Language and Cognition

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Linguistic diversity

Humans are unique not just for having language but for using over 6,500 distinct languages. A cursory glance at these languages shows pervasive diversity at every level of linguistic structure. Only around a dozen contrastive speech sounds (phonemes) are used by speakers of Rotokas (Papua New Guinea), while speakers of !Xóõ (Botswana) use over a hundred. Like other Khoisan languages, !Xóõ is remarkable for having click sounds as part of its phonological inventory—something rarely seen in other parts of the world. But there are also languages that exist without a single speech sound. There are perhaps 300 sign languages in use today that rely on the manual modality instead.

Elementary notions expressed in the lexicon differ too. Only three basic color words are attested in Umpila (Cape York, Australia), while there are nearly a dozen in English (plus hundreds of secondary lexemes). To take another example, "drinking" (i.e., ingesting fluids) and "smoking" are conflated under a single verb, *pii*, in Punjabi (Pakistan and India); this contrasts with the verb *khaa*, for "eating" (i.e., ingesting solids). Speakers of Jahai (Malay Peninsula) do not have a generic verb for eating, however. Instead they must specify whether they *gey* (eat starchy food), *hɛ̃w* (eat leafy greens), *but* (eat ripe fruit), or *muc* (eat animal).

When it comes to combinatorics, the variation is no less striking. To indicate who did what to whom, some languages use word order (e.g., French) and others case marking (e.g., Finnish), while neither word order nor case marking will indicate the relations definitively in Riau Indonesian. Some languages put the subject of a sentence before the verb (e.g., English, Japanese), others the verb before the subject (e.g., Tagalog, in the Philippines, and Welsh), and yet others place the object before either (e.g., Hixkaryana, in Brazil). Sounds, meanings, and how they are combined vary from language to language.

Cognitive consequences

What are the consequences of this linguistic variation for cognition? According to many, nothing substantive. A founding postulate of modern-day anthropology—upheld by such venerable thinkers as Adolf Bastian, Edward B. Tylor, W. H. R. Rivers, and Claude Lévi-Strauss—is the "psychic unity" of humankind. Though many of these scholars were fervent upholders of linguistic and cultural diversity, they nevertheless subscribed to the doctrine of a universally shared mental endowment.

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The alternative view that language plays a critical role in shaping thought—and that mind, therefore, is variable between peoples—was suggested by Johann Gottfried von Herder, Wilhelm von Humboldt, and, at the turn of the twentieth century, Edward Sapir and Benjamin Lee Whorf. The resulting proposal has come to be known as the Sapir–Whorf hypothesis, or sometimes just the Whorfian hypothesis: "language affects thought." This simplified "hypothesis" is the eventual restatement and reworking of a more complex and nuanced idea that—put bluntly—holds that languages differ and thus differentially guide speakers' habitual thought and behavior. This view is ascribed to neo-Whorfians, such as John Lucy, Stephen Levinson, Dan Slobin, and Lera Boroditsky. Every element of this proposal is controversial to date. Detractors—such as Steven Pinker, Lila Gleitman, and John McWhorter—contest whether languages really vary in a substantive manner from one to another (or from a common blueprint); whether language is critical for thinking or, instead, merely reflects thinking; and whether any attested Whorfian effects are profound or important. The linguistic relativity proposal continues to be fiercely debated.

It is important to recognize that each generation recasts the issues based on their contemporary views of "language" and "thought." The modern understanding of "thinking" has changed drastically with the advent of cognitive psychology. When early scholars contemplated the role of language in thought, they debated how language shaped "worldview" or "construal of reality." Today, most researchers identify thought with "cognition"—that is, the mental processes involved in remembering, judging, problem solving, perceiving, planning, and so on. So, the question of whether language affects thought becomes a question about which linguistic structures influence which processes of remembering, perceiving, and so on. This deconstruction of thought into its component parts stands in stark contrast to the holistic interpretations articulated by Herder and Humboldt. But this finer-grained distinction also means that one can commit to relativity for some aspects of cognition but not others. Whorf himself, for example, subscribed to relativity in thinking but universality in perception. Contemporary views vary. For example, Slobin (e.g., 1996) suggests language only affects cognition in the moment of use—that is, when "thinking-for-speaking"—whereas Boroditsky (e.g., 2011) claims language has invaded cognition pervasively.

Types of linguistic relativity

To unpack the issues further, John Lucy (1996) offers a useful framework in which he proposes three levels to examine the relationship between language and cognition. So far, we have considered one type, often discussed under the rubric of "linguistic relativity." That is, does speaking one language versus another (e.g., Punjabi versus Jahai) influence the way speakers of each language think? We will come back to this below. But there are at least two other ways to quiz the relationship between language and thought: first, investigate cognition without language and, second, examine how cognition is affected by different language practices.

Semiotic relativity

Does merely having a language influence thinking? Or, put differently, what is cognition like without a language system at all? To address this question, one approach is to compare prelinguistic infants to linguistic children and adults. Studies of infant cognition show surprisingly rich conceptual structure even before the child has learned a specific language (Spelke 1994). Nevertheless, there is still a chasm between the infant and adult mind, and in this great divide it is difficult to disentangle which differences come about as the result of language learning specifically and which differences come about as the result of general learning and maturation, which in turn arise during the process of development.

Ideally, then, one would compare adults with and without language. Unfortunately, that possibility exists. Today there are still deaf individuals who have severely limited language exposure. Because of their hearing loss, some people cannot learn a spoken language, and some people born to hearing parents receive no sign-language input either. Without full access to a conventional spoken or sign language, children nevertheless invent simple gestural systems—"homesigns"—to communicate (Goldin-Meadow 2003). If sufficient numbers of deaf people are brought together, these simple gestural systems become more complex, and over generations have the full expressive potential of any natural language (Senghas 2005). The study of deaf individuals with variable linguistic input has meant it is possible to probe what specific role language plays in various aspects of cognition. This can be contrasted with attempts to examine individuals without language input that focus on "feral" or "wild" children—that is, children who have been isolated, confined, or abandoned. In such cases, the individuals have often experienced abuse and trauma, and have deprived social and physical environments too (Skuse 1984). In contrast, the deaf individuals and communities under study have not experienced such extreme deprivation. The evidence from homesigners and multigenerational creators of emerging sign languages suggests that language plays a critical role in relational reasoning for spatial cognition, numerical cognition, and theory-of-mind reasoning (e.g., Gentner et al. 2013; Pyers and Senghas 2009; Pyers et al. 2010; Spaepen et al. 2011).

Comparative studies relying on prelinguistic infants or deaf individuals study minds and brains that have evolved to accommodate natural language. Studying other species, therefore, can give us insight into what sorts of cognitive feats can be accomplished by a brain that is not language ready, since only humans have language in its full guise as a productive symbolic system. Michael Tomasello (1999) has argued that what distinguishes human cognition from other primates is the ability to understand physical causality and, perhaps more importantly, the intentions and mental states of others. Using a different sort of paradigm, some researchers have tried to teach animals simplified symbolic systems in the lab to shed light on the possible transformative effects of language. It appears that language-enculturated animals do better than language-naive animals in relational reasoning, and perhaps also in forming some types of categories and understanding others' mental states (Kuczaj and Hendry 2003).

Functional relativity

Language usage differs within communities (e.g., dialects) and across contexts (e.g., registers). So, one can ask how different usage patterns affect cognition. One locus that has attracted considerable research interest is how literacy or schooling might influence cognition. The transformative effect of literacy on modern culture is undeniable—it is inconceivable that humans would have landed on the moon or invented the internet without it. But whether reading and writing have similar transformative effects on cognition is a separate matter. At the turn of the twentieth century, Lucien Lévy-Bruhl ([1910] 1985) argued that nonliterate thought patterns differed substantially from literate thought patterns, but experimental data addressing the matter did not come until later. In the 1930s, Alexander Luria studied illiterate men and women from Uzbekistan and Kirghizia in Central Asia and found a number of aspects of cognition differed between illiterate and literate people. For example, illiterate individuals did not classify colors into groups (e.g., red, green) when asked to, but rather organized them continuously according to hue or saturation. Similarly, when shown drawings of a hammer, saw, hatchet, and log, people did not choose a categorical match (e.g., where "log" is the odd one out) but rather looked for functional relations between entities (e.g., "hammer" is the odd one out because it alone cannot be used to split the log). In addition to these differences in categorization, Luria (1976) noted similar differences between literates and illiterates in reasoning, problem solving, imagination, and construals of self.

These early studies have been critiqued on numerous grounds (Huettig and Mishra 2014), but the possible effects of literacy on cognition continue to be studied today. For example, literacy appears to shape verbal memory. Anthropologists have long remarked on the incredible feats of memory among peoples without a tradition of writing, for whom elaborate stories and songs survive through generations. This suggests nonliterate people may, in fact, have superior memorization abilities. Perhaps off-loading memories onto external devices (such as paper or mobile phones) weakens memory among literates. But the evidence suggests otherwise. Literacy improves short-term verbal memory—in standardized tasks at least. Illiterate people perform worse in experiments testing immediate serial recall of pictures and digit span. In a digit-span test, people see or hear a sequence of letters or numbers and have to recall the sequence. Individuals are tested with successively longer sequences with the longest number of sequential digits remembered accurately indicating the person's working memory span. Literacy appears to extend verbal working memory (Demoulin and Kolinsky 2016).

At the same time, literacy exerts a cost on aspects of cognition too. Reading is recent in human history, and therefore it is implemented in a brain not specifically evolved for its execution. Instead, reading recruits brain areas that were specialized for other functions. For example, brain areas dedicated to face recognition are partly co-opted to distinguish fine-grain differences in letter forms (Dehaene et al. 2010). Consequently, face processing differs, such that illiterate people are more likely to process faces holistically than literates (Ventura et al. 2013). Further insights in how literacy shapes cognition come from comparative studies of different literacy practices. Writing and reading seem to entrain cognition into certain grooves such that English and Arabic speakers, for example, come to use space in different ways to think about nonspatial entities. The directionality of writing becomes a default cognitive template. So, while English-speakers organize temporal sequences from left to right, Arabic-speakers organize them from right to left instead (Tversky, Kugelmass, and Winter 1991). Similar differences in visual attention accompanying different writing systems have been observed in other studies (Huettig and Mishra 2014).

Linguistic relativity

Finally, we come back to the question of whether the language people speak affects the way they think. In principle, for every element of linguistic variation, one could ask the concomitant question of its consequences for cognition. For example, do speakers of a language with tone have better musical cognition? Are speakers of a language with a fully fledged smell lexicon better at remembering and reasoning with odors? Does recursion in grammar facilitate higher-order theory-of-mind reasoning? In practice, not all aspects of language have been researched for their possible cognitive consequences in equal depth.

There are broadly two approaches to addressing questions of linguistic relativity: structure centered and domain centered (Lucy 1992b). A structure-centered approach begins from language: it characterizes grammatical structures relevant for reference (e.g., gender, number, aspect) and then asks whether there follow any cognitive consequences of attested linguistic differences. Lucy (1992a) has famously used this approach in an extended case study of Yucatec and English. He has shown that, while English-speakers obligatorily indicate plurality for a wide array of nouns, Yucatec-speakers optionally indicate plurality for a subset of nouns instead. Moreover, English-speakers can enumerate entities by using a numeral to directly modify the accompanying noun (e.g., "two bananas"), but Yucatec-speakers have to use a different construction involving a numeral classifier (e.g., "two one-DIMENSIONAL banana," in which the classifier is glossed in small capitals). Lucy argues that this is because the Yucatec noun refers to the material or substance (i.e., Yucatec *há'as* means "banana stuff") and the numeral classifier provides the shape or form. This linguistic difference has cognitive consequences. Whereas English-speakers attend more to the shape of objects, Yucatec-speakers pay more attention to material substance. Along these lines, researchers have explored the possible cognitive consequences of grammatical gender, tense, aspect, and so on.

Although not in the purview of the structure-centered approach as advocated by Lucy, one could include here other investigations of linguistic relativity that examine differential linguistic structures and their possible cognitive effects. For example, the different phonological systems of Cantonese and English appear to influence speakers' nonlinguistic auditory cognition. Cantonese-speakers—whose language has lexical tone—have better pitch discrimination and melody perception than English-speakers (Bidelman, Hutka, and Moreno 2013). This phonological difference has no referential import, and yet there is a clear associated difference in cognition.

The second approach—the domain-centered approach—begins with an arena of experience (e.g., color, space, motion) and then asks how languages categorize that domain. Where languages differ in their partitions, one can investigate possible effects on cognition. This approach has been more prolific, resulting in hundreds of publications.

Studies show speakers' memory and perceptual discrimination follow along language lines (Regier and Kay 2009). Color is perceptually continuous, but language partitions this continuum into discrete categories. In addition, people are faster and more accurate at discriminating two colors that cross a lexical boundary (e.g., a shade of green and blue) than two colors from the same category (e.g., two shades of blue). Critically, languages differ in which categorizes are lexicalized. For example, around a third of the world's languages do not make a distinction between "blue" and "green" but have a single "grue" category. Speakers of such languages differ in their memory and perceptual judgments of colors consistent with the lexical patterns in their language (e.g., Roberson et al. 2005). Similarly, different frames of reference used to describe the relationship between objects in small-scale space affect how people remember and reason about objects in space (Majid et al. 2004), including their own body (Haun and Rapold 2009).

This brief summary may suggest a consensus that is not, in fact, there—as alluded to earlier. Although there is considerable evidence for language affecting thought, for every positive demonstration, there are failures to find effects too. This has led to a closer examination of the conditions under which we should and should not expect language to influence cognition. Various schemes for typologizing the effects have been proposed, and more efforts to synthesize across structures and domains are emerging (see Evans and Levinson 2009; Gentner and Goldin-Meadow 2003; Gumperz and Levinson 1996; Lucy 1992b; Malt and Wolff 2010).

The reciprocal relationships between language and cognition

If cognition varies across languages as suggested here, then the obvious question to ask is what causes what. Moreover, how both language and cognition are related to culture is unclear. Various causal scenarios can be entertained. One possibility would be that differing cultural practices express themselves in differing language uses, which then impact cognition. Alternatively, different linguistic structures may lend themselves to certain cultural constructs, which are then reflected in cognition. Or perhaps cognition varies between peoples and this in turn shapes both culture and language.

Language, culture, and cognition—in their usual circumstances—support each other such that these different scenarios are difficult to disentangle. Experimental studies can shed light on some issues. For example, laboratory studies show that even brief training with a new linguistic structure can change nonlinguistic cognition (e.g., Dolscheid et al. 2013), indicating language is causal in shaping cognitive processes. Another possibility would be to conduct a close comparison of communities where aspects of language and culture are dissociated. This would provide an ideal testbed for examining certain causal scenarios. Ultimately, then, we need an account of when and how language, culture, and cognition scaffold each other.

SEE ALSO: Africa, Language Research in; Biocultural Diversity; Brain and Culture; Cognition, Causal; Cognition and Communication; Cognition and Emotion; Cognitive Development; Consciousness; Cultural Relativism; Endangered Cultures and Languages, Documentation of; Ethnobiology; Ethnomathematics and Numerical Cognition; Indigenous Theory; Interaction; Language and Anthropology; Language and Identity; Lévy-Bruhl, Lucien (1857–1939); Linguistics, Anthropological; Literacy; Literacy Practices across Cultures and Sectors; Oral Cultures; Primate Intentional Communication; Relevance; Sapir, Edward (1884–1939); Stylistics

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