

# Linguistic Relativity

## *From Whorf to Now*

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### **1 Who's afraid of Benjamin Whorf? Some controversial ideas about the relation between language, meaning, and thought – and why they are controversial**

Brown (1976, 128) introduced a widely adopted distinction between “strong” and “weak” interpretations of the LRH:

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- (1) *LRH, weak interpretation*  
Structural differences between language systems will, in general, be paralleled by nonlinguistic cognitive differences, of an unspecified sort, in the native speakers of the two languages.
- (2) *LRH, strong interpretation*  
The structure of anyone's native language strongly influences or fully determines the worldview he will acquire as he learns the language.

In general, the debate about **language-on-thought** (LoT) effects – causal effects from language and speech on cognition (and in the narrow sense, specifically on nonlinguistic cognition) – has focused on effects caused by aspects of the semantic system of natural languages, regardless of whether these are expressed by functional categories, syntactic constructions, or lexical items. This is also my focus here. It is worth noting, however, that other kinds of causal effects from language on cognition have been investigated, and the existence of such effects is far less controversial. Thus, it is well established that the phonology of the languages one habitually speaks can influence one's perception of speech sounds, including both the sounds of the same as well as those of other languages. Languages that have been acquired as first languages appear to play a particularly strong role in influencing perception. For instance, speakers of languages that phonologically distinguish between /l/ and /r/, such as English, seem to generally categorize these sounds more accurately than speakers of languages such as Japanese, in which they are allophones of a single phoneme (Miyawaki et al. 1975). Similarly, speakers of tone languages seem to perceive tones more accurately than speakers of languages without phonemic tone, although L1 tone systems can also interfere with the perception of non-L1 systems (Huang and Johnson 2010; Hume and Johnson 2001).

In addition, we routinely assign people to social identity categories on the basis of the languages they speak (Gumperz 1958; Purnell, Idsardi, and Baugh 1999; Irvine and Gal 2000; Buchholtz and Hall 2004; inter alia). These identity categories influence social attitudes and the essentialist attribution of various behavioral traits. Such categories are also self-attributed, and they are language- and culture-specific. Since we self-identify socially partly on the basis of the languages we speak, and use these to express allegiances with some social groups while distancing ourselves from others, the languages we speak *correlate* with how we perceive members of particular social groups. Correlation, however, is a necessary, but insufficient, criterion for causation. Here we encounter one of the principal questions that have dogged the debate about LoT effects: in what sense can language ever be said to play a causal role in any nonlinguistic behavior? I examine this question below. Figure 1 provides an overview of various different types of hypothetical LoT effects. The effects of language on *linguistic* cognition – language-on-language (LoL) effects – represented by the left branch from the top are discussed in section 3.3.<sup>1</sup>

Assuming Brown's characterizations concern only LoT effects in the narrow sense of effects of semantic/pragmatic categorization on nonlinguistic cognition, they may thus be paraphrased as follows:

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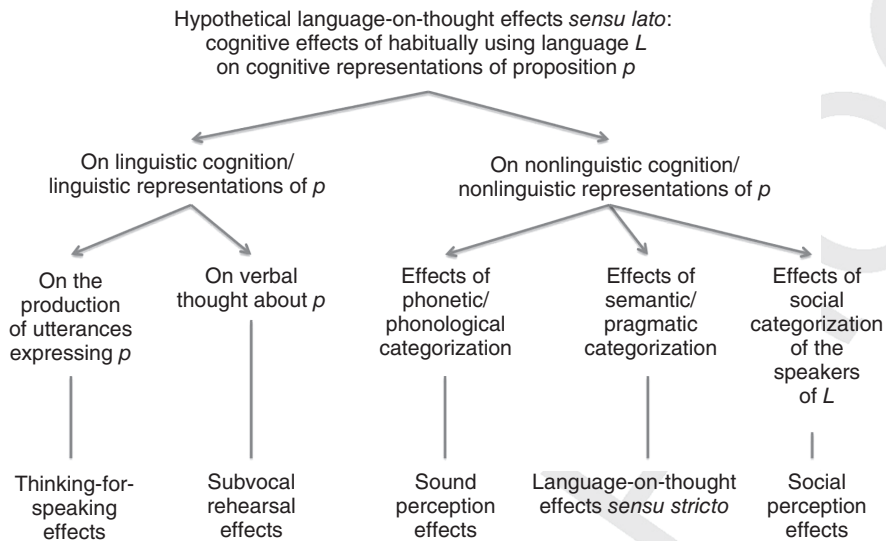


Figure 1 A classification of LoT effects

- (1') *LRH, weak interpretation*  
Language-specificity in the semantic/pragmatic system may cause differences in nonlinguistic cognition in speakers of different languages.
- (2') *LRH, strong interpretation*  
The semantic/pragmatic system of anyone's native language strongly influences or fully determines the worldview they will acquire as they learn the language.

While Whorf did not apparently intend to propose *any* version of the LRH – he instead argued for a “Relativity Principle” as a methodological principle in ethnographic studies (cf. Lee 1996) – there are clear indications that he considered a strong version to be true (cf. section 3.2 below). In contrast, the so-called “neo-Whorfian” paradigm launched by Lucy (1992a; with precursors including Kay and Kempton 1984) has concerned itself exclusively with experimental tests of weak versions. None of its proponents have argued for strong versions. However, their ideas seem to have in some cases been received under this interpretation, a misconception that was presumably aided by the neo-Whorfian scholars in question choosing not to explicitly distance their proposals from strong interpretations of the LRH. Since the notion of “worldview” is difficult to operationalize in the terms of contemporary cognitive psychology, it is not even immediately obvious how a test of strong versions of the LRH might proceed.

All versions of the LRH involve a conjunction of two propositions. The first of these postulates the existence of (possible) causal effects from language on non-linguistic cognition, while the second holds that the particular triggers of such effects may be language-specific; that is, they may occur in some languages but not in others, or may be more prevalent in some languages than in others. Many

linguists, philosophers, and psychologists embrace the first of these propositions, but reject the second, and therefore the LRH. For instance, Carruthers (2002) argues that language affords a-modal cognitive representations and therefore is a cognitive system particularly well suited for reasoning that integrates information from different sensory modalities. De Villiers and de Villiers (2000; 2002) and de Villiers and Pyers (2002) have suggested that syntactic complementation plays an important role in supporting reasoning about false beliefs. Jackendoff (1987; 1996) has hypothesized that the capability of encoding thought in perceivable phonological form may be a key ingredient in consciousness. And a long line of studies has demonstrated the impact of verbal descriptors on recall memory, going back as far as Carmichael, Hogan, and Walter (1932). Effects on witness testimony have been studied by Loftus (1974; 1975), Loftus and Palmer (1974), Loftus and Zanni (1975), and more recently by Fausey and Boroditsky (2010). But these kinds of effects are presumably universal, in the sense that all fully-fledged<sup>2</sup> natural languages likely have triggers.<sup>3</sup> And the proposals and hypotheses of these authors therefore do not entail any version of the LRH (which Carruthers 2002, for example, explicitly rejects). Conversely, students of crosslinguistic variation in semantics do not necessarily hold the LRH to be true. An example of a scholar who strongly endorses the study of culture-specificity in semantic systems, yet simultaneously is an outspoken detractor of the LRH, is Harrison (2007, 184).

The remainder of this chapter is organized as follows. Section 2 examines the history of the debate over the LRH. Section 3 surveys the major lines of investigation revolving around or connected to the LRH and the landmark studies that have found evidence of thinking-for-speaking (TfS) and LoT effects. Section 4 reviews some prominent recent failures of finding support for the LRH. Section 5 concludes.

## 2 Language, thought, and the evolving reception of the LRH

It is often said that the LRH predates Whorf. Sapir, Boas, and Humboldt are commonly cited as precursors. However, while these scholars seem to have indeed considered language to play a key role in thought, and thought therefore to be language-specific, they also seem to have understood thought primarily as verbal reasoning, much as (even contemporary) philosophers might view it. If thought is understood as a form of internal language use, then LoT effects are never more than **thinking-for-speaking** (TfS) (Slobin 1987; 1996; 2003) effects; that is, causal effects from the grammar and lexicon of a language on the production of utterances in that language. This contrasts with the much broader contemporary notion of “cognition,” which covers any kind of generation and processing of representations of internal states and/or the environment by biological or artificial systems. Cognition in this sense extends to the “peripheral” systems of motor control, the various modalities of sensory perception, and language itself. The transfer and translation of information between these systems is afforded by “central” systems, which are also assumed to support the processes of reasoning and consciousness that constitute thought in the traditional sense. But to what extent these central

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systems rely on symbolic representations with a language-like algebraic structure, schematic iconic representations closer to the perceptual systems, or a combination of the two types of representations is an open and empirical question. In this historic context of the foundational assumptions of cognitive science – the “cognitive paradigm” – the LRH takes on a meaning that it could not have had for Whorf and his precursors even if they had viewed (or did view) relativism as an empirical hypothesis: the question of the extent to which any kind of representations and processes of nonverbal cognition are influenced by the language(s) “housed” in the mind-brains that generate these representations and processes.<sup>4</sup>

The tides of interest in the LRH have followed closely the evolution of the relation between cultural anthropology and the cognitive sciences. During the formative period of cognitive science, there was much interest in the new perspectives on the study of culture afforded by the cognitive paradigm. A flurry of studies of the LRH by both anthropologists and psychologists was part and parcel of this interest in the nexus between culture and cognition. Later, this early boom gave way to alienation in response to the rise of the dominant rationalist and nativist paradigm in linguistics and psychology. Concomitantly, work in semantic typology (cf. section 3.1) – especially Berlin and Kay (1969) – reported evidence of a possibility space for crosslinguistic variation that seemed much smaller than what had been assumed in the days of Sapir and Whorf. This trend reversed itself again in the 1990s, thanks to a renewed interest in crosslinguistic variation and a realization that the early reports of uniformity had been somewhat overstated.

Resistance to the LRH has been fueled by four factors:

- i. Strong interpretations of the LRH are difficult to reconcile with the contemporary view of cognition as a (computationally more or less modular) representational system encompassing faculties from motor control and perception to language (cf. section 1).
- ii. The dominant paradigm in cognitive science since the 1960s postulates an innate core to cognition. Even under weak interpretations of the LRH, every Whorfian effect entails an element of language/culture-specificity of some aspect of cognition and thus reduces the hypothetical domain of the innate core.
- iii. Conversely, much interest in the LRH has been motivated by the question of the role of culture in cognition. However, many scholars view the search for evidence of culture-specificity in cognition with reservations, among other things because they see it as potentially in conflict with the postulate of the “Psychic Unity of Mankind” (Bastian 1860), a tenet that has informed much research in the social and behavioral sciences since the early twentieth century.
- iv. The potential existence of *any* bias in cognition, be it introduced by language, culture, or any other factor, undermines “naive realism” (Ross and Ward 1996) and becomes a potential complicating factor for scientific realism by generating support for factual (epistemic) relativism.

At least some of these attitudes – notably (ii) and (iii) – are currently coming under reexamination as evidence in support of weak interpretations of the LRH has

been mounting. This development can be seen as part of a much larger slow-moving empiricist turn that has been affecting the cognitive sciences at large since approximately the 1990s. The role of the neo-Whorfian paradigm in this empiricist turn is explored further in section 5.

### 3 Effects from what on what?

This section attempts a classification of some of the ways in which language has been argued to influence nonlinguistic cognition. These effects should not be thought of as mutually exclusive, but on the contrary as generally conspiring. Consider Figure 2 and Figure 3 for an illustration of the relations among some of these putative effects. These diagrams presuppose that all LoT effects in the narrow sense are rooted in language-specific properties of semantics and pragmatics affecting nonlinguistic cognitive categorization. Such differences in semantic categorization are discussed in section 3.1. Language-specific properties of the semantic/pragmatic system are predicted to potentially affect the formation of conceptual categories especially during first and second language acquisition and language change. This would imbue language use, and via it language itself in the sense of grammars and lexicons, with the power to serve as conduits of the cultural transmission and diffusion of conceptual distinctions. Figure 2 focuses on this external, cultural perspective on LoT effects. The hypothetical role of language in conceptual development and the cultural transmission of cognitive practices is the topic of section 3.2.

Figure 3 focuses on the hypothetical processes involved in LoT effects inside the individual mind. The layout of the diagram is based on the speech production model of Levelt (1989), complemented by a parallel comprehension model. Comprehension and production are distinguished in Figure 3 because they must be

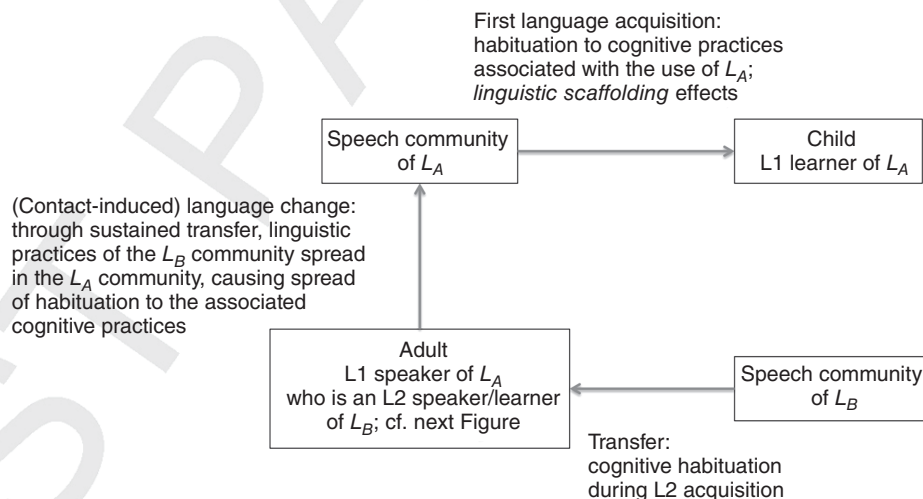


Figure 2 Some hypothetical LoT effects I: external perspective

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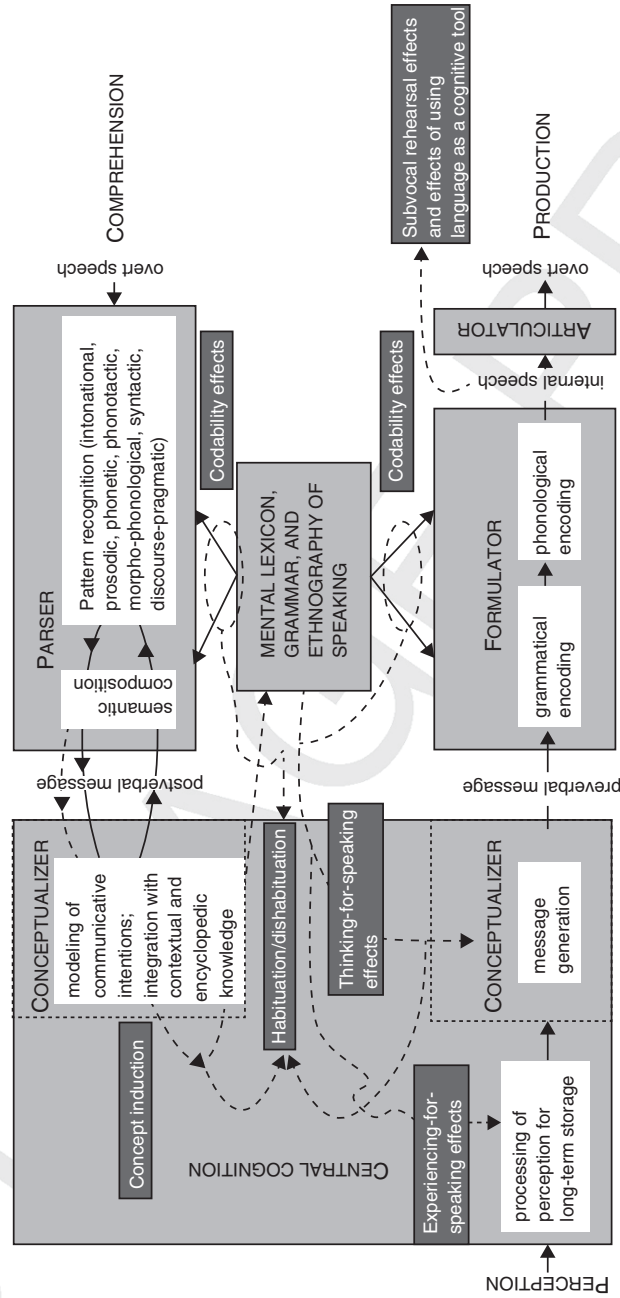


Figure 3 Some hypothetical LoT effects II: internal perspective (lighter shaded boxes and solid arrows – computational components of the speech processing system; darker shaded boxes and dashed arrows – proposed LoT effects)

assumed to have different causal efficacies in bringing about LoT effects: the comprehension system provides input to conceptual development via a process termed here “concept induction” (which strictly speaking involves both comprehension and production elements, although comprehension takes the lead; cf. section 3.1 (esp. Figure 4), and section 3.2) in Figure 3, while the production system generates TfS effects (cf. section 3.3). Both systems, however, also support the habituation of certain concepts and the dishabituation of others.

The “conceptualizer” is central cognition in its capacity of generating preverbal conceptual representations for the purpose of stepwise translation into not-yet-articulated internal linguistic representations, assembling the appropriate resources from the mental lexicon and grammar and the inventory of practices of language use of the speech community (the “mental ethnography of speaking” in Figure 3). In Figure 3, the same system is depicted as also rendering the conceptual evaluation of the output of the comprehension process. Codability effects relate to the relative complexity, frequency, and pragmatic status of the available expressions. These may influence the generation of the preverbal message during production, leading to TfS effects. TfS effects influence the association between states of affairs and the conceptual categories under which they are subsumed for the purposes of verbal encoding. Habituation then by hypothesis accustoms the speaker not only to activating particular linguistic categories to communicate about a state of affairs of the relevant kind, but also to conceptualizing this state of affairs in the relevant terms. Section 3.3 is dedicated to codability and TfS effects. It also considers codability constraints on the processing of experience for long-term memory, termed “experiencing-for-speaking” effects in Levinson (2003b, 301–307).

Lastly, the potential role of internal (pre-articulated) speech in nonlinguistic cognition has been invoked in the literature. Some experimental findings pointing toward LoT effects can be explained as effects of internal speech (“subvocal rehearsal”) rather than effects on nonlinguistic cognition. A closely related topic is the use of linguistic representations as tools during the processing of tasks of nonlinguistic cognition. Both issues are discussed in section 3.4.

### 3.1 The role of semantic categorization

The source of potential LoT effects in the narrow sense are language-specific properties of semantics and pragmatics. These are hypothesized to potentially influence the formation and habituation of conceptual categories during language use, including – but not restricted to – first and second language acquisition and language change. A useful perspective on such phenomena of language specificity is **semantic categorization**, the linguistic representation of a particular (type of) stimulus or referent in a given language. **Semantic typology** is the crosslinguistic study of semantic categorization.<sup>5</sup>

In order to compute a linguistic representation of some state of affairs, speakers and hearers negotiate the membership of the individuals and predicates involved in it in conceptual categories that have conventional labels or can be referred to compositionally. Consider example (3):



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- (3) A bee flew into the house.

The more obvious categorization choice points involved in (3) concern the animal, the activity it engages in, the location change caused by this activity, the building that defines the endpoint of this location change, and the spatial relation between the animal and the building at the culmination of the location change. And all of the categories involved are language-specific. A native speaker of Yucatec Maya might describe the same event saying something like (4):<sup>6</sup>

- (4) H-óok                    hun-túul    kàab    ich    le=nah=o'  
 PRV-enter(B3SG) one-CL.AN honey in DEF=house=D2  
 'A bee entered the house.'

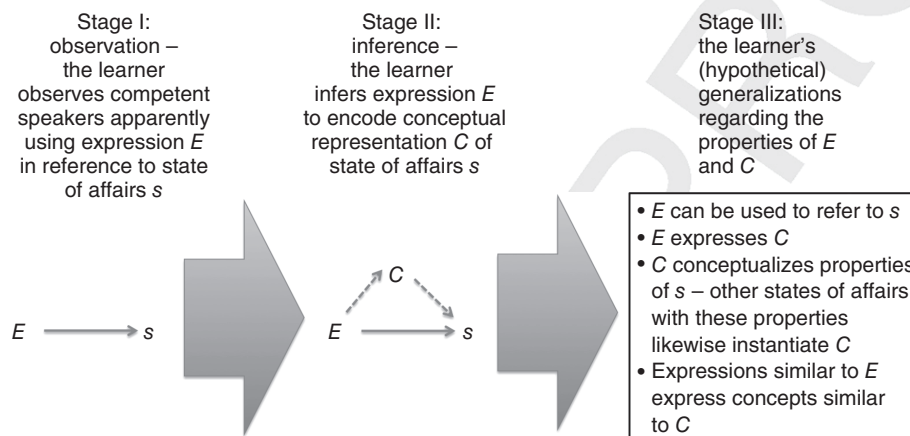
There is no reference to flying in (4). And the verb glossed 'enter' in (4) more literally means 'become inside'. The description in (4) would also be true of an event in which somebody placed a toy house over a motionless bee (Bohnenmeyer 2010). The noun used in reference to the bee is also used to refer to honey and beehives. According to one analysis (Lucy 1992b, 23–84), this and many other Yucatec nouns lexicalizing natural kinds are not polysemous, but rather (from an English perspective) underspecified, denoting substances such as "bee stuff/essence" rather than sets of individuals. Lastly, the preposition *ich* 'in' selects the inside of the house as a point of reference, but does not indicate whether this place marks the endpoint of a motion event, as in this case, or the beginning (*A bee flew out of the house*), some point in between (*A bee flew through the house*), or the location of an entity (*There is a bee in the house*) – all of these meanings can be expressed with the same preposition (Bohnenmeyer 2010).

There are further categorical differences between (3) and (4) that go beyond lexical meaning. Both languages use a distinct lexical category to label kinds of events. This lexical category is customarily identified as a verb by linguists working on both languages. However, the range of concepts lexicalized by verbs is somewhat narrower in Yucatec. There are no stative verbs in this language; meanings such as 'know' and 'love' are lexicalized in nouns (Bohnenmeyer 2002, 153–199). And the two verb categories also differ in their morphosyntactic properties. In English, the verb inflects for tense and aspect; in Yucatec, it inflects for aspect and mood. Yucatec is arguably a tenseless language. The past tense meaning suggested by the English translation of (4) is merely a conversational implicature (cf. Bohnemeyer 2002; 2009).

How might such differences in semantic categorization affect nonlinguistic cognition? Any answer to this question presupposes a consideration of the relationship between linguistic meaning and nonverbal thought in general. As depicted in Figure 3, utterances are produced as verbalizations of nonverbal conceptual representations and comprehended by computing nonverbal conceptual representations that interpret them. It is generally assumed that the same holds for the constituents of utterances down to the morphemic level. While *some* theories assume that the meaning of linguistic representations (utterances, phrases, words, and morphemes) is their mapping into internal conceptual

representations (e.g., Jackendoff 1983; 2002), *all* theories must assume that the meanings of linguistic representations and the content of the conceptual interpretations they map into are *consistent* with one another.

One principal hypothetical source of LoT effects is the process of **concept induction**. Assume that competent speakers of language  $L$  conventionally use expression  $E$  to refer to states of affairs of kind  $s$ , while entertaining conceptual representations of the form  $C$  to think about states of affairs of kind  $s$ . See Figure 4:



**Figure 4** Language learning and concept induction

A learner of  $L$  either already generates fully formed conceptual representations  $C$  of  $s$  or is in the process of learning to generate such conceptual representations. In the former case, she needs to discover the mapping between  $E$  and  $C$ . In the latter, she needs to acquire (i) the knowledge of how to generate  $C$ , (ii) the conventional meaning associated with  $E$  (to the extent that it is assumed not simply to be identical with  $C$ ), and (iii) the link between the two. Either way, her task requires her to infer certain properties of  $C$  from observing competent speakers of  $L$  using  $E$  in reference to instances of  $s$ . The evidence she can potentially draw on to accomplish this is the result of observations of any or all of the following:

- the situational contexts in which  $E$  is used, including in the simplest case the referent of  $E$  itself, but importantly also the observable behavior of the interlocutors and what it suggests about their communicative intentions;
- the discourse contexts in which  $E$  is used;
- the syntagmatic relations between  $E$  and other constituents of the utterances in which it occurs and what these suggest about the paradigmatic relations between  $E$  and other expressions of  $L$ .

For example, the fact that the preposition *ich* 'in' in (2) does not specify a path relation is straightforwardly inferable from its distribution: it heads prepositional phrases used in reference to events in which the designated containment relation comes about at the end of a motion event, but also events in which this relation obtains solely in the beginning and states in which a containment relation obtains

without change. This allows the conclusion that the concept that interprets this preposition in the minds of Yucatec speakers represents containment, but not motion or path.

The learner is thus able to derive inferences, from observations of linguistic interactions, regarding the concepts that members of the speech community of  $L$  generate or activate in their minds during the interactions. In Figure 4, this is represented by the separate associations the learner acquires listed in the box on the diagram's lower right side. This makes it possible in principle to also use the observation of utterances as a basis for learning new concepts, and thus for language to serve as a medium or conduit for the cultural transmission of concepts during first language acquisition and their diffusion during second language acquisition and language change. Actual studies that provide support for these hypothetical processes are discussed in section 3.2.

Concept induction is based not merely on the observation of utterances by competent members of the speech community, but also on observations of how community members react to the learner's own attempts at production. It thus involves both comprehension and production processes. The production side of concept induction is ignored in Figure 4 for the sake of simplicity, since comprehension must presumably take the lead in concept induction. It should also be stressed that concept induction based on the observation of language use is merely one source of evidence in concept learning. As far as the cultural transfer of conceptual knowledge is concerned, this presumably always involves inductive generalizations on the basis of observed behavior. Verbal behavior is merely one form of such observable behavior that may form the source of concept induction.

Many linguists and psychologists reject the hypothesis that language can serve to provide cues for concept learning. There are theories of the mind that largely or entirely deny the existence of conceptual development, postulating instead strict innateness of concepts – notably, Fodor (1975). However, as long as such theories draw a distinction between the concepts encoded in the genome of an individual and the concepts the individual actually has access to at a given moment in time, they are not necessarily incompatible with the hypothesis that language may influence conceptual accessibility. There are also influential theories of language acquisition and conceptual development that hold that the latter largely if not exclusively precedes semantic acquisition, and the learner's principal task during semantic acquisition consists in discovering the correct mapping between linguistic expressions and the concepts that interpret them (e.g., Piaget 1929; Pinker 1984; 1989; 2007). Such views by and large preclude the existence of LoT effects. Empirical evidence of conceptual development (whether or not it involves learning) proceeding to some extent in tandem with linguistic development is reviewed in section 3.2.

Beyond providing conceptualization cues, there is a second type of potential impact of categories of linguistic meaning onto categories of nonlinguistic cognition. If the production and comprehension of expression  $E$  in reference to state of affairs  $s$  involves the generation or activation of the concept  $C$ , then repeated use of  $E$  in reference to  $s$  will *habituate* speakers and hearers to generating/activating  $C$  and to thinking about  $s$  in terms of  $C$ . It will thus make them more accustomed

to, and more adept at, thinking about *s* in terms of *C*. And given the finite time an individual has at her disposal, habituation of *C* will be in competition with the habituation of alternative conceptual representations of *s*. In this manner, the use of *L* may come to reinforce and enhance certain cognitive practices in its speakers and to weaken others.<sup>7</sup> Evidence of habituation effects is discussed in the next section as well.<sup>8</sup>

### 3.2 Language, conceptual development, and cultural transfer

This section briefly reviews two series of studies that have led to the discovery of key empirical support for a role of language in cognitive development and the cultural transfer of cognitive practices.

Despite the central role that (first and second) language learning must be hypothesized to play in LoT effects, few empirical studies of the nexus between language learning and conceptual development have been carried out to date. This is hardly surprising, given the amount of effort such studies require, as they combine the inherent complexity of neo-Whorfian designs (both linguistic and cognitive tests performed on multiple populations) with the challenges of language acquisition research (multiple age groups or longitudinal observation), especially child language research (participants whose minds and communicative practices are more distinct from the researchers' than those of the adult members of any culture). If one of the study populations must be tested under field conditions – as tends to be the case with languages maximally different from European languages and cultures maximally different from Western culture – the demand level increases further.

Nevertheless, the role of typology in linguistic and cognitive development has been studied since the 1970s despite these obstacles. Bowerman (2011, 606–611) provides a brief overview. The volume edited by Bowerman and Levinson (2001) presents an earlier sample of studies. Perhaps the most influential series of studies that have probed the role of language in cognitive development is the work by Bowerman and Choi on the development of spatial semantics and cognition in children learning English and Korean (cf. also Gleitman and Papafragou 2012 for critical discussion). Choi and Bowerman (1991) present evidence of language specificity in how 17–20-month-olds spontaneously use placement descriptions: the English-learning toddlers distinguish between actions bringing about containment (*put in*) and support configurations (*put on*), whereas the Korean-learning infants distinguish between actions creating tight-fitting (*kitta* 'interlock', 'fit tightly') vs non-tight-fitting configurations (the latter are described by various verbs, including *nehta* 'put loosely in/around'). Subsequent elicited production (Bowerman 1996; Choi 1997) and comprehension studies (Choi et al. 1999) confirm the effect. McDonough, Choi, and Mandler (2003) then show that infants at 9, 11, and 14 months of age discriminate conceptually between tight-fit and loose-fit containment, regardless of whether they are growing up in an English-speaking or in a Korean-speaking environment. In contrast, adult speakers of Korean show much greater sensitivity to tightness of fit than do adult speakers of English. This finding is partially consistent with both the view of an innate basis of spatial cognition that children can rely on when embarking on

the task of language acquisition, and at the same time with that of language as a formative influence in conceptual development. However, in this case, rather than “molding”<sup>9</sup> categories of nonlinguistic cognition by providing linguistic cues for their formation, language seems to selectively reinforce certain prelinguistic cognitive distinctions by making use of them and dull others by failing to make use of them – effects of habituation and dishabituation. This is remarkably similar to how language-specific phonological distinctions have been found to selectively enhance the acuity of their perception in infants, while the perception of phonetic distinctions that do not have phonemic status in the languages children learn degrades (Kuhl 2004).

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However, the central flashpoint in the debate over the existence, nature, and distribution of LoT effects has become the role of language in the use of so-called spatial frames of reference (cf. “Spatial Prepositions”). **Spatial reference frames** are sets of axes that are used to define directions and regions of space with respect to an origin point in which they intersect. This origin point is most commonly the volumetric center of an object – the “figure” (i.e., theme) of a representation of orientation (5) or the/a “ground” or reference entity of a representation of location (6) or motion (7).<sup>10</sup> In the following examples, the figure is underlined and the ground bolded:

- (5) The chair is facing <sup>E</sup>left/<sup>G</sup>north/<sup>G</sup>(toward) THE WINDOW.
- (6) The ball is <sup>E/I</sup>left/<sup>G</sup>north/<sup>G</sup>toward THE WINDOW of/from **the chair**.
- (7) The ball rolled <sup>E/I</sup>to the left/<sup>G</sup>north/<sup>G</sup>toward THE WINDOW from **the chair**.

The superscripted indices refer to different types of frames. These can be distinguished in terms of the “anchor,” the entity or environmental feature after which the axes are modeled:<sup>11</sup> egocentric frames (E) are derived from the body of an observer, geocentric frames (G) from some entity or feature of the environment, and intrinsic frames (I) from the ground. The anchor is capitalized where it is explicitly mentioned in (5)–(7); but in most spatial representations, the anchor remains implicit. *E/I* in (6) and (7) indicates ambiguity (on Levinson’s 1996a; 2003b analysis) or underspecification (on the analysis proposed in Bohnemeyer 2012, which builds on Zwarts and Winter 2000).

What makes reference frames so interesting for the study of LoT effects is a combination of two properties: First, the types of frames used to interpret utterances such as (5)–(7) appear to serve this very same function with nonlinguistic representations of internal cognition. For instance, we may use the same egocentric, geocentric, or intrinsic coordinates to memorize the orientation of the chair and the location of the ball with respect to it (see below). And representations interpreted in these coordinate systems also demonstrably serve as the basis for inferences about spatial relations (Levelt 1984; 1996). And second, the use of the various frame types in certain domains is not uniform across populations. At the scale of geographic representations, all human populations appear to prefer geocentric frames. In contrast, for reference to small-scale space, Westerners are unaccustomed to using geocentric frames, preferring instead egocentric

frames, with intrinsic frames as a minor backup strategy. Until the 1970s, it was assumed that this distribution holds universally. Then reports began to surface of populations that (i) did not use egocentric frames at all or used them only as a minor strategy, and that (ii) either used geocentric frames across the board or used mostly intrinsic frames for small-scale space. This was first attested in Aboriginal Australia (Laughren 1978; Haviland 1979), then with indigenous populations of Mexico (Brown and Levinson 1992; 1993), and eventually with non-Western populations all over the world (see Bohnermeyer et al. 2015 and Majid et al. 2004 for overviews). Pederson et al. (1998) present the results of a series of so-called “referential communication” studies<sup>12</sup> and a recall memory experiment conducted with speakers of five unrelated languages: Arrernte (Pama-Nyungan, Australia), Dutch, Japanese, Longgu (Oceanic, Guadalcanal), and Tseltal (Maya, Mexico).<sup>13</sup> The recall memory task introduced the “array reconstruction” paradigm, which subsequently became a standard in research on the use of reference frames in nonverbal cognition: participants memorize arrays of toy animals and rebuild them from memory on a second table after 180° rotation. If the participants use an egocentric frame to memorize the orientation of the array and the order of the animals, the rebuilt array will be a mirror image of the original array. In contrast, if they use a geocentric frame, the rebuilt array will be related to the original by transposition, preserving the orientation of the array and the order of the animals vis-à-vis the environment. (No distinct response pattern is predicted in case an intrinsic frame is used.)<sup>14</sup> It was found that the members of the linguistically egocentric populations – Dutch and Japanese – strongly preferred memorizing the arrays egocentrically as well, whereas the members of the three linguistically geocentric populations strongly preferred geocentric encoding in the recall memory task. A host of subsequent studies has confirmed this alignment between linguistic and cognitive bias without exception (cf. Wassmann and Dasen 1998; Mishra, Dasen, and Niraula 2003; Haun et al. 2011; Li et al. 2011; Bohnermeyer et al. 2015).

As pointed out by Levinson (1996a; 2003b) and Pederson et al. (1998), it is hardly surprising that participants tend to use the same type of reference frame for memorizing a spatial configuration and for talking about it. Divergence between the frames used for these purposes generally requires encoding the information in both frames, as translation of a proposition from one frame type to another is impossible unless the location of figure and ground with respect to both anchors is known. Thus, the presumed driving force behind avoiding divergence is economy or efficiency.

The question is thus not why the linguistic and cognitive biases align; the question is what explains best which strategies the members of a given population converge on for the small-scale domain, given the large amount of cross-population variation. Two hypothetical accounts have emerged – two and a half if a perceived internal division within the relativist camp is taken into consideration:

- One group of Neo-Whorfians (Levinson 1996a; 2003b; Levinson et al. 2002; Pederson et al. 1998; Majid et al. 2004; Haun et al. 2011) have argued that language is a factor in shaping a community’s cognitive preferences in

spatial reference, as the linguistic behavior of competent community members provides learners with cues regarding which solutions are preferred and dispreferred by the members of the community at large and simultaneously with an opportunity to practice the application of the preferred strategy.

- A second group has argued for language as a factor as well, but has thought to distance their position from that of the first group, stressing that language is at most one factor among others in shaping cognitive frame use, not the sole factor and not necessarily the dominant one (Le Guen 2011; Mishra et al. 2003; Wassmann and Dasen 1998; *inter alia*). These authors thus attribute to the first set of scholars the reductionist view of language as the sole determinant, or at any rate an overwhelmingly powerful determinant, of nonlinguistic reference frame use, which would amount to an orthodox Whorfian rather than a neo-Whorfian position (cf. section 1).
- Li and Gleitman (2002) propose that all reference frame types may be innately available to members of all populations, and that the observed variation in biases in both linguistic and nonlinguistic tasks may be driven by nonlinguistic factors, in particular, literacy and education, topography and population density, and infrastructure. These variables vary greatly across populations and thus broadly co-vary with language, which on Li and Gleitman's proposal may be creating the illusion of a LoT effect. This position appears to be implicitly assumed and extended in Li et al. (2011) as well (cf. also section 4.1). Li and Gleitman also criticize the design of the recall memory study of Pederson et al. (1998) and subsequent work as "open-ended" and inviting second guessing of the goals of the experiment and covert LoL effects (cf. Levinson et al. 2002 for a response). Gleitman and Papafragou (2012) generalize this criticism to other studies that have reported evidence of LoT effects.

The perceived internecine rift in the neo-Whorfian camp is indeed largely a matter of perception, as no member of the first set of authors has ever claimed language to be the sole or even a necessary factor in reference frame selection. Particularly revealing in this regard is the discussion of geocentrically anchored gesture as a distinct semiotic system in Levinson (2003b, 244–271). Members of geocentric populations have been shown to tend to produce non-emblematic iconic gestures – gestural maps and event representations – that retain the orientation of the represented entities and actions vis-à-vis the environment (Haviland 1993; Le Guen 2011; Levinson 1996b). The geocentric alignment of these gestures is conspicuous above all due to the signer's frequent need to reorient their body. Anticipating Le Guen (2011), Levinson notes that children growing up in geocentric communities will be cued into the prevalence of geocentric frames in their cultures as much by observing older members gesture as by observing their speech.

However, there has been a conspicuous absence of disclaimers in the works of the first group of researchers that clearly distance their research from strong, "orthodox" interpretations of the LRH.<sup>15</sup> An exception is the following passage, in which Levinson (2003a) seems to suggest that even Whorf himself was no proponent of a strong version of the LRH.<sup>16</sup>

No one, not even Whorf, ever held that our thought was in the infernal grip of our language. Whorf's own idea was that certain grammatical patterns, through making obligatory semantic distinctions, *might* induce corresponding categories in habitual or non-reflective thought in just the relevant domains. (Levinson 2003a, 33; emphasis mine)

The question of the respective influence of language and the nonlinguistic variables proposed by Li and Gleitman (2002) in reference frame selection is currently being investigated by two large-scale collaborative research projects based at the University at Buffalo and funded by the National Science Foundation, "Spatial Language and Cognition in Mesoamerica" (BCS-0723694) and "Spatial Language and Cognition beyond Mesoamerica" (BCS-1053123). These studies apply designs similar to those used in much of the research on reference frame use in language and cognition to larger sets of populations and use multivariate statistical modeling to pit languages against the various alternative potential influences on reference frame use that have been discussed in the literature. Preliminary results published in Bohnemeyer et al. (2014; 2015) suggest that crosslinguistic variation in reference frame use in both language and nonverbal cognition can be attributed partially to cultural and environmental factors, but also that language remains an irreducible predictor of reference frame use even when those influences are factored in. In response to these findings, Bohnemeyer et al. (2015) propose the **Linguistic Transmission Hypothesis**, a hypothesis that complements weak versions of the LRH:

- (8) a. *Linguistic Transmission Hypothesis (LTH) – abstract formulation*  
Using any language or linguistic variety – independently of its structures – may facilitate the acquisition of cultural practices of nonlinguistic cognition shared among the speakers of the language.
- b. *Linguistic Transmission Hypothesis – concrete formulation*  
The comprehension of utterances may provide clues to the cognitive practices involved in their production, and both the comprehension and the production of utterances may afford habituation to these cognitive practices. The cognitive practices so acquired may or may not subsequently be extended beyond the domain of speech production.

The LTH entails the existence of effects from language use on nonlinguistic cognition, but it neither entails nor precludes the existence of effects from knowledge of the lexicon and/or grammar, unlike the LRH in the formulation cited in (1). Moreover, the LTH entails that the cognitive practices that are transmitted via language exist independently of language, whereas the LRH neither entails nor precludes this.<sup>17</sup>

### 3.3 Codability, thinking-for-speaking effects, experiencing-for-speaking effects

The codability of a given meaning in a given language is the processing cost attached to its available expressions in the language from the perspective of



speaker and hearer. This processing cost in turn seems to be a function of the complexity of the expression, its frequency, and its sociopragmatic status. Codability has long been suggested to be correlated with ease and reliability of memory retrieval (Carmichael, Hogan, and Walter 1932; Brown and Lenneberg 1954), although the precise nature of this effect is somewhat unclear. At the same time, codability affects utterance planning – perhaps both directly and via Gricean pragmatics – giving rise to **thinking-for-speaking (TfS) effects**. TfS effects are causal effects from the grammar and lexicon of a language on the production of utterances in that language. They are thus language-on-language (LoL) effects (cf. Figure 1) rather than LoT effects, although they might be part of a causal chain that leads to LoT effects, since it provides an association between the state of affairs the speaker wishes to refer to and the conceptual categories she chooses to express for this purpose, and repeated usage may strengthen this association and over time allow it to occur independently of speech (cf. Figure 3).

The existence of TfS effects as distinct from LoT effects was first explicitly hypothesized and empirically supported by Slobin (1987; 1996; 2003). Slobin compared the frequency of manner-of-motion descriptions in “Frog Story” narratives from speakers of a variety of languages. The relevant typological distinction is that between “verb-framed” and “satellite-framed” representations of motion events (Talmy 2000, 2: 21–146). These differ in the locus of encoding of two types of information: information about the trajectory or “path” covered by the moving entity or “figure” during the motion event and information about the “manner” of motion, an action or activity that involves the figure and prototypically causes it. In **verb-framed** (henceforth “V-framed”) descriptions, the path information is lexicalized in verb roots that describe location change, with meanings such as ‘enter’, ‘descend’, and ‘go’. The representation of manner is optional in such descriptions and requires a separate verbal projection (see (9)). In contrast, in **satellite-framed** (henceforth “S-framed”) descriptions such as (10), path information is encoded outside the main verb root, by a verb particle or secondary predicate (what Talmy calls a “satellite”), an adposition, or a nominal case marker. The main verb root of an S-framed description encodes manner information.

(9) Floyd entered the library (walking).

(10) Floyd walked into the library.

The grammar and lexicon of a language may license one type of description or both. English employs both types of descriptions, but V-framed representations such as (9) are more common in written than in colloquial registers. Overall, verb framing appears to be much more common than satellite framing in the languages of the world.

Slobin (2003) compared descriptions of the wordless picture book *Frog, Where Are You* (Mayer 1969) by speakers of three S-framed and three V-framed languages and found that the speakers of the S-framed languages encoded manner roughly twice as frequently as the speakers of the V-framed languages. This can

easily be explained with reference to Gricean manner implicatures. In V-framed descriptions, manner encoding is optional and increases the complexity of the representation. Thus, it is reserved for representations of non-stereotypical events and contexts in which manner of motion is for whatever reason at issue. In contrast, in S-framed representations, manner verbs are typically the most common choice for the main verb position. Manner-neutral verbs such as *move* or *locomote* are used much less frequently and often belong to more formal or technical registers. Thus, manner encoding is the default choice in a way that it is not in V-framed representations.

Much experimental research has been conducted to test the hypothesis that Slobin's TfS effect is accompanied by a similar LoT effect, along the lines of speakers of predominately S-framed languages paying more attention to manner information than speakers of predominately V-framed languages when categorizing motion events nonverbally, with mixed but mostly negative results (cf. section 4.2).

Research on TfS effects is still in an early phase. A study of TfS effects outside the motion domain (though still within spatial semantics) is Belloro et al. (2008). A special issue of the journal *Language, Interaction and Acquisition* (issue 3 (2), 2012) has been dedicated to TfS effects in bilinguals (see Treffers-Daller 2012), featuring contributions that further examine the motion domain, but also some that venture outside of it.

Levinson (2003b, 301–307) argues for the existence of greatly expanded TfS effects, which he calls “experiencing for speaking” (EfS). In order to be expressed in a particular language, a given nonlinguistic cognitive representation must conform to the semantic and pragmatic requirements and biases of that language. Levinson notes that the primary causal efficacy of semantic and pragmatic output constraints lies in fact in generating TfS effects. However, as depicted in Figure 3, TfS effects are restricted to the production system. Thus, neither TfS effects in the narrow sense nor output constraints on the cognitive encoding of experience can directly account for learners tuning in to the community's cognitive categories and practices through observing its speakers' language use, and thus for the apparent role of language as a conduit for the cultural transmission of cognitive practices. This power is unique to concept induction. What TfS/EfS effects presumably accomplish is to force the speaker to actually encode an idea she or he wishes to communicate, and indirectly an experience she or he wishes to be able to communicate at a later point in time, in those language-specific terms she or he has acquired via concept induction. In addition, TfS/EfS effects boost the frequency of activation of the relevant cognitive representations and thereby their habituation.

### 3.4 Language as a cognitive tool

It has been suggested that nonlinguistic cognition may at times tap into language as a resource for solving various kinds of nonlinguistic problems. Perhaps the most straightforward benefit of using language in this way is enhanced working memory (Baddeley and Hitch 1974; Baddeley 2000). For instance, everyday

experience suggests that verbal encoding greatly facilitates even the simplest arithmetic operations. Unsurprisingly, then, it has been claimed that speakers of languages with no more than rudimentary numeral systems exhibit apparent effects on the cognitive processing of quantitative information (Gordon 2004). Evidence that verbal metaphors influence folk theories of certain domains of knowledge and thereby reasoning about phenomena in this domain goes back as far as Gentner and Gentner (1983). Evidence of potential language-specific effects of this kind was first reported in Boroditsky (2001).

A series of studies have provided evidence that participants in categorization experiments at times tap into subvocal linguistic encoding as a resource. A case in point is one of the earliest experimental demonstrations of an LoT effect, Kay and Kempton (1984). Kay and Kempton presented triads of color chips from both sides of the linguistic blue–green boundary of English to speakers of English and Tarahumara. Tarahumara (or Rarámuri) is a Uto-Aztecan language of Chihuahua in northern Mexico that has a single “grue” term used in reference to greens and blues to the exclusion of other hues. In one condition, all possible triads drawn from a set of eight chips were shown to English and Tarahumara speakers, and the three chips of each triad were presented simultaneously. The participants’ task was to pick the “odd man out” in each triad. In this first experiment, Kay and Kempton found a categorical perception effect along the linguistic boundary among the English speakers, whereas the Tarahumara speakers performed at chance level.

In a second experiment, only triads of hues adjacent in color space were shown, and they were presented in such a fashion that the participants could only ever see two adjacent chips at once, never all three at the same time.<sup>18</sup> This second experiment was administered to English speakers only. The experimenter asked the participants to compare the first two chips of each triad in terms of their relative greenness and the second two chips in terms of their relative blueness (or vice versa) and then to determine whether the greenness difference of the one pair was greater or smaller than the blueness difference of the other pair. In this experiment, the English speakers responded at random just as the Tarahumara speakers had done in the first experiment. Kay and Kempton reasoned that the English speakers in the first experiment relied on a subvocal naming strategy. The design of the second experiment apparently blocked the use of this strategy, since the participants were instructed to categorize the pivot of each triad both in terms of blueness and in terms of greenness.

Evidence of subvocal rehearsal effects has been found in a number of categorization experiments aimed at LoT effects; cf. Gleitman and Papafragou (2012) and section 4.2. The implications of this evidence are twofold: on the one hand, it cautions us to examine newly attested LoT effects for whether they are more than subvocal rehearsal effects – and thus “shallow” in the sense that they are not part of truly nonverbal cognition. On the other hand, it raises the question to what extent such effects play a role in everyday cognition outside experimental cognitions. This role could well be considerable. But studying it empirically poses nontrivial challenges, as it calls for methods that involve minimal manipulation and/or maximize ecological validity.

#### 4 Beautiful losers: failures to find evidence for the LRH

Numerous studies have found evidence of LoT effects, and numerous other studies have failed to find such evidence. The present section addresses the failures.

Recollect the reformulation of the weak version of the LRH given in (1') above, repeated for convenience in (11):

- (11) *LRH, weak interpretation*  
 Language-specificity in the semantic/pragmatic system may cause differences in nonlinguistic cognition in speakers of different languages.

The LRH in this formulation does not predict that *all* semantic categorization differences between two languages will cause concomitant differences in the nonverbal cognition of the members of the two speech communities. This, of course, means that it is relatively easy to find evidence in support of this weak version of the LRH, and there is no readily apparent way to disprove it. This makes (11) less interesting than a stronger version that attributes causal efficacy to any semantic/pragmatic contrast.

Nevertheless, failures to find support for the LRH can be insightful. They can provide important information about the syntax–semantics interface and the language–cognition interface. To reap these benefits, one must of course ask *why* the study in question failed to find an effect. This question is unfortunately all too often not addressed when scholars publishing studies with negative results wish to present these as evidence against the LRH. A failure to find evidence of LoT effects in a given study can have three possible sources:

- i. The study was using an invalid design.
- ii. LoT effects do not occur under the conditions observed and manipulated in the study.
- iii. LoT effects do not exist at all – the LRH is false.

Occam's Razor requires that these possible explanations be considered in the order in which they are listed above. In light of the positive evidence for the LRH that has already been amassed (only a small portion of which was discussed in section 3), explanation (iii) should be considered the most "costly" option in terms of the amount of empirical data that would require an alternative explanation if (iii) is to be true. The following two subsections briefly discuss (i) and (ii).

##### 4.1 Design flaws in Whorfian studies

Valid empirical tests of the LRH involve a design with the following necessary components:

- i. A typological contrast in semantic categorization (cf. section 3.1) must be demonstrated (not merely surmised) to differentiate the linguistic behavior of two or more speech communities.

- ii. A concomitant contrast in nonlinguistic cognition must be demonstrated to differentiate some aspect of nonverbal behavior across the members of these speech communities.
- iii. If (i) and (ii) have been successfully carried out, additional tests must be conducted to discriminate between causation and mere covariation. Such tests might tap into developmental evidence or examine whether the impact of linguistic predictor variables can be reduced to covariation with cultural or environmental variables (cf. section 3.2).

Design flaws in Whorfian studies can be the result of simple “mechanical” failures to create the appropriate conditions for the observation, manipulation, or control of the relevant aspects of behavior. A more interesting possibility is that an otherwise internally valid design is mismatched to the typological contrast that is the source of the hypothetical LoT effect. In the simplest case, the study populations may not actually exhibit the contrast in question – a sampling error. Alternatively, the contrast in nonverbal behavior observed in the study may itself be mismatched to the typological contrast.

Problems with the typological contrast hypothesized to underlie a potential LoT effect have beset several of the studies that set out to probe the population-specific use of reference frames in nonlinguistic cognition in the wake of Pederson et al. (1998) (cf. section 3.2). Li and Gleitman (2002) attempted to show that L1 speakers of American English can be induced by environmental factors to use geocentric frames of reference in small-scale space just like speakers of Tzeltal Maya and other languages whose speakers show a geocentrism bias according to Pederson et al. To this end, they carried out a recall memory experiment modeled after that described in Pederson et al. (1998) with students whose first language was American English. They manipulated the setting in which the participants were tested – indoors vs outdoors – and the stimulus array. The latter was presented as in the original Pederson et al. task in one condition, but with an object – a toy duck pond – added in the other. Both manipulations had a significant effect in the direction the authors had predicted: the outdoors setting and the presence of the toy pond made the participants – University of Pennsylvania undergraduates – more likely to produce geocentric responses.

Levinson et al. (2002) attempted and failed to replicate the effect of the setting variable with Dutch-speaking students at Radboud University in the Netherlands. Regarding the toy duck pond, Li and Gleitman assumed that the participants were treating it as a landmark defining a geocentric reference frame. However, Levinson et al. hypothesized that since the toy duck pond was approximately the same scale as the toy animals and equally readily manipulable, Li and Gleitman’s participants had memorized it as part of the array rather than as an external landmark, using an intrinsic frame to encode the order and orientation of the animals vis-à-vis the pond. To test this hypothesis, they replicated the duck pond condition under 90° rotation of the participants between stimulus and recall table rather than the original 180° of Pederson et al. and Li and Gleitman. This manipulation made it possible to distinguish true geocentric coding, under which the orientation of the configuration remains constant vis-à-vis the external

environment, from intrinsic coding, under which the orientation of the configuration may (but need not) shift. As Levinson et al. had predicted, the great majority of responses suggested an intrinsic rather than a geocentric representation. Thus, from Levinson et al.'s perspective, Li and Gleitman's duck pond condition was invalid as a test of the hypothesis that Dutch and English speakers could be induced to prefer geocentric coding in small-scale space. Crucially, this invalid design had arguably been informed by a misunderstanding of the typological difference between landmark-based and intrinsic reference frames.

Li and Gleitman attempted to show that English speakers could be induced to use geocentric frames in small-scale space. In a similar vein, Li et al. (2011) tried to show that speakers of Tzeltal Maya, a language that makes no more than marginal use of relative (i.e., egocentric extrinsic) frames, were nevertheless equally adept at memorizing spatial configurations in geocentric and relative terms. They conducted a series of experiments in which participants had to memorize arrays vis-à-vis the environment in geocentric conditions and vis-à-vis their own bodies in egocentric conditions. As they had predicted, they found the Tzeltal participants performed equally well or better in the egocentric condition compared to the geocentric one. However, since the participants were memorizing the stimulus configurations with respect to their own bodies in the egocentric conditions, the participants' bodies served as both anchor and ground in the participants' cognitive representations of the stimuli, and the reference frames they used were thus egocentric, but also intrinsic (cf. section 3.2). Intrinsic frames, however, are not predicted to play the same marginal role as relative frames in Tzeltal speaker's linguistic practice. Thus, the validity of the design of these experiments for a test of the authors' predictions is doubtful, just as in the case of Li and Gleitman (2002). And once again, a mismatch between the variables manipulated in the experiment and the relevant typological contrasts is arguably the root cause of the problem.

#### 4.2 Possible non-efficacious contrasts

For an initial illustration, consider the representation of the order of events in discourse in two languages that employ quite distinct structural means to this effect, German and Yucatec Maya. As mentioned in section 3.1, Yucatec is a tenseless language. Moreover, it also lacks temporal connectives with meanings such as 'after', 'before', or 'while' (Bohnmeyer 1998a; 1998b; 2009). It does, however, express a rich set of contrasts of viewpoint aspect, mood, and degrees of temporal remoteness.<sup>19</sup> In contrast, Standard German has tenses and temporal connectives, but lacks fully grammaticalized expressions of viewpoint aspect. Bohnmeyer (1998b, 523–640; 2000) reports on a study that involved L1 speakers of these two languages matching pairs of video clips that differed from one another solely in the order of events. Each trial involved a dyad of speakers in a referential communication design (cf. section 3.2). Bohnmeyer found that both populations were equally proficient at solving the task, despite substantial differences in the verbal resources they employed to this end. The German speakers used specific temporal connectives such as 'before' and 'while' in about 24% of their descriptions and generic connectives such as 'when' in 68% of their descriptions. In contrast, the

Yucatec speakers used generic connectives in just 1% of their descriptions and specific connectives not at all, as those are absent from the language. Nevertheless, no significant difference in error rates emerged. Mismatches occurred in just 15% of Yucatec trials (18 out of 120 trials) and 14.3% of German trials (16 out of 112 trials).

To account for this similarity in performance, Bohnemeyer argued that while the descriptions the two groups of participants had produced differed greatly in their expressive resources, descriptions of the same scenes were nevertheless pragmatically equivalent. Compare (12) and (13), a German and a Yucatec description of the same clip:

- (12) German  
 Also, kurz **nachdem** sie aufgehört hat zu schreiben,  
 so shortly after she stopped(PTCP) has(PRS) to write(INF)  
 durch-quert die andere Frau den Raum (...)  
 through-cross(PRS) the other woman the room  
 ‘So shortly **after** she stops writing, the other woman crosses the room (...)  
 (Bohnemeyer 1998b, 630)
- (13) Yucatec<sup>20</sup>  
 (...) ts’o’k u=ts’iib-t-ik le=kàarta le=x-ch’úupal=o’,  
 TERM A3=write-APP-INC(B3SG) DEF=letter DEF=F-female:child=D2  
 káa=h-k’at+máan le=chak u=nòok’=o’.  
 CON=PRV-cross+pass DEF=red(B3SG) A3=garment=D2  
 ‘(...) the girl has/d written the letter, and the red-dressed one passes/d through.’  
 (Bohnemeyer 1998b, 542)

The temporal relation expressed by the connective *nachdem* ‘after’ in (12) is conveyed in (13) by way of a stereotype implicature to the effect that the two clauses have identical reference times. The perfect-like “terminative” aspect marker of the first clause constrains this time to a time after the writing of the letter, and the perfective aspect of the second clause puts the event of the red-dressed woman crossing the stage inside this reference time interface. The implicature to the identity of the two reference times is known as “temporal anaphora” in the literature (cf. Bohnemeyer 2009 for a detailed account of temporal anaphora in Yucatec).

A surprisingly large number of studies have looked for LoT effects in the categorization of motion events following the work by Talmy and Slobin (see section 3.3). The great majority of these studies employed variations on a design whereby participants compare pivot scenes to two variants, one in which the manner of motion is altered and one in which the path is altered. Their task is to determine that variant which is most/least similar to the pivot, or alternatively to pick the scene that is least like the other two. Several of these studies have found effects of prior verbal encoding on nonverbal categorization that can be attributed to TfS effects (see section 3.3.). Table 1 summarizes some of these studies.

Table 1 Some “Talmy triads” studies in comparison

Study	Populations		Findings			
	S-framed	V-framed	Manner bias	Path bias	Evidence consistent with LoT effect	Evidence of subvocal rehearsal
Montero-Melis et al. (2017)	Dutch; English; Estonian German; Polish; Russian; Tiriyó (Carib)	Basque; Catalan; French; Hindi; Italian; Jalonke (Mande); Japanese Spanish; Tamil; Tidore; Turkish; Yucatec	Some groups	Some groups	No	Not tested
Finkbeiner et al. (2002)	English	Japanese, Spanish	Some groups	No	Yes	Yes
Gennari et al. (2002)	English	Spanish	No	One group	Yes	Yes
Loucks and Pederson (2010)	English	Spanish	Yes	No	No	Not tested
Papfragou, Massey, and Gleitman (2002)	English	Greek	No	Yes	No	Not tested



One thing that stands out about Table 1 is the inconsistency of the studies' findings. In addition, Montero Melis et al. (2017) is remarkable for having found significant differences in the behavior of the study populations that however cannot overall be interpreted as LoT effects since not all of them are in the direction predicted by the particular languages' placement on Talmy's typology. This has the consequence that strategically selected subsets of the study's sample could be used as evidence for and against LoT effects. This obviously tells a cautionary tale regarding the dangers of overinterpreting results from studies on speakers of just two or three languages.

How can the failure of an LoT effect to materialize in these studies be explained? The rationale underlying the studies in Table 1 is that speakers of S-framed languages encode manner verbally more routinely than do speakers of V-framed languages. Therefore, manner of motion might also play a greater role in their nonverbal categorizations of motion events than it does in speakers of V-framed languages. However, suppose that this were indeed the case, but that the difference was too small to overcome an overall population-independent path categorization bias. Since every trial involves a forced choice between categorization by manner and categorization by path, a potential small relative boost in manner categorization on the part of the speakers of S-framed languages might well go undetected in the outcomes of a study. In other words, the triads design is arguably a poorly chosen instrument for studying a potential LoT effect in this domain, given that path presumably plays a large role in the categorization of motion events that is unaffected by typology. Support for this conjecture comes from a new study by Montero-Melis and Bylund (2016). The authors tested L1 speakers of Spanish (V-framed) and Swedish (S-framed). Instead of a triad design, the authors employed a free-pile-sort design, in which participants may group the stimulus items into as many categories as they see fit. The results do indeed suggest that, even though path played overall a far greater role in predicting event similarity than manner, manner also played a relatively greater role in the categorizations of the Swedish speakers than in those of the Spanish speakers, consistent with the predictions derivable based on Talmy's typology and Slobin's work.<sup>21</sup>

However, the inconsistency of the findings in Table 1 and a great amount of intra-population variability observed in Montero Melis et al. (2017) point toward another explanation, albeit one that is not mutually inconsistent with the one just considered. Event conceptualization is a complex and multifaceted process. In the case of the "Talmy triads," the events featured in the stimuli involve at the very least, aside from path and manner, the properties of the moving entity (or "figure"; cf. section 3.2) and those of the reference entities (or "grounds") with respect to which the path is defined. Rather than being stored globally in long-term memory, conceptual representations of these events are presumably assembled online. It seems at least plausible that this process would allow for a dynamic assessment of the relative salience of the various components that responds to contextual information and task demands. Thus, rather than being fixed, the relative salience of path and manner would be determined on the basis of the participants' interpretation of the task, among other things. It may be that the nonverbal conceptualization of entities – especially events – is more dynamic and context-/task-specific that

their semantic categorization, which after all is subject to pressures toward social uniformity without which communication would presumably be impossible.

## 5 Conclusions: why bother?

The debate over the LRH has suffered from proponents and detractors talking past one another, especially with regard to the distinction between strong and weak interpretations. Scholars on both sides seem (in some cases apparently deliberately) to have chosen to remain vague regarding this dichotomy, regularly inviting maximal interpretations.

While there is strong evidence in support of weak forms of linguistic relativity, a strong version not only lacks empirical support, but arguably requires a pre-cognitivist view of thought as necessarily involving silent verbal encoding. Weak versions of the LRH do not entail that all typological contrasts in semantic categorization cause LoT effects. Non-efficacious contrasts in semantic categorization may involve representations that differ at the semantic level, but are pragmatically equivalent. Another possibility is that some aspects of nonverbal categorization may be more dynamic and context-specific than their verbal representations, which are socially shared. In addition, weak versions of the LRH also do not require language to be the sole or even the dominant influence on any aspect of nonverbal cognition.

Three hypothetical pathways for LoT effects have been discerned in this chapter. First, language learning may influence conceptual development via a process termed here “concept induction.” This involves the learner observing more competent members of the speech community interact and inferring the conceptual categories underlying their reference acts. On this basis, language, along with other forms of observable behavior, may serve as a conduit for the transfer of conceptual knowledge. Secondly, language imposes codability constraints on the preverbal messages to be communicated (TfS effects) and, arguably, also on the processing of perceptual content for storage in long-term memory (EfS effects). TfS/EfS effects force the speaker to encode an idea she or he wishes to communicate, and indirectly an experience she or he wishes to be able to communicate at a later point in time, in language-specific terms. In addition, such effects boost the habituation of the cognitive categories involved. And lastly, language appears to sometimes become involved as a resource in the solution of problems of nonverbal cognition. This can have a variety of reasons, including the effectively working-memory-enhancing effect of verbal encoding, the availability of concrete verbal metaphors for abstract phenomena, and also the suitability of semantic categories to serve as a model when a nonverbal categorization decision has multiple possible solutions none of which is vastly more salient than the others.

Weak versions of the LRH are difficult to disprove, especially in the face of the steadily growing body of evidence of LoT effects. The question then arises why we should even bother continuing to study this hypothesis. The answer is that in doing so we help to map out the role of cultural transfer in the mind, thus demarcating the territories of nature and nurture in cognition and one day hopefully

understanding how the two interact. The question of whether and to what extent language influences thought thus ultimately derives its interest from the larger question of the role of culture in the mind, via the role of language as a conduit for the cultural transmission and diffusion of cognitive practices.

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### Notes

1. Unlike the existence of LoT effects (narrowly construed), the existence of LoL effects is uncontroversial. One line of argumentation that has been advanced by skeptics against the LRH hypothesizes that most or all of the apparent evidence of LoT effects can in fact be reduced to mere LoL effects (Gleitman and Papafragou 2012 and references therein).
2. Learner varieties and interlanguages such as pidgins may lack expressions of the relevant kind. A relevant contrast between an interlanguage and a creole derived from it – Nicaraguan Sign Language – is explored in de Villiers and Pyers (2002).
3. Fausey and Boroditsky (2011) examine an apparent language-specific effect that may be the result of a combination of the universal linguistic bias in eyewitness memory and language-specificity in the representation of certain kinds of events (accidentally caused events).
4. Whorf discusses his view of thinking and its relation to language in “Thinking in Primitive Communities” (Whorf 1956, 65–86), a paper the editor of Whorf (1956), John B. Carroll, reports to have discovered among Whorf’s unpublished manuscripts. In it, Whorf writes: “One of the clearest characterizations of thinking is that of Carl Jung, who distinguishes four basic psychic functions: sensation, feeling (*Gefühl*), thinking, and intuition. It is evident to a linguist that thinking, as defined by Jung, contains a large linguistic element of a strictly patterned nature ... Thinking may be said to be language’s own ground, whereas feeling deals in feeling values which language indeed possesses but which lie rather on its boundaries. These are Jung’s two rational functions, and by contrast his two irrational functions, sensation and intuition, may fairly be termed nonlinguistic ... We are thus able to distinguish thinking as the function which is to a large extent linguistic” (Whorf 1956: 66).
5. The term “semantic typology” was introduced in Pederson et al. (1998). Evans (2010), Koptjevskaja-Tamm (2015), and Moore et al. (2015) provide surveys of this field.
6. Abbreviations used in language glosses: A – crossreference “set A” ( $\approx$  ergative; for actor arguments of transitive verbs, the single argument of intransitive verbs in certain aspect/mood categories, and the nominal possessor); AN = animate; APP – applicative; B = cross-reference “set B” ( $\approx$  absolutive; covering the theme argument of nonverbal predications, transitive undergoers, and the single argument of intransitive verbs in certain aspect/mood categories); CL = classifier; CON – connective; D2 = clause-final particle indicating the presence of a distal-deictic or anaphoric expression in the clause; DEF – definite; F – feminine; INC – incomplete “status” (aspect/mood-inflection expressed by suffixes); PRV = perfective aspect; TERM – terminative aspect.
7. Whorf frequently invokes the notions of *habitual patterns* of thought and language, particularly in “The Relation of Habitual Thought and Behavior to Language”

(Whorf 1956 [1939], 134–159) and “Language, Mind, and Reality” (Whorf 1956 [1941], 246–270). His perspective combines the sense of habituality as cultural practice with that of habituality as routine and facility. In contrast, a theme that is not much present in his published writings is that of the connection between language learning and conceptual development.

8. Levinson (2003b, 301–307) suggests that a uniquely neo-Whorfian theoretical perspective views language as imposing constraints on nonlinguistic cognition. This by hypothesis gives rise to “experiencing-for-speaking” effects; cf. Figure 3. Such effects are addressed in section 3.3.
9. The metaphor of semantic categories as “molds” of conceptual categories, often attributed to Whorf, appears to actually have been introduced by Bruner, Goodnow, and Austin (1956, 10–11).
10. The terms “figure” and “ground,” borrowed from Gestalt Psychology, were popularized in spatial semantics by the work of Talmy (2000).
11. The term “anchor” is introduced in Danziger (2010) after Levinson’s (1996a; 2003b) “anchor point.”
12. Referential communication designs involve two participants per trial who verbally instruct one another to identify stimuli and manipulate them in certain ways while a barrier prevents them from sharing a visual field. Originally developed for psycholinguistic research into interactional strategies (Clark and Wilkes-Gibbs 1990), they have become a staple in semantic typology (Moore et al. 2015).
13. The studies were actually conducted with speakers of 13 languages pertaining to 10 genealogical groups. However, only the recall memory data from those five populations that showed a clear preference for egocentric or geocentric frames in the linguistic task were included in the statistical test of the hypothesis that a population’s preferred strategy in the linguistic task predicts that population’s preferred strategy in the recall memory task.
14. As in all applications of recall memory designs to categorization studies, recall memory merely serves as a convenient window on the cognitive encoding of the relevant information, which in this case is a spatial representation. The question is which reference frame the participants employ to mentally encode this representation. One advantage of instructing the participants to rebuild the array from memory rather than to do so “online,” in full view of the original, is that the memory component tends to distract the participants from the true purpose of the experiment. Another is that the participants are forced to rely entirely on their internal representation when rebuilding the array, whereas in an online version of the task, they can update their internal representations with the results of continuing visual inspection of the stimulus array.
15. Levinson’s (2003a; 2003b) embrace of the ambiguous and misleading label “linguistic determinism” has presumably done little to clarify the situation.
16. This interpretation of Whorf’s proposals is literally accurate inasmuch as Whorf did not actually argue for any version of the LRH at all, but rather for a Linguistic Relativity *Principle*, intended primarily as a methodological maxim for ethnographic studies. However, there are indications that Whorf did indeed consider strong versions of the LRH to be true. As suggested in section 1, this is to a significant extent the result of Whorf’s reduction of thought to verbal thought. Consider how Whorf introduces his Relativity Principle: “We are thus introduced to a new principle of relativity, which holds that all observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar, or can in some way be

calibrated" (Whorf 1956, 214). This is a near-paraphrase of Brown's (1976) characterization of the strong interpretation of the LRH cited in (2) above.

17. Put differently, the LRH, but not the LTH, is compatible with outlandish scenarios in which language creates cognitive practices on its own – although to my knowledge, neither Whorf nor any neo-Whorfian has proposed this possibility.
18. The three chips of each triad were shown arranged in a row in a box with a sliding top that would only ever reveal two chips at a time. The participants were able to slide the lid back and forth as often as they wished.
19. Functional categories expressing degrees of remoteness (Comrie 1985, 83–101) are often termed "metric tenses." However, the Yucatec operators in question are not tense-like in that they presuppose rather than express a temporal relation vis-à-vis a reference time (cf. Bohnemeyer 2009).
20. See note 6 for abbreviations.
21. The domain explored in this study differed from that of the studies in Table 1. Whereas those studies all examined the categorization of motion events that do not involve causers distinct from the moving "figure," Montero-Melis and Bylund studied caused motion events.

## References

- Baddeley, Alan D. 2000. "The Episodic Buffer: A New Component of Working Memory?" *Trends in Cognitive Science*, 4: 417–423.
- Baddeley, Alan D., and Graham Hitch. 1974. "Working Memory." In *The Psychology of Learning and Motivation: Advances in Research and Theory*, edited by G. H. Bower, 8: 47–89. New York, NY: Academic Press.
- Bastian, Adolf. 1860. *Der Mensch in der Geschichte: Zur Begründung einer psychologischen Weltanschauung* [Man in History: On the Foundation of a Psychological Worldview]. Leipzig: Verlag Otto von Wiegand.
- Belloro, Valeria, Jürgen Bohnemeyer, Dedre Gentner, and Katharine Braun. 2008. "Thinking-for-speaking: evidencia a partir de la codificación de disposiciones espaciales en español y yucateco" [Thinking for Speaking: Evidence from the Encoding of Spatial Dispositions in Spanish and Yucatec]. *Memoria del IX Encuentro Internacional de Lingüística en el Noroeste*, 2: 175–190.
- Berlin, Brent, and Paul Kay. 1969. *Basic Color Terms: Their Universality and Evolution*. Berkeley, CA: University of California Press.
- Bohnemeyer, Jürgen. 1998a. "Temporal Reference from a Radical Pragmatics Perspective: Why Yucatec Does Not Need to Express 'After' and 'Before'." *Cognitive Linguistics*, 9 (3): 239–282.
- Bohnemeyer, Jürgen. 1998b. "Time Relations in Discourse: Evidence from Yucatec Maya." PhD diss., Tilburg University.
- Bohnemeyer, Jürgen. 2000. "Event Order in Language and Cognition." In *Linguistics in the Netherlands 17*, edited by H. de Hoop and T. van der Wouden, 1–16.
- Bohnemeyer, Jürgen. 2002. *The Grammar of Time Reference in Yucatec Maya*. Munich: LINCOM.
- Bohnemeyer, Jürgen. 2009. "Temporal Anaphora in a Tenseless Language." In *The Expression of Time in Language*, edited by W. Klein and P. Li, 83–128. Berlin: De Gruyter.
- Bohnemeyer, Jürgen. 2010. "The Language-Specificity of Conceptual Structure: Path, Fictive Motion, and Time Relations." In *Words and the World*, edited by B. Malt and P. Wolff, 111–137. Oxford: Oxford University Press.

- Bohnmeyer, Jürgen. 2012. "A Vector Space Semantics for Reference Frames in Yucatec." In *Proceedings of the Sixth Meeting on the Semantics of Under-Represented Languages in the Americas (SULA 6) and SULA-Bar*, edited by Elizabeth Bogal-Allbritten, 15–34.
- Bohnmeyer, Jürgen, Katharine Donelson, Randi E. Moore, et al. 2015. "The Contact Diffusion of Linguistic Practices: Reference Frames in Mesoamerica." *Language Dynamics and Change*, 5 (2): 169–201.
- Bohnmeyer, Jürgen, Katharine Donelson, Randi E. Tucker, et al. 2014. "The Cultural Transmission of Spatial Cognition: Evidence from a Large-Scale Study." *Proceedings of the 36th Annual Meeting of the Cognitive Science Society*, 212–217.
- Boroditsky, Lera 2001. "Does Language Shape Thought? Mandarin and English Speakers' Conceptions of Time." *Cognitive Psychology*, 43: 1–22.
- Bowerman, Melissa. 1996. "The Origins of Children's Spatial Semantic Categories: Cognitive vs. Linguistic Determinants. In *Rethinking Linguistic Relativity*, edited by John J. Gumperz and Stephen C. Levinson, 145–176. Cambridge: Cambridge University Press.
- Bowerman, Melissa 2011. "Linguistic Typology and First Language Acquisition." In *The Oxford Handbook of Linguistic Typology*, edited by J. J. Song, 591–617. Oxford: Oxford University Press.
- Bowerman, Melisa and Stephen Levinson. 2001. *Language Acquisition and Conceptual Development*. Cambridge: Cambridge University Press.
- Brown, Roger 1976. "Reference: In Memorial Tribute to Eric Lenneberg." *Cognition*, 4: 125–153.
- Brown, Roger, and Eric H. Lenneberg. 1954. "A Study in Language and Cognition." *Journal of Abnormal Social Psychology*, 49: 454–462.
- Brown, Penelope, and Stephen C. Levinson. 1992. "'Left' and 'Right' in Tenejapa: Investigating a Linguistic and Conceptual Gap." *Zeitschrift für Phonetik, Sprachwissenschaft und Kommunikationsforschung*, 45 (6): 590–611.
- Brown, Penelope, and Stephen C. Levinson. 1993. "'Uphill' and 'Downhill' in Tzeltal." *Journal of Linguistic Anthropology*, 3 (1): 46–74.
- Bruner, Jerome S., Jacqueline J. Goodnow, and George A. Austin. 1956. *A Study of Thinking*. New York, NY: John Wiley & Sons.
- Bucholtz, Mary, and Kira Hall. 2004. "Language and Identity." In *A Companion to Linguistic Anthropology*, edited by A. Duranti, 369–394. Malden, MA: Blackwell.
- Carmichael, L., H. P. Hogan, and A. A. Walter. 1932. "An Experimental Study of the Effect of Language on the Reproduction of Visually Perceived Form." *Journal of Experimental Psychology*, 15: 73–86.
- Carruthers, Peter. 2002. "The Cognitive Functions of Language." *Behavioral and Brain Sciences*, 25: 657–726.
- Choi, Soonja. 1997. "Language-Specific Input and Early Semantic Development: Evidence from Children Learning Korean. In *The Crosslinguistic Study of Language Acquisition*, vol. 5: *Expanding the Contexts*, edited by Dan I. Slobin, 41–134. Hillsdale, NJ: Erlbaum.
- Choi, Soonja and Melissa Bowerman. 1991. "Learning to Express Motion Events in English and Korean: The Influence of Language-Specific Lexicalization Patterns." *Cognition*, 41: 83–121.
- Choi, Soonja, Laraine McDonough, Melissa Bowerman, and Jean M. Mandler. 1999. "Early Sensitivity to Language-Specific Spatial Categories in English and Korean." *Cognitive Development*, 14 (2): 241–268.
- Clark, Herbert H., and Deanna Wilkes-Gibbs. 1990. "Referring as a Collaborative Process." In *Intentions in Communication*, edited by P. Cohen, J. Morgan, and M. Pollack, 463–493. Cambridge, MA: MIT Press.
- Comrie, Bernard. 1985. *Tense*. Cambridge: Cambridge University Press.

- Danziger, Eve. 2010. "Deixis, Gesture, and Cognition and Spatial Frame of Reference Typology." *Studies in Language*, 34 (1): 167–185.
- De Villiers, Jill G., and Peter A. de Villiers. 2000. "Linguistic Determinism and False Belief." In *Children's Reasoning and the Mind*, edited by P. Mitchell and K. Riggs, 189–226. Hove: Psychology Press.
- De Villiers, Jill G., and Peter A. de Villiers. 2002. "Language for Thought: Coming to Understand False Beliefs." In *Language in Mind: Advances in the Study of Language and Cognition*, edited by D. Gentner and S. Goldin-Meadow. 335–384. Cambridge, MA: MIT Press.
- De Villiers, Jill G., and Jenny E. Pyers. 2002. "Complements to Cognition: A Longitudinal Study of the Relationship Between Complex Syntax and False-Belief-Understanding." *Cognitive Development*, 17: 1037–1060.
- Evans, Nicholas. 2010. "Semantic Typology." In *The Oxford Handbook of Typology*, edited by J. J. Song, 504–533. Oxford: Oxford University Press.
- Fausey, Caitlin, and Lera Boroditsky. 2010. "Subtle Linguistic Cues Influence Perceived Blame and Financial Liability." *Psychonomic Bulletin and Review*, 17 (5): 644–650.
- Fausey, Caitlin, and Lera Boroditsky. 2011. "Who Dunit? Cross-Linguistic Differences in Eye-Witness Memory." *Psychonomic Bulletin and Review*, 18 (1): 150–157.
- Finkbeiner, Matthew, Janet Nicol, Delia Greth, and Kumiko Nakamura. 2002. "The Role of Language in Memory for Actions." *Journal of Psycholinguistic Research*, 31: 447–457.
- Fodor, Jerry A. 1975. *The Language of Thought*. Cambridge, MA: Harvard University Press.
- Gennari, Silvia, Steven A. Sloman, Barbara Malt, and W. Tecumseh Fitch. 2002. "Motion Events in Language and Cognition." *Cognition*, 83: 49–79.
- Gentner, Dedre, and Donald R. Gentner. 1983. "Flowing Waters or Teeming Crowds: Mental Models of Electricity." In *Mental Models*, edited by D. Gentner and A. L. Stevens. 99–129. Hillsdale, NJ: Erlbaum.
- Gleitman, Lila, and Anna Papafragou. 2012. "New Perspectives on Language and Thought." In *Cambridge Handbook of Thinking and Reasoning*, 2nd ed., edited by K. J. Holyoak and R. G. Morrison, 543–568. New York, NY: Oxford University Press.
- Gordon, Peter. 2004. "Numerical Cognition without Words: Evidence from Amazonia." *Science*, 306: 496–499.
- Gumperz, John. 1958. "Dialect Differences and Social Stratification in a North Indian Village." *American Anthropologist*, 60: 668–681.
- Harrison, K. David. 2007. *When Languages Die: The Extinction of the World's Languages and the Erosion of Human Knowledge*. Oxford: Oxford University Press.
- Haviland, John B. 1979. "Guugu Yimidhurr." In *Handbook of Australian Languages*, edited by R. M. W. Dixon and B. Blake, 27–180. Canberra: ANU Press.
- Haviland, John B. 1993. "Anchoring, Iconicity, and Orientation in Guugu Yimithirr Pointing Gestures." *Journal of Linguistic Anthropology*, 3 (1): 3–45.
- Huang, Tsan, and Keith Johnson. 2010. "Language Specificity in Speech Perception: Perception of Mandarin Tones by Native and Nonnative Listeners." *Phonetica*, 67: 243–267.
- Hume, Elizabeth, and Keith Johnson, eds. 2001. *The Role of Speech Perception in Phonology*. New York, NY: Academic Press.
- Irvine, Judith T., and Susan Gal. 2000. "Language Ideology and Linguistic Differentiation." In *Regimes of Language: Ideologies, Politics, and Identities*, edited by P. V. Kroskrity, 35–84. Santa Fe, NM: School of American Research Press.
- Jackendoff, Ray. 1983. *Semantics and Cognition*. Cambridge, MA: MIT Press.
- Jackendoff, Ray. 1987. *Consciousness and the Computational Mind*. Cambridge, MA: MIT Press.
- Jackendoff, Ray. 1996. "How Language Helps Us Think." *Pragmatics and Cognition*, 4 (1): 1–34.



- Jackendoff, Ray. 2002. *Foundations of Language: Brain, Meaning, Grammar, Evolution*. Oxford: Oxford University Press.
- Kay, Paul, and Willett Kempton. 1984. "What is the Sapir-Whorf Hypothesis?" *American Anthropologist*, 86: 65–79.
- Koptjevskaja-Tamm, Maria. 2015. "Semantic Typology." In *Handbook of Cognitive Linguistics*, edited by E. Dabrowska and D. Divjak, 453–472. Berlin: De Gruyter.
- Kuhl, Patricia K. 2004. "Early Language Acquisition: Cracking the Speech Code." *Nature Reviews Neuroscience*, 5: 831–843.
- Laughren, Mary. 1978. "Directional Terminology in Warlpiri." *Working Papers in Language and Linguistics*, 8: 1–16.
- Lee, Penny. 1996. *The Whorf Theory Complex: A Historical Reconstruction*. Amsterdam: John Benjamins.
- Le Guen, Olivier. 2011. "Speech and Gesture in Spatial Language and Cognition among the Yucatec Mayas." *Cognitive Science*, 35: 905–938.
- Levelt, Willem J. M. 1984. "Some Perceptual Limitations on Talking about Space." In *Limits in Perception*, edited by Andrea J. van Doorn, Wim A. van der Grind, and Jan J. Koenderink, 323–358. Utrecht: VNU Science Press.
- Levelt, Willem J. M. 1989. *Speaking: From Intention to Articulation*. Cambridge, MA: MIT Press.
- Levelt, Willem J. M. 1996. "Perspective Taking and Ellipsis in Spatial Descriptions." In *Language and Space*, edited by Paul Bloom, Merrill F. Garrett, Lynn Nadel, and Mary A. Peterson, 77–107. Cambridge, MA: MIT Press.
- Levinson, Stephen C. 1996a. "Frames of Reference and Molyneux's Question: Crosslinguistic Evidence." In *Language and Space*, edited by P. Bloom, M. A. Peterson, L. Nadel, and M. F. Garrett, 109–169. Cambridge, MA: MIT Press.
- Levinson, Stephen C. 1996b. "The Body in Space: Cultural Differences in the Use of Body-Schema for Spatial Thinking and Gesture." *Cognitive Anthropology Research Group Working Paper 39*. Nijmegen: Max Planck Institute for Psycholinguistics.
- Levinson, Stephen C. 2003a. "Language and Mind: Let's Get the Issues Straight!" In *Language in Mind: Advances in the Study of Language and Cognition*, edited by D. Gentner and S. Goldin-Meadow, 25–46. Cambridge, MA: MIT Press.
- Levinson, Stephen C. 2003b. *Space in Language and Cognition*. Cambridge: Cambridge University Press.
- Li, Peggy, and Lila Gleitman. 2002. "Turning the Tables: Language and Spatial Reasoning." *Cognition*, 83 (3): 265–294.
- Loftus, Elizabeth F. 1974. "Reconstructing Memory: The Incredible Eyewitness." *Psychology Today*, 8: 116–119.
- Loftus, Elizabeth F. 1975. "Leading Questions and the Eyewitness Report." *Cognitive Psychology*, 7: 560–572.
- Loftus, Elizabeth F., and John C. Palmer 1974. "Reconstruction of Automobile Destruction: An Example of the Interaction Between Language and Memory." *Journal of Verbal Learning and Verbal Behavior*, 13: 585–589.
- Loftus, Elizabeth F., and Guido Zanni. 1975. "Eyewitness Testimony: The Influence of the Wording of a Question." *Bulletin of the Psychonomic Society*, 5: 86–88.
- Loucks, Jeff, and E. Pederson 2010. "Linguistic and Non-Linguistic Categorization of Complex Motion Events." In *Event Representation in Language and Cognition* edited by J. Bohnemeyer and E. Pederson, 108–133. Cambridge: Cambridge University Press.
- Lucy, John A. 1992a. *Language Diversity and Thought: A Reformulation of the Linguistic Relativity Hypothesis*. Cambridge: Cambridge University Press.
- Lucy, John A. 1992b. *Grammatical Categories and Cognition: A Case Study of the Linguistic Relativity Hypothesis*. Cambridge: Cambridge University Press.





- Mayer, Mercer. 1969. *Frog, Where Are You?* New York, NY: Dial Books.
- McDonough, Laraine, Soonja Choi, and Jean M. Mandler. 2003. "Understanding Spatial Relations: Flexible Infants, Lexical Adults." *Cognitive Psychology*, 46: 229–259.
- Miyawaki, Kuniko, Winifred Strange, Robert Verbrugge, et al. 1975. "An Effect of Linguistic Experience: The Discrimination of [r] and [l] by Native Speakers of Japanese and English." *Perception and Psychophysics*, 18 (5): 331–340.
- Montero-Melis, Guillermo, and Emanuel Bylund. 2016. "Getting the Ball Rolling: Cross-Linguistic Differences in the Representation of Caused Motion." *Language and Cognition*, 9 (3): 446–472.
- Montero-Melis, Guillermo, Sonja Eisenbeiß, Bhuvana Narasimhan et al. 2017. "Satellite- vs. Verb-Framing Underpredicts Nonverbal Motion Categorization: Insights from a Large Language Sample and Simulations." *Cognitive Semantics*, 3: 36–61.
- Moore, Randi E., Katharine T. Donelson, Alyson Eggleston, and Jürgen Bohnemeyer. 2015. "Semantic Typology: New Approaches to Crosslinguistic Variation in Language and Cognition." *Linguistics Vanguard*, 1 (1): 189–200.
- Papafragou, Anna, Christine Massey, and Lila Gleitman. 2002. "Shake, Rattle, 'n' Roll: The Representation of Motion in Language and Cognition." *Cognition*, 84: 189–219.
- Pederson, Eric, Eve Danziger, David P. Wilkins, et al. 1998. "Semantic Typology and Spatial Conceptualization." *Language*, 74: 557–589.
- Piaget, Jean. 1929. *The Child's Conception of the World*. London: Routledge and Kegan Paul.
- Pinker, Stephen. 1984. *Language Learnability and Language Development*. Cambridge, MA: Harvard University Press.
- Pinker, Stephen. 1989. *Learnability and Cognition*. Cambridge, MA: MIT Press.
- Pinker, Stephen. 2007. *The Stuff of Thought: Language as a Window into Human Nature*. London: Penguin.
- Purnell, Thomas, William Idsardi, and John Baugh. 1999. "Perceptual and Phonetic Experiments on American English Dialect Identification." *Journal of Language and Social Psychology*, 18 (1): 10–30.
- Ross, Lee, and Andrew Ward. 1996. "Naive Realism in Everyday Life: Implications for Social Conflict and Misunderstanding." In *Values and Knowledge*, edited by E. S. Reed, E. Turiel, and T. Brown, 103–135. Hillsdale, NJ: Erlbaum.
- Slobin, Dan I. 1987. "Thinking for Speaking." *Proceedings of the Thirteenth Annual Meeting of the Berkeley Linguistics Society*, 435–445.
- Slobin, Dan I. 1996. "From 'Thought and Language' to 'Thinking for Speaking'." In *Rethinking Linguistic Relativity*, edited by J. J. Gumperz and S. C. Levinson, 70–96. Cambridge: Cambridge University Press.
- Slobin, Dan I. 2003. "Language and Thought Online." In *Language in Mind*, edited by D. Gentner and S. Goldin-Meadow, 157–192. Cambridge, MA: MIT Press.
- Talmy, Leonard. 2000. *Toward a Cognitive Semantics*. Cambridge, MA: MIT Press.
- Treffers-Daller, Jeanine. 2012. "Thinking for Speaking and Linguistic Relativity Among Bilinguals: Towards a New Research Agenda." *Language, Interaction and Acquisition*, 3 (2): 288–300.
- Wassmann, Jörg, and Pierre R. Dasen. 1998. "Balinese Spatial Orientation: Some Empirical Evidence for Moderate Linguistic Relativity." *The Journal of the Royal Anthropological Institute*, 4 (1): 689–711.
- Whorf, Benjamin L. 1956. *Language, Thought and Reality: Selected Writings of Benjamin Lee Whorf*. Cambridge, MA: MIT Press.
- Zwarts, Joost, and Yoad Winter. 2000. "Vector Space Semantics: A Model-Theoretic Analysis of Locative Prepositions." *Journal of Logic, Language and Information*, 9 (2): 171–213.

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**Abstract:** The term "Linguistic Relativity Hypothesis" (LRH) has come to be used as a cover term for a family of related hypotheses about the possible causal impact of learning and speaking particular languages on nonlinguistic cognition. This chapter aims to distinguish among some of these hypotheses, trace their origins, and discuss the presently available evidence for and against them. It also examines the implications of the hypotheses and the sources of the interest in them. And it chronicles the waxing and waning of this interest since the writings of Benjamin Lee Whorf (1897–1941), which launched an at times heated debate about these ideas among scholars from across a range of academic disciplines. A classification of different types of language-on-thought effects is proposed. Special emphasis is placed on the role of the language-specificity and culture-specificity of linguistic meaning in the debate.

**Keywords:** concept induction; language-on-thought effects; linguistic anthropology; linguistic relativity; Linguistic Relativity Hypothesis; Linguistic Transmission Hypothesis; semantic categorization; semantic typology; thinking-for-speaking effects; Whorf, Benjamin Lee