Linguistic Relativity

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INTRODUCTION

Linguistic relativity, sometimes called the Whorfian hypothesis, posits that properties of language affect the structure and content of thought and thus the way humans perceive reality. A distinction is often made between strong Whorfian views, according to which the categories of thought are determined by language, and weak views, which argue that language influences thought without entirely determining its structure. Each view presupposes that for language to affect thought, the two must in some way be separable. The modern investigation of linguistic relativity began with the contributions of Benjamin Lee Whorf and his mentor, Edward Sapir. Until recently, much experimental work has focused on determining whether any reliable Whorfian effects exist and whether effects truly reflect differences in thought caused by linguistic variation. Many such studies compare speakers of different languages or test subjects at different stages of language acquisition. Other studies explore how language affects cognition by testing prelinguistic infants or nonhuman animals and comparing these groups to children or adults. Significant progress has been made in several domains, including studies of color, number, objects, and space. In many areas, the status of findings is hotly debated.

EDITED COLLECTIONS

Often, leading researchers in the field summarize their newest findings and views in edited collections. These volumes are good places to begin research into the topic of linguistic relativity. The listed volumes arose from papers presented at conferences, symposia, and workshops devoted to the topic. Gumperz and Levinson 1996 arose from a symposium that revived interest in the linguistic relativity hypothesis, leading to a wave of new research on the topic. Highlights of this work are reported in Bowerman and Levinson 2001, Gentner and Goldin-Meadow 2003, and Malt and Wolff 2010.

> **Bowerman, Melissa, and Stephen C. Levinson, eds. 2001. *Language acquisition and conceptual development*. Cambridge, UK: Cambridge Univ. Press.**
>
> [DOI: 10.1017/CBO9780511620669]
>
> This volume brings together research on language acquisition and conceptual development and asks about the relation between them in early childhood.

Gentner, Dedre, and Susan Goldin-Meadow, eds. 2003. *Language in mind: Advances in the study of language and thought*. Cambridge, MA: MIT Press.

The volume starts with a collection of perspective papers and then showcases papers that bring data to bear to test claims of linguistic relativity. The papers are delineated on the basis of the types of language effects on thought: language as a tool kit, language as a lens, and language as a category maker.

Gumperz, John J., and Stephen C. Levinson, eds. 1996. *Rethinking linguistic relativity*. Papers presented at the Werner-Gren Symposium 112, held in Ocho Rios, Jamaica, in May 1991. Cambridge, UK: Cambridge Univ. Press.

A collection of papers arising from the "Rethinking Linguistic Relativity" Wenner-Gren Symposium in 1991 that brought about renewed interest in the topic.

Malt, Barbara C., and Phillip M. Wolff. 2010. *Words and the mind: How words capture human experience*. Oxford: Oxford Univ. Press.

Researchers across disciplines (linguists, psychologists, and anthropologists) contributed to this collection of papers documenting new advances in language-thought research in various domains (space, emotions, body parts, causation, etc.).

REFERENCE RESOURCES

Psycholinguistics textbooks often have entries on the topic of linguistic relativity, as do cognitive science encyclopedias. Two examples are Boroditsky 2003 and Wolff and Holmes 2011. Boroditsky 2003 is a short encyclopedic entry that orients beginners to research supporting linguistic relativity, organized by domain (e.g., space, time, object perception), while Wolff and Holmes 2011 is a lengthier entry that is organized by types of effects language has on thought.

Boroditsky, Lera. 2003. Linguistic relativity. In *Encyclopedia of cognitive science*. Edited by Lynn Nadel, 917–921. London: Macmillan.

Reviews research in support of linguistic relativity in domains such as space, time, gender, and object-substance construal.

Wolff, Phillip M., and Kevin J. Holmes. 2011. Linguistic relativity. *Wiley Interdisciplinary Reviews: Cognitive Science*. 2.3: 253–265

[DOI: 10.1002/wcs.104]

Classifies research in a wide range of domains into different types of effects of language on thought,

such as thinking in line with language to produce language, using language to augment thinking and reasoning online, and habitual use of language shaping speakers' attention.

FOUNDATIONAL WORKS

Many classic works have shaped current debates on language and thought. Humboldt 1988, taking the perspective that language is a vehicle of thought, discusses ways cross-linguistic variations in grammatical structures might shape thought. This work paved the way for the American linguist Edward Sapir and his student Benjamin Whorf, whom we have come to associate with the notion of linguistic relativity (see Sapir 1949 and Whorf 1956 for their theorizing and Lucy 1992 for a synopsis of the Whorfian hypothesis and how to go about testing it). Another important commentator on the role of language in thinking is Lev Vygotsky. A contemporary of Sapir and Whorf, Vygotsky shared their position that language is very much a social and cultural construct. However, as a psychologist, Vygotsky did not focus on structural differences across languages and its effects on thought. Instead, he focused on understanding language as a social form that influences the development of an individual. For example, he studied the internalizing of language for thinking in child development. The ideas on language and thought in Vygotsky 1986 have been very influential in the field of education and developmental psychology.

Humboldt, Wilhelm von. 1988. *On language: The diversity of human language-structure and its influence on the mental development of mankind*. Translated by Peter L. Heath. Cambridge, UK: Cambridge Univ. Press.

First published in 1836. The first of three volumes that explore cross-linguistic variation and its effect on the expression of human thought, focusing on the case study of Kawi, the sacred language of Java. Humboldt takes the strong view that language determines the capacity for human thought, explaining some cross-cultural cognitive differences.

Lucy, John A. 1992. *Language diversity and thought: A reformulation of the linguistic relativity hypothesis*. Cambridge, UK: Cambridge Univ. Press.

An in-depth introduction to Whorfian thought and its history and part of a two-book study that includes experiments on Yucatec Mayan that suggest a role for mass-count syntax in shaping thought.

Quine, Willard V. O. 1969. *Ontological relativity and other essays*. New York: Columbia Univ. Press.

Describes Quine's theory of ontological relativity, in which he argues that the notion "object" is constructed in large part via linguistic experience.

Sapir, Edward. 1949. *Language: An introduction to the study of speech*. New York: Harcourt Brace Jovanovich.

[DOI: 10.1037/13026-000]

Provides Sapir's views on language and its "relation to other fundamental human interests—the problem of thought, the nature of the historical process, race, culture, and art (p. v)." Originally published in 1921 and still in print.

Vygotsky, Lev. 1986. *Thought and language*. Cambridge, MA: MIT Press.

Argues that language is a means through which adults can instruct and scaffold children's cognitive development and proposes that although language and thought initially develop independently, the two become interdependent as language becomes internalized and used in problem solving and reasoning.

Whorf, Benjamin Lee. 1956. *Language, thought, and reality: Selected writings of Benjamin Lee Whorf*. Edited by J. B. Carroll. Cambridge, MA: MIT Press.

A classic collection of papers in which Whorf describes his theory of how language affects nonlinguistic thought.

THEORETICAL PERSPECTIVES

A wide spectrum of views regarding linguistic relativity has been proposed. By some accounts, thought is a nonverbal reflection of linguistic processing, such that the two are not readily distinguished (e.g., see Chomsky 2000). Others make a crisp distinction between natural language and the "language of thought" and offer differing views on how these systems might interact (e.g., see Fodor 1980). In the early 21st century many researchers who endorse a Whorfian view believe that effects are weak in nature, such that cross-linguistic differences in language structure cause speakers to attend to different aspects of experience without fundamentally transforming their perceptions of the world. Those who object to the Whorfian view, sometimes called "universalists," argue that language is a window to thought and that different languages express thought and experience differently without actually altering it. Still others argue that thought that supports linguistic processing (thinking for speaking) differs from nonlinguistic thought and perception. The diversity of positions, from those subscribing to strong-to-moderate linguistic relativity effects to those subscribing to weak-to-no effects, can be seen by comparing Levinson 2003 and Slobin 2003 with Pinker 2007 and Gleitman and Papafragou 2005. These scholars review the same literature but provide different interpretations of it. Additionally, some researchers advocate that language, as a symbolic system, allows humans to consciously reflect upon thoughts or to express more complex thoughts in ways unavailable to nonlinguistic creatures (Carruthurs 2011, Spelke and Tsvikin 2001).

Carruthurs, Peter. 2011. Language in cognition. In *The Oxford handbook of philosophy of cognitive science*. Edited by Eric Margolis, Richard Samuels, and Stephen Stich, 382–401. New York: Oxford Univ. Press.

Proposes a dual-system architecture, where an evolutionarily recent "system two" involving slow, serial, reflective processes (such as the use of inner speech in rehearsing and reasoning) is grafted on top of "system one," a collection of evolutionarily ancient, fast, unconscious processes.

Chomsky, Noam. 2000. *New horizons in the study of language and mind*. New York: Cambridge Univ. Press.

A series of essays on the philosophy of language and mind that includes comments on the Sapir-Whorf hypothesis, echoing Wilhelm von Humboldt's view that language and thought are not easily dissociated.

Fodor, Jerry. 1980. *The language of thought*. Cambridge, MA: Harvard Univ. Press.

Argues for a sharp distinction between language and a nonlinguistic "language of thought" or "mentalese." For Fodor, the language of thought is a computational system whose representations are mental particulars that are governed by a syntax and semantics that are independent of natural language.

Gleitman, Lila, and Anna Papafragou. 2005. Language and thought. In *Cambridge handbook of thinking and reasoning*. 2d ed. Edited by Keith J. Holyoak and Robert G. Morrison Jr., 633–661. Cambridge, UK: Cambridge Univ. Press.

Offers a skeptical appraisal of Whorfian claims and offers counterproposals to explain data in the linguistic relativity literature.

Levinson, Stephen C. 2003. Language in mind: Let's get the issues straight! In *Language in mind: Advances in the issues of language and thought*. Edited by Dedre Gentner and Susan Goldin-Meadow, 25–46. Cambridge, MA: MIT Press.

Argues against a "simple nativism" position that word learning involves mapping words to antecedently available concepts. Instead, lists evidence that semantic patterns covary with cognition to argue that word learning involves building language-given concepts.

Pinker, Steven. 2007. Fifty thousand innate concepts and other radical theories of language and thought. In *The stuff of thought: Language as a window into human nature*. By Steven Pinker, 89–152. New York: Viking.

Lists a continuum of claims regarding linguistic relativity, from weak to strong effects, and critiques these claims and the data used to support them.

Slobin, Dan I. 2003. Language and thought online: Cognitive consequences of linguistic relativity.

In *Language in mind: Advances in the investigation of language and thought*. Edited by Dedre Gentner and Susan Goldin-Meadow, 157–191. Cambridge, MA: MIT Press.

Outlines the author's seminal idea of "thinking-for-speaking" and illustrates it with examples from his years of research in addition to proposing how habits of thinking for speaking may have anticipatory or consequential effects on thinking.

Spelke, Elizabeth S., and Susanna Tsivkin. 2001. Initial knowledge and conceptual change: Space and number. In *Language acquisition and conceptual development*. Edited by Melissa Bowerman and Stephen C. Levinson, 70–81. Cambridge, UK: Cambridge Univ. Press.

[DOI: 10.1017/CBO9780511620669]

Proposes a central role for language as a system for combining concepts from modular systems of representation.

COLOR

Beginning with the early contribution of the Brown and Lenneberg 1954 experimental techniques and the Berlin and Kay 1969 cross-cultural typology of color vocabulary, this literature has made significant progress in exploring the relationship among color perception, the development of perceptual categories, and language. Brent Berlin and Paul Kay's early work and their more recent replication (Kay, et al. 2003) suggest that languages privilege certain color terms over others, measured by the likelihood that a particular color concept appears in a language. This work and subsequent research also report that languages differ with respect to how they segment color space. In some languages two words are used to label different regions of a color space that are named with only one label in other languages. These findings and subsequent experimental studies point to the existence of (1) universal constraints on color categories and (2) variability in how such categories are mapped to words by language learners. Initial investigations of linguistic relativity found little or no support for it (Rosch Heider 1972). More recently, it has been found that linguistic variation appears to predict differences in how speakers categorize and remember colors, in support of the Whorfian hypothesis (Davido, et al. 1999; Roberson and Henley 2007). However, such effects are less often found when subjects are using language for a different task (verbal interference). Also speakers of different languages appear to show identical behaviors when tasks do not involve categorization, speeded judgments, or memory but instead require the perceptual discrimination of colors (measured as "just noticeable differences"). Recent work has explored whether language learning causes the processing of color information to shift from right hemisphere cortical areas to left hemisphere areas and has explored changes in color perception as children begin to acquire color words (see Regier and Kay 2009 for review).

Berlin, Brent, and Paul Kay. 1969. *Basic color terms: Their universality and evolution*. Berkeley: Univ. of California Press.

Maps out the basic color terms of twenty languages and proposes universal constraints on the

organization and linguistic evolution of color terms.

Brown, Roger W., and Eric H. Lenneberg. 1954. A study of language and cognition. *Journal of Abnormal and Social Psychology* 49:454–462.

[DOI: 10.1037/h0057814]

This is the first work on the effect of color codability (i.e., how easily colors are named and communicated) on color memory. The authors adapted techniques from psychology to study the Whorfian hypothesis and distinguished between linguistic and nonlinguistic measures.

Davido, Jules, Ian Davies, and Debi Roberson. 1999. Colour categories in a Stone-Age tribe. *Nature* 398:203–204.

[DOI: 10.1038/18335]

Finds that linguistic color boundaries influence memory for color and that speakers have a more difficult time categorizing colors according to nonnative than native color boundaries. The authors use the data to support linguistic relativity and challenge the universality of color categories.

Kay, Paul, Brent Berlin, L. Ma, and W. R. Merrield. 2003. *The world color survey*. Palo Alto, CA: Center for the Study of Language and information.

A rigorous follow-up to Berlin and Kay 1969. Presents color term data from 110 unwritten languages spoken by monolingual speakers. In addition to the data, which are publicly available for analysis, the authors provide updates to and a brief history of their theory on the universality of color term evolution.

Regier, Terry, and Paul Kay. 2009. Language, thought, and color: Whorf was half right. *Trends in Cognitive Science* 13:439–446.

[DOI: 10.1016/j.tics.2009.07.001]

This review attempts to reconcile universalist and relativist views of color language and perception. The authors suggest that language influences perception only in the right visual field and that color categories are influenced both by universal constraints and by linguistic variation.

Roberson, Debi, and J. Richard Henley. 2007. Color vision: Color categories vary with language after all. *Current Biology* 17:R605–R607.

Argues against universal constraints and for linguistic relativity by drawing on studies from both modern and remote cultures that have found linguistic influence on color memory and discrimination.

Rosch Heider, Eleanor. 1972. Universals in color naming and memory. *Journal of Experimental Psychology* 93:10–20.

[DOI: 10.1037/h0032606]

Finds support for universal color categories in that speakers of many languages more easily labeled the universal focal colors and in that speakers of Dani, a language lacking in hue terms, could remember and learn to label focal colors better than nonfocal colors.

OBJECT-SUBSTANCE

Since Jean Piaget's first discussions of "object permanence," psychologists have debated the origin and nature of object representations not only in infants but also in adults. On the view that object representations are constructed, language offers a representational format for binding together disparate or "scattered" experiences under a single label, thereby creating the notion of a unit or individual. This view is entertained in Quine 1960 with the prediction that preverbal infants should not make a clear distinction between words like "red," "water," and "mama" until they have acquired linguistic structures that differentiate them (e.g., mass-count syntax). This idea had a strong impact on Whorfian theorizing, leading researchers such as John A. Lucy (Lucy 1992) to conduct cross-cultural studies that showed that speakers of mass-count languages differ from speakers of classifier languages on tasks that measure object perception and categorization as well as word learning. Other researchers have offered alternative explanations for these cross-group differences on object categorization (e.g., Mazuka and Friedman 2000; Barner, et al. 2009; Li, et al. 2009; see Barner, et al. 2010 for review).

Barner, David, Shunji Inagaki, and Peggy Li. 2009. Language, thought, and real nouns. *Cognition* 111:329–344.

[DOI: 10.1016/j.cognition.2009.02.008]

Shows that, despite syntactic differences between the languages, speakers of Japanese and English have similar semantic representations for common nouns. Argues that online syntactic processes, rather than conceptual differences, mediate previously reported linguistic differences on word learning tasks.

Barner, David, Peggy Li, and J. Snedeker. 2010. Words as windows to thought: The case of object representation. *Current Directions in Psychological Science* 19:195–200.

[DOI: 10.1177/0963721410370294]

A review of evidence that, in the case of object perception, conceptual representations appear to drive syntactic learning rather than the opposite.

Li, Peggy, Yarrow Dunham, and Susan Carey. 2009. Of substance: The nature of language effects on entity construal. *Cognitive Psychology* 58.4: 487–524.

[DOI: 10.1016/j.cogpsych.2008.12.001]

Presents a collection of studies that find no differences in object perception across languages and argues that cross-linguistic effects on word learning tasks are due to online syntactic processes rather than differences in thought.

Lucy, John A. 1992. *Grammatical categories and cognition*. Cambridge, UK: Cambridge Univ. Press.

[DOI: 10.1017/CBO9780511620713]

Presents a description of Yucatec Mayan, a classifier language spoken in the Yucatán Peninsula of Mexico, which differs critically from mass-count languages like English. Nouns in classifier languages behave like mass nouns in mass-count languages, leading Lucy to propose that nouns in Yucatec, like many English mass nouns, denote kinds of substances and not individuated things. Lucy presents experiments supporting this view.

Mazuka, Reiko, and Ronald S. Friedman. 2000. Linguistic relativity in Japanese and English: Is language the primary determinant in object classification? *Journal of East Asian Linguistics* 9:353–377.

[DOI: 10.1023/A:1008356620617]

A critical reexamination of Lucy's claim that cross-linguistic differences in mass-count syntax cause differences in thought. This study fails to replicate John A. Lucy's results in a population of educated Japanese participants.

Quine, Willard V. O. 1960. *Word and object*. Cambridge, MA: MIT Press.

In chapter 3, "The Ontogenesis of Reference," Quine argues that the ontology that underlies language is a cultural construction that children learn through their mastery of language.

OBJECT-SUBSTANCE AND ACQUISITION

These studies explore how language relates to the perception of objects and substances by exploring language development. Soja, et al. 1991 provides the first study asking whether learning a mass-count distinction, as in English, is necessary for developing the ontological distinction between objects and substances. Relatedly, Samuelson and Smith 1999 asks whether English-speaking children's ability to distinguish between objects and substances is the product of learning correlations between perceptual properties and syntactic cues of early nouns. Subsequently, Imai and Gentner 1997 and others reported on a direct comparison of children learning mass-count languages like English and classifier languages like Japanese and Chinese (see Imai and Mazuka 2003 and Gentner and Boroditsky 2001 for review).

Gentner, Dedre, and Lera Boroditsky. 2001. Individuation, relativity, and early word learning. In *Language acquisition and conceptual development*. Edited by Melissa Bowerman and Stephen C. Levinson, 215–256. Cambridge, UK: Cambridge Univ. Press.

[DOI: 10.1017/CBO9780511620669]

Argues that the perception of entities is organized along an "individuation continuum," which can be affected by cross-linguistic differences in mass-count syntax.

Imai, Mutsumi, and Dedre Gentner. 1997. A cross-linguistic study of early word meaning: Universal ontology and linguistic influence. *Cognition* 62:169–200.

[DOI: 10.1016/S0010-0277(96)00784-6]

Presents evidence that two-year-olds learning English, a mass-count language, are more likely to construe novel referents as objects than two-year-olds learning Japanese, a classifier language.

Imai, Mutsumi, and Reiko Mazuka. 2003. Re-evaluation of linguistic relativity: Language-specific categories and the role of universal ontological knowledge in the construal of individuation. In *Language in mind: Advances in the issues of language and thought*. Edited by Dedre Gentner and Susan Goldin-Meadow, 430–464. Cambridge, MA: MIT Press.

Shows that English learners are more likely than Japanese learners to categorize by object-kind than by substance-kind in a similarity judgment version of the Imai and Gentner 1997 word learning task and argues that learning count-mass syntax shifts the likelihood of construing entities as objects in nonlinguistic situations.

Samuelson, Larissa K., and Linda B. Smith. 1999. Early noun vocabularies: Do ontology, category structure, and syntax correspond? *Cognition* 73:1–33.

[DOI: 10.1016/S0010-0277(99)00034-7]

This study asks how mass-count syntax is related to referential properties like solidity, material substance, and shape and thus how language shifts attention to different kinds of entities.

Soja, Nancy N., Susan Carey, and Elizabeth Spelke. 1991. Ontological categories guide young children's inductions of word meaning: Object terms and substance terms. *Cognition* 38:179–211.

[DOI: 10.1016/0010-0277(91)90051-5]

Against the strong Whorfian predictions laid out by Willard V. O. Quine, this study shows that children represent a conceptual distinction between objects and substances before they learn mass-count syntax.

KINDS AND CATEGORIES

These studies share an interest in how grammatical categories and linguistic labels relate to the categorization of objects and in particular how labels act as "invitations" to form new categories. Waxman and Markow 1995 and Lupyan, et al. 2007 show that giving objects a common label facilitates category learning. Malt, et al. 1999 explores whether learning category labels for objects, such as words for containers, affects the perceived similarity of the objects. Dessalegn and Landau 2008 asks whether labeling, relative to other cuing methods, is an effective way to get people to attend to and remember visual information.

Dessalegn, Banchiamlack, and Barbara Landau. 2008. More than meets the eye: The role of language in binding visual properties. *Psychological Science* 19.2: 189–195.

[DOI: 10.1111/j.1467-9280.2008.02066.x]

Four-year-old children had to identify which visual displays of each of two different color patches matched the one previously shown. Even though children did not know the meanings of "left" and "right," labeling the left-right relations of the color patches in the initial display improved subsequent identification. Authors argue that language helps temporarily bind visual information.

Lupyan, Gary, David H. Rakison, and James L. McClelland. 2007. Language is not just for talking: Redundant labels facilitate learning of novel categories. *Psychological Science* 18.12: 1077–1083.

[DOI: 10.1111/j.1467-9280.2007.02028.x]

Shows that attaching names to members of novel categories facilitates adults' learning of the distinctions between categories, even when this name information is redundant.

Malt, Barbara C., Steven A. Sloman, Silvia Gennari, Meiyi Shi, and Yuan Wang. 1999. Knowing versus naming: Similarity and the linguistic categorization of artifacts. *Journal of Memory and Language* 40:230–262.

[DOI: 10.1006/jmla.1998.2593]

Speakers of English, Chinese, and Spanish were shown a large collection of common containers (e.g., mugs, cups, bowls) for which they generated distinct naming patterns. Despite this cross-linguistic difference, the speakers of these languages did not differ in their similarity judgments for these objects, suggesting that cross-linguistic variation in labeling did not affect nonlinguistic perception of the objects.

Waxman, Sandra R., and Dana B. Markow. 1995. Words as invitations to form categories: Evidence from 12- to 13-month-old infants. *Cognitive Psychology* 29:257–302.

[DOI: 10.1006/cogp.1995.1016]

Shows that English-speaking infants are more likely to learn distinctions between categories when these categories are labeled with a word.

GRAMMATICAL NUMBER

Whereas studies of the object-substance distinction focus mainly on one aspect of grammatical number marking (the mass-count distinction), researchers have also examined how other forms of number marking affect the processing of objects, sets, and quantity across languages. In English, for example, singular-plural marking is obligatory and is acquired from a very early age. Some researchers have asked whether the conceptual distinction between singular-plural sets precedes the linguistic distinction or whether learning language drives the development of set representations (see Barner, et al. 2007; Li, et al. 2009). Other studies have looked at how number marking affects perception and categorization in classifier languages like Mandarin Chinese. Unlike mass-count languages like English, classifier languages do not allow numerals to directly modify nouns. Instead, an intervening classifier must be used (similar to how English mass nouns require unitizers like “piece” and “slice”). Interestingly, nouns that occur with a particular numeral classifier often share semantic properties like shape, raising the possibility that the use of a word with a classifier shifts how it is perceived. A series of studies investigate this possibility by comparing how speakers of different languages interact with objects whose labels either share or do not share classifiers (e.g., Srinivasan 2010, Gao and Malt 2009, Saalbach and Imai 2007, Schmitt and Zhang 1998).

Barner, David, Dora Thalwitz, Justin Wood, and Susan Carey. 2007. On the relation between the acquisition of singular-plural morpho-syntax and the conceptual distinction between one and more than one. *Developmental Science* 10:365–373.

[DOI: 10.1111/j.1467-7687.2007.00591.x]

Shows that English-speaking children make a conceptual distinction between singular and plural sets by around twenty-two months of age and that this ability is correlated with children’s production of singular-plural morphology.

Gao, Ming Y., and Barbara C. Malt. 2009. Mental representation and cognitive consequences of Chinese individual classifiers. *Language and Cognitive Processes* 24.7: 1124–1179.

Proposes that classifiers vary in the coherence of how they classify nouns into well-defined, prototype, or arbitrary classes. The coherence of classes has cognitive consequences on Mandarin speakers’ and to some extent English speakers’ memory for nouns.

Li, Peggy, Tamiko Ogura, David Barner, S. Yang, and Susan Carey. 2009. Does the conceptual distinction between singular and plural sets depend on language? *Developmental Psychology* 45:1644–1653.

[DOI: 10.1037/a0015553]

Shows that two-year-olds learning English, Japanese, and Mandarin Chinese make a conceptual distinction between singular and plural sets at around the same stage in development, though only English exhibits mass-count syntax and plural marking.

Saalbach, Hendrik, and Mutsumi Imai. 2007. The scope of linguistic influence: Does a classifier system alter object concepts? *Journal of Experimental Psychology: General* 136.3: 485–501.

[DOI: 10.1037/0096-3445.136.3.485]

Asks whether learning classifiers causes speakers of Mandarin Chinese to interact with objects differently from speakers of German, a mass-count language. When asked to make categorization decisions, speakers of both languages made judgments that respected either thematic or taxonomic relations but showed no difference attributable to the existence of classifiers in Chinese.

Schmitt, Bernd H., and Shi Zhang. 1998. Language structure and categorization: A study of classifiers in consumer cognition, judgment, and choice. *Journal of Consumer Research* 25.2: 108–122.

[DOI: 10.1086/209530]

Experiments showed that objects named by the same classifiers are seen as more similar and are better remembered in a set and that its common features are more accessible. Last, the valence of one object can influence consumer choice of another sharing the same classifier.

Srinivasan, Mahesh. 2010. Do classifiers affect cognitive processing? A study of nominal classification in Mandarin Chinese. *Language and Cognition* 2.2: 177–190.

[DOI: 10.1515/LANGCOG.2010.007]

Speakers of Mandarin, English, and Russian performed a speeded enumeration task in which displays contained heterogeneous sets of objects whose labels either shared a numeral classifier in Mandarin or required different numeral classifiers. When objects had labels that shared a classifier, Mandarin speakers were slower at enumerating the sets than English and Russian speakers, suggesting that classifier categories affect processing of numerosity.

INTEGERS

Integer acquisition offers a compelling test of the Whorfian hypothesis, since the acquisition of count words is not universal and languages exhibit a degree of variation in how their count lists are structured. Studies of nonhuman animals, infants, and adults have argued that some number representations clearly exist in the absence of language but that these differ sharply from the representations that are acquired when children

learn to count (Carey 209). Adult speakers of languages that lack extensive number words, such as members of the Pirahã and Munduruku groups, are unable to represent and reason about large exact numerosities like "77" (see Gordon 2004 and Frank, et al. 2008 for Pirahã; Pica, et al. 2004 for Munduruku). This is perhaps the clearest existing example of how language can serve as a foundation for creating new concepts and thereby alter thought. Subsequent studies have explored how number systems are created de novo by children who have developed a "home sign" system (Spaepen, et al. 2011).

Carey, Susan. 2009. *The origin of concepts*. New York: Oxford Univ. Press.

A comprehensive review of children's conceptual development that outlines a core set of cognitive capabilities that infants are born with and posits the linguistic mechanisms that build on these capabilities to drive the development of mature numerical, spatial, and linguistic abilities.

Frank, M. C., D. L. Everett, E. Fedorenko, and E. Gibson. 2008. Number as a cognitive technology: Evidence from Pirahã language and cognition. *Cognition* 108:819–824.

[DOI: 10.1016/j.cognition.2008.04.007]

Argues that language acts as a cognitive tool for thinking about number and not as the foundation for all numerical representation. Shows that adults who lack count words succeed at matching two sets of visible objects on the basis of their number but fail when matching relies on remembered sets.

Gordon, Peter. 2004. Numerical cognition without words: Evidence from Amazonia. *Science* 306:496–499.

[DOI: 10.1126/science.1094492]

Shows that adults without access to a count list succeed at exact numerical judgments for magnitudes smaller than four and at approximate numerical judgments for larger magnitudes but are unable to manipulate or represent large exact numerical magnitudes.

Pica, Pierre, C. Lemer, Véronique Izard, and Stanislas Dehaene. 2004. Exact and approximate arithmetic in an Amazonian indigene group. *Science* 306:499–503.

[DOI: 10.1126/science.1102085]

Shows that adult speakers of a language containing few number words can successfully perform nonverbal, approximate numerical tasks but fail to make accurate exact numerical judgments.

Spaepen, Elizabeth, Marie Coppola, Elizabeth S. Spelke, Susan Carey, and Susan Goldin-Meadow. 2011. Number without a language model. *Proceedings of the National Academy of Sciences* 108.8: 3163–3168.

[DOI: 10.1073/pnas.1015975108]

A study of home signers, deaf individuals who never learned a natural language but developed their own system of communication via hand signs. When tested on a series of number tasks, home signers lacked a symbolic count list to represent large exact numbers but could use signs (fingers) to represent numbers approximately.

SPACE

Being able to reason about directions and locate entities in our environment is essential in our everyday life. One would therefore believe that how we talk about space ought to be a straightforward reflection of our spatial concepts. However, languages differ in the way they partition the continuum of spatial relationships into semantic categories. The semantic categories of one language may overlap or crosscut categories of another language, and in some cases the semantic categories available in one language may be entirely absent in another language. The observations of cross-linguistic variations have led researchers to question what conceptual structures support language acquisition and language use and to explore whether language learning might involve the creation of new spatial concepts. Additionally, would habitual attention to language-specific differences, whether for learning or speaking the language, eventually lead different language speakers to conceptualize and categorize spatial relations differently? These questions are discussed in many papers showcased in Bloom, et al. 1996 that subsequently led to many case studies in this domain. Four prominent case studies in the domain of spatial relations are referenced in the subsections Tight-Fit, Loose-Fit, Path-Manner, Frames of Reference, and Reorientation.

Bloom, Paul, Mary A. Peterson, Lynn Nadel, and Merrill F. Garrett, eds. 1996. *Language and space*. Cambridge, MA: MIT Press.

A collection of papers from leading researchers asking how space is represented in the mind and in language, how language maps onto spatial cognition, and what roles language and culture play in our conception of space.

Tight-Fit, Loose-Fit

In English we describe events such as “putting a Lego on a Lego stack” and “putting a block on another block” as events of “put on.” For events such as “putting a cassette tape into its container,” we use the phrase “put in.” However, instead of or in addition to lexicalizing support and containment relations, other languages might focus other aspects of the event. For example, Korean focuses on tightness-of-fit relations, so that “putting a cassette tape into its container” and “putting a Lego on a Lego stack” are categorized as similar events with the verb *kkita*, “to fit tightly,” while using a different verb, *nohta*, “to place on a flat surface,” to describe “putting a block on another block.” Given these differences, researchers have tracked English and Korean speakers’ abilities to categorize events linguistically and nonlinguistically in terms of containment-support or tightness-of-fit relations. Hespos and Spelke 2004 and Norbury, et al. 2008 are representative of studies examining English and Korean speakers’ categorization behaviors. For summary and literature review,

see Bowerman and Choi 2003 and Casasola 2008.

Bowerman, Melissa, and Soonja Choi. 2003. Space under construction: Language specific spatial categorization in first language acquisition. In *Language in mind: Advances in the study of language and cognition*. Edited by Dedre Gentner and Susan Goldin-Meadow, 387–428. Cambridge, MA: MIT Press.

Reviews and discusses mechanisms by which children come to acquire the lexical pattern of their language, drawing on the Korean–English difference as an example.

Casasola, Marianella. 2008. The development of infants' spatial categories. *Current Directions in Psychological Science* 17:21–25.

[DOI: 10.1111/j.1467-8721.2008.00541.x]

A review of infants' developments of spatial abilities, how they build categories, and how language learning shapes category formation. Focuses on tight versus loose, containment versus support as test cases.

Hespos, Susan J., and Elizabeth S. Spelke. 2004. Conceptual precursors to language. *Nature* 430:453–456.

[DOI: 10.1038/nature02634]

Five-month-old infants in an English-speaking environment, in contrast to English-speaking adults, were found to be sensitive to the tight versus loose distinction typically marked in Korean and not in English. Authors argue that tight versus loose contrast is universally available to infants, allowing them to learn languages such as Korean. However, sensitivity to the distinction diminishes if it is not marked in one's language.

Norbury, Heather M., S. R. Waxman, and H. Song. 2008. Tight and loose are not created equal: An asymmetry underlying the representation of fit in English and Korean speakers. *Cognition* 109:316–325.

[DOI: 10.1016/j.cognition.2008.07.019]

Questions the assumption that the dimension of fit (tight versus loose) is symmetrical and finds that both English and Korean speakers are more likely to notice and categorize events by tight versus loose when tight events are first demonstrated than when loose events are first demonstrated.

Path-Manner

All languages have some means of encoding motion in terms of the path (or trajectory) of a figure object in relation to a ground object or the manner (or fashion) of movement of the figure object. Languages, however,

differ in how path and manner information is lexically or grammatically realized. Path languages (e.g., Greek, Spanish) typically encode path information in the verb and the manner as an adverbial phrase (e.g., "The bottle entered the cave floatingly"). Manner languages (e.g., English, German) typically encode manner information in the verb and path information as prepositional phrases (e.g., "The bottle floated into the cave"). Many researchers agree that at the onset of language learning, children can abstract path and manner information (see Göksun, et al. 2009 for review). However, more contentious is whether the type of language one learns (path or manner) comes to direct its speakers' attention to the aspects of an event that their language encodes, influencing how they construe and remember events. So would a manner-language speaker remember the manner of motion better than a path-language speaker would, whose language optionally encodes manner with an adverbial phrase? Some researchers believe the answer is "yes" (Slobin 2003; Kersten, et al. 2010), while others believe the answer is "no" (Gennari, et al. 2002; Papafragou, et al. 2006; Papafragou, et al. 2008)

Gennari, Silvia P., Steven A. Sloman, Barbara C. Malt, and Tecumseh Fitch. 2002. Motion events in language and cognition. *Cognition* 83:49–79.

[DOI: 10.1016/S0010-0277(01)00166-4]

Spanish and English speakers were tested for their recognition memory and similarity judgment of events. The two groups did not differ in their recognition memory, whether they described the events or not while watching. However, similarity judgment was affected; those who described the events were more likely to group events as similar on the basis of their language.

Göksun, Tilbe, Kathy Hirsh-Pasek, and Roberta M. Golinkoff. 2009. Trading spaces: Carving up events for learning language. *Perspectives on Psychological Science* 5:33–42.

[DOI: 10.1177/1745691609356783]

A literature review on infants' conceptual development, how they come to learn language-specific patterns for talking about events, and how language comes to shape their attention to aspects of events. Discusses components of events (containment-support, path-manner, source-goal, figure-ground) that infants must process.

Kersten, Alan W., Julia Lechuga, Justin S. Alberechtsen, Christian A. Meissner, Bennett L. Schwartz, and Adam Iglesias. 2010. English speakers attend more strongly than Spanish speakers to manner of motion when classifying novel objects and events. *Journal of Experimental Psychology* 139.4: 638–653.

In a category-learning task, Spanish and English speakers were asked to sort animated novel objects. Figuring out whether manner or path was the basis of the categories was influenced by the language experience, with English speakers being able to hone in on the manner information more quickly than did Spanish speakers.

Papafragou, Anna, J. Hulbert, and J. Trueswell. 2008. Does language guide event perception? Evidence from eye movements. *Cognition* 108:155–184.

[DOI: 10.1016/j.cognition.2008.02.007]

An eye-tracking study compared Greek and English speakers as they prepared to describe an event; participants' gaze focused on language-relevant information, supporting thinking for speaking. When asked to simply observe the event, participants' gazes did not differ cross-linguistically during the event but differed at the termination as they prepared for a memory test. Participants' gaze at termination focused on information not easily encoded in their language.

Papafragou, Anna, Christine Massey, and Lila Gleitman. 2006. When English proposes what Greek presupposes: The cross-linguistic encoding of motion events. *Cognition* 98:B75–B87.

Greek speakers were more likely to include manner information when speaking about scenes for which manner of motion is not easily inferable, suggesting that Greek speakers are implicitly noting the manner of motion even though their language favors the use of path verbs.

Slobin, Dan I. 2003. Language and thought online: Cognitive consequences of linguistic relativity. In *Language in mind: Advances in the investigation of language and thought*. Edited by Dedre Gentner and Susan Goldin-Meadow, 157–191. Cambridge, MA: MIT Press.

Introduces the path versus manner distinction with cross-linguistic data of language use from various sources (e.g., descriptions of picture stories, text, translations) and provides a framework for thinking about how language can influence cognition.

Frames of Reference

Languages vary in their stock of spatial frames of reference terms or coordinate systems for indicating directions and locations of objects. Some languages, like English or Dutch, prefer body-defined terms ("left-right"). Others, like Hai||om or Tseltal, prefer environment-defined terms ("north-south") (see Levinson 2003 for review). Researchers asked whether practice from language use results in greater facility and preference for language-congruent strategies over language-incongruent ones. For example, are Tseltal speakers better at reasoning about absolute space than are English speakers, who might prefer their own body or perspective instead? In support, Stephen C. Levinson and colleagues found that, when asked to re-create the "same" spatial array, Hai||om and Tseltal speakers encoded spatial relations between objects based on their geocentric orientation (e.g., north-south), whereas Dutch and English speakers focused on the positions of objects relative to their egocentric frame of reference—that is, left versus right (Levinson 2003; Majid, et al. 2004; Haun, et al. 2006). Other researchers, however, have questioned whether these tasks demonstrate linguistic relativity (Li and Gleitman 2002; Li, et al. 2011). Recent data on children's language acquisition and spatial reasoning might help resolve the debate (e.g., Haun, et al. 2006; Dasen and Mishra 2010).

Dasen, P. R., and Ramesh C. Mishra. 2010. *Development of geocentric spatial language and cognition*. Cambridge, UK: Cambridge Univ. Press.

[DOI: 10.1017/CBO9780511761058]

A cross-linguistic study of children's acquisition of geocentric language in relation to developments in performing nonverbal spatial tasks with considerations of the spatial environments and the sociocultural contexts in which children are learning the language.

Haun, Daniel B. M., Christina J. Rapold, Josep Call, Gabriele Janzen, and Stephen C. Levinson. 2006. Cognitive cladistics and cultural override in hominid spatial cognition. *Proceedings of the National Academy of Sciences of the United States of America* 103.46: 17568–17573.

[DOI: 10.1073/pnas.0607999103]

Nonhuman primates and children who have not fully acquired the linguistic frames of reference are better at solving tasks requiring geocentric than egocentric relations. However, after the acquisition of language, Dutch (egocentric/relative) speakers are better at solving tasks requiring egocentric relations, while Hai||om (geocentric/absolute) speakers remain better at geocentric relations. The authors argue for a universal starting point but with language acquisition shaping spatial cognition.

Levinson, Stephen C. 2003. *Space in language and cognition: Explorations in cognitive diversity*. Cambridge, UK: Cambridge Univ. Press.

[DOI: 10.1017/CBO9780511613609]

An extensive review of the author's and his colleagues' work documenting linguistic differences and its consequential effects on how people encode and recall spatial relationships.

Li, Peggy, Linda Abarbanell, Lila Gleitman, and Anna Papafragou. 2011. Spatial reasoning in Tenejapan Mayans. *Cognition* 120:33–53.

[DOI: 10.1016/j.cognition.2011.02.012]

Could pragmatic inferences—considerations of how participants' communities customarily talk about space—account for why speakers re-create spatial arrays differently and in a language-congruent manner? Consistent with this, when tasks are not open-ended, Tseltal participants do not prefer or show greater facility in responding in a language-congruent manner when performing spatial tasks.

Li, Peggy, and Lila Gleitman. 2002. Turning the tables: Language and spatial reasoning. *Cognition* 83:265–294.

[DOI: 10.1016/S0010-0277(02)00009-4]

This paper questions the linguistic relativity claims of prior studies that report that speakers preferred

to re-create spatial arrays using language-congruent frames of reference. New experiments show that English speakers flexibly switch away from language-congruent frames of reference under certain testing contexts. The authors argue for language-independent cognitive flexibility and environmental effects on spatial reasoning and spatial language use.

Majid, Asifa, Melissa Bowerman, Sotaro Kita, Daniel Haun, and Stephen C. Levinson. 2004. Can language restructure cognition? The case for space. *Trends in Cognitive Science* 8.3: 108–114.

[DOI: 10.1016/j.tics.2004.01.003]

Reviews data collected by the Max Planck Institute at Nijmegen, The Netherlands, on a series of spatial tasks in support of spatial reasoning skills covarying with language.

Reorientation

Reorientation pertains to the ability to "reorient" or find one's bearings after being lost or disoriented. Researchers noted a phenomenon in which toddlers and animals instinctively use geometric information (shape of a room) when reorienting. However, these creatures fail to incorporate nongeometric features. When an object is hidden in one corner of a rectangular room (e.g., long wall to the left and short wall to the right), toddlers search the geometrically equivalent corners. However, when a colored wall differentiates the corners, toddlers fail to use color information and again search equally in either geometrically equivalent corner. Use of wall color is linked to children's emerging ability to talk about relations of objects with "left" and "right." Some researchers suggest this is a paradigmatic example of language serving as a means to combine information from two encapsulated modules with dedicated processes (i.e., one that is sensitive to geometric information and another that is sensitive to features of objects), resulting in a richer representation. Shusterman and Spelke 2005 provides a review of research supporting this position, while Newcombe and Ratcliff 2007 provides a critique of it. New experiments are being conducted that bear on this debate (e.g., Pyers, et al. 2010).

Newcombe, Nora S., and Kristin R. Ratliff. 2007. Explaining the development of spatial reorientation: Modularity-plus-language versus the emergence of adaptive combination. In *The emerging spatial mind*. Edited by Jodie M. Plumert and John P. Spencer, 53–76. New York: Oxford Univ. Press.

A critique of the view that language serves as a means for flexibly combining geometric representations and landmark representations in the case of reorientation. Instead, the authors favor the adaptive combination view that both landmarks/objects and geometry are processed by the same underlying mechanism and information about landmarks and geometry are weighed according to experience of their validity.

Pyers, Jennie E., Anna Shusterman, Ann Senghas, Elizabeth S. Spelke, and Karen Emmorey. 2010.

Evidence from an emerging sign language reveals that language supports spatial cognition. ***Proceedings of the National Academy of Sciences*** **107.27: 12116–12120.**

[DOI: 10.1073/pnas.0914044107]

Supports the view that spatial language underpins spatial cognition by demonstrating that adults with no knowledge of the words “left” and “right” fail to locate hidden objects after being spatially disoriented at significantly higher rates than do speakers with knowledge of the words “left” and “right.”

Shusterman, Anna, and Elizabeth S. Spelke. 2005. Language and the development of spatial reasoning. In ***The innate mind: Structure and contents*****. Edited by Peter Carruthers, S. Laurence, and S. Stich, 89–106. New York: Oxford Univ. Press.**

A review of the human and nonhuman spatial navigation and reorientation literature that provides evidence for nonverbal and species-general systems for navigation and describes how human language modifies and enhances these systems.

TIME

Studies from this literature ask whether differences in the symbolic systems used to express time might affect how people reason about it. For example, Kelly, et al. 1999 explores languages in which the order of the months and days of the week are made transparent through the use of explicit numbering (January = “month one,” February = “month two”) and whether speakers of such languages can more easily compute questions regarding the passage of time. Other studies have examined languages that express time using words like “before” and “after,” which can be used to describe horizontal spatial relations or, alternatively, languages that use words like “up” and “down,” which can describe a vertical axis of space (compare Boroditsky 2001 and January and Kako 2007). In yet other studies, researchers compared languages that prefer space-congruent adjectives (“long time”) to languages that prefer quantity-congruent adjectives (“much time”) in talking about time (see Casasanto 2010 for review). In each case, effects of such language on the perception of time and its relation to space have been explored. Recent work, such as Srinivasan and Carey 2010, has examined infants’ prelinguistic organization of time and how this relates to space to test the idea that linguistic metaphor derives from prelinguistic relations between different modalities.

Boroditsky, Lera. 2001. Does language shape thought? English and Mandarin speakers’ conceptions of time. ***Cognitive Psychology*** **43.1: 1–22.**

[DOI: 10.1006/cogp.2001.0748]

Building on previous work showing that spatial primes can influence temporal judgments, this paper shows that speakers of English, who talk about time using horizontal spatial metaphors, differ from speakers of Mandarin, who talk about time using vertical spatial metaphors in which spatial primes influenced temporal judgments.

Casasanto, Daniel. 2010. Space for thinking. In *Language, cognition, and space: State of the art and new directions*. Edited by Vyvyan Evans and Paul Chilton, 453–478. London: Equinox.

A review of spatial metaphors in talk about time and of studies showing language-specific patterns of metaphor use affect judgments of elapsed time. When judging the time it takes to draw a line, English speakers were influenced by the length of the line, and when judging the time it takes to fill a tank, Greek speakers were influenced by the amount in the tank.

January, David, and Edward Kako. 2007. Re-evaluating evidence for linguistic relativity: Reply to Boroditsky (2001). *Cognition* 104.2: 417–426.

[DOI: 10.1016/j.cognition.2006.07.008]

Six experiments that fail to replicate Boroditsky 2001.

Kelly, Melissa K., Kevin F. Miller, Ge Fang, and Gary Feng. 1999. When days are numbered: Calendar structure and the development of calendar processing in English and Chinese. *Journal of Experimental Child Psychology* 73.4: 289–314.

[DOI: 10.1006/jecp.1999.2503]

Reports that Chinese speakers (children and adults) were faster in responding than English speakers when asked to name the month or day a specified length of time from a given time. Chinese speakers primarily used numbers to calculate their answers, while English speakers primarily resorted to reciting names.

Srinivasan, Mahesh, and Susan Carey. 2010. The long and the short of it: On the nature and origin of functional overlap between representations of space and time. *Cognition* 116.2: 217–241.

[DOI: 10.1016/j.cognition.2010.05.005]

Reports that adults and prelinguistic infants are better able to notice relations between spatial length and temporal duration than between spatial length and loudness. Based on the infant finding, the study concludes that this difference does not result from a metaphorical restructuring of time by language but instead reflects an evolutionarily ancient recycling of spatial representations to reason about time.

THEORY OF MIND

Theory of mind involves the ability to attribute mental states (e.g., beliefs, intents, knowledge, etc.) to oneself and to others to predict and understand behavior. Linguistic relativity research has focused on how learning words like “think,” “know,” and “believe” (and their correlated syntactic structures) affects theory of mind development. Although some researchers suggest that prelinguistic children have sophisticated theory of mind abilities (see Baillargeon, et al. 2010 for a review of infant studies), many studies show correlations

between children's language skills and their ability to pass a false-belief task. See Astington and Baird 2005 for a collection of papers proposing various relations between language and theory of mind development. Some researchers have argued that learning a specific linguistic construction, the sentential complement (e.g., "Sarah thinks that Santa Claus is real"), could lead to improvements in false-belief understanding, since mental-state verbs are used in similar structures (see de Villiers and de Villiers 2000). Many studies in this area use unique populations to further understand the role of language in false-belief understanding, including studies of late language learners and speakers of Nicaraguan Sign Language (e.g., Pyers and Senghas 2009).

Astington, Janet W., and Jodie A. Baird, eds. 2005. *Why language matters for theory of mind*. New York: Oxford Univ. Press.

This collection of papers discusses the role of language in theory of mind. Topics include the importance of communication and social understanding in promoting theory of mind, the possible roles of learning the semantics of mental state terms or of learning syntax in driving theory of mind development, and how environmental and genetic factors might affect development.

Baillargeon, Renée, Rose M. Scott, and Zijing He. 2010. False-belief understanding in infants. *Trends in Cognitive Science* 14.3: 110–118.

[DOI: 10.1016/j.tics.2009.12.006]

Argues that false-belief understanding ability is present in prelinguistic infants by reviewing studies showing that infants can pass "spontaneous-response" versions of false-belief tasks and offers an account of why older children fail traditional "elicited-response" versions of false-belief tasks.

de Villiers, J. G., and P. A. de Villiers. 2000. Linguistic determinism and the understanding of false beliefs. In *Children's reasoning and the mind*. Edited by Peter Mitchell and Kevin J. Riggs, 189–226. Hove, UK: Psychology Press.

This paper considers possible interactions between language and theory of mind, favoring the acquisition of sentential complements as the driving force for developing false-belief understanding. Evidence for this position comes from longitudinal studies that show that the emergence of sentential complements in acquisition predicts improvement in false-belief understanding and from correlational studies that find that deaf children with linguistic delays also are delayed in false-belief understanding.

Pyers, Jennie, and Ann Senghas. 2009. Language promotes false-belief understanding: Evidence from Nicaraguan Sign Language. *Psychological Science* 20:805–812.

[DOI: 10.1111/j.1467-9280.2009.02377.x]

Studies examined false-belief understanding in deaf adult signers of Nicaraguan Sign Language, an emerging sign language. Those adults who had a high mental-state vocabulary performed better on

false-belief tasks than those with a low mental-state vocabulary. Over the course of two years, those who improved in mental-state vocabulary also improved on false-belief tasks. The authors argue that language learning drives the development of theory of mind.

GRAMMATICAL GENDER

Many languages (e.g., Spanish, German) have systems of classifying nouns by gender. Nouns are assigned to feminine or masculine gender or sometimes neuter. The classification of nouns is typically arbitrary. For example, in Spanish bridges, violins, and clocks are assigned masculine gender, while in German the same words are assigned feminine gender. Researchers have asked whether learning these language-specific classifications causes speakers to think about objects differently. For example, are bridges perceived as more masculine by speakers of Spanish than by speakers of German? A wide range of methods has been used to explore this issue. For example, participants have been asked to assign feminine or masculine voices to objects (Sera, et al. 2002), to list adjectives that might describe objects (Boroditsky, et al. 2003), to judge similarities between sets of pictures (Vigliocco, et al. 2005), or to make inferences about biological genders of animals (Imai, et al. 2010).

Boroditsky, Lera, Lauren Schmidt, and Webb Phillips. 2003. Sex, syntax, and semantics. In *Language in mind: Advances in the study of language and thought*. Edited by Dedre Gentner and Susan Goldin-Meadow, 61–79. Cambridge, MA: MIT Press.

Reviews the authors' experiments showing how grammatical gender influences properties associated with objects, the ability to remember proper names, and judgments on similarities between objects.

Imai, Mutsumi, Lennart Schalk, Henrich Saalbach, and Hiroyuki Okada. 2010. Influence of grammatical gender on deductive reasoning about sex-specific properties of animals. In *Proceedings of the 32nd Annual Conference of the Cognitive Science Society*. Edited by S. Ohlsson and R. Catrambone, 1160–1165. Austin, TX: Cognitive Science Society.

Compared German and Japanese children and found learning a grammatical gender system affects children's inference about the biological properties of animals.

Sera, Maria, Chryle Elieff, James Forbes, Melissa Burch, Wanda Rodríguez, and Diane Poulin-Dubois. 2002. When language affects cognition and when it does not: An analysis of grammatical gender and classification. *Journal of Experimental Psychology: General* 131.3: 377–397.

[DOI: 10.1037/0096-3445.131.3.377]

Spanish and French speakers but not German speakers were more likely to assign male or female voice in congruence with grammatical gender. A connectionist model simulated and accounted for the findings.

Vigliocco, Gabriella, David P. Vinson, Federica Paganelli, and Katharina Dworzynski. 2005. Grammatical gender effects on cognition: Implications for language learning and language use. *Journal of Experimental Psychology: General* 134:501–520.

[DOI: 10.1037/0096-3445.134.4.501]

Proposed similarity and gender (shared linguistic context leads to inference of meaning similarity) and sex and gender (noted associations between gender and sex for nouns referring to humans get extended to other nouns) as two possible mechanisms by which grammatical gender may come to affect meaning. Data from speech errors and similarity judgment of nouns and pictures were used to support sex and gender account.

EMOTION

This literature explores how the experience of emotion differs as a function of culture and linguistic experience. Wierzbicka 1999 examines cross-linguistic differences and similarities in emotional language. Niemeier and Dirven 1997 presents different perspectives and approaches to the study of the language of emotions by researchers of various disciplines (anthropology, sociology, linguistics, psychology). Barrett, et al. 2007 offers new methodologies and data from psychology and neuroscience on effects of language on categorizing emotion.

Barrett, Lisa Feldman, Kristen Lindquist, and M. Gendron. 2007. Language as a context for emotion perception. *Trends in Cognitive Science* 11:327–332.

[DOI: 10.1016/j.tics.2007.06.003]

The authors propose a language-as-context view, which suggests that language functions as a context in emotion perception.

Niemeier, Susanne, and René Dirven, eds. 1997. *The language of emotions: Conceptualization, expression, and theoretical foundation*. Amsterdam: John Benjamins.

A volume divided into four topic areas: theoretical issues in the analysis of emotions, the conceptualization of emotions in specific cultures, the acquisition of the emotion language and its relation to the experience of emotions, and the use of emotional language in text and discourse.

Wierzbicka, Anna. 1999. *Emotions across languages and cultures: Diversity and universals*. Cambridge, UK: Cambridge Univ. Press.

[DOI: 10.1017/CBO9780511521256]

This book offers a framework for the analysis of emotional language and identifies cross-cultural universals and variations.

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