

New Directions in Linguistic Relativity Research

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Abstract

Does language influence how we view the world? This century-old question has inspired a great number of researchers from various disciplines to test whether speakers of different languages understand reality in different ways. Despite the significant progress, our understanding of the interface of language and thought has been limited due to several challenges on both theoretical and methodological levels. With the aim of moving linguistic relativity research forward, this article critically assesses the challenges that persist in the field and outlines the new directions in which linguistic relativity research should develop in the future. These new directions are addressed in the article from three perspectives: language (what aspects of language should be investigated), population (what kinds of language users should be investigated), and models (what goal should we aim for). Each of these perspectives calls for researchers to approach the debate on language and thought in a more comprehensive and systematic manner. Finally, the article encourages the researchers to engage in more interdisciplinary cooperation in order to achieve more fine-grained understandings of language and thought.

Keywords: Language and thought; linguistic relativity hypothesis; levels of linguistic relativity; bilinguals; model

1. Introduction

Does language influence thought? The linguistic relativity hypothesis (LRH), or the Sapir-Whorf hypothesis (SWH), posits that the answer to this question is “yes.” This subject has sparked hot debates and discussions for more than half of a century, during which time, the empirical studies on this topic became more interdisciplinary, and the tested domains became more diverse. The key concern of linguistic relativity research is to explore the relationship between one’s linguistic experience and thought patterns. Researchers pursuing this key research question are mainly concerned with two important factors: language and population. Language refers to the linguistic knowledge, such as lexicon, morphological structures, syntactic structures, and semantic and pragmatic features of linguistic

expressions. Population refers to different types of language users who have categorically different linguistic experiences, such as monolinguals and bilinguals. Further developing linguistic relativity requires that we address the challenges in these two major factors. Furthermore, I argue that researchers must reflect upon their goal in studying linguistic relativity. For more than half a century, researchers have been obsessed with finding evidence to (dis)prove the LRH, which has shrunken the goal of the entire research paradigm to the simple binary of “yes” or “no.” Given that a large number of empirical studies have already demonstrated that language does influence thought (e.g., Pavlenko, 2014), the time is ripe for researchers to reset the goal and focus on *how* language influences thought.

To move this vibrant research focus forward, in this paper, I will critically assess the challenges that persist in the research area and outline the new directions to pursue. I will discuss these challenges from three perspectives: language (what aspects of language should be investigated), population (what kinds of language users should be investigated), and models (what goal should we aim for).

2. Language: What aspects of language should be investigated?

The question of language and thought was framed by Whorf in his 1940 paper as how “reality” is built upon the language habits of the group—in other words, how linguistic knowledge scaffolds our understanding of the reality. Whorf believed that linguistic knowledge includes not only the knowledge of syntactic and semantic representations, but also the knowledge about how a language is actually used in a cultural community. That is to say, language is a communicative act, one that demands that language users not only master the structures of the message itself, but also take into consideration the addressee, the channel as well as the context as a whole. Moreover, Whorf argued that the reality extends beyond the physical to include social reality as well. To put it another way, we are not living in a purely material world, but rather a world full of social relationships. Whorf’s way of framing the problem shed light on the nature of the interface of language and thought: Namely language may influence thought at several different levels. Although Whorf himself did not make any clear proposals concerning this issue, half a century later, Lucy (1997a, p.292) clarified this point by proposing three levels of linguistic relativity:

- Semiotic level: Does having a code with a symbolic component transform thinking?
- Structural level: Do different morphosyntactic configurations of meaning affect thinking about reality?
- Functional level: Do discursive practices affect thinking either by modulating structural influences or by directly influencing the interpretation of the interactional context?

In what follows, I will elaborate on the challenges we face in these three levels when we study language and thought.

2.1 The semiotic level

According to Lucy (1997a), the search for evidence for or against linguistic relativity at the semiotic level demonstrates the widespread concern for how the signs and symbols of world language might influence the thought. One research question that addresses this concern at this level is whether language speakers with different writing systems view the world differently. For example, do the logographic writing systems, like Chinese, and the alphabetic writing systems, like many Indo-European languages, influence their users' thinking in different ways? However, of the three levels of linguistic relativity, the semiotic level has received the least amount of attention. One of the main reasons lies in linguists' conventional view of what language is, as can be seen in Bloomfield's (1933) argument that spoken language is primary to written language and the function of the latter is just to record what is said. Pae (2020), in her book addressing the promising future of finding scripts effects on thought, argued that the idea of spoken language primacy stemmed from some misbeliefs and misconceptions about writing systems: namely, thinking that writing is merely an extension of speaking. However, many studies have demonstrated that although speech and writing are interrelated, there are many differences between the two. For example, writing systems need to be explicitly learned, and there are structural and contextual differences between spoken and written language (Chafe & Tannen, 1987). Since linguistic relativity research has shown that habitual use of spoken language can influence how people perceive the reality, it is reasonable to argue that habitual use of different writing systems may similarly yield different cognitive patterns.

Another important reason why the attempts to probe linguistic relativity at the semiotic level are sparse is that it is difficult to draw a link between a writing system and its potential influence on thought. It is not clear what cognitive domains these script effects could relate to. Pae (2020) spends an entire body citing a bevy of empirical studies to show the consequences that different scripts may have on our brains. Nonetheless, most of the evidence she cited comes from psycholinguistic and neurolinguistic studies that sought to demonstrate the cross-linguistic differences in reading processes. This script effect on reading processes alone is not convincing enough to draw the conclusion that different scripts influence our thought. Pae did, however, also propose some hypotheses from the perspective of culture as another prospective candidate to explain interplay between script and thought. For example, based on Logan (2004), she puts forward that logographic writing systems and alphabetic writing systems might have yielded cultural differences in attention and perception (holistic vs. analytic) and problem solving (relation vs. categorization) between the East and the West. The proposal is of some interest, but the touchy issue is how we can prove the potential relationship between these cultural differences and these writing systems.

Linguistic relativity at the semiotic level remains an underdeveloped zone but is certainly an area of interest. Researchers should pay more attention to how writing systems might influence thought by tracing the origin of orthography and accumulating more solid evidence on the potential influence of orthography on cultural formation.

2.2 The structural level

The research on linguistic relativity at the structural level is the most robust among all the levels, with a large number of empirical studies exploring how different syntactic structures affect the understanding of the meaning entailed by those structures. Moreover, another outstanding feature of the studies at this level is that researchers, most of whom are psychologists, seek a link between the structural patterns with referential entailments and their non-linguistic cognitive assessments of individual speakers (Lucy, 2016).

The main reason for the continued interest in studying linguistic relativity at the structural level is that the referential function of language to the physical reality, such as referring to objects, relationships, and properties, provides researchers with a more directly accessible window into the inquiry of language and thought. Despite the fruitful research outcomes that have been produced thus far, one of the main challenges at this level is the difficulty in making cross-linguistic comparisons of the world languages without presupposing any language or its way of construing reality as the privileged framework (Lucy, 1997a). For example, when comparing the morphosyntactic structures of motion verbs, some linguists have concluded that the linguistic encodings of manner and path in Chinese behave like other satellite-framed languages, such as English, in which path is encoded in the prepositional phrases (e.g., Shi & Wu, 2014; Talmy, 2000), whereas other linguists have counterargued that linguistic encodings of manner and path in Chinese are different, for path is usually expressed by means of verbs (Slobin, 2004). The issue concerning the linguistic status of path in serial-verb languages like Chinese directly affects how researchers set up a testable hypothesis in the motion domain. Another vivid example is the Thematic Hierarchy proposed by Jackendoff (1990), which states that agents are the most prominent role and patients secondary because agents are often linguistically encoded as subjects and patients as objects. This hypothesis was made based mainly on the observations from English examples. However, a recent study has found that the Thematic Hierarchy does not apply well to the case of Japanese language, in which human patients are given the most prominent role because human entities are generally selected as subjects in the sentences (Qu & Miwa, 2022). Therefore, many studies based on this hypothesis, such as Rissman and Majid (2019), should be taken with a grain of salt. In 1940, Whorf issued a plea to researchers to study “exotic” languages, a clarion call that remains vital even today, more than half a century later. We must make far more progress in understanding typological

differences in world languages before we can draw any general conclusions about the effects of certain linguistic features on thought. The rise of Chomskyan linguistics in the 1950s greatly discouraged the interests in language documentation, the framework set up by Boasian linguists, and the consequences echo to this day. It by no means indicates that there are no linguistic universals, but before we rush to these “universals,” which are often coined based on our own linguistic categories, we need to scrutinise these “universals” from other linguistic perspectives. This requires that linguists document more languages and analyse their syntactic structures in their own context so that the structures we observe are not ripped out of their holistic semantic system.

This point brings us onto another challenge at the structural level of exploration: the interconnected relationships between structures in a single language. When a structure of a language is analysed, linguists tend to make cross-linguistic comparisons but ignore how this specific structure might relate to other structures in this specific language (Enfield, 2015). Japanese speakers are less likely than speakers of other languages to use transitive verbs when describing accidental causal events (Bohnemeyer et al., 2010). For example, when describing a scene where a boy accidentally spills his milk, in Japanese it is more natural to say *miruku-ga koboreta* (*the milk spilled*), whereas in English it is more common to say *he spilled the milk*. The Japanese preference for non-agentive expressions is usually linked to the perception and memorisation of agents by researchers studying linguistic effects on thought (e.g., Fausey et al., 2010). Although this is reasonable, a broader and deeper analysis of the Japanese language might reveal a bigger picture. Ikegami (2005) argued that many constructions in Japanese, such as tense and aspect, person, transitive and intransitive verbs, etc., are not independent but interrelated and point to Japanese speakers’ subjectivity-prominent construal of events. Based on this framework, Japanese speakers’ preference for non-agentive expressions when describing accidental causal events can be arguably linked to their having an egocentric perspective in event construal. That is, Japanese speakers tend to focus on the state change of events because they conceptualise the situations as if they were experiencing them themselves. In this way, a single linguistic structure might restrict us to seeing only part of the greater picture, and we may end up drawing short-sighted links between structural patterns and their non-linguistic cognitive assessments.

2.3 The functional level

Compared to the structural level, the research on linguistic relativity at the functional level is being conducted on a much smaller scale. The past two decades have witnessed some social psychologists and applied linguists allocate more attention to the research question of how language use in the interactional context might influence the construct of self in narratives, emotions regularisation, inner speech, interpretative frames of events, etc. A principal challenge in this branch of

study is that researchers still lack a full awareness of and appreciation for the importance of finding evidence regarding language and thought at this level. This line of inquiry emphasises the emotive and phatic functions of language, both important functions of language (Jakobson, 1960). There is no justified reason for us to assume the referential function, which is usually addressed at the structural level, is more important than the emotive and phatic functions (Enfield, 2015). Moreover, unlike the structural level, the researchers studying language and thought at the functional level are not obsessed with non-linguistic methodologies because the potential effect of discursive practices on thought is always mediated by language. In other words, it is impossible to imagine that the social behaviours, such as delivery of emotions, autobiographical memory, and inner speech, etc., could be conducted without using language, which challenges the argument that we must use non-linguistic evidence to test the LRH (e.g., Bylund & Anthanasopoulos, 2014). Thus, the language and thought studies at the functional level deserve more recognition and attention.

One of the main reasons why the researchers are not very motivated to probe linguistic relativity at the function level is that it departs from traditional studies of language and thought in terms of methodology. Although applied linguists and anthropologists have played an active role in studying linguistic relativity, most of the leading studies in this field have been conducted by experimental psychologists. They are passionate about testing the LRH in labs by carefully designing experiments, controlling variables and noise, and in most cases recruiting college students as research participants (Kagan, 2012). Nonetheless, when it comes to exploring linguistic relativity at the functional level, it is challenging to stick to the quantitative methodologies because testing the hypothesis that the emotive and phatic functions of language might influence our thought may require researchers to elicit data outside labs, along with noise and variables that are hard to control, and to analyse data based on interpretive frameworks. For example, the researchers interested in linguistic effects in constructing autobiographical narratives often collect data from interviews, language learners' diaries and journals, and language memoirs. Compared to statistical data analysis, qualitative data analyses can be much more susceptible to researchers' own subjective interpretations, though this is not inherently negative (Sutton & Austin, 2015), because the data themselves are multi-layered and subject to socio-political, interactional, and cultural contexts. Therefore, what researchers are dealing with is not a collection of facts but discursive constructions that need subjective interpretations (Pavlenko, 2007). This approach is certainly not favoured by experimental psychologists. However, the difficulty in data elicitation and data analysis that exists in the exploration of linguistic relativity at the functional level should not cloud the importance of this line of inquiry and should not prevent the researchers from negotiating a reasonable approach to this line of inquiry. For example, Grigoroglou and Papafragou (2019) conducted a series of experiments focusing on how pragmatic factors influence the production of events in the

conversation. The participants were asked to describe a target event while they were playing a guessing game with a “naïve” listener. In this interactional context, the participants became more informative, and eventually the event components in their descriptions increased. This study demonstrates that the phatic function of language can influence how events are conceptualised in the mind. We need more attempts like this to invigorate the exploration of linguistic relativity at the functional level.

3. Population: What kinds of language users should be investigated?

Ever since the birth of the LRH, researchers have been almost exclusively interested in comparing monolingual speakers of different languages. However, monolingual speakers represent only one type of language users. Other types include speakers of more than one language (bilinguals), deaf people, and people with developmental language disorders, among which bilinguals are an ever-increasing group of language users due to globalisation. Studying different types of language users helps researchers explore how different varieties of linguistic experience might influence thought (Lucy, 2016). Therefore, it is vital that equal attention is paid to other types of language users in addition to monolinguals.

3.1 Bilinguals

The last two decades have seen that researchers have gradually realised the importance of including non-monolinguals in the discussion. Neo-Whorfianists, who hold the view that language as a tool guides our thinking, have started to pay more attention to the thinking patterns of bilinguals. What is fascinating about bilinguals is that, compared to monolinguals, the linguistic forms of later-learned language(s) are often dissociated from their cognitive and discursive functions due to the factors such as acquisition age, acquisition context, and context of language use, etc. (Jarvis & Pavlenko, 2008). This special linguistic input and use makes bilinguals a promising target for research into interface of language and thought. Pavlenko’s 2014 book, *The Bilingual Mind*, is a compilation of the studies from the past two decades on the thought patterns of bilinguals. The general findings of these studies indicate that bilinguals show complicated interactions between different thinking patterns mediated by different languages, and theories on monolinguals are not sufficient to explain the complexity of bilingual cognition. Although studying bilinguals has given us more insights about the linguistic effects on thought, many challenges remain. In what follows, I will specifically talk about the challenges in studying bilingual speakers.

When researchers attempt to answer the questions concerning bilinguals’ thought, they are faced with the challenge of characterising the linguistic experience of bilingual participants, for

bilingual experience is a complicated and dynamic cognitive and social construct (Grosjean, 2013). The challenge is only increasing as the rise of globalisation creates even more language contacts and the world grows more linguistically diverse (Luk & Esposito, 2020). Documenting participants' linguistic experience directly influences the interpretation of the results because the extracted factors used to characterise bilingual speakers, such as L1 competence, L1 maintenance, late L2 learning, L2 competence, late L2 immersion, are treated as the dependent variables in the statistical models. If we want to deepen our understanding of how these variables affect the thinking patterns of bilingual speakers, obtaining an accurate and transparent documentation of the linguistic experience of bilinguals is indispensable. To do this, researchers often use questionnaires with detailed questions about participants' language history. The issue with using questionnaires is that different questionnaires may not be comparable. Kaščelan et al. (2022) reviewed 48 questionnaires quantifying bilingual experience in children, and after identifying 32 overarching constructs, such as language exposure and use, activities, and current language skills, they discovered that these questionnaires evinced great variability in the constructs used to document bilingual children. In other words, the questionnaires did not document the same constructs in bilingual children, which makes research results hard to compare. This further influences the quality of meta-analyses or systematic reviews of the studies in the field (Leivada et al., 2021). This points to an urgent need to call for greater transparency in developing comparable questionnaires to document bilinguals.

The need to construct more comparable questionnaires to be shared among researchers is not the only issue at hand. Another transparency-related issue is achieving transparency in reporting bilingual experience in research articles. Even if researchers can gradually advance toward more accurate and objective documentation of bilingual experience, if it is not reported well, comparability across studies will remain low. Surrain and Luk (2017) did a systematic review of how bilingual participants were described in studies published between 2005 and 2015. They found that less than half of the studies reported proportional usage of languages by bilinguals, and even less than 30% of the studies described the sociolinguistic contexts from which the samples were drawn. This calls for greater transparency when reporting results upon publications.

Beyond the transparency issue, another challenge in studying bilinguals is how questionnaires might address the bilingual experience across a person's lifespan. This is important because bilingualism is an experience that changes with time. Investigation into this area may help shed light on the changes in the thinking patterns of bilinguals across the trajectory of their whole lives, but accomplishing this requires questionnaires that can produce snapshots across different life periods. Anderson et al. (2018) criticised that the widely used questionnaires such as the Language Experience and Proficiency Questionnaire (LEAP-Q) and the Language History Questionnaire (LHQ), etc., saying they mainly target

young adults and do not sufficiently represent the structures of bilingual experience for children and older adults. Using a factor analysis, Anderson and his colleagues showed that the structures of linguistic experience of bilinguals in different life periods are different: Children's language use is most reflected and shaped by their home environment, young adults' by their social environment, and older adults' by their nuclear family and close friends. These results illuminate the issue of achieving accurate characterisations of bilinguals through questionnaires, calling for more attention to how linguistic experience is influenced by different environments in different life periods.

3.2 Other types of language users

Above, I discussed the challenges that researchers are faced with when studying bilinguals. As mentioned before, there are other groups of language users that may also be of interest in studying the interface between language and thought, such as deaf people and people with developmental language disorders (DLD). Previous studies on the cognitive performance of deaf children (e.g., Morgan & Kegl, 2006; Schick et al., 2007) have found that deaf children with late access to language performed poorly on false belief tests compared to age-matched children with normal hearing, which indicates the vital role that language input plays in cognitive development. However, deaf individuals do not always show disadvantages compared to hearing individuals. In visuospatial cognitive tasks, such as spatial memory, movement detection, and face recognition, deaf children do not show general deficiencies compared to hearing children (Mayberry, 2002), arguably because deaf children use sign language, which has higher iconicity and facilitates greater form-meaning mapping compared to spoken language (Sümer & Özyürek, 2022). Generally speaking, the number of language and thought studies on deaf individuals and people with DLDs is limited, leaving many important research questions unanswered. For example, does the lack of auditory language input lead to different developmental patterns of inner speech, emotional regularisation, interpretative frames of events, temporal processing of events, etc.? The question of how lessened linguistic input and use in the deaf population might affect thought needs to receive as much attention as similar questions in the monolingual and bilingual populations.

4. Models: What goal should we aim for?

In the tradition of psycholinguistics, researchers often regard model development as their research goal because models can predict and explain the psychological processes of an observed phenomenon in a straightforward manner. In contrast to this tradition, researchers in linguistic relativity, most of whom are non-psycholinguists, are not concerned with model establishment. Instead, they conduct experiments to investigate those well-established linguistic domains with the purpose of finding

evidence for or against the LRH. In a review on linguistic relativity, Lucy (2016) pointed out that linguistic relativity research lacks a systematic exploration of language and cognitive activities that an overall theoretical framework can explain. I interpret this as a call for a model that can piece individual studies together to explore the full range of the relationships between language and thought.

There are a number of reasons that researchers are not greatly motivated to set up models as a systematic way to explore linguistic effects on thought. For one, language is a complex cognitive-social construct with different levels. For another, linguistic relativity research is at the crossroads of various disciplines that have different traditions and use different approaches to this research topic. A third important reason is that ever since this research field was officially initiated by psychologists in the 1950s, researchers have largely dwelled on finding evidence for or against the LRH. In other words, the whole research paradigm focuses on *whether* rather than on *how*. Although it may have been reasonable to do so back in 1950s, when the initial proposal of the LRH sparked heated debates, there is less value and meaning in clinging to this purpose today, as there now exists a great body of work demonstrating that language does indeed influence thought. We need to acknowledge that researchers nowadays are more aware of the necessity of shifting their focus onto *how*, such as by studying which aspects of cognition are more or less affected by which aspects of language, establishing simple models, and investigating the temporal points of cognitive processing at which linguistic effects emerge. However, our current efforts are far from sufficient to establish elaborate models with stronger explanatory power. In what follows, I will specify the efforts that researchers should make in developing a robust model to understand the interface between language and thought.

4.1 Metalinguistic relativity: What is language?

The first challenge that researchers face in developing a model is the definition of language itself. One's linguistic view directly influences how one understands the potential linguistic effects on thought. This is known as metalinguistic relativity. Researchers working in this field have various ontological views of language, which directly gives rise to different interpretations of "linguistic relativity" and consequently produces divergent opinions on the relationship between language and thought. If we intend to model language and thought, we must first clarify our linguistic view before jumping to draw a model. Blomberg and Zlatev (2021) summarised three kinds of ontological views of language among researchers. The first view is that language is a conventional, monolithic, and self-contained semiotic system that is socially maintained. This view is often held by anthropological linguists, such as Boas, Sapir, and Whorf. They emphasise community-specific ways of using language and the boundless diversity of linguistic structures. Neo-Whorfianists hold the same basic linguistic view, but they are more concerned with contexts of use and the synchronic and diachronic change of

language. Moreover, Neo-Whorfianists treat linguistic categories as less of a holistic system and more as a way of mapping one linguistic category onto one cognitive domain; they actively explore the link between linguistic categories and their corresponding cognitive domains. The second view is that language is generally universal, in that the key aspect of language is a biologically instantiated “language faculty.” This view is principally held by Chomskyan linguists. The third view is that language is the outcome of social interactions. This view, which is held by social-cultural theorists, overlaps with the first view in the sense that both take into consideration the linguistic diversity and specificity of a linguistic community. Nonetheless, the two views diverge on their points of emphasis: The first view prioritises linguistic structures, while the third view focuses on the contexts and situations in which language is used as a social practice rather than an abstract system. Each of these three linguistic views has guided researchers to take different stands on linguistic relativity by focusing on different aspects of how language may affect thought. For example, classical relativists, who hold the first view, actively test the relationship between an entrenched linguistic structure and its reference to a cognitive domain, such as aspect and temporal perception, plural markings, and substance perception; universalists seek evidence that the “thought potential” of language speakers is universally the same and language underrepresents rich thoughts (e.g., Pinker, 1994; Papafragou & Gleitman, 2005); and social-cultural theorists dedicate themselves to showing that language and thought are not separable because language is always employed as a tool in any situated conversation.

Although researchers still face numerous difficulties in reaching a consensus on what language is and thus have yet to arrive at a united stance on how to approach linguistic relativity, what we can do as a first step toward establishing an overarching model is acknowledge and clarify our own linguistic views so that we know where our starting point is. This is a hard-to-achieve yet important step toward establishing a systematic framework in studying language and thought.

4.2 A time-locked model

To better describe the relationship between language and thought, we need a robust model that captures in detail the processes of linguistic effects on thought. To this end, an important step is to figure out the temporal points in cognitive processes that linguistic effects might come into play. Wolff and Holmes (2011, p. 254) listed several ways that language influences thought from a temporal perspective:

(1) Thinking before language: How we think about reality is guided by how we encode it linguistically later.

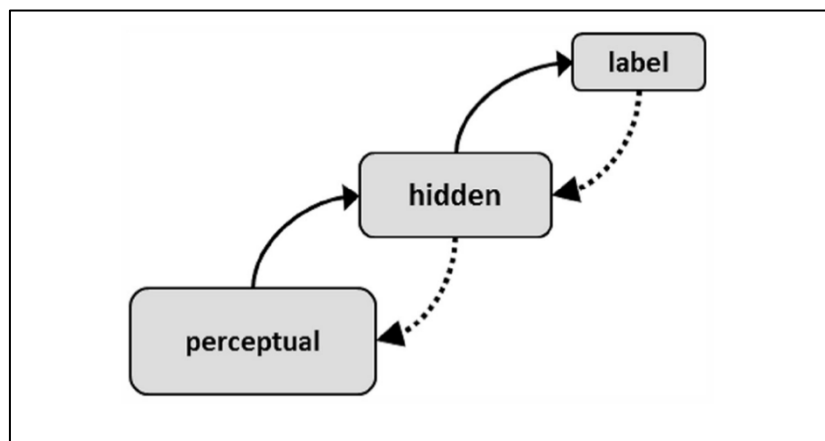
(2) Thinking with language: Language might serve as a meddler, competing with thought simultaneously, or it might serve as an augments, extending thought.

(3) Thinking after language: Language might function like a spotlight, making certain types of thinking more salient, or it might function like an inducer, priming certain types of thinking.

These three types of interactions between language and thought may seem alike, but the time at which thought is influenced by language differs. Much previous work has already argued that thinking before language is the most probable type of language-thought interaction. For example, Slobin's (1996a) thinking for speaking hypothesis proposes that we think in the way that is most readily encodable in the language we speak. Many psychological studies have supported "thinking before language" by showing that language as a label gives feedback to thought, and thought generated before the involvement of language is modified later. A model that tentatively accounts for this mechanism is the label-feedback hypothesis (LFH) by Lupyan (2012). Fig. 1 demonstrates the model. This model simulates linguistic effects on perception. First, the perceptual layer is provided with a feature-based input of an object, whereupon it activates a linguistic label. Then, the linguistic label gives its feedback to help perceptual reprocessing. The hidden layer represents interferences that prevent feedforward and feedback. This model predicts that the more feedback the perceptual system gets from linguistic labels, the more modulations the perceptual processing receives.

Figure 1

Lupyan's Label-Feedback Hypothesis (LFH)



Note. The solid lines represent feedforward connections and dashed lines feedback connections. From "Linguistically Modulated Perception and Cognition: The Label-Feedback Hypothesis" by G. Lupyan, 2012, *Frontiers in Psychology*, 3, p. 5.

The LFH is an admirable first attempt to model the interface of language and thought, but several aspects can be developed upon and improved. First, it fails to address the specific temporal points at which the linguistic label starts to feed back to the perceptual layer. Researchers already have

tools to explore cognitive processing down to the millisecond and measure brain activity in real time. The time is ripe for researchers to take advantage of these tools to pin down the time window(s) at which linguistic effects on thought emerge. Ascertaining these time windows will help shed light on which aspects of cognition are more or less affected by which aspects of language. For example, using an EEG oddball paradigm, Kamenetski et al. (2022) found that cross-linguistic differences in manner encoding had effects on attention that were revealed in a late positivity, approximately 400ms after the stimulus was presented. They concluded that manner encoding difference impacts attention at a later stage. Another example comes from Misersky et al. (2021), who employed EGG to investigate the time window when grammatical aspect influences object representation. They observed that different grammatical aspects resulted in different heights of amplitude P300, around 300ms after the stimulus was presented. Taken together, these two experiments suggest that grammatical aspects, being highly automatised and obligatory concepts, generate feedback to perception at an earlier stage than lexicalised concepts, e.g. manner encoding.

A second way in which the LFH is lacking is that it has yet to address more complex linguistic structures. The “label” as conceived of by the LFH refers to one-to-one mapping between a referent and a linguistic symbol, such as the colour blue and its corresponding linguistic encoding “blue” or a square and its linguistic encoding “square.” This line of inquiry has long been the tradition of linguistic relativity research. However, labels can extend to complex relationships between several entities (Sauppe & Flecken, 2020). For example, an image showing a dog chasing after a man includes two objects, “dog” and “man”, as well as their thematic roles, “agent” and “patient”, which are linked by an action, “chase.” This type of linguistic label denotes relational information that is much more complex than the label of one-to-one mapping, and the complexity of the label might directly influence when the label itself is activated by the feedforward connections from the perceptual layer as well as when the label feeds back to the perceptual layer. This example shows why researchers need to take various linguistic structures into consideration when establishing time-locked models. That said, time-locked models do have their limits. This approach mainly works for linguistic relativity research at the structural level, where time-locked studies can be designed, but it may not work well at the functional level, where language is inseparable from social practices and time-locked studies are hard to design.

5. Conclusion

This article has critically assessed the challenges in the field of linguistic relativity with the purpose of sketching out new directions in which future research should develop. These new directions have been addressed from three perspectives: language, population, and models. Each of these

perspectives brings new opportunities for researchers to deepen our understanding of language and thought. For language, more attention should be given to how the semiotic level and function level of language influence the thinking patterns of language speakers, and researchers should be more careful when making cross-linguistic comparisons of linguistic structures and when drawing links between structures and cognitive domains. For population, researchers should give more consideration to accurate and transparent documentation of the linguistic experience of bilinguals, address the bilingual experience across the human lifespan, and more deeply investigate other understudied groups of language users, such as the deaf population and people with DLDs. For the goal of linguistic relativity research, researchers are encouraged to dedicate themselves to establishing systematic frameworks by first clarifying their own ontological views of language, then setting up models and designing time-locked studies to examine which aspects of cognition are more or less affected by which aspects of language.

The advancement of linguistic relativity research requires dialogue across different disciplines, such as psychology, linguistics, and anthropology, for language, by its very nature, is a complex construct that is generated by the mind, situated in society, and intertwined with culture. Any interpretation restricted by the traditions and presumptions of a certain discipline narrows our perspective and compromises our understanding of linguistic effects on thought. In addition to interdisciplinary cooperation, multi-lab cooperation is also vital. Comparing research results from different labs using the same measures and methods can help reduce researchers' biases and identify false positive or false negative effects resulting from idiosyncratic differences in data collection (Leivada et al., 2021). In this way, our century-old research into linguistic relativity will start to embrace a more comprehensive and coherent framework.

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