives it is hard to see how language acquisition would take place at all:

> The claim that we're making about primitive notions is that if data were presented in such a way that these primitives couldn't be applied to it directly, prelinguistically, before you have a grammar, then language couldn't be learnt... We have to assume that there are some prelinguistic notions that can pick out pieces of the world, say, elements of this meaning and this sound.

According to this view, language acquisition essentially presents children with a mapping problem: the main task of the learner is to figure out which aspects of the input language correspond to which nonlinguistic conceptual primitives—or combinations thereof. Specific proposals have addressed the question of how the mapping problem may be solved at the very early stages of language development (see Gleitman, 1990; Pinker, 1984).

Other researchers argue that the human conceptual typology can and does undergo change during development. According to this view, cognitive development is characterized by deep *discontinuities* in mental architecture. There are several accounts of the exact nature of such discontinuities and of the way they affect specific conceptual domains (e.g., our notions of space, number, or mental state representation; see Dillon & Spelke, 2014; Carey 2009; Gopnik & Wellman, 1996, respectively). Furthermore, a growing class of discontinuity theories considers language itself (in particular, the acquisition of grammatical categories) a major cause of conceptual change. In the words of Bowerman and Levinson (2001),

> Instead of language merely reflecting the cognitive development which permits and constrains its acquisition, language is being thought of as potentially catalytic and transformative of cognition. (pp. 12–13)

According to this approach, language learning does not simply depend on prior representational resources but carries the potential of affecting those resources by introducing or otherwise modifying an individual's concepts. Carried to its logical conclusion, this view predicts that there should be deep conceptual differences not only between young and experienced learners of a language (i.e., between children and adults) but also between speakers of different languages. In this sense, recent proposals about language-driven discontinuities bear a more or less close relationship to the theories of B.L. Whorf, who famously argued in the early 20th century that the grammatical categories of a language affect (or even streamline) the conceptual life of its speakers (Whorf, 1956). There is currently a growing body of theoretical and experimental work which looks for linguistic influences on conceptual organization and cognitive development (Bowerman & Levinson, 2001; Gentner & Goldin-Meadow, 2004; Gopnik, 2001; Gumperz & Levinson, 1996; Levinson, 1996a, 1996b; Lupyan, 2012; for discussion, see Gleitman & Papafragou, 2005; Landau et al., 2010; Malt & Wolff, 2010; Wolff & Holmes, 2011, among many others).

In this chapter, we want to contribute to recent discussions of the language–thought relation by investigating how language, and especially the acquisition of grammatical categories, relates to conceptual organization. We focus on a specific case, the grammatical distinction between count and mass expressions. Count expressions refer to individual objects (*We need these tables*) or kinds of individual objects (*Tables are furniture*), while mass expressions refer to portions of quantities (*There is a lot of water on the floor*) or kinds of quantities (*Water is found in the sea*). Put differently, count nouns refer to discrete, well-delineated groups or entities, while mass nouns don't make explicit how their referents are to be divided into objects. Syntactically, count expressions co-occur with quantifiers such as *each*, *every*, *many*, *several*, *few*, (stressed) *some*, the indefinite article *a(n)*, use counting phrases (*five*, *a score of*) and

can be pluralized; mass expressions, on the other hand, co-occur with quantifiers such as *little, much*, (unstressed) *some*, use measurement phrases (*liters of*), and cannot be pluralized.

This grammatical distinction is linked to the conceptual distinction between objects and substances: cross-linguistically, objects tend to be named by count nouns (*cat, table*), and substances by mass nouns (*milk, wool*; cf. Markman, 1985). However, objects and stuff do not exhaust the range of referents for count and mass nominals, respectively. In English, for instance, count nouns name objects (*a dog*), but also abstract entities (*an indication*), or events (*an adventure*). Similarly, English mass nouns denote substances (*water*), but also abstract entities (*beauty*), solid materials (*wood*), or unindividuated groups of objects (*jewelry*).

For these reasons, the semantic underpinnings of the count/mass distinction are properly characterized in terms broader than the object/substance distinction (as a number of commentators have noticed; cf. Chierchia, 1998; Gillon, 1992; McCawley, 1975/1979; Schubert & Pelletier, 1987). On a widely held view, count/mass syntax maps onto a quantificational distinction between individuals and nonindividuated entities (Bloom, 1994b; Gordon, 1985, 1988; Link, 1983; Wisniewski, Imai, & Casey, 1996).[1] The cognitive notion of individual relates to properties such as countability, indivisibility, and boundedness, and corresponds approximately to "discrete bounded entity." Possible individuals may be material objects (*a dog*), events which take a bounded interval of time (*a race*), mental states (*a migraine*) or temporal stretches (*a week*; see Bloom, 1994a for extensive discussion). This way of semantically characterizing the count/mass distinction has the advantage of capturing the denotation of the entire class of mass and count nouns, as shown above. Moreover, it makes linguistic sense. From a formal quantificational point of view, there is no difference between *moment* and *mouse*, or between *seriousness* and *snow*: the first pair, unlike the second, contains nouns which denote kinds of individuals and can form more complex nominal expressions (NPs) to denote single individuals (*a moment, a mouse*).[2]

[1]We should point out that there are several different proposals about the semantics of mass nouns, not all of which share the idea that mass denotation excludes individuation (see, e.g., Chierchia, 1998, Gillon, 1992, Barner & Snedeker, 2005).

[2]This view also seems to account for certain empirical facts about how adults spontaneously interpret count and mass syntax. In one experiment, adults were taught novel words referring to sensations or sounds (Bloom, 1994b). The syntax of the word was kept neutral between count and mass status. The new word was offered as a description of either something that occurs in discrete units of time (temporal individuals) or of something that occurs over continuous periods of time (unbounded, unindividuated entities). As predicted, subjects categorized words for temporal individuals as count nouns and names for temporal stretches as mass nouns.

The precise form of the link between linguistic individuation (count/mass marking) and nonlinguistic ontological categories has given rise to intense debate within linguistics and philosophy, and we will review some of the relevant arguments in the sections to follow. More crucially, for present purposes, this link has become fertile ground for several discontinuity proposals. These proposals have come in two main varieties. Strong discontinuity theorists have proposed that the quantificational system of natural language (including the count/mass distinction) helps children arrive at the ontological distinction between individuals and nonindividuals. Other, weaker discontinuity proposals are consistent with the existence of a universal (object/substance) ontology but explore the possibility that typological differences among languages in encoding count/mass status may affect the salience or the boundaries of our ontological categories.

Our goal in what follows is to reconsider the arguments which have been used in support of such discontinuity theories. We begin by asking whether learning the count/mass distinction may help children think about objects and stuff in ways that were not antecedently available to them. We present several lines of experimental results which give us reasons to think that the count/mass distinction presupposes, rather than introduces, basic ontological distinctions. In the second part of the paper, we discuss whether the weaker view may be true—i.e., whether cross-linguistic differences in count/mass categories affect the individuation criteria of speakers of different languages. We review a number of recent findings that have been interpreted as showing such effects of count/mass syntax on nonlinguistic cognition and argue that they do not conclusively demonstrate language-specific influences on mental life.

14.2 STRONG DISCONTINUITY PROPOSALS

14.2.1 Quine

Perhaps the most radical proposal about how a grammatical category such as the count/mass distinction may affect the development of human conceptual categories belongs to Quine (1960). According to Quine, the ontological distinction between objects and substances that underlies language is a cultural construction. In other words, before mastering the relevant aspects of their language, children do not represent the world in terms of stable objects, but as histories of sporadic encounters, an undifferentiated portion of what goes on. For instance, prelinguistic infants do not conceptualize a dog as an individuated, countable entity, but as an instance of doghood. They may still interact with it, learn several things associated with it (e.g., that it barks), and

use shape and other criteria to identify it. Still, in order to isolate and individuate a dog, infants need to use the resources made available to them through the quantificational system of natural language: by being exposed to phrases such as *a dog, these dogs*, etc., which carve out boundaries of perceived experience, the child could find a way of bootstrapping into the adult ontological system (see Carey, 1994 for discussion). According to Quine, then, the count/mass syntax offers the means for discriminating objects versus substances during development.[3]

Soja, Carey, and Spelke (1991) designed an experiment to address Quine's claim that knowledge of individuation is a product of mastering the count/mass distinction. They taught English-speaking 2-year-olds who did not show productive command of the count/mass syntax novel words in reference to various stimuli. In each case, the target stimulus was named by a nonsense word embedded in a frame which did not mark it for count/mass status (e.g., *This is my blicket*). In one condition, the stimulus was a solid object (e.g., a pyramid made of wood). The children were then shown two alternatives, one of the same shape as the original but made out of different material (e.g., a pyramid made out of sculpting material), the other of different shape but made of the same stuff (e.g., pieces of wood). When asked to choose which of the alternatives was *the blicket*, children in this condition consistently chose the same-shape alternative.

In the second condition, the target stimulus was some nonsolid substance arranged in an interesting shape (e.g., Nivea cream). Again, children were shown two alternatives, one which maintained the shape of the target but consisted of different material (e.g., hair-setting gel), and another which consisted of piles of the target substance (e.g., piles of Nivea cream). Children generalized the target name to the same-substance display. On the basis of these results, Soja et al. concluded that children possess innate ontological commitments which guide the extension of novel words for objects and substances prior to the acquisition of count/mass syntax.

There is further compelling evidence that, *pace* Quine, the logical resources to represent objects are available very early in life. Several studies have shown that even young babies use spatiotemporal criteria for individuating solid, small, moveable, coherent objects. In one experiment (Spelke, Kestenbaum, Simons, & Wein, 1995), babies of

[3]A similar view is found in the writings of B.L. Whorf, who argued that the individuated/nonindividuated distinction "is somewhat forced upon our description of events by an unavoidable pattern in the English language (i.e., the count/mass syntax)" (Whorf, 1956: 141).

4.5 months were shown two screens side by side. Then one object appeared from the left edge of the left screen and went back behind it; after a suitable interval, a second object appeared from the right edge of the right screen and returned behind it. Babies habituated to this event. When the screens disappeared, babies looked longer at (i.e., were surprised by) displays featuring one object rather than two. This shows that babies, just like adults, reason that objects cannot be in two places at the same time and that they continue to exist behind opaque screens (cf. Mehler & Fox, 1985; Spelke, 1985, 1990; Xu & Carey, 1996). Other work has shown that babies of this age can distinguish one object from two numerically distinct but physically similar objects (Baillargeon, 1993; Wynn 1992, 1995; Uller, Carey, Huntley-Fenner, & Klatt, 1999). This research shows that the concept "object" is not constructed through experience with natural language quantification, but is probably part of the core knowledge of the human conceptual system.

Further evidence comes from the work of Susan Carey and her colleagues, who have shown that very young infants possess something close to an object/substance distinction. In one of these studies (Huntley-Fenner, 1995; cf. Carey 1994, 2001; Huntley-Fenner, Carey, & Solimando, 2002), 8-month-old babies were familiarized with either a solid object in the form of a sand pile which was suspended from a narrow thread and moved around as a coherent object (the Object condition) or a quantity of sand (the Sand condition). In the Object condition, babies saw a sand object being put behind a screen, then a second sand object lowered behind the screen. When the screen was removed, babies showed no surprise when two objects appeared, while they showed surprise at the unexpected outcome of one object. In the Sand condition, babies saw an amount of sand being poured onto a surface and then being hidden behind a screen. After some more sand was poured next to the first pile behind the screen, the screen was lifted. Babies now showed no surprise at the unexpected outcome of one pile of sand but looked slightly longer at the expected outcome of two, which is also the baseline preference. It is reasonable to assume that the reason babies fail in the Sand condition is the noncohesiveness of the sand. If so, these experiments show that preverbal infants draw a spontaneous and systematic distinction between individuated and nonindividuated material objects. Hence these babies appear to possess some rudimentary form of a distinction which they may presumably use in order to acquire the count/mass distinction in English.

We conclude that infants' individuation capabilities overall support the continuity/universality approach to grammaticizable concepts: *pace* Quine, early individuation capacities predate the acquisition of the quantificational count/mass distinction in natural language.

14.2.2 Abstract Individuation in Language and Thought

Recall that the count/mass distinction corresponds to a much more abstract individuation distinction than the object/substance distinction. One question worth raising at this point is whether young children are sensitive to these more abstract individuation considerations. It could be hypothesized that children start out attending to—and learning names for—highly individuatable concrete referents and only later come to grasp the notion of an abstract individual. There are two lines of findings which speak against this idea: the first concerns the individuation capacities of prelinguistic infants, which seem to extend beyond a simple object/substance distinction; the second involves young children's ability to map these complex individuation concepts onto the count/mass syntax.

There are good reasons to believe that the appreciation of abstract individuals is not a late cognitive achievement. As we hinted earlier, infants have been shown to individuate a variety of nonobject, nonphysical entities (see Section 14.2.1). The main evidence comes from infants' ability to count. Counting is usually taken as evidence for individuation, since in order to count something, one has to know what it is they are counting (or at least discriminate among distinct occurrences of the counted entity). Infants can count very diverse entities, including randomly arranged household objects depicted in photographs (Starkey, Spelke, & Gelman, 1990), sounds (Starkey et al., 1990), and actions such as jumps (Wynn, 1995). If this is true, then prelinguistic children possess a complex notion of individual, which may be comparable to the sophisticated conception which has been argued to be part of adult cognition (but see Brooks, Pogue, & Barner, 2011).

Of course, nobody would deny that objects and substances are prime examples of individuals and nonindividuated entities, respectively. It is very plausible that we are cognitively biased to treat discrete objects as canonical individuals. Young children are particularly prone to this bias: Shipley and Shepperson (1990) found that, when children are presented with an array of objects and asked to count colors or parts, they go on to count objects regardless. In the context of word learning, it has been shown that children have trouble learning words for solid substances (e.g., *wood*), a fact which is explained by the presence of the cognitive bias to treat objects as canonical individuals (Bloom, 1994b; Prasada, 1993). Notice, however, that this bias can be overriden: as we saw, young children can count not only objects but also noncanonical individuals such as sounds and actions.

There is also evidence that the count/mass syntax in young children does not build directly on the object/substance classes but connects to the richer individuation system outlined above. Sure enough, object names make up a higher proportion of the child vocabulary than that

of adults (Gentner & Boroditsky, 2001; Macnamara, 1982). But children's early count nouns already refer to much more besides objects: there is considerable evidence that 20-month-olds use words such as *bath*, *breakfast*, *friend*, *day*, or *uncle* (Nelson, Hampson, & Shaw, 1993).

More importantly, children can use syntactic marking as a cue to individuation. In a classic study, Brown (1957) showed preschoolers a picture of an unfamiliar action performed with an unfamiliar object on an unfamiliar substance. One group of children heard: "In this picture, you can see a sib. Now show me another picture of a sib." Another group was told: "In this picture, you can see some sib. Now show me another picture of some sib." When count syntax was introduced, children understood the nonsense noun to refer to the object, while when mass syntax was present, children interpreted the noun as referring to the substance. Such syntactic cues have been shown to be very powerful. When intuitions about individuation contrast with the count/mass status of a novel noun (e.g., when an unfamiliar substance is named by a count noun), very young learners override perceptual/cognitive factors in favor of the syntactic cues (Gordon, 1985; cf. Gordon, 1988; Subrahmanyam, Landau, & Gelman, 1999).

More strikingly, perhaps, children can use count/mass syntax to infer the name of kinds of individuals which are not objects. Soja (1992) studied 2-year-olds with productive command of count/mass syntax. She found that they can use a word's mass status to infer that it refers to a nonsolid substance (e.g., *water*) or count status to infer that its referent is a bounded individual made of that substance (e.g., *puddle*). Bloom (1994b) found that 3-year-olds will take a plural count noun that describes a series of actions ("These are feps") as referring to the individual actions and a mass noun describing the same series ("This is fep") as referring to the undifferentiated activity. Finally, Bloom and Kelemen (1995) showed that adults and older children can use count noun syntax to learn names for novel collections, terms such as *flock* and *family* that refer to groups of distinct physical entities.

In sum, the evidence just surveyed suggests that children may possess individuation criteria that approximate those of adults, and that these criteria (rather than a cruder object/substance distinction) form the basis for their semantic interpretation of the count/mass distinction. These data offer further support against strong discontinuity proposals which claim that early individuation criteria are provided by the linguistic distinction between count and mass nouns.

14.3 WEAK DISCONTINUITY PROPOSALS

Several studies have pursued the question whether cross-linguistic differences in marking the count/mass distinction affect speakers'

individuation patterns. Overall, these studies recognize that there may be strong constraints on children's initial presuppositions about individuation but leave open the possibility that language may also play a causal (albeit weaker, more restricted) role in determining individuation criteria.

14.3.1 Cross-Linguistic Studies

One series of studies comes from John Lucy and his colleagues (Lucy 1992, 1996; Lucy & Gaskins, 2001), who have conducted comparative research with English speakers and speakers of Yucatec Maya. Yucatec Maya (like Chinese, or Japanese) is a *classifier* language: its nouns are all mass (in Lucy and Gaskins' words, they are "semantically unspecified as to quantificational unit," op.cit.: 261). The language only optionally marks plural on certain nouns—mostly those denoting animate entities; for most nouns, there is no alternation of the kind "table/tables." Moreover, numerals are not able to combine directly with nouns: a classifier is necessary to individuate units which may then be counted. For instance, in this language, one cannot say "one banana" but rather has to say "one portion of banana" (cf. *un-tz'iit kib'*—"one long thin candle," *ka'a-tz'iit kib'* – "two long thin candle").

On the basis of these grammatical properties, Lucy and his team hypothesized that Yucatec Maya and English nouns draw the speakers' attention to different properties of the nouns' referents. Their reasoning goes as follows. In order to refer to any discrete object[4], English speakers use mostly shape considerations to determine which count noun is most appropriate to name the object (e.g., *candle*). But speakers of Yucatec Maya, since nouns in their language do not typically denote individuated objects, cannot use shape as a criterion for naming objects; instead they must take into account the objects' material composition (e.g., *kib'* – "wax/candle"). Given that these criteria for verbally labeling objects are repeatedly and massively used in the respective speech communities, it is plausible that members of these communities develop distinct preferences for attending to shape versus material even in nonlinguistic tasks involving individual objects. Moreover, it is likely that adults will be more "contaminated" by these language-specific preferences than younger learners of English or Maya since the adults have had much longer exposure to the naming practices of the community.

These predictions were tested in a number of experiments. In a typical experiment, adult participants were presented with a triad of everyday objects consisting of an original pivot object (e.g., a small cardboard box)

[4]Reference to nondiscrete objects (substances) is supposed to be more similar among these two languages, so no major cognitive differences are expected.

and two alternate objects, one of which shared its shape with the pivot (e.g., a small plastic box) and the other its material (e.g., a small piece of cardboard). When asked to choose which of the alternate objects the pivot object was more similar to, Yucatec Maya speakers were more likely than English speakers to choose the same-material alternate, while English speakers were more likely to pick the same-shape alternate. The triads experiment was also used to test the developmental predictions outlined above. It turned out that, while both English-speaking and Yucatec-speaking children at earlier ages preferred shape-based classifications, by the age of 9 years children in the two communities had converged on the adult classification patterns: English-speaking children made shape-based choices and Yucatec children made material-based choices.

A related line of findings comes from word learning studies, which asked whether cross-linguistic differences in learning nominals reveal underlying differences in ontological assumptions. Imai and Gentner (1997) used as a starting point Soja et al.'s results. The authors reasoned that if indeed the object/substance distinction is prior to and independent of count/mass syntax, then learners of classifier languages like Japanese should behave just like learners of English in extending words to novel referents. Imai and Gentner tested monolingual Japanese and American children and adults using Soja et al.'s tasks. They found that both American and Japanese adults and children as young as 2 years extended names for complex objects (e.g., a porcelain lemon juicer) on the basis of shape rather than substance. This finding replicates Soja et al.'s results and offers strong support for early ontological categories (and against Quine's strong discontinuity conjecture). But Imai and Gentner also found that, in naming simple objects (e.g., a cork pyramid), speakers of the two languages diverged: English speakers from 2 years onwards predominantly attended to shape, while Japanese children were at chance. Differences were also found in naming substances (e.g., sawdust): only the Japanese subjects extended the label on the basis of material, while the American subjects were at chance. Based on these results, Imai and Gentner concluded that universal ontological categories guide word learning for canonical objects and stuff; however, categorization for items that fall in between these two canonical kinds (i.e., simple objects which could in principle be conceptualized either as substances or as individuated objects) is determined by factors specific to the language being learned (cf. also Gentner & Boroditsky, 2001).[5]

[5]Some aspects of the word learning results are more difficult to explain. For instance, since substances are claimed to be a canonical category in the universal ontology (rather than a case of indeterminate individuation), the difference between American and Japanese subjects in naming substances is unexpected. Note incidentally that these findings differ from those in Soja et al. for American subjects.

Taken together, these cross-linguistic experiments have been interpreted as evidence for the position that, alongside universally shared ontological commitments (broadly, a distinction between individuated vs. nonindividuated entities), there are language-specific effects on the boundaries of nonlinguistic ontological categories (specifically affecting the classification of simple objects). Furthermore, such effects of language are claimed to increase with age and exposure to the language. However, the precise interpretation of these results is not straightforward. Other research shows that simple and complex objects are not treated differently by our prelinguistic individuation mechanisms. For instance, infants have no difficulty individuating simple objects made of sand alongside complex (i.e., structured and purposeful) objects and substances (Huntley-Fenner, 1995). This result is hard to reconcile with the claim that the individuation of simple objects is indeterminate and therefore open to linguistic influences.

There is also considerable debate surrounding the proper treatment of the count/mass distinction (see Section 14.2.2). Several authors have pointed out that the distinction is not absent in classifier languages but shows up in places other than noun reference (e.g., in the kind of classifier used; cf. Cheng & Sybesma, 1999). More crucially, as we saw, many commentators have emphasized that the denotation of mass nouns is abstract and cannot be directly linked to notions like "substance" (Chierchia, 1998; Krifka, 1995; McCawley, 1975; Pelletier & Schubert, 1989, and Introduction). Thus it is unlikely that the denotation of nouns in classifier languages can give rise to a "material bias."

This last point has been confirmed by studies examining the interpretation of nouns in classifier languages. In a study by Imai and Gentner (2003), Japanese children were first introduced to and given a label for an item (e.g., a wooden pyramid). Then they were given choices that were either the same shape (e.g., a cork pyramid), the same material (e.g., wooden pieces), or distractors (e.g., a wax kidney bean). The children were given free reign to choose as many matches as they wanted but preferred only one choice. If they picked the shape match, they did not pick the material match, and vice versa. This result is in contrast to another condition in which the item was introduced, but never labeled. In this latter condition, children often picked multiple matches (i.e., both the shape match and the material match). This study shows children think that nouns either name a kind of object or a kind of substance, but not both. This importantly debunks the notion that nouns have to refer to substance kinds in a classifier language. These data also show that young speakers of classifier languages perform differently in linguistic and nonlinguistic categorization tasks, a point we return to in the next section.

Further studies have compared children's earliest vocabularies in English and Japanese. Colunga and Smith (2000) asked adult native

speakers to determine whether the nouns young children know referred to entities that had similar shape or similar material, and whether they referred to solids or nonsolids. Of interest is whether more nouns in Japanese refer to material. Colunga and Smith found similarities in the types of noun repertoires in these two languages. The majority of the nouns refer to solid entities. Furthermore, nouns in both languages more often refer to categories high in shape similarity and less often to categories high in material or color similarity. Overall, Japanese and English share roughly equal proportions of "shape-based" and "material-based" nouns. Similar results have been obtained by looking at maternal input in English and Mandarin (Sandhofer, Smith, & Luo, 2000). Collectively, the Japanese, Mandarin, and English data support the conclusion that both the nouns children learn and the nouns they hear in their environment do not refer to items of similar material.

14.3.2 Language-on-Language Effects

Given the results surveyed above, how are we to interpret the data from cross-linguistic studies on individuation? In the following paragraphs, we consider an alternative explanation of these findings which does not rest on linguistic influences on thought (see also Fisher & Gleitman, 2002, Gleitman & Papafragou, 2005).

Beginning with the word learning studies, recall that Imai and Gentner's task involved making guesses about the referents of novel nouns. It is reasonable to assume that such guesses must have been affected, among other things, by English and Japanese speakers' knowledge of how linguistic forms map onto meanings in their native language. We know from prior work that people's guesses about the reference of novel verbs (Naigles & Terrazas, 1998) or adjectives (Waxman, Senghas, & Benveniste, 1997) is affected by knowledge of language-specific syntax-semantics mappings. We also know that children are sensitive to probabilistic expectations about what the words in their language mean or how they are combined into sentences (Choi & Bowerman, 1991; Slobin, 1996, 2001). Such probabilistic expectations guide how novel words will be interpreted, especially in contexts that supply poor or ambiguous information as to what the novel word could name.

In light of these observations, let us reconsider the word learning findings. As we saw, subjects in both languages picked the "object" interpretation for a novel noun when the materials included nonaccidental-looking structure-rich objects. However, when the display included uninformative, "simple" objects, which could in principle be considered either as objects or as substances, subjects fell back upon language information to solve the task. Japanese does not formally

distinguish between object or substance expressions, so Japanese speakers chose at random for those ambiguous stimuli. For English speakers, the presentation conditions sought to replicate this indeterminacy by avoiding count- or mass-biasing syntax (*This is my blicket*). However, given the much higher proportion of count nouns in English, it is likely that American participants construed the novel label as a new count noun referring to the kind of object displayed rather than a new mass noun. If this is true, then the English–Japanese difference in novel word extensions is not an effect of language on thought but rather an effect of "language on language" (see Fisher & Gleitman, 2002, Gleitman & Papafragou, 2005 for discussion).

It is an open possibility that such linguistic considerations intrude into otherwise nonlinguistic memory/categorization tasks and affect subjects' individuation preferences. Imai and Mazuka (1997), reported in Imai (2000) using a nonlinguistic version of the Imai and Gentner tasks found very similar results to the original word-extension experiments: in picking the object that was "the same" as the pivot, English adults focused on common shape and Japanese adults focused on common material. As we saw, Lucy and his colleagues reported similar results for nonlinguistic tests comparing Yucatec Mayan and English speakers. A plausible hypothesis is that, in the absence of clear grounds on which to perform classification (what counts as "the same" may vary indefinitely), adults implicitly use verbal mediation to solve these tasks—thereby reproducing the results of the linguistic (word extension) studies.[6]

Support for this hypothesis comes from the fact that, in both Lucy's and Imai and Mazuka's nonlinguistic experiments, adults make language-consistent categorization choices but children do not: for instance, recall that in Lucy's studies only by the age of 9 years did

[6]Cultural considerations may also bias speakers for or against shape- or material-based classification. The English-speaking population in Lucy's tasks lives in a culture where shape is very important, from children's toys to traffic signs. By contrast, Yucatec Mayans are part of a rural community where the material of many everyday objects is important and salient. This difference might explain why, in more recent versions of the triad tasks which involved sorting, Lucy and Gaskins find clearer preference for material on the part of the Mayan adults. According to the authors, in these new tasks,

> [t]he Yucatec speakers were constantly evaluating the material composition of the test items before sorting them: feeling how heavy they were, poking their nails into them to test for malleability, scraping the surface to see what the material under the paint was, smelling and tasting the objects. . .—and all this with familiar objects. (2001: 272)

Similar studies which have removed the cultural differences from the subject populations (by studying Chinese and English speakers) have failed to replicate Lucy's results (Mazuka & Friedman, 2000).

Mayan speakers adopt the adult-like preference for material in categorization tasks. This difference is unexpected according to the view that linguistic influences of the count/mass syntax are responsible for the adult categorization patterns: after all, children have mastered the basics of the syntax of classifier languages well before the age of 9. However, the findings make sense according to the alternative hypothesis, since children, unlike adults, may be unable to fall back onto linguistic labels to solve nonlinguistic (memorial or categorization) tasks. This is in line with memory research showing that young children do not spontaneously coopt linguistic representations in support of memorial recall and that this ability undergoes considerable developmental changes (Hitch, Woodin, & Baker, 1989; Palmer, 2000).

This line of argument predicts that speakers of classifier and nonclassifier languages should behave identically in a nonlinguistic individuation task which tests for intuitions about kind membership without evoking linguistic mediation. In another study, Li, Dunham, and Carey (2009) asked English, Japanese, and Mandarin speakers to rate on a scale of 1–7 how likely they are to construe a novel specimen as a kind of object or a kind of substance. This method avoids vague instructions and is overall less open to linguistic intrusions. Results show that adults in all three languages were alike in their ratings. (Interestingly, when the same experimental stimuli were embedded as targets in a standard match-to-target triad task, the language difference reappeared, with English speakers making more shape-based choices.) These results offer compelling evidence that cognitive individuation criteria are independent of language-internal distinctions such as those encoded in count/mass syntax.

Further relevant evidence comes from Barner, Inagaki, and Li (2009) who tested Mandarin–English bilinguals on a word-extension task. Half the bilinguals were tested in English and half in Mandarin. Bilinguals extended words by shape more often when tested in English than they did when tested in Mandarin, further demonstrating that it is linguistic surface cues, like the lexical statistics of count nouns, that make English speakers more likely to extend novel words to objects, not conceptual differences caused by learning count syntax (see also Iwasaki, Vinson, & Vigliocco, 2010).

14.4 MATERIAL AND SHAPE CUES IN LABELING AND CATEGORIZATION

Much of the literature on the count/mass distinction (and on word learning, more generally) we have reviewed often makes the following

two assumptions. First, at least for some classes of count nouns (e.g., those that refer to discrete objects), shape is typically the basis for extending the noun to other members of the referent class (what has been called the *shape bias*). Second, at least for some classes of mass nouns, material is typically the basis for extending the noun to other members of the referent class (what can be called the *material bias*). Before we conclude, we want to discuss the role of shape and material considerations in naming and categorization. Where do these "biases" come from? Are they language-based generalizations? On weak discontinuity views, at least, children and adults who speak languages with count nouns come to map perceptual properties of objects (such as shape) onto count syntax *as a result of their experience with count nouns*, and hence develop a preference for extending count nouns to objects of similar perceptual contour. Similarly, children and adults who speak classifier languages with exclusively mass nouns come to map the material constitution of objects (i.e., the stuff) onto mass syntax *as a result of their experience with mass nouns*, and hence are more likely to extend novel nouns to objects of similar material composition. The question we want to address now is whether the shape and the material bias are, in fact, tied to word learning, more specifically the acquisition of the count/mass distinction.

Beginning with mass nouns, notice that the "material bias," if true, has limited applicability: it only holds for mass nouns with *physical* referents and not for abstract nouns such as *information* or *nobility*. Furthermore, there are exceptions to this bias even within the class of concrete, physical mass nouns. Perhaps the largest class of relevant counterexamples in English comes from mass superordinates (*food*, *jewelry*, *footwear*, etc.): the decision to call a plastic chair, a wooden table and a leather sofa *furniture* is explained by the fact that they all share characteristics which relate to their creation, purpose, and everyday use. The general conclusion then is that, although "concrete" in reference, superordinate mass nouns do not refer to objects which share material constitution, but rather functional properties—and this seems to be true cross-linguistically (Markman, 1985; Wisniewski et al., 1996).

Even in cases of mass nouns with basic-level, observable referents, the decision to name an object with a mass noun takes into account far more than simple material constitution. Suppose you find out that what you considered to be tea in your cup was in fact water from the tap which had passed through a tea filter at the reservoir. It is unlikely that you would go on calling it *tea*, even though its contents may be identical to the ingredients of an ordinary cup of tea (cf. Chomsky, 1995). What determines labeling here, as in so many other cases, is sameness of *kind* (rather than sameness of material): our reluctance to call the new substance *tea* comes from our reluctance to classify it as an instance

of that kind of beverage. What will be classified as an instance of a kind is often not easy to determine (and may vary depending on one's perspective, goals, etc.). The lesson to be drawn here is that naming decisions may be affected by a host of complex considerations which may not correlate in any simple way with ease of individuation.

Similarly, the decision to name an object by a count noun is generally governed by a number of complex criteria which may include the object's function (*a computer*), the intentions of its creator (*a painting, a collection*), and its internal properties and characteristics, its essence (*an animal*; see Bloom, 2001; Soja, Carey, & Spelke, 1992). As we have already pointed out, what licenses (and in fact guarantees) sameness of name is sameness of *kind*: we give the same verbal label to objects which fall in the same category. Our naming decisions typically depend on our decisions about kind membership.

What about the "shape bias"? Shape has been shown to be a central factor in the naming practices of both young children and adults and to be preferred over color, size, or texture as a basis of labeling objects with count nouns (Landau, Jones, & Smith, 1992; Landau & Leyton, 1999; Landau, Smith, & Jones, 1992, 1998). The question is whether attention to shape comes about as a consequence of learning count nouns, as the weak discontinuity proposals assume. Recall that, according to this view, speakers of languages which possess count nouns come to map perceptual properties of objects (such as shape) onto count syntax as a result of their linguistic experience, and hence develop a preference for extending count nouns to objects of similar perceptual contour.

Our position provides an alternative explanation for the fact that names for objects are often projected according to shape (see also Bloom, 1994a, 2001 for related discussion). Notice that, for several different reasons, humans are able to draw quick and correct inferences about object kind membership on the basis of perceptual contour. For artefact categories, shape is linked to function: whether something is a shoe (and has the function of being worn on one's feet) places constraints on its shape. In the case of natural kinds, such as plants or animals, their shape is linked to their biological properties and evolutionary history: the giraffe's neck is an obvious example. The usefulness and importance of shape for nonlinguistic cognition have been repeatedly emphasized in studies of nonlinguistic categorization and of the visual representation of objects (see Landau & Jackendoff, 1993; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976, respectively).

If shape is a privileged cue to category membership for objects, it is no surprise that objects which have similar shapes (and probably belong to the same kind) also tend to share the same label. Expressions such as *giraffe* and *shoe* are typically extended to entities which share

the same shape because people use shape to categorize objects as giraffes or shoes, independently of language. If this is true, then attention to shape is not a product of learning count nouns (governed by a "shape bias") but a general cognitive preference which enters into categorization decisions.

Could it be that a shape bias, even though not quite accurate as a description of how adults label objects or individuals, determines naming decisions in children? Even 2- and 3-year-olds have been shown to be sensitive to this bias (Landau et al., 1992). It might be that children start out with this special procedure for extending count nouns to novel objects and only later come to use more fine-grained cues to form (and label) object categories.

An obvious problem with this view is that children learn lots of count expressions for kinds which do not share shape: preschoolers talk about grandmothers and telephones, animals, and games. More generally, there is evidence that shape is not the only (or even the dominant) factor in early object labeling: when it contrasts with other important properties, it can be overridden. For instance, 4-year-olds know that a sponge shaped to look like a rock is in reality a sponge—and do not hesitate to call it such (Flavell, Flavell, & Green, 1983). Slightly older children recognize that membership to a kind (and labeling) is not determined by appearance only: a porcupine which has been transformed to look like a cactus is still a porcupine (and should still appropriately be called so; Keil, 1989). Other studies have demonstrated the importance of intention in children's naming decisions. When asked to draw a balloon and a lollipop, 3- and 4-year-olds typically produce similarly shaped drawings; nevertheless, they name these representations not on the basis of shape but according to what they intended them to depict (Bloom, 2001). In another study in this series, 4-year-olds recognized that what a picture is of does not depend only on what the picture looks like but crucially on the creator's intent (e.g., which object the person who drew the picture was looking at while drawing). As before, children's naming decisions in these experiments go beyond perceptual features and incorporate deeper properties which determine kind membership.

If children name objects on the basis of kind membership, one would expect to see changes in the relative importance of shape during development, as children acquire increasingly sophisticated ways of generalizing object categories—and this seems to be true (Becker & Ward, 1991; Macario, 1991; Imai, Gentner, & Uchida, 1994). We conclude that it is not experience with language (more specifically, the acquisition of count nouns) that creates a shape bias for young learners; rather, attention to shape emerges as an accurate means of categorizing (and labeling) object kinds.

14.5 CONCLUSION

In the previous pages, we have surveyed several versions of the thesis that language may cause conceptual discontinuities both across ages and across different speech communities. Specifically, we focused on the grammatical distinction between count and mass expressions and we looked at how this distinction relates to our ontological concepts of objects and substances. We began by considering evidence against strong discontinuity proposals, according to which our ontological concepts are necessarily mediated by language. We next reviewed certain experimental results that have been taken as evidence for weakly discontinuous development of our folk ontology. While the results are certainly intriguing, neither the data as they stand nor the reasoning behind these studies have yet conclusively demonstrated language-related influences on the conceptualization of objects or stuff. Finally, we have argued that decisions to use material or shape as the basis for common labeling do not result from language-internal biases but are mediated by considerations of how material or shape impact decisions about kind membership.

Importantly, the data we surveyed revealed that humans already from infancy use individuation criteria that are more subtle than the object/substance distinction. Such criteria form a prime candidate for "core knowledge" (to use Spelke's term), i.e., universal conceptual primitives which precede and structure language development. Both the precise form of these primitives and their relationship to the count-mass syntax offer fertile ground for future experimentation and theorizing. Results from such investigations will be important in further tracing the complex relations between early linguistic and conceptual categories.

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