Thinking Through Language*

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1. Introduction

What would it be like to have never learned English, but instead only to know Hopi, Mandarin Chinese, or American Sign Language? Would that change the way you think? Imagine entirely losing your language, as the result of stroke or trauma. You are aphasic, unable to speak or listen, read or write. What would your thoughts now be like? As the most extreme case, imagine having been raised without any language at all, as a wild child. What—if anything—would it be like to be such a person? Could you be *smart*; could you reminisce about the past, plan the future?

There is a common sense set of answers to these questions, one that represents the mainstream in many circles of cognitive science (see Pinker, 1994 for a lucid exposition). Under this view, the language you speak does not affect how you think. Rich, powerful and abstract cognition can take place within minds that, due to injury or deprivation, have no natural language. Even babies know about the kinds and individuals that occupy their world. They just don't know their names. Before being exposed to words in a language such as English, all humans possess the concepts that these words correspond to, as part of what Jerry Fodor (1975) calls 'mentalese' or 'a language of thought'. Under this view, as Fodor puts it, all language learning is actually *second* language learning—when a child learns the vocabulary of English, all that happens is that the child learns the mappings from the English words onto the symbols of this prior language of thought.

There is another perspective, however, one that is also rooted in common sense, and which is popular across many disciplines. Many linguists and anthropologists claim that the language one learns has a profound influence on how

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one thinks. Many developmental psychologists have been struck by the correlation between language development and cognitive development—a 12-month-old has few words and a limited mental life; a 24-month-old has many words and a much richer mental life—and see this as showing that language development has a profound influence on cognitive development. And many philosophers reject the idea that thought, or at least rich and abstract thought, can exist without language. Indeed, it is often claimed that the unique cognitive powers of our species are largely by-products of our evolved communicative abilities (see Bloom, 1998 for review and discussion). From this perspective, speakers of English think differently from speakers of Hopi, and people who have no language will inevitably have an impaired mental life.

There are many versions of the language-affects-thought claim. One version, most often associated with Whorf (1956) and Sapir (1921), is that differences between languages, such as between English and Hopi, lead to differences in thought. Another version, sometimes attributed to Vygotsky (1962), is that cognition is shaped by properties that all languages share. From this second perspective, the interesting contrast isn't between speakers of English versus speakers of Hopi; it is between speakers of *any* language versus those people or animals who have no language at all.[1]

These two views are not independent. One can sensibly claim that there exist language-general effects without believing in linguistic-specific effects—universal features of language shape human thought, but differences are irrelevant. For instance, if one were to hold the view that the acquisition of basic syntactic structure (phrases and sentences) has a profound effect on how people think about the world, this would be a language-general theory but not a language-specific theory—since all languages have this basic syntactic structure. On the other hand, it would be perverse to claim that differences between languages have an effect on thought, but to deny that there is also some more general effect of knowing a language as opposed to not knowing a language. Even putting aside the more subtle universal properties posited by linguists, nobody would doubt that all languages have words and that all languages have syntax. And it is words and syntax that are most often argued to have effects on thought.

In sum, we see three tenable positions, each of which is very much in play in the cognitive science community. One can believe in language-general effects. One can believe in both language-general effects and language-specific effects. And, of course, one can believe that neither of these effects exists.

A second sort of distinction between different theories of how language

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1   There is also the view, defended by Bickerton (1995), that it is not exposure to a natural language such as English that gives rise to cognitive effects—it is the mere possession of a language faculty. This view merits discussion, but for reasons of space, we will restrict ourselves to the more standard proposal that exposure to a natural language is a catalyst to human thought.

affects thought concerns the aspect or aspects of language that are said to matter. The most obvious cut is between words and syntax. Some scholars argue that the specific words that a language has determines how our minds break reality into different chunks; others propose that our thoughts coalesce into larger complexes through the vehicle of syntax. But this contrast is oversimplified. Morphology lies at the interface between words and syntax, and can move from the level of the word to the level of the sentence, especially when polysynthetic languages are considered. Semantics principles of compositionality, such as those involved in quantifier scope resolution, blend the boundaries between grammar and word meaning. And words themselves are a heterogeneous class—verbs, for instance, are sometimes argued to have a radically different role in influencing thought than nouns; closed class words, such as conjunctions and prepositions, are sometimes argued to have very different cognitive effects than open class words, such as nouns and verbs.

A third distinction concerns the assumed magnitude of the effect of language. Language can be seen as having mild effects on some aspects of cognition; mere icing on the mental cake. Alternatively, language can be seen as having such a massive effect that those who lack it have a profound and crippling deficit. Daniel Dennett (1996, p. 17) characterizes the strongest version of the proposal with characteristic panache: 'Perhaps the kind of mind you get when you add language to it is so different from the kind of mind you can have without language that calling them both minds is a mistake.'

A fourth distinction concerns the types of effect that language is said to have. Here the proposals are quite varied. For instance, language has been said to affect our on-line perception of the world, to shape the categories we form, to enable us to perform logical inference and causal reasoning; to underlie social reasoning, and to structure our basic ontological commitments (about time, space, matter). We will discuss many of these specific claims in what follows.

Our goal in this paper is not to provide a systematic geography of the different claims. Nor will we discuss all the major threads of theory and research; the literature is just too big to do so here.[2] We will focus instead on more general methodological and theoretical questions: How can we make real progress on the debates over what, if anything, language does to thought? What evidence is most relevant? Which versions of the language–affects-thought claim are coherent, and which are likely to be *true*?

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[2] Largely absent from our discussion will be an analysis of three interesting and provocative claims about cognitive development—the proposals that words aid in the formation of sortal concepts (Xu, 1999; Xu and Carey, 1996), that words serve to link up the output of distinct modules (Carruthers, 1996; Mithen, 1996; Spelke and Tsivkin, 2001), and that syntax leads to the emerging understanding of the mental states of other people (e.g., deVilliers and deVilliers, in press; Tager-Flusberg & Sullivan, 2000). We hope to discuss these views elsewhere.

Before getting to all this, however, we should point out that the issue here is not about whether language can have an effect on thought. Of course it can. (If it couldn't, why would you be reading this?). Nobody doubts that language can inform, convince, persuade, soothe, dismay, encourage, and so on. This is what language is *for*. It is clear that much of the content of our minds exists because of information conveyed through the medium of language. Without language there would be no quantum physics, constitutional democracy, or professional sports. As Steven Pinker (1994), one of the most ardent critics of Whorfian theories, notes: 'A common language connects the members of a community into an information-sharing network with formidable collective powers'.

The debate, as we see it, is not whether language shapes thought—it is whether language shapes thought in some way other than through the semantic information that it conveys. That is, the interesting debate is over whether *the structure of language*—syntactic, morphological, lexical, phonological, etc.—has an effect on thought. This distinction will be clearer when we consider specific cases below.

2. The Effects and Non-effects of Cross-linguistic Differences

Does the language you speak affect how you think? It is surprisingly hard to tell (see also Lucy, 1992). Suppose one was to argue, for instance, that the syntax and morphology of a language affects how speakers think about time and space. At minimum, you would have to assess the syntax and morphology of members of two different communities (is there a difference?) *and* you would have to study how these people think about time and space (is there a difference?).

This might seem obvious, but it is not always done in practice. To take a classic example, Whorf suggested that Hopi speakers, just by virtue of having learned Hopi, think about time and space in a very different way than speakers of languages such as English. English-speakers have a linear Newtonian perspective on space/time; while Hopi-speakers are natural physicists, adhering to relativistic principles. Whorf's claims about the Hopi language have not been supported (Malotki, 1983), but the concern here is more general: Whorf never actually showed that Hopi think any differently about time and space than Americans do. He just came to this conclusion on the basis of looking at their languages (Brown, 1958). This sort of circular reasoning is common in this area, and is the subject of a parody by Gregory Murphy (1996, p. 183):

> **Whorfian**: Eskimos are greatly influenced by their language in their perception of snow. For example, they have *N* words for snow [*N* varies widely—see Pullum, 1991], whereas English only has one, *snow*. Having all these different words makes them think of snow very differently than, say, Americans do.

Skeptic: How do you know they think of snow differently?
Whorfian: Look at all the words they have for it! *N* of them!

If one finds a connection between a cross-linguistic difference and a cognitive difference, one must then show a causal relation. The correlation between language and cognition might exist, for instance, because the cognitive difference causes the linguistic difference, not vice-versa. Or it might exist because of some third factor, such as some more general cultural factor that affects both language and thought. Moreover, problems in interpretation arise if the task you are using to test for a cognitive difference itself draws on linguistic performance, because then you cannot be sure that you are finding an effect of language on thought—as opposed to an effect of language on language. With all of this in mind, we can look at some specific claims that have been made.

Some claims come from outside the academy. After the French Revolution, many leaders felt that the *tu/vous* distinction encouraged thought about class and power differences and so the use of *vous* was banned and *tu* was to be used in a symmetrical way in all conversations. Robespierre would even address large groups with *tu*. After the Russian revolution, the *ty/vy* contrast was abolished for similar reasons. As Slobin notes: 'if you regularly speak a language in which you must pick a form of second-person address (you) that marks your social relationship to your interlocutor . . . you must categorize every person you talk to in terms of the relevant social dimensions'. (Slobin, 1996). A similar concern shows up in some contemporary debates over sexist language. Of course, you don't need to be a Whorfian to object to such language (you might simply find it offensive). But the more interesting complaint, for the present purposes, is that terms like 'mankind' or use of a male pronoun 'he' as a default actually shape people's ideas about males and females.

What about scientific studies? Motivated by the claims of Whorf, the first wave of such studies explored the claim that differences in color word vocabulary cause difference in color perception. English speakers, for instance, should be particularly sensitive to the distinction between blue and green because English has two words ('blue' and 'green') for the two colors; speakers of a language that describes the colors with a single word should be less sensitive to the distinction. Cross-cultural research, however, has revealed that this prediction is false—all people perceive and categorize color the same way (Berlin and Kay, 1969), presumably because all people share the same system of color vision, a system that is unaffected by language.[3]

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[3]   There are some more recent studies showing differences in color word memory as a function of language (e.g., Kay & Kempton, 1994), but these differences only arise in instances where the experimental subjects most likely perform the task by explicitly describing the colors to themselves (see Pinker, 1984). We will return to the role of language in explicit memory later in the discussion.

Alfred Bloom (1981) argued that counterfactual thought is more difficult in Chinese than languages such as English—because constructions like 'If X were to do Y, then Z would happen' have no easy translation in Chinese. To support this, Bloom did a series of studies that found that Chinese speakers did worse than Americans on counter-factual reasoning tasks, presumably because the Chinese language makes it hard for people to think about such scenarios. It turned out, however, that there were serious problems with the experimental design of these studies—and when these are fixed, the Chinese/English difference goes away (e.g., Au, 1983).

As a third example, John Lucy and Suzanne Gaskins (2001) report a series of experiments in which subjects are shown a target object and two alternatives, one of the same shape but a different material from the target, the other of a different shape but the same material. When asked which of the alternatives was most similar to the target, the dominant response by English-speaking adults is to choose the object of the same shape. Lucy and Gaskins also tested native speakers of Yucatec Maya, a classifier language, and found that these adults did not show the same-shape bias; instead, they tend to generalize to the material match. This corresponds to a linguistic difference. English describes the shape-match using the same word that describes the target, while Yucatec describes the substance-match with the same expression. (For instance, a long thin candle would usually be described in English as 'candle', a word that would be extended to other entities on the basis of shape and function. But the same candle would be described in Yucatec with a classifier plus a mass noun, an expression akin to 'one-long-thin wax', and this mass noun would be extended to other entities on the basis of substance.) As Lucy and Gaskins suggest, their findings are consistent with the view that judgments of similarity are shaped by the language one knows.

There are alternatives, however. For one thing, subjects might explicitly use their linguistic knowledge when doing the similarity task. That is, they use the strategy of naming the target object to themselves and then look towards the other objects and see which get the same name. Alternatively, the effect might be due to cultural factors independent of language; these might have to do with how people from different cultures behave when asked to make similarity judgments or how they think about simple artifacts. The reason to favor such alternatives is that Lucy and Gaskins also tested 7-year-olds on the same task, and found no difference across the two groups—*all* subjects showed a strong shape bias. Since the 7-year-olds already know either English or Yucatec, this suggests that the adult difference is not an effect of language. (One might try to argue that somehow the language effect takes time to 'sink in', but such arguments don't carry much weight in the absence of a theory of what this sinking-in is, and why it is necessary.)

The final domain we will discuss concerns some research on spatial cognition. When describing the spatial relations between objects, languages typically use multiple frames of reference and choose the frame according to

the situation. Dutch, like English, tends to use either an *intrinsic* frame that employs the spatial properties of objects in the scene (as in 'the boy is in front of the truck') or a *relative* frame based on the viewer's own position (as in 'the boy is to the left of the truck'). In contrast, there is a dialect of Tzeltal, a Mayan language spoken in the community of Tenejapa within Chiapas Mexico, that uses an *absolute* system. The Tenejapans describe objects using a three-way *intrinsic* system: *downhill* (roughly north), *uphill* (roughly south), and *across* (roughly, east and west). So the same situation that would be described by a Dutch speaker as the equivalent of 'the boy is in front of me' might be described by a Tzeltal speaker as the equivalent of 'The boy is uphill of me'. Phrases such as 'take the first right turn' are simply untranslatable into Tzeltal; there is no way for that language to express spatial notions that are entirely independent of absolute location.

Steven Levinson (1996) predicted that Dutch speakers would think about objects in close proximity in terms of relative notions like right and left while Tzeltal speakers would think about them in terms of absolute notions such as north and south. In one study, four toy animals were placed on a table in a random order—such as, in left-to-right order (and North to South order): cow, pig, horse, sheep. Subjects were asked to remember the array, were rotated 180 degrees to face another table, and were asked to recreate the array 'exactly as it was'. Dutch speakers tended to preserve relative order; they would put on the table, in left-to-right order: cow, pig, horse, sheep. The Tenejapans tended to do the opposite, putting the animals on the table, in left-to-right order, sheep, horse, pig, cow, violating relative order but preserving absolute location.

In another study, Tenejapan subjects were asked to face north, and then shown a cartoon in which there was movement from east to west (and left-to-right). The subjects were then moved to another room and asked to tell someone else about the cartoon, and their spontaneous gestures were surreptitiously observed. Unlike Dutch subjects, who imitated the relative direction of the movement (left-to-right), the Tenejapans tended to preserve the absolute east–west movement in their gestures, and so they either gestured from right-to-left or left-to-right, *depending on which direction they were facing when telling the story*.

This is methodologically impressive: We have here a difference in language and an independently assessed difference in cognition, as well as a cognitive task that does not itself directly tap linguistic knowledge. Just as with the Lucy and Gaskins studies, however, one needs to rule out the possibility that some third factor explains both the linguistic and the non-linguistic differences between members of the two cultures. It might be, for instance, that the physical environment in which the Tenejapans live encourages *both* the use of an absolute spatial system in Tzeltal *and* an absolute spatial encoding of objects, but that there is no direct effect of learning Tzeltal on the Tenejapans' spatial thought. Along these lines, Li and Gleitman (1999) have shown that simple manipulations of landmark cues can

reproduce the same sorts of shifts in spatial reference frames even within native English speakers. Nonetheless, we see this research of Levinson and his colleagues as one of the most promising attempts to explore the relationship between the linguistic difference and cognitive differences.

What have we learned from this quick and incomplete survey? We see four potential directions for further research.

1. We need to undertake large-scale multiple comparisons across many languages if we are to ever make real progress ruling out cultural confounds. Imagine how much more compelling the claims about spatial cognition would be if a dozen languages from all over the world that used the egocentric frame were contrasted with another dozen languages that use environment centered frame. If, across such a range of cultures, the same cognitive contrast emerged, it would be much more difficult to argue that the effect is due to cultural confounds, as they would essentially be factored out if a rich and variable enough set was used.
2. We need to state more clearly the different facets of language that might be relevant. A sophisticated proponent of the view that language affects thought might wish to distinguish between the potential effects of, say, lexical fields, classifier systems, word length, gender and tense markers, and anaphoric relations. A further distinction is that between implicit vs. explicit aspects of language. One is well aware that one has words for certain concepts and categories and is probably aware of differences in word length; but many aspects of grammar remain unconscious (except perhaps to trained linguists). Do explicit and implicit aspects have different kinds of effects on cognition?
3. We need to state more clearly precisely *where* in cognition we think we will find effects and why. Alfred Bloom (1981) proposes that it is very unlikely that the perceptually granted categories of color, or the ways we parse up the components of visual events, could be overridden by a specific language, but that the influence of language should be most likely in domains where perception is less relevant, like counterfactual reasoning. Is this true? Other possibilities for areas of maximal influence include: categories above the basic level, social and cultural categories, forms of logical reasoning, and reasoning patterns that have high memory loads. These factors might also intersect with facets of language listed in point 2.
4. We need to consider more carefully the differences between tasks that are language-dependent and those that are language-free. If the task itself requires that the person use inner speech, for instance, then any effect of language on performance is considerably less interesting.

3. Universal Effects of Language on Thought

It is sometimes proposed that the acquisition of a natural language—*any* natural language—gives rise to an alternative representational medium with which to

think. One way of looking at this view is that babies only have a language of thought; adults have a language of thought plus a natural language such as English. The notion of language as providing new representational capacities has been a compelling one for many years, and was perhaps best known early from the writings of Vygotsky (1962).

One key idea here is that once we have acquired a language like English we can 'talk to ourselves' in this language. The most obvious use of such inner speech would be for cognitive tasks that are themselves related to language, such as planning what to write, or imagining what someone else would say in the course of a conversation. But many scholars have argued that it plays a larger role. Peter Carruthers (1996) has suggested that certain types of thought, such as causal reasoning and social cognition, require the support of an internalized natural language. For instance, when one tries to anticipate the thoughts of others (what will Joe think if I don't cite his work?), one might do so in *English* because a language of thought is not sufficient. Similar proposals have been made by Dennett (1996) and Vygotsky (1962).

Knowledge of a natural language cannot be necessary for all causal and social reasoning, since non-linguistic creatures, such as babies and chimpanzees, have competence in these domains, and some social reasoning capacities are necessary to explain how word learning starts in the first place (see Bloom, 2000 for a review). But certain developmental phenomena may be explained by this proposal. Consider the false belief task. In one version of this task, the experimenter shows the children a Smarties container (the American equivalent to Smarties is M&Ms); and shakes the container, making a rattling noise. The children are asked, 'What is inside?' and they inevitably reply 'Smarties'. Then the container is opened and they are shown that it actually contains small pencils. They are then asked how another child who has not seen the opened container will answer when he is asked the same question: 'What is inside?' By the age of about four, children answer as do adults, saying 'Smarties'. But younger children tend to answer 'pencils', and will give the same answer even when asked what they themselves had previously thought was in the container before it was opened (Perner, Leekham and Wimmer, 1987).

The explanation for this developmental effect is a matter of some debate, and many scholars have blamed children's difficulties on task demands, not actual lack of competence (e.g. Bloom and German, 2000). But Carruthers raises the possibility that young children's poor performance is due to their failure to encode the situation into natural language (see also de Villiers and de Villiers, in press). Natural language may provide a unique medium, via propositional attitude verbs and their complements, for reasoning about false beliefs.

Evidence from adult aphasics is relevant here. Some types of aphasics show an apparent dissociation between language and thought. They give the impression of being rational people struggling to communicate. They are not

retarded or deranged, but instead act as we would act if our primary ability to communicate were stripped from us. As one would expect, they are frustrated by their problems with language, and try to compensate by communicating in other ways, such as drawing and gesture. Such cases provide an excellent opportunity to explore Carruther's claim. Varley and Siegal (2000) tested a severely aphasic man on tasks involving causal reasoning and an understanding of false beliefs (a variant of the Smarties task above). He was unable to produce or comprehend anything more than strings of isolated words, but he nonetheless did perfectly well at such tasks. This doesn't show that language is irrelevant for the understanding of these notions (after all, he had *once* had language). But it does suggest that the on-line computation of causal and intentional inferences does not require the possession of a natural language.

In other domains, however, the original inner voice proposal may have considerable merit. It seems likely, following Dehaene (1997), that the ability to reason about the larger numbers—to understand, for instance, that if you remove two objects from twenty objects, eighteen will remain—is impossible without the possession of a natural language. Without language, all that remains is the approximate accumulator mechanism that humans share with rats and other animals. In support of this view, there is evidence for a clinical dissociation between precise numerical reasoning (arguably the product of language) versus approximate numerical reasoning (arguably the product of the accumulator mechanism) (Dehaene, 1997). Indeed, more fine-grained deficits seem to emerge as a function of the kind of aphasia involved. Retrieval of multiplication facts seemed to be more impaired in Broca's aphasics while more general calculation deficits seemed to be associated with Wernicke's aphasics (Delazer *et al.*, 1999). Similarly, developmental studies of children with acquired brain lesions reveal a close relation between extent of aphasia and difficulty with mathematical calculations (Martins *et al.*, 1999).

A further potential role of language is to provide an alternative way to keep track of information. There have been a stunning series of recent studies on change blindness, the phenomenon that people are remarkably oblivious to dramatic changes in their visual world. But change blindness effects are greatly reduced for any aspects of the scene that people verbally label—if you describe the scene to yourself in natural language, you have a better ability to notice any change that might occur (Simons, 1996). This fact might well help explain developmental differences between pre-verbal and verbal children in the ability to notice changes in a variety of experimental tasks.

Along the same lines, imagine that one hides an object in one corner of a rectangular room, where a long white wall is on the right and short red one on the left. Adults have no difficulty relocating the object by using the spatial and color information, but young children use only the spatial information, not the color information. The children's problem could be for a variety of reasons, but parallel analysis of their language development suggests that they

may not be sufficiently facile at using language to code the color relation (Wang, Hermer, and Spelke, 1999). This suggestion is powerfully reinforced by blocking adult usage of language in the same task. If one asks adults to engage in a verbal task (such as counting backwards by sevens) while watching the object being hidden, there is no drop in performance in using the spatial cues, but a dramatic drop in using the color cues (Hermer–Vazquez, Spelke, and Katsnelson, 1999).

The effects of language on memory might have other implications. One of the most dramatic proposals about language concerns the riddle of infantile amnesia. It has been known for many years that all of us have a fairly continuous stream of autobiographical memories back to about 3 years of age. If we go back much younger than three our memories break up and soon evaporate altogether. Perhaps younger children are not able to embed their life experiences in narrative structures, structures that are almost impossible to imagine as existing outside of language (Fivush and Schwarzmueller, 1998). Right about when children are able to talk about their lives in a narrative way that sees them journeying along a time line is the age when their memories are likely to be recalled later on in life. This proposal as been further reinforced in cross-cultural studies where Korean children have later autobiographical memories than American Korean children do (Mullen and Yi, 1995). This difference was predicted because of different cultural practices in how parents interact with their children. Parents in traditional Korean families do not invite young children to be nearly as full participants in everyday conversations, thus delaying the build up of their children's narrative skills.

4. Words and Concepts

Suppose that language affects thought not by creating a new format for mental computation and memory, as discussed above, but by actually creating new concepts. These concepts emerge through exposure to words. Under the strongest version of this claim, children start with none of the concepts that language-using adults have. It is wrong, then, to say that first children know what a shoe is and then they learn the word for it. Instead, it is by hearing the word *shoe* that they come to know about shoes. In fact, the very notion of a solid object is sometimes argued to derive from exposure to the words and grammar of natural language (Quine, 1960). More cautiously, many developmental psychologists propose that exposure to words might serve to establish the boundaries of novel concepts (e.g. Bowerman, 1996; Gopnik and Meltzoff, 1997; Waxman and Markow, 1995). Since the lexicons of languages differ, it would follow that speakers of different languages would come to possess different concepts.

How coherent is this proposal? Consider a simple example:

> Q: How is it that people can think about time?
> A: Because we learn the language of time, words like 'was' and 'tomorrow'.

But this answer immediately raises another question: How do we learn these words? *The answer to this had better not presuppose a prior ability to think about time.* More generally, any theory positing that the understanding of X requires a grasp of the linguistic expression that conveys X has to explain how this linguistic expression can be acquired without prior understanding of X.

There are proposals of how this might happen; ways in which exposure to words can give rise to concepts that were not previously present. Imagine that someone dumped fifty small objects in front of you, of different colors and textures, and the person pointed to all of those object that were red and soft and called them 'doops'. This would cause you to view the red soft objects as falling into a distinct category, and forming the category might affect how you reason about and recall other sets of objects you encounter, even in contexts that have nothing to do with communication. In this regard, language can motivate the formation of a concept, by drawing one's attention to features that diverse entities in the world have in common.

We suspect, however, that when many psychologists make claims about effects of language, they are thinking of a more dramatic process. A child might start with a cognitive seed of a notion of time. Language then might amplify this seed into a more complex notion of time. In turn, that new cognitive structure might become stable and form a platform for further growth and elaboration by language, and so on. This sort of bootstrapping proposal is consistent with Piagetian theory, as well as more recent 'theory-theory' approaches to cognitive development (e.g. Carey, 1986; Gopnik and Meltzoff, 1997; see Keil, 1998 for discussion).

We have little to say (here) about the merits of this proposal, but we do want to insist on the distinction between the interesting claim that language induces theory change because of *linguistic structure* (e.g. the particular words it has) versus the trivial claim that language induces theory change because of the information it conveys. There is a big difference, after all, between arguing that children's developing theory of, say, the social world is shaped by the specific lexical divisions that their languages make (interesting) versus arguing that children's developing theory of the social world is shaped by what they hear people talking about (trivial).

What is the developmental evidence here? Gelman and Markman (1986, 1987) did the following sorts of studies: Children were told that a brontosaurus—described as 'a dinosaur'—has one property (cold blood) and a rhinoceros has another property (warm blood). They are then asked which property a triceratops—also described as 'a dinosaur'—has: cold blood or warm blood? They tend to infer that the triceratops has cold blood, even though it looks more like the warm-blooded rhinoceros.

Is this evidence for the power of words? It is often cited as such, but the problem here is that children might have made the very same inference even if they hadn't been given the labels. Children's assumption that the brontosaurus and the triceratops have the same sort of blood might be solely based on their knowledge that both are dinosaurs—not on the basis of the fact that they were both *called* 'dinosaurs'. There have been several subsequent studies that have attempted to pursue this issue, and the data are messy—but the overall finding seems to be that words can shape category judgements, but only when there is some *independent* evidence that the objects that get the same name belong to the same category (e.g. Davidson and Gelman, 1990; see Bloom, 2000 for review). Language is relevant to concept formation; but it is not sufficient for concept formation.

In fact, their caution about using words as a cue to conceptual structure makes sense. There is an excellent reason for children *not* to automatically assume that if two objects get the same name, they belong to the same category. This is the existence of homophones: one word can correspond to many concepts. Flying mammals and instruments for hitting baseballs are both 'bats', and so a child who had the assumption of same word = same concept would end up with a strange concept indeed. Because of this, children cannot lean too heavily on words when forming new concepts.

A less dramatic effect of words concerns processing load. This effect can be shown quite elegantly in bilinguals for whom the same concept is represented by long vs. short words in the two languages. If those words are part of a memory-intensive computational process, the lengths can have an effect. For example in children who are bilingual in Welsh and English, their ability to perform mathematical calculations in English runs far ahead of their ability to perform the same calculations in Welsh, an effect that is attributed to the much longer number words in Welsh (Ellis and Hennelly, 1980). We presume that the children understand the number concepts and operations at some central level, but actually executing those computations is closely linked to a language and its own properties.

In a somewhat analogous manner, bilingual adults who learn a new computational technique that achieves an exact answer will show a benefit primarily in the language that they learned in, but will not show a language specific effect for a new technique related to inexact estimation (Spelke and Tsivkin, 2001). This kind of result again illustrates how the effects of words can be on very distinct aspects of cognition and not others, such as on two distinct aspects of mathematical thought. But this result also illustrates that the most potent effects of cross-linguistic differences on cognition occur in domains that themselves are related to language, in this case, verbal mathematical skills.

5. Conclusion

Does language influence thought? Obviously yes; this is why we use language in the first place. Does language have a dramatic influence on thought in some

other way than through communication? Probably not. It is often proposed that the language we learn enables us to perform abstract inferences (as in the domain of theory of mind), and helps us carve the external world into distinct categories (as in the domain of object categories). Such proposals might turn out to be true, but there is considerable evidence to the contrary.

Does language have a *mild* influence on thought in some other way than through communication? It might. We have reviewed certain domains, such as mathematical reasoning, memory for scenes, and spatial navigation, where language does appear to have some effect—both the specific language that one speaks (as in mental calculation in Welsh vs. English) as well as language more generally (as with the onset of explicit memories about the past). All of these effects are controversial, and warrant further explorations, but it seems as if language does play some interesting role in how we think, above and beyond its role in communicating information.

Taken together, however, the available research does not challenge the mainstream view towards language. This is that language is a lot like vision. Language and vision are both excellent tools for the transfer of information. People who are blind find it harder to pick up certain aspects of human culture than people who can see, because they lack the same access to books, diagrams, maps, television, and so on. But this does not mean that vision makes you smart, or that explaining how vision evolves or develops is tantamount to explaining the evolution and development of abstract thought. Language may be useful in the same sense that vision is useful. It is a tool for the expression and storage of ideas. It is not a mechanism that gives rise to the capacity to generate and appreciate these ideas in the first place.

Why, then, is the idea of more dramatic changes effects of language on thought so resistant to extinction, emerging over and over again in psychology and other disciplines? We think there are two reasons for this.

First, it escapes no one that humans have a special proficiency with natural languages. Even under the most charitable interpretation, no other species shows remotely the same facility in this domain. Language is the most salient of all our faculties that differ from other animals, and this salience leads to the inference that it is the largest difference and therefore drives the other cognitive differences. But this argument does not work. We do not know that language is the largest difference between us and other species. (We are not even sure what such a claim would really amount to when considered carefully.) Moreover, even if we agree that language was the largest difference, this would in no way entail that it caused the other differences.

Second, on a subjective level, languages are extremely different from one another. A monolingual speaker of English, for instance, will hear Chinese or Turkish as gibberish—as odd and unfamiliar noise. The phenomenally alien nature of other languages might lead to the impression that there must be profound differences at deeper cognitive levels as well. English and other languages seem so massively different; surely those differences must lead to

commensurate differences in other areas of cognition. This impression is magnified by cultural differences that so often correlate with linguistic differences.

We think the intuition here is wrong in two ways: Languages do not really differ as much as people think they do. Our 'folk linguistics' is wrong in this regard. And correlation is not causation; the fact that people who speak different languages tend to belong to different cultures does not entail that language has a profound influence on thought. So although there is a strong impression that the language one speaks must influence how one thinks, we think that this impression is more seductive than it is instructive.

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