Culture, Language, and Thought

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Summary:
The relations among language, culture, and thought are complex. The empirical evidence from diverse domains suggests that culture affects language, language affects thought, and universally shared perception and cognition constrain the structure of language. Although neither language nor culture determines thought, both seem to highlight certain aspects of the world, with stronger influence when there are no clear perceptible categories. Research must delve into how language, culture, perception, and cognition interact with one another across different domains.

Keywords: language and thought, Whorfian hypothesis, language, culture, cognition, psycholinguistics, developmental psychology, cultural psychology

Overarching Questions

Language divides the continuous world and human experiences into discrete categories. These linguistic categories, created both by words and by grammar, are diverse across different languages. A number of important questions arise here. To what extent are linguistic categories common for different languages of the world, despite their apparent diversity? Are there factors that constrain the linguistic division of the world?

We can also flip the question and ask: To what degree is thought shaped by language? This question has often been labeled as "the Whorfian hypothesis," named after the American linguist Benjamin Lee Whorf. According to Whorf, language determines, or at least influences, thought, and researchers investigating this thesis ask whether speakers of different languages think differently, particularly in perceptual and cognitive activities that do not seem to recruit language. In addition, the Whorfian hypothesis has been investigated in light of whether and how language may change children's "thought."

One might also wish to learn the relation between language and thought not only at the level of individuals but also at the level of culture. The relations among language, culture, and thought can be investigated in various ways. We may ask, for example: To what extent does language reflect a particular value or worldview of the culture within which the given language is spoken? Does culture affect the collective thought of people without the mediation of language? Are there cases in which the influence of culture and influence of language are independent of, or in conflict with, each other?

Introduction

When we think about how language or culture influences thought, we generally consider how differences in language and culture lead to differences in thought. However, the relations among culture, language, and thought can also be considered from the other direction, in terms of how the structure of "language" (as a collective noun referring to all languages) is constrained by our universally shared perception or conceptualization. In this article, we explore the relations among culture, language, and thought not only in the former, typical approach but also from the latter angle.

The first section explores language in relation to thought and culture by asking to what degree language is structured or constrained by the universal "thought" as well as cultures across the globe. The second section discusses the relation from the other direction—whether language shapes thought, based on both cross-linguistic and developmental approaches.

The final section briefly discusses how culture might affect thought, reviewing the literature of cognitive anthropology, cognitive psychology, and cultural psychology. This exploration also discusses the question of whether it is language or culture that affects thought more prominently. Before starting our exploration, however, we should first specify how "language," "culture," and "thought" are defined in this article.

What Is Language?

The term "language" has been used to denote a broad range of meanings in the language and thought debate. Any feature of language, such as phonetic, lexical, and grammatical characteristics, can be a topic of investigation pertaining to the relation between language and thought. However, researchers who investigate the Whorfian hypothesis within the tradition of cognitive psychology or psycholinguistics generally focus on the influence of lexical or grammatical categories on perception, categorization, and knowledge representation (Gentner & Goldin-Meadow, 2003; Gumperz & Levinson, 1996; Malt & Wolff, 2010, for state-of-art reviews).

In contrast, researchers of cultural psychology would consider culturally unique

epistemologies and discourses as a higher level of linguistic phenomena (Chiu, Hsieh, Kao, & Lee, 2007; Dehghani et al., 2013; Imai & Masuda, 2013; Kashima, 2009; Kashima, Peters, & Whelan, 2008; Kitayama, Markus, Matsumoto, & Norasakkunkit, 1997). Here, "language" is treated as a collection of narratives that reflect culture-specific value systems and epistemologies, and it is often discussed at the level of discourse (Ambady, Koo, Lee, & Rosenthal, 1996; Chiu, Leung, & Kwan, 2010; Masuda & Yamagishi, 2010; Miller, Fung, & Koven, 2010; Senzaki, Masuda, & Ishii, 2014).

What Is Culture?

The influence of "culture" on language has also been approached differently by cognitive psychologists, cognitive anthropologists, and cultural psychologists. Although there is no well- known, shared definition of culture in cognitive psychology, cognitive psychologists of language and thought research generally discuss specific features of cultural communities such as living situation (e.g., rural vs. urban) and ecological contexts and subsistence (e.g., farming vs. hunter-gathering; Majid, Bowerman, Kita, Haun, & Levinson, 2004). Cognitive anthropology may consider more features because culture is a large pool of information, or "programs," about any actions and understandings that are passed along from generation to generation (D'Andrade, 1981).

In contrast, cultural psychologists within the tradition of social psychology treat culture as the intersubjective reality rather than the external, ecological context (Geertz, 1973; Miller, 1999). Cultural psychologists for the past three decades have developed theoretical frameworks to characterize people in light of core meaning systems shared in each society. One prominent theoretical point is that people in different cultures have different ways of viewing the world, and each worldview is substantiated in the ways they categorize themselves, others, objects, and the world (Masuda, 2017; see Masuda, Li, Russell, & Lee, 2019, for review). A well- accepted theory contrasts two social orientation models: an independent social orientation and an interdependent social orientation. Those who live in a culture where independent social orientation is dominant tend to view themselves as independent of other social members and hold cognitive styles that emphasize self-direction, autonomy, and self- expression. In contrast, those who live in a culture where interdependent social orientation is dominant tend to view themselves as socially embedded within a web of dense relationships among social members; they hold cognitive styles that emphasize harmony, relatedness, and connection (Kitayama & Uskul, 2011; Kitayama, Varnum, & Salvador, 2019; Markus & Kitayama, 1991, 2010; Miyamoto, 2013; Nisbett, 2003; Varnum, Grossmann, Kitayama, & Nisbett, 2010). We will explore how these different ways of viewing "culture" are reflected in language use and narrative construction, and how language and culture together or separately affect thought in the section "How Do Culture and Language Affect Thought?"

What Is Thought?

As in the cases of language and culture, there is no single answer to the question of what "thought" is. Researchers often use the term "thought" to refer to conceptual representation, but they also use the term to mean a wide range of functions, such as perception, reasoning, and learning. Various measures have been used to index "thought," including category making, similarity judgments, and response latency. Recently, neurophysiological data have been used in cognitive psychology to unravel subtle differences in "thought" that cannot be detected behaviorally (e.g., Thierry, Athanasopoulos, Wiggett, Dering, & Kuipers, 2009). Cultural psychologists have also begun to employ methodologies commonly used in cognitive psychology and neuroscience (Chee, Zheng, Goh, Park, &

Sutton, 2011; Goto, Ando, Huang, Yee, & Lewis, 2010; Han, Northoff, Vogeley, Waxler, Kitayama, & Varnum, 2013; Na & Kitayama, 2011).

Influence of Thought and Culture on Language

Influence of Perception on the Lexicon

Are there forces that structure the lexicon across culturally unrelated languages? Previous research in cognitive anthropology and psychology suggests that, although superordinate- category labels vary across cultures, the lexical structures of the basic-level labels for natural kind objects are strikingly consistent across widely different environments and living styles, from people living in indigenous cultures without much modern technology to people living in urban, industrialized environments (Malt, 1995; Rosch, 1978; Rosch, Mervis, Gray, Jonson, & Boyes-Braem, 1976). There seem to be constraints on labeling natural objects, reflecting perceptual or conceptual gaps that are detectable to everyone regardless of living environment or other culture experiences (Berlin, 1992; Hunn, 1975; Medin, Lynch, Coley, & Atran, 1997; see Malt, 1995, for a review).

The naming of colors is another good example as it appears to differ vastly across languages. Whereas the Dani language in Papa New Guinea does not have specific terms to refer to hues (except the terms vaguely refer to "dark/black" and "light/white"), Russian has 12 basic color terms (e.g., Berlin & Kay, 1969). Even in such diverse domains, cross-cultural consistency has been observed. Berlin and Kay (1969) argued that the naming of colors follows a systematic pattern in which the number of color terms predicts which specific hues receive labels. For example, all languages with only two color terms have "black" and "white" and all languages with three color terms additionally label "red." More recently, following the proposal by Jameson and D'Andrade (1997), Regier, Kay, and Khetarpal (2007) analyzed the color-naming data by speakers of 110 different languages, and reported that the assignment of color categories maximizes perceived similarity within categories while minimizing similarity across categories. Although there is room for a linguistic convention to modify the assignment, the color-naming pattern seems to follow a perceptually optimal partitioning of color space at least to some degree.

Culture-independent constraints may be found in the verb lexicon as well. The domain of human locomotion can provide such insights. Languages differ in how they divide the walking- running continuum by applying different verbs for the running or walking motions done in different speed. Barbara Malt and colleagues (Malt et al., 2008) had adult speakers of English, Spanish, Dutch, and Japanese produce words to describe 24 locomotive actions that differed in speed. The Dutch speakers distinguished the motions using up to seven (monolexemic) verbs, whereas the Japanese speakers produced only two verbs to describe the same spectrum. The Spanish and English speakers were in the middle, distinguishing the motions with three and four verbs, respectively. Thus, the four languages differ in how finely they divide the continuum of locomotion. Strikingly, however, speakers of all four languages agreed on the transition point from walking to running: English, Spanish, and Dutch speakers changed from one verb to another at the same point that Japanese speakers shifted from *aruku* (to walk) to *hashiru* (to run). There appeared to be a salient perceptual gap along the continuously changing motion, and all (or most) languages would respond to this gap in their linguistic categories. However, such strong constraints are not abundant in the lexicon. When the team led by Malt conducted another study with a broader range of natural locomotion that differed not only in speed but also in *manner* (e.g., marching, skipping; Malt et al., 2014), there was no strong common pattern across the four languages in the ways they were lexicalized.

The actions denoted by "carrying" and "holding" in English are another example of cross- linguistic differences in the labeling of actions. English does not seem to care about how the object is held by an actor, putting all actions of supporting an object by the hands or other parts of the body (e.g., shoulder, head) in one lexical category, distinguishing actions only in light of whether the actor is moving (carrying) or not (holding). Although moving and nonmoving is a salient perceptual contrast, this perceptual gap does not always play a role in the lexicalization patterns in many languages. For example, languages like Chinese, Japanese, and Korean divide this domain much more finely by the manner of hand shape or by the body part that supports the object (Saji et al., 2011; Saji & Imai, 2013), while ignoring the movement. Likewise, in the domain of clothing verbs, English strictly distinguishes actions of putting things on the body and the state of wearing things, but the verb system in many languages does not use this feature.

Thus, although the biophysical distinction between walking and running may invite a fairly strong lexical distinction which a great majority of languages in the world would follow (Malt et al., 2008), it is generally difficult to foresee what perceptual features are codified into the lexicon for lexical distinction. Nevertheless, the idea of typological tendencies has been suggested by many researchers (Goddard, 2001; Goddard & Wierzbicka, 2014; Greenberg, Ferguson, & Moravcsik, 1978; Talmy, 2000, Von Fintel & Matthewson, 2008; Wierzbicka, 1996; Zaefferer, 1991).

Another important angle from which to consider the relation between perception and language is to compare perceptual accessibility and lexical codability. It has been noted that humans rely on vision, audition, and motion perception more strongly than other modalities such as haptic, olfactory, or gustatory perception. Hence researchers (in the WIERD—Western, Industrial, Educated, Rich and Domestic—culture) have assumed that experience of visual perception is more dominant in language than that of touch, smell, or taste. Words denoting odor as a primary sense are particularly sparse in many languages in Western cultures, and olfactory sensation is expressed only via metaphorical extension of sensation in another modality (e.g., taste or tactile words such as sweet, soft) or as a simile of the source object (e.g., like the smell of pear).

Majid and colleagues challenged this view. They pointed out that once languages outside of Western or Westernized society are considered, there are languages, such as Jahai (Majid & Brurenhult, 2014) and Maniq (Wnuk & Majid, 2014), that have an extensive lexicon of olfaction, where the sense of smell is lexicalized in abstract categories, without alluding to the source object. Furthermore, Majid and Kruspe (2018) demonstrated that only hunter- gatherers show ease in naming odor, suggesting that subsistence is the most likely factor to contribute to the ease of access to odor labels. It is important for future research to examine how lexicon of different perceptual modules besides visual modality is constrained, and in so doing, researchers need to move beyond languages spoken in Western or Westernized cultures.

Influence of Culture on Lexical Categories

The lexicon of a language seems to contain items that reflect a culture's value systems: Finer lexical distinctions tend to be made for things that are important to the culture. The Japanese language has three different linguistic categories about rice: "*kome* (rice grain)," "*ine* (rice crops)," and "*gohan* (cooked rice)." A single species of Japanese fish is named differently depending on maturity: "*mojako* (baby amberjack)," "*hamachi* (young amberjack)" and "*buri* (fully mature amberjack)." Turkish makes a similar distinction among bluefish at different levels of maturity, while English distinguishes between sheep and lamb. The Chinese language makes very fine distinctions for kinship terms. In Mongolian, although there are many names for animals such as horse, sheep, cow, camel, and goat, the words

regarding fish are limited. Further, Native American languages tend to have much more sophisticated lists of vocabularies about trees (e.g., Medin, Ojalehto, Waxman, & Bang, 2015). Majid and Kruspe (2018) suggests that the presence of an elaborate lexicon of odor is linked to cultural importance—here, both in light of subsistence and traditional values and beliefs rooted in mythologies.

From a cultural psychology approach, if a society values an interdependent social style, discourse may be less agent-oriented, specifying the agent of the sentence and blurring the boundary between speakers and listeners. Conversely, if the society values an independent social style, discourse may be more agent-oriented, clearly identifying who did what. One linguistic characteristic that reflects this cultural difference may be the dropping of pronouns that specify agents in the scenes described. Kashima and Kashima (1998) investigated the relationship between the level of individualism and the pragmatic leniency of the pronoun drop across 29 languages and found that the more a language community values an individualistic social style, the less it allows the omission of pronouns (see also Fausey & Boroditsky, 2010; Kanero, Hirsh-Pasek, & Golinkoff, 2016; Fausey & Boroditsky, 2011).

There is a strong possibility that the mutual constructions of such discourses through conversation in the long run affect both pragmatics and syntax. Mutual dependence between culture and language may also be reflected in honorific systems. East Asian languages such as Korean, Japanese, and Chinese are more likely than English to use a variety of honorific forms in vocabulary, syntactic structures, and discourse structures. However, within Western languages, some languages such as French and German make lexical distinction in referring to the second person ("you"), based on formality or distance in the relations. Furthermore, English once had this distinction, but it has been lost over time. Considering this, the simple theoretical framework contrasting Western and East Asian culture is likely to be insufficient to explain the distribution of honorific systems in world languages. But it is still worth investigating the relation between culture and honorific language in terms of the honorific system as a whole—that is, how elaborately and extensively formality and social distance are reflected beyond the distinctions of the second person reference (e.g., the lexical choices of verbs such that the same action is expressed by different words depending on the social rank of the actor).

Influence of Perception, Conceptualization, and Culture on Language: The Case of Nominal Classification Systems

Language categorizes the world not only by words but also by the grammar. Exploration of how language classifies the entities in the world through grammar provides insights into how language is constrained by perception or conceptualization that are shared by all humans and how divergence of linguistic classification may arise due to culture.

Numeral classifier systems are found across unrelated language families from geographically diverse regions. Classifiers are used when a given noun appears with a numeral (i.e., enumerated). For example, in Japanese, the classifier *ko* takes three-dimensional objects (e.g., ball) and *hon* is used for one-dimensionally extended (long and thin) items (e.g., stick, home run). The classifier *tou* is used for big or important animals such as lions and cows, and *hiki* is for small animals like rabbits and insects. The English phrase "five oxen" is translated as "*go tou no usi* (5 classifier GEN cattle)" in Japanese, in which the classifier *tou* functions as a unit of quantification roughly equivalent to the English quantifier "head". A literal translation of "five oxen" is not possible in Japanese, but the closest translation would be "five heads of cattle" (Quine, 1969).

The classifier systems consist of a large number of semantically formed grammatical categories, often more than 100 (Adams & Conklin, 1973; Aikhenvald, 2000; Craig, 1986; Grinevald, 2000; Senft, 2000). Yet the semantic features underlying the system are fairly

consistent, including animacy, size, shape, dimensionality, functionality, and rigidity (Allan, 1977; Croft, 1994). This indicates that there are certain features in the world that are salient or important to humans, regardless of environment or culture, and that these features organize the grammatical classification of nouns.

However, even though nominal classification systems may be organized based on universal semantic features, the actual implementation of categories differs greatly across cultures. For example, although Japanese and Chinese both employ animacy and shape dimensionality in their classifier systems, Japanese follows the animate-inanimate dimension much more strictly than Chinese; snakes are in the "small animal" category in Japanese and "long and flexible" category in Chinese (Saalbach & Imai, 2012). Thus, even though languages may employ similar nominal classification systems that are organized by shared semantic systems, resulting categories can be very different, in terms of which nouns are included in a specific grammatical category. It is not clear to what extent the decision of category membership— e.g., whether "table" should be included in the "flat things" category or the "mechanical things" category—is influenced by culture-specific construal of things.

In considering the extent to which universally natural conceptualization governs grammatical classifications of nouns, it is interesting to see whether the distinction concerning countability, an important conceptual distinction in English and other related languages, is reflected in numeral classifier systems. The concept of countability has been considered critical for organizing human concepts, and hence it has been called an "ontological concept" (Quine, 1960, 1969). This distinction is grammatically marked in many languages (Fedden & Corbett, 2018). Because classifiers are required for all nouns, it has been long assumed that classifier languages do not mark countability by grammar and treat all nouns as mass nouns (e.g., Chierchia, 1998; Lucy, 1992; Quine, 1969). However, some theorists have proposed that classifier languages do distinguish count nouns and mass nouns through the selection of classifiers (Cheng & Sybesma, 1998, 1999; Yi, 2009, 2010; Zhang, 2007, 2013). They argue that nouns denoting nonindividuated things (i.e., mass nouns) are quantified by mass classifiers, analogous to quantifiers in English that specify the unit of quantification. In contrast, nouns denoting countable things (i.e., count nouns) accompany different kinds of classifiers (i.e., count classifiers), which classify nouns by their semantic type, as described earlier. Thus, the countability of nouns may be a good example of a universal factor that is reflected in nominal classification systems in grammar (e.g., Fedden & Corbett, 2018).

Besides countability (i.e., the distinction between count/mass), gender is one of the dominant semantic criteria for noun classification (Corbett, 1991). Here again, many languages spoken in geographically and culturally distant regions employ gender marking systems. Furthermore, many of them employ countability and gender simultaneously in their noun classification systems (e.g., Fedden & Corbett, 2018). It seems that countability and gender are salient and critical conceptual distinctions in organizing noun concepts regardless of culture. However, as is the case with numeral classifier categories, the ways in which each language implements the gender marking grammatical system are diverse across languages. Many languages have more than two gender classes, adding extra semantic classes: some languages additionally have the neutral class (i.e., neither female or male); other languages create their own classes that appear exotic and incomprehensible to nonspeakers. For example, Ngam'gityemerri, an Austlarian language, has 15 gender classes, including male, female, canine, animal, vegetable, tree/thing, as well as semantically very specific genders for long woomeras, canegrass spears, and digging sticks (Fedden & Corbett, 2018, originally reported in Reid, 1997, p. 165). Some of these semantic classes seem deeply rooted in the culture's mythology and tradition, but it is difficult to draw generalizations about how culture

contributes to the formation of language-specific gender grammar systems (Fedden & Corbett, 2018).

Summary and Synthesis: Does Language or Culture Affect the Structure of Language?

This article has considered how thought—both perception and conceptualization—and culture might affect the structure of language, addressing whether it was culture or language that contributes to the diversity in how language codifies perceptual or conceptual information, and whether there is universally encoded information despite the great diversity. Languages carve up the world differently, both lexically and grammatically. Constraints on linguistic structure exist in many lexical or grammatical domains (e.g., the conceptual distinction between walking and running or semantic distinctions that are encoded in nominal classification systems), pulling unrelated languages toward loosely principled ways of dividing the world (Malt et al., 2008). These commonalities seem to arise not only from perception but also from natural conceptualization shared by all humans, as is the case with countability and gender.

There does not seem to be a simple or general rule about how languages divide the world into discrete lexical and grammatical categories and which universal perceptional or conceptual features are codified into a specific language. However, in some domains with a relatively small semantic space, such as the continuum from walking to running, language may be more likely to encode natural boundaries all humans perceive (Malt et al., 2008). Also, as per grammatical categories, although there are universal features such as countability, gender, shape, and animacy that are commonly coded in grammatical categories classifying nouns, cultural factors such as culture-specific value systems and mythology also add semantic classes and contribute to determining category membership. Perhaps the most reasonable conclusion is that perception, universally shared natural conceptualization, and culture affect each other in a complex manner for the structure of the lexicon and grammatical classes.

Influence of Language and Culture on Thought

The Whorfian Hypothesis: Stronger Versions

We now explore the relation between language and thought from the other end—that is, whether and how language might affect thought. As noted, the relation between language and thought has typically been investigated with respect to the Whorfian hypothesis (Whorf, 1956), which was traditionally interpreted as the question of whether language influences perception and cognition to the degree that speakers of different languages have incommensurably different conceptual representations and cognitive styles (e.g., Gleitman & Papafragou, 2013; Pinker, 1994).

There has been a long-lasting disagreement on whether the Whorfian hypothesis can be supported. Some researchers, especially those who advocate that universally shared modularized cognitive functions are behind language, strongly deny the Whorfian view and argue that any effect that seems to show differences in cognition is ephemeral and peripheral to human cognition (e.g., Gleitman & Papafragou, 2013; Pinker, 1994). However, recent research in cognitive psychology, psycholinguistics, and cognitive anthropology have accumulated evidence for the influence of language on thought in many different ways. In some domains, the influence seems fairly strong, and in other domains, it is more nuanced.

Fairly strong support for the Whorfian hypothesis has been reported in the conceptualization of space (Levinson, 1996, 2003) and numbers (Gordon, 2004). Languages use different frames of reference (FoR) in describing spatial relations—the relative FoR and the absolute FoR. The relative FoR uses terms such as front/back/left/right, thereby the position

of the target object is described in light of a relative perspective from the speaker or the hearer in a given context. The absolute FoR determines the position of the target object using geographically absolute terms such as north/south/west/east. English and many other languages use both FoR systems, but the relative frame is more dominant. Several languages rely on the absolute
FoR and do not have relative terms such as front/back/left/right. They also use the absolute FoR when describing the relative location of a small object on a table (Levinson, 2003; Pederson et al., 1998). For example, Guugu Ymidirr, an Australian Aboriginal language described the picture in Fig. 1 as follows: "There are two girls. One's nose points to the east and the other to the south. There is a tree in the middle." (cf. Haviland, 1993, 1998)

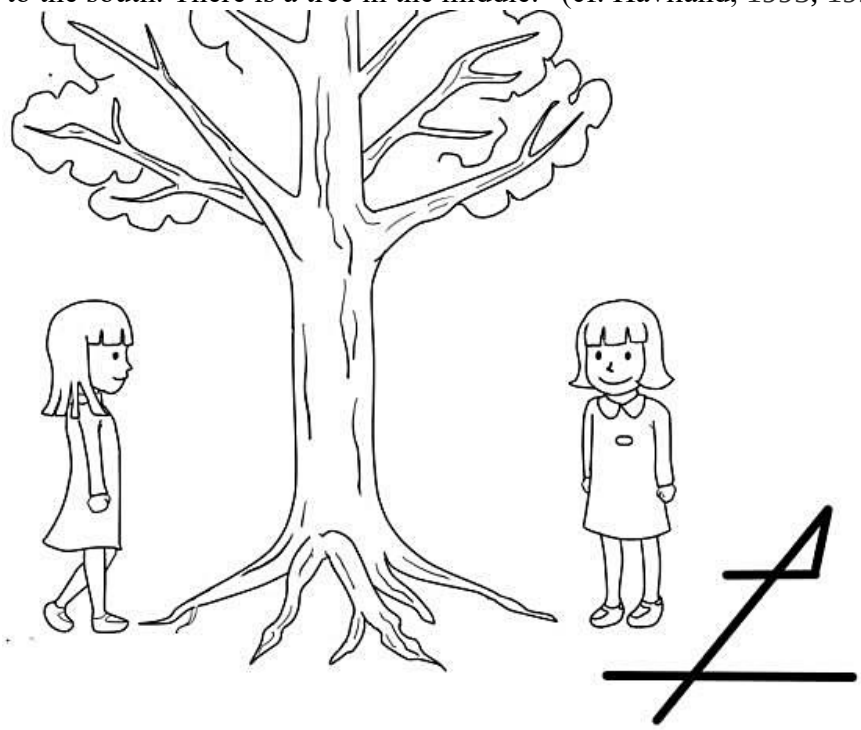

Figure 1. Picture book for description of the spatial relation of the two girls. From Levinson (2003, Fig. 4.2; also see Haviland, 1993, 1998).

Does the constant use of absolute FoR improve the ability of speakers to keep track of the absolute direction? Levinson (1997, 2003) compared dead reckoning abilities in speakers of languages using absolute FoR and speakers of Dutch, who dominantly use the relative FoR. The participants were taken to a distant, unfamiliar location away from home, and were asked to point to the direction of their home. The speakers of languages using the absolute FoR were much more accurate than speakers of Dutch, including experts in orienteering competitions (but see Li & Gleitman, 2002, and Li, Abarbanell, Gelitman, & Papafragou, 2011, for a view against this; see also Levinson, Kita, Haun, & Rasch, 2002).

A similar pattern of results has been found for the domain of numbers. Pirahã, a language in
Amazonia, does not have number words. The language seems to vaguely distinguish "one" and "two." Any number larger than two is expressed as "large quantity" or "much." Even the distinction between "one" and "two" is not applied consistently, so the word may mean "small quantity" or "little," in an English sense (Frank, Everett, Fedorenko, & Gibson, 2008; Gordon, 2004).

Do speakers without number words think differently about numbers than those who have an elaborate number word system in their lexicon? Gordon (2004) addressed this via a

simple experiment with adult speakers of Pirahã. The researchers tapped Pirahã speakers on the shoulder and asked them to tap back the same number of taps. The Pirahã speakers' tapping behavior was inaccurate and inconsistent: when tapped three times, they would tap back twice, three times, four times, five times, and so on. Just as continuously describing spatial relations with the absolute direction may change speakers' dead-reckoning ability, the presence or absence of number words may change speakers' number concepts.

These findings may be taken as strong support for the Whorfian hypothesis, in that lexical systems strongly change cognitive ability or concepts that are fundamental to human cognition, such as spatial cognition or number concepts.

The Whorfian Hypothesis: Weaker Versions

Differences in pattern of lexicalization across languages do not always produce a dramatic consequence as in the domain of space and number. It is not that no effect has been found, but that the effect seems to be more nuanced. One such example is the domain of color.

The domain of color was brought to researchers' attention in evaluating the Whorfian hypothesis. As mentioned in the introduction, some languages such as Dani distinguish only two colors, lacking all corresponding English color terms. If a strong version of the Whorfian hypothesis holds true, speakers of the Dani would not be able to distinguish colors as do English speakers. However, a series of experiments by Rosch (1973) rejected this possibility (see also, Heider, 1971). Rosch tested Dani children and adults and demonstrated that Dani people were not only able to distinguish "different" colors in the English sense but also to distinguish focal colors, which are a shade of colors that are considered as the best example of a given color category, against non-focal colors: The participants were able to remember focal colors better than nonfocal colors in a memory task and were able to learn new labels attached to focal colors better than nonfocal colors. These results were taken as strong evidence against the Whorfian hypothesis at that time.

However, a plethora of research thereafter showed the effect of language on color perception in more nuanced ways. In their classic study, Kay and Kempton (1984) presented speakers of English and of Tarahumara, a language spoken in a community in Northern Mexico, with a triad of three chips of different shades of blue and green varied by brightness. Tarahumara and many other languages do not lexically distinguish the colors labeled as "green" and "blue" in English, whereas other languages make finer lexical distinctions than English. For example, languages like Russian, Greek, and Japanese name light blue and dark blue with different monomorphemic (basic-level) names. In the study, participants judged which of the three chips was the "odd one," or least like the other two. As Tarahumara does not lexically distinguish blue and green, all chips were in the same lexical category; in contrast, in English, the chips belonged to two different categories (i.e., blue and green). The study found that English speakers distorted the distance according to the lexical boundary: two chips were perceived to be more similar when they were within the same lexical category, and less similar when two chips crossed the lexical boundary. No such pattern was seen in the Tarahumara speakers.

A great number of studies were conducted to unravel how this effect arises at a fine level of cognitive and neural processing (e.g., Fontenau & Davidoff, 2007; Gilbert, Regier, Kay, & Ivry, 2006; Holmes, Franklin, Clifford, & Davies,2009; Regier & Kay, 2009; Roberson, Pak, & Hanley, 2008; Siok et al., 2009; Tan et al., 2008; Thierry et al., 2009; Winawer et al., 2007). For example, Thierry et al. (2009) tested the brain response of English and Greek speakers using event-related potential (ERP) methods. Using the oddball paradigm, in which the participant is presented with a repetitive sequence of stimuli from the same category that is disrupted by the appearance of a stimulus from another category (i.e.,

oddball), English and Greek speakers observed two types of color changes: the change from (prototypical) blue to light blue and the change from (prototypical) green to light green. The presentation oddballs is known to sometimes elicit mismatch negativity (MMN) in ERP experiments. In English, both tokens of blue colors were labeled "blue" and both tokens of green were labeled "green." In contrast, Greek has different words for blue and light blue, but not for green and light green, so that the change from blue to light blue goes across lexical boundaries whereas the change from green to light green is within the same lexical category. The researchers found the MMN in Greek speakers for the blue–light blue change, but no such change for the green–light green change. English speakers did not show MMN for either change. Importantly, the visual stimuli changed not only in color but also in shape (i.e., a circle and a square), and the participants were instructed to detect the shape change and did not consciously pay attention to the color change in either condition. Speakers of English and Greek can detect color changes when they pay enough attention, and in this sense, they share a "common" perception for colors. However, they showed a different neural response without even realizing it.

A similar pattern has been observed for the similarity rating of everyday objects. People speaking different languages do notice common features that are not encoded in labels or identify similarity among objects, even though they do not receive the same lexical label (e.g., Malt, Sloman, Gennari, Shi, & Wang, 1999, objects; Malt et al., 2008, walking). Clearly, people's sense of similarity between objects or categories they spontaneously form is not perfectly determined by lexical categories in their language. At the same time, differences in lexical categories influence the sense of similarity in a nuanced way. Masuda et al. (2017) asked English and Japanese speakers to rate the similarities in a pair of objects, using images of objects that corresponded to two distinct linguistic categories in English (e.g., "bean" and "pea"), but only one category in Japanese (e.g., "*mame*"). In both language groups, objects belonging to one linguistic category in their own language were perceived as more similar than those belonging to two separate categories.

Thus, in the domains of color and objects, lexical boundaries seem to affect thought, but the effects may be subtler and more nuanced than the previously discussed cases of space and number domains.

Influence of Grammatical Categories on Thought

We now consider whether different systems of nominal classification affect the construal of entities. First, let us consider the presence or absence of consistent marking of count/mass distinction in grammar. As discussed in the previous section, the count/mass grammar marks a critical ontological distinction (i.e., countability) that is directly related to the notion of identity of entities. This critical difference between objects and substances leads to fundamentally different extension principles for the determination of category membership across the two ontological kinds. For example, the label "cup" is applied to any whole object of a similar "cup" shape, regardless of its color and material components. If a "cup" is broken into pieces, each piece no longer constitutes a "cup." In contrast, the word "clay" is extended to any portion of clay, irrelevant of shape. Thus, the distinction pertaining to individuation has been considered as one of the most important ontological distinctions (e.g., Pelletier, 1979; Quine, 1969; Soja, Carey, & Spelke, 1991).

Theorists disagree on whether or not numeral classifier languages grammatically mark the count/mass distinction (Allan, 1977; Chierchia, 1998; Krifka, 1995; Lucy, 1992; Quine, 1969, vs. Chen & Sybesyma, 1999; Mizuguchi, 2004; Yi, 2009, 2010; Zhang, 2007, 2013). Even if we take the position that countable nouns and uncountable nouns are distinguished by the choice of classifiers or particular linguistic constructions for quantifications, the

distinction is much less salient and consistent compared to the ways English-type language marks it.

Does grammatical marking of countability affect thought? Three predictions are possible in response to this question. In the strongest version, we might predict that speakers of a language that does not have a grammatical system that explicitly and systematically marks the count/mass status of the noun do not possess the ontological distinction between objects and substances. Here, it is implied that the ontological distinction is acquired through repeated and consistent exposure to the distinction in grammar; for example, if a child's native language does not provide this linguistic opportunity, she or he will not learn the conceptual distinction (Quine, 1969). The second possibility is the opposite of the first prediction. The conceptual distinction between objects and substances is so fundamental that the difference in grammatical coding of this conceptual distinction would not affect thought. Japanese children might possess the distinction between the object kinds and substance kinds innately, or at least by the time they start learning words (Soja et al., 1991; also see Hespos, Ferry, & Rips, 2009). Also, because the distinction between object kinds and substance kinds are perceptually transparent, Japanese speakers' construal of objects and substances—how they determine a given entity is countable or uncountable—would be no different from that of English speakers. The third prediction lays in the middle of the two extreme possibilities, which would be analogous to the pattern found for the color domain: Speakers of classifier languages, including young infants, can understand the fundamental conceptual distinction between object kinds and substance kinds, but how they determine the category membership of the two kinds is different due to the influence of language.

Imai and colleagues investigated this question (Imai & Gentner, 1997; Imai & Mazuka, 2007). The results supported the third possibility. Japanese children, whose language does not saliently mark the count/mass status of nouns, did show appreciation of the ontological distinction between object kinds and substance kinds. They were able to generalize a novel noun associated with an object and a substance in the way that manifests appreciation of the ontological distinction, even when the noun was presented without any linguistic cue flagging its count/mass status (e.g., with a classifier used for objects or a mass classifier used for substances). This result might be taken as evidence against the strong version of the Whorfian hypothesis, as speakers showed the understanding of the ontological distinction regardless of language. However, at the same time, English and Japanese speakers differed in where they drew a line between objects and substances. When Japanese speakers, both toddlers and adults, were presented with an entity made of solid substance with a simple shape that did not imply any function, Japanese speakers did not show a preference for object construal versus substance construal. In other words, they treated the entities with ambiguous perceptual affordance as ambiguous. In contrast, English-speaking toddlers and adults showed a strong bias toward object construal for these simple-shaped solid entities. While English speakers judged that a solid thing would likely be an object, regardless of whether or not it has an apparent function, Japanese speakers seemed to require both solidity and shape complexity (that indicates functionality) for a physical entity to be construed as a countable object. Thus, although the conceptual distinction between objects and substances are available much before children start learning language, especially learning the grammatical distinction between count nouns and mass nouns, exposure to language does affect the concepts of object kinds and substance kinds in the category boundary of the two ontological kinds (see Imai & Mazuka, 2007, and Imai & Masuda, 2013, for more detailed discussion).

Likewise, evidence for a weak version of the Whorfian hypothesis has been found for the classifier systems. Saalbach and Imai (2007, 2012; also see Imai, Saalbach, & Stern, 2010) tested whether the classifier categories would influence speakers' sense of similarity between objects. Three possible scenarios were tested: (1) classifier categories function as a

dominant organizer of concepts (cf. Lakoff, 1987; Zhang & Schmitt, 1998); (2) classifiers do not have any cognitive impact; (3) classifiers heighten speakers' sense of conceptual similarity but have no major influence on how concepts are structured in their minds. Again, the results supported the third hypothesis, that is, the middle ground position: Chinese and German speakers relied on taxonomic and thematic relations in judging similarity and in drawing inductive inference about nonobvious properties. This result rejects the first possibility, which is the strong version of the Whorfian hypothesis. However, Chinese speakers rated similarity between a pair of objects belonging to the same classifier category significantly higher than a pair in which two objects were drawn from different classifier categories (see also Imai, Schalk, Saalbach, & Okada, 2014; Saalbach, Imai, & Shalk, 2012 for additional support for the middle ground position on the influence of grammatical gender on the representation of biological sex of animals)

Summary and Synthesis: Influence of Language on Thought

Overall, support for the Whorfian hypothesis has been accumulated in the literature, but the strength or directness of the effect of language on thought varies across conceptual domains. If the presence or absence of a particular lexicalization system enhances certain cognitive ability or invites emergence of concepts, that would be taken as fairly strong evidence for the Whorfian hypothesis. Such strong evidence has been reported in the domain of spatial cognition (Levinson, 2003; Majid, Bowerman, Kita, Haun, & Levinson, 2004) and number concepts (Gordon, 2004). However, the effect of language is much more nuanced and subtler in most perceptual/conceptual domains. People notice similarity among different colors, objects, or actions even though they are put into different lexical or grammatical categories. At the same time, cross-linguistic differences in lexical or grammatical categories often lead to subtle differences, such as category boundary shifting, category perception, construal of similarity, and differential brain responses.

How Do Culture and Language Affect Thought?

Does Culture or Language Affect Thought?

In evaluating the Whorfian hypothesis, it is extremely difficult to determine whether the effect assumed to be evidence for the Whorfian hypothesis is truly attributable to language or if it should be attributed to culture instead, because language is deeply embedded in culture. However, researchers have attempted to separate language and culture as much as possible. The term "culture" is meant and treated differently by cognitive psychologists/anthropologists and cultural psychologists. We begin with the former case.

Cognitive anthropologists/psychologists have reported results of field research that show spatial cognition and number concepts are heavily influenced by language (see the section "In fluence of Language and Culture on Thought"). However, the data discussed in this article were collected from regions where ecology (the natural environment), subsistence, and values are very different from industrialized societies that rely on modern technologies. One way to narrow down whether the different cognitive abilities possessed by indigenous societies should be attributed to language or culture is to investigate cognitive abilities across indigenous societies with similar ecology, lifestyles, and level of education but with different languages.

In the domain of spatial cognition, the results seem to suggest that language rather than culture leads to the cognitive difference. Levinson (2003) compared the dominant FoR and ability of way-finding between Guugu Yimidir and Dutch people and studied speakers of Tzeltal, a Mayan language, in Tenejapa, Mexico (Brown & Levinson, 2000). This language also uses the absolute FoR and does not have relative terms like front/back/left/right, as does

the language of the Guugu Yimidir people. Speakers of Guugu Yimidir and those of Tzeltal are indigenous people whose level of education is comparable, but the natural environment surrounding these people as well as their subsistence are very different. The former are hunter-gatherers and the latter are agricultural people. It turned out that Guugu Yimidir and Tzeltal speakers both show superior ability of way-finding (i.e., the ability of dead reckoning). This result may be interpreted to imply that language rather than culture is a critical factor behind the dead-reckoning ability.

What about the number concept? Again, it seems to be language rather than culture. Spaepen, Coppola, Spelke, Carey, and Goldin-Meadow(2011) tested profoundly deaf individuals in Nicaragua, who use homemade gestures (home signs) due to the lack of proper exposure to a conventional sign language. These home-signers are integrated into a numerate society, yet have difficulty generating exact numbers that are larger than three, like Pirahã adults. These results provide support for the possibility that language is critical for the acquisition of exact numbers.

However, the dominance of language over culture on thought does not seem to hold for all major perceptual/conceptual domains. For the domain of olfaction, Majid and Kruspe (2018) examined whether the exceptionally superior ability to categorize and label olfaction in Jahai and Manique people (Majid & Burenhult, 2014; Wnuk & Majid, 2014) should be attributed to ecology, subsistence, or language. For that purpose, Majid and Kruspe (2018) further investigated two language communities, Semaq Beri and Semelai, which belong to the same language family and live in the same ecological environment (tropical rainforest), but differ in subsistence. Semaq Beri are hunter-gatherers and Semlai are not. Different from the cases of spatial cognition and number concepts, they reported that only hunter-gatherer Semaq Beri showed superior olfactory performance, similar to other hunter-gatherers such as Jahai and Manique people. This finding suggests that, different from the case with spatial cognition and number cognition, the special ability is more likely to be attributed to culture than to language.

Taken together, it is difficult to draw a general conclusion on whether language or culture affects special cognitive ability or manner of conceptualization in a particular domain. It is likely that a culture-specific, special manner of cognition or conceptualization arises from a complex interaction of culture, language, and the nature of the conceptual domain.

One thing we need to consider, however, is what aspect of "culture" affects thought. Cognitive anthropologists and psychologists seem to define culture in light of how people live, for example, whether they subsist by hunter-gathering or agriculture. In contrast, cultural psychologists see culture as a combination of internal factors such as collective values or worldviews shared among members of the society. Perhaps hunter-gatherers have different value systems than horticulturists, and these collective value systems may be related to the superior ability to categorize odor.

Culture and Language Can Affect Thought Simultaneously

It is also possible that language and culture influence thought simultaneously. As discussed earlier, an important theoretical framework in cultural psychology contrasts cultures that have independent social orientation versus interdependent social orientation. Members of the former type of culture tend to view themselves as independent of other social members, whereas the latter tend to view themselves as socially embedded within a web of dense relationships among social groups (Kitayama & Uskul, 2011; Kitayama, Varnum, & Salvador, 2019; Markus & Kitayama, 1991, 2010; Miyamoto, 2013; Nisbett, 2003; Varnum et al., 2010). Nisbett and colleagues (Nisbett, 2003; Nisbett, Peng, Choi, & Norenzayan, 2001) have further proposed that East Asian people tend to have an interdependent social orientation, while Caucasian Europeans (Westerners) tend to have an independent social

orientation. These orientation styles lead to differences in attention to relations that connect elements in the environment. Westerners tend to focus on individual elements of the environment separately, and East Asians tend to pay attention to the unified whole. Based on this scheme, the researchers made a specific prediction regarding the conceptual structures of East Asians and Westerners: East Asians, with their predisposition to see a scene or event as a whole, are expected to categorize the world around thematic relations; Westerners, with their focus on properties of individual objects, are expected to categorize the world by taxonomic relations (Nisbett, 2003; Nisbett, Peng, Choi, & Norenzayan, 2001).

Saalbach and Imai (2007) employed a paradigm in which the influence of language (the impact of a classifier system) and culture (culture-specific biases of Easterners and Westerners) on conceptual structures were examined simultaneously, in that the relative importance of taxonomic relations, thematic relations, and classifier relations were evaluated within the culture. Participants in both language groups gave the highest ratings for the taxonomic pairs, followed by the thematic pairs, followed by the classifier pairs. Consistent with the results of the categorization task, both Chinese and German participants rated the "same classifier" pairs as more similar than the control pairs, in which two objects did not share any of the three relations (i.e., taxonomic, thematic, classifier). This result suggests that even speakers of nonclassifier languages can detect an inherent similarity between objects belonging to the same classifier category. However, the results also indicates that this inherent similarity is magnified for speakers of classifier languages. For example, Chinese participants' similarity judgments for pairs drawn from the same classifier classes were significantly higher than those of the German participants. Importantly, Chinese speakers also gave higher similarity ratings for thematically related object pairs than the German speakers. Thus, taken together, the pattern of results suggests that language and culture could influence people's concepts and cognitive processes simultaneously and independently, and warrants reconsideration of the traditional approach, which assumes the influence of language and culture to be contrastive and asks which single factor shapes thought.

Conclusion and Future Directions

This article has provided a comprehensive review of research on the relations among language, culture, and thought, and suggests that no simple conclusion can be drawn. Both children and adults share universal conceptual structures and basic cognitive functions that are likely to have arisen from factors given by the world (e.g., perceptual) and those residing within humans (e.g., natural conceptualization). This does not mean that there is no room for language or culture to modulate perception and cognition. Language and culture highlight certain aspects of the world and provide bases for categorization. The influence of language and culture on thought becomes stronger when there are no perceptible divisions and becomes subtler when the divisions are perceptually salient.

The relations among language, culture, and thought are not unidirectional and are extremely complex, such that culture affects language, language affects thought, and universally shared thought determines the structure of language. In many conceptual domains, linguistic categories are likely to reflect universal division or salient commonalities in the world, but at the same time, linguistic categories modify perceived similarities (see Imai & Mazuka, 2003, 2007; see also Malt, 1995, for a relevant discussion). Culture and language can conjointly affect thought. For example, cultural values affect how finely a given conceptual domain is labeled, but labels invite contrasts among differently named categories and increase attention to corresponding conceptual distinctions and relational commonalities (Gentner, 2016; Gentner & Christie, 2010; Lupyan, 2012; Lupyan, Rakison, & McClelland, 2007).

Given such complexity, the relations among language, culture, and thought defy simple and extreme views (e.g., the view that universally shared thought determines human conceptualization across different cultures and languages and the view on the other extreme, i.e., language or culture determines thought). It is important to investigate these relations at different levels, but with clear specification of what "language" means and whether language is separable from culture in the particular investigation at hand (Imai, Kanero, & Masuda, 2016; Imai & Masuda, 2013). Because the relative weights of the three are likely to differ across domains, future research needs to specify not only how thought is constrained by language, culture, and universally shared perceptual and cognitive bases but also how these factors interact with one another across diverse conceptual domains. It is also important to uncover the developmental trajectory along which language or culture-specific "thought" emerges.

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