

Effects of Second Language Learning on  
Mental Representations of Time

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### **Abstract**

The following thesis is a domain-centered study that examines the effects of second language (L2) learning on mental representations of time in native English learners of L2 Mandarin Chinese. The design of this study attempts to observe the effects of the existence and use of spatiotemporal metaphors in Mandarin Chinese on L2 learners of the language. The methodology used for data collection includes a three-dimensional pointing paradigm—a partially language-independent task—which attempts to isolate cognitive behavior. The task requires participants to answer questions (by pointing) regarding space and time on imaginary axes in front of their person using their own fist as the reference point in their answer; this precludes any language effects caused by having to use language in completing experimental tasks. The participants of the study include advanced L2 learners of Mandarin Chinese as the focus experimental group and English native speakers as the control group. Results confirm the hypothesis that learning a second language does influence speakers' mental representations of time; while English native speakers significantly preferred the transverse axis in virtually all cases, L2 Mandarin learners displayed a preference for both the transverse and sagittal axes, without significantly distinguishing between the two. This study adds to previous literature in the field, providing evidence in support of the linguistic relativity theory.

*Keywords:* crosslinguistic influence, bilinguals, conceptual transfer, linguistic relativity theory, Mandarin Chinese, English, second language learning, cognitive restructuring, mental representations, spatiotemporal metaphors

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**List of Abbreviations**

ACTFL	American Council on the Teaching of Foreign Languages
ANOVA	analysis of variance
CL	classifier
D	distractor question
FB	front-back
L1	first language
L2	second language
LPT	Listening Proficiency Test
M	mean
N	non-spatial
NS	native speaker(s)
OPI	Oral Proficiency Interview
RPT	Reading Proficiency Test
SD	standard deviation
SPSS	Statistical Package for the Social Sciences
UD	up-down

## Chapter 1. Introduction

For hundreds of years, academics of all cultures have recognized that speaking different languages may influence a person's perception of the world around them. An old Chinese proverb says, "To learn a language is to have one more window from which to look at the world." Still, one of the most famous—and somewhat comical—sayings regarding language is attributed to Emperor Charles V, "I speak Spanish to God, Italian to women, French to men and German to my horse." While there is no real logical reasoning behind any of these specific categorical usages of language, some academics would say he might be on to something. Students of international studies, business, relations, etc. are almost always instructed by their mentors or required by their academic programs to study one, if not two or three foreign languages. Why? Because the best way to truly understand and relate to another culture is by learning and communicating in that culture's native tongue. Apart from the obvious reason of ease of communication, is this possibly because being able to speak that culture's language makes a person more likely to think as people of that culture do?

There are many linguists and social scientists, such as Dr. Benjamin Whorf, the father of linguistic determinism and the later revised linguistic relativity theory, who would answer with a resounding "yes." The grammar, vocabulary, the words that we (do not) use, and the overall structure of the languages we speak all affect the way we shape our thoughts and the way we view the world. While there are (to a certain degree) universal semantics that seem to appear in many languages regardless of cultural or societal differences, experiments from the past few decades have shown that there are indeed linguistically-caused differences in cognition that influence the way we perceive and interpret the most fundamental domains of existence, e.g., time and space. More recent studies have focused on crosslinguistic influence of bilinguals and

how their mother tongue influences their second language, or have attempted to display the differences in conceptualizing domains of experience between speakers of multiple languages. There have not, however, been many studies looking at the effects L2 has on pre-established cognitive habits and conventions. Moreover, most studies test and compare native speakers of different languages. This study will focus on the effects of learning a second language, testing advanced learners of the language, and how that language influences the way they perceive or think about time and space, aiming to add to the existing literature on the subject of linguistic relativity and crosslinguistic influence—more specifically, second language learning and its effects on conceptual perceptions, i.e., mental representations of time. As previous research suggests, there are many cultural and linguistic patterns and factors that could contribute to these differences in conceptual perception (e.g., Athanasopoulos, et. al, 2015; Jarvis, 2008; Whorf & Carroll, 1998; Fuhrman, et. al, 2011; Lai & Boroditsky, 2013). Writing system, writing direction, calendar use, even modern technology such as smartphones could have the power to influence these conceptual perceptions over time. How we talk about and reference time within the boundaries of language is also an extremely important factor that this study shows to influence this cognitive restructuring.

This thesis begins in the next chapter by discussing previous literature on the subject of linguistic relativity as a field of study, then narrows its scope down to more specific domain-centered studies on language and conceptualization, and finally discusses the most recent literature on the matter and the need for further study. Chapter 3 then provides my research questions, describes the methodology that I used to design and conduct my specific study, and lays out the procedure of the experiment used with each participant. Chapter 4 reports the results of the experiment using statistical analysis data from IBM's Statistical Package for the Social

Sciences (SPSS) software. Chapter 5 attempts to explain and expound upon the findings from the results chapter, referring back to previous literature to link and compare findings from this study with previous ones in an attempt to offer original conclusions. The thesis concludes by summarizing the study, discussing limitations, and offering suggestions for future studies in the field.

## **Chapter 2. Literature Review**

This chapter begins by introducing the theory of linguistic relativity and its origins, followed by its reception by the scientific community at the time and the emergence of studies which emphasized a kind of universality amongst languages regardless of culture, society, or location. The chapter discusses new concepts and methodologies that began to develop which provided support for and strengthened the theory, focusing on studies that dealt with how languages influence the conceptualization of the fundamental domains of space and time. The chapter then examines more recent studies that concentrate on crosslinguistic influence, and provides brief descriptions of a few relevant studies that looked at second language acquisition and the interaction effect between multiple languages and thought. Most of these studies are designed in an attempt to isolate these effects by having participants complete nonverbal tasks in which they are not actively using language and instead are thinking and reacting to stimuli or primers. The chapter introduces the studies from which the current thesis received its inspiration, which focus on comparing Mandarin native speakers and English native speakers' mental representations of time and space, and finally discusses the need for further research in the field and the significance of the current study.

### **2.1 Linguistic Relativity Theory Origins and Background**

The father of linguistic relativity, Dr. Benjamin Lee Whorf claimed that we as users of language are unaware of the effects language has on us, and instead we regard it as simply a background phenomenon. Dr. Whorf asserted that the patterns of language are different for each respective language, and that the grammar and structure of each language directs its users to perceive the world in a certain way, resulting in varied views of the world by people of different

languages and cultures (Whorf & Carroll, 1998). Whorf, along with other scholars such as Humboldt, Boas, and Sapir, believed that semantic structures of different languages might be a reason for differences in cognitive and social behaviors of people from different cultures and societies (Gumperz & Levinson, 1991). This idea sparked intrigue from the public and scholars of multiple fields of study ranging from anthropology to psychology. According to Gumperz and Levinson (1991), the excitement was cut short when the cognitive sciences began to progress in the 1960s and claimed that human cognition and its development were universal, backed by linguistic anthropological discoveries of semantic universals in color terms (Berlin & Kay, 1969), structure of ethnobotanical nomenclature (Berlin, 1972), and parental kinship terms (Murdock, 1959).

## **2.2 Opponents of the Theory**

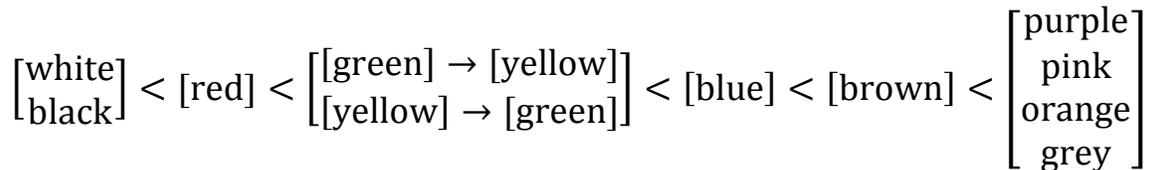
In the 20<sup>th</sup> century, there were numerous studies within the field of cognitive sciences that challenged Whorf's theory that varying semantic structures in different languages are one of the reasons for differing thoughts and behaviors between societies and cultures. These studies focused on covering what are now called "semantic universals" that appear in a multitude of languages regardless of the culture or society in which the language is spoken.

Murdock (1959) explored the universal tendency for young children or infants, regardless of culture, to make the easiest sounds possible, and consequently these utterings become the meaning of "mother" or "father" in "baby talk," and ultimately transition into adult language (Murdock, 1959). He asserted that the easiest sounds to make for infants are nasal consonants, such as [m], and low vowel sounds, such as [a], resulting in sounds or words such as "ma,"

“mama,” or “ama.” We can see these similarities not just in numerous European languages, but also in East Asian languages, such as Mandarin Chinese (媽 *mā*) and Korean (엄마 *eom-ma*).

A decade later, Berlin and Kay (1969) undertook a research project which suggested that semantic universals exist in the domain of color vocabulary and seemed to be related to the historical development of all languages in an evolutionary way. They found there was a “universal inventory” of basic color categories that exist amongst different languages and that there appeared to be chronological “stages” of color recognition and lexical encoding (Berlin & Kay, 1969).

*Figure 2.1* Temporal-Evolutionary Ordering of Color Terms (Berlin & Kay, 1969, p. 4)



For instance, as seen in the figure above, languages that had words for green/yellow also had words for red and white/black. Languages that did not have a word for blue, however, also did not have a word for brown or, consequently, for purple, pink, orange, or grey.

Similar to the Berlin and Kay (1969) study, Berlin (1972) presented data that indicated an “orderly and predictable temporal appearance” of ethnobotanical<sup>1</sup> naming categories in various cultures and languages (Berlin, 1972). Berlin found that there were ultimately six major ethnobotanical categories that appeared in lexicons of mostly all languages and cultures, and,

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<sup>1</sup> Ethnobotany is the study of the relationships between plants and people, locating plants within their cultural context in societies and placing people within their ecological context.

similar to Berlin and Kay (1969), the lexical encoding of each of these categories occurred in a temporal pattern as seen below.

*Figure 2.2 Suggested Development of Ethnobotanical Lexicon (Berlin, 1972, p. 53)*

$$\text{generic} \rightarrow \begin{bmatrix} \text{life form} \\ \text{specific} \end{bmatrix} \rightarrow \begin{bmatrix} \text{intermediate} \\ \text{varietal} \end{bmatrix} \rightarrow \text{unique beginner}^2$$

It is important to note that most of these early studies challenged what is called, “linguistic determinism”<sup>3</sup>, which was mentioned in the previous chapter. Studies such as these found that, because there are universal semantics, semantic structure cannot be a major factor in explaining differences in thought process and behavior between societies. There are certain unmistakably similar, collective human experiences, e.g., oral limitations as infants, visual perception of color, and our encounters with nature around us—shared human experiences—that unquestionably result in similar outcomes.

The fact remains, however, that although there are “universal” similarities in semantics, there are also differences in the development of languages over time because of initial progress or limitations (e.g., in Berlin and Kay’s (1969) study where some languages never obtained or initially did not have the need for the development of lexical terms for specific colors), which could lead to linguistic influence in other cognitive characteristics generations later.

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<sup>2</sup> Generic names appear first and are fundamental (e.g., oak, pine, maple). These are succeeded by major life-form names (e.g., tree, vine, grass) and specific names (white oak, red oak, sugary maple), followed by intermediate and varietal taxonomic group names (e.g., northern red oak). The last category that gets “lexically designated” in any ethnobotanical lexicon development is the unique beginner (e.g., plant) which is kind of an all-inclusive lexical category (Berlin, 1972).

<sup>3</sup> An extreme, albeit less popular, position of linguistic relativity which holds that the semantics of a language can affect the way in which its speakers perceive and conceptualize the world and *completely shape thought* (Woff & Holmes, 2011).

### **2.3 New Concepts and Methodologies**

There was a change in approach to research of linguistic relativity in the late 20<sup>th</sup> and early 21<sup>st</sup> centuries. As discussed above, linguistic determinism was, more-or-less, dismissed as an invalid theory; experts concluded that language alone could not determine thought and behavior. Anthropologists and psychologists began to pursue different approaches to see if language did still *influence* perception and cognition, even in the slightest of ways. Thus, following this initial foundational period in which important theoretical concepts and methods were created was a transformational period where new research and advancements in concepts and methodology prompted new studies (Lucy J. A., 2016). The main challenge was how to meet anthropological *and* psychological requirements for research: anthropology demands that languages be compared in terms of a neutral typological framework that respects the structural organization of each language (i.e., draw comparisons between languages in structural categories of lexicon, such as number, gender, or aspect marking), while psychology requires that language patterns produce referential entailments linked to nonlinguistic cognitive assessments of individual speakers (i.e., make logical conclusions based on analysis of nonlinguistic actions, behaviors, habits, etc.); and thus, a descriptive typology of reference to a cognitive assessment of speakers emerged, with two distinct approaches (discussed below).

### **2.4 Structure-Centered Approach**

The structure-centered approach takes structures in language as the starting point, choosing one or multiple lexicogrammatical structures relevant to reference—for example, number, gender, or aspect marking—and then explores how they differ amongst languages (Lucy J. A., 2016). Lucy (1992a, 1992b) designed the first fully-developed structure-centered approach

to linguistic relativity. This study contrasted English and Yucatec Maya number marking within a crosslinguistic typological framework. Lucy (1992b) stated that languages with obligatory plurals typically do not require numeral unitizers and vice versa, and languages with both forms usually show them in corresponding distribution across various noun phrase types. For instance, most English nouns are explicitly marked as either singular or plural, and this is “obligatory.” Maya, on the other hand, has a significant group of nouns that does not have this obligation. Lucy compared this to mass nouns in English, e.g., fish, sand, deer. Lucy asserted that English and Yucatec Maya speakers have referential differences regarding number and unit for nouns which predict cognitive differences in nonverbal classification and memory tasks across both languages. This kind of structure-centered approach, however, is rather difficult to implement: language comparison requires thorough structural analysis and comparative typological framing, and the results may not produce referential entailments suitable (referents that are not texts or language) for developing a cognitive assessment (Lucy J. A., 2016).

## **2.5 Domain-Centered Approach: Language and Conceptualization of Fundamental Domains**

The second approach is domain-centered and chooses a domain of experience, such as color, time, or space, and explores how various languages categorize and conceptualize these (Lucy J. A., 2016). The first fully-developed domain-centered approach was conducted by Majid and colleagues (expounded upon below in Section 2.4), whose most well-known research dealt with the location of objects in space using different spatial frames of reference (Majid, Bowerman, Kita, Haun, & Levinson, 2004).

Majid, et al. (2004) argued that language plays an important role in structuring the domain of spatial cognition, e.g., frames of reference and specifying the location of objects in relation to others. A simple example given, “Think where you left your glasses. Of course, they were to the right of the telephone,” showed a referencing of spatial location that we might use on a daily basis (Majid, et al., 2004). The study concluded that cognitive diversity is associated with linguistic diversity, reflected by people’s language-independent solutions to spatial tasks and unintentional gestures when speaking. They further suggested that not all cognitive categories are universal and thus added to the (re-)emerging view that language can play an integral role in the structuring and restricting of human cognition.

Conducting a similar study, Mishra, Dasen, and Niraula (2003) tested the relationship between ecology, culture, and language and how spatial information was encoded in 545 children aged 4 to 14 years in India and Nepal. The field sites were specifically chosen because of how people organized spatial directions and what language they spoke (Hindi). They hypothesized that the spatial orientation system and language would adapt to the surrounding ecological conditions, i.e., in Nepal, the most obvious feature is the slope of the mountains, so “up” and “down” are used for directional uses; whereas in the area of study in India (Ganges), it is mostly flat plains, therefore, cardinal directions were more commonly used. Results suggested that children who used predominantly geocentric language also tended to use absolute encoding on certain tasks, and those who used predominantly egocentric language used relative encoding, which hinted that there is a correspondence between language used and the encoding process (Mishra, Dasen, & Niraula, 2003).

The importance of the studies above and similar studies to the current thesis is that their methodology attempted to rely, at least in part, on language-independent tasks to isolate

cognitive behavior and habit based on linguistic, cultural, or other factors. Over the past twenty years, studies have found that language affects cognition of “color, musical pitch, number, spatial orientation, motion, time, cause and animacy, object type and gender, and false belief,” among others (Lucy J. A., 2016). There is now a plethora of evidence that supports the influence language-specific patterns have on cognition; the “burden of proof has shifted,” so to speak (Lucy J. A., 2016). The current study attempts a similar approach, but explores the influence second language learning has on the mind.

## **2.6 Second Language Acquisition, Crosslinguistic Influence & Cognitive Restructuring**

In recent years, there have been several studies that have focused on the effects of learning a second language (L2) on cognition, i.e., cognitive restructuring due to (advanced) language acquisition. Athanasopoulos, Damjanovic, Burnand, and Byland (2015) is one such study. The study investigated motion event cognition in native English (L1) learners of German (L2). The study stated that speakers of grammatical aspect<sup>4</sup> languages, such as English, focused less on the endpoint of events than did speakers of non-aspect languages like Swedish during a nonverbal categorization task that involved working memory. The main question of the study was whether or not native speakers of aspect languages (English) began to pay more attention to event endpoints when learning a non-aspect language (German). Results showed that the English learners of L2 German were more likely to make similarity judgments based on endpoint emphasis rather than “ongoingness” like English monolinguals (Athanasopoulos, Damjanovic,

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<sup>4</sup> *Aspect* deals with the internal temporal constituency of actions, events, states, processes or situations; in English, these differences are expressed by grammatical means, i.e., past tense vs. past progressive (Hamm & Bott, 2016)

Burnand, & Bylund, 2015). The findings supported the theory that cognitive restructuring can occur through extensive experience with a second language.

Brown and Gullberg (2008) investigated the possibility of a bidirectional relationship in second language acquisition via the domain of (manner of) motion in speech and gesture. Results displayed strong effects in gesture patterns which indicated that bidirectional interaction could occur between languages in a multilingual mind, even in intermediate proficiency, and gestures could be used to observe interactions between languages as a nonverbal method of analysis (Brown & Gullberg, 2008). Pavlenko and Malt (2011) tested the influence L2 (English) has on L1 (Russian) naming of common household objects. The study investigated whether the strength of L2 influence on L1 is determined by the speaker's "linguistic trajectory," i.e., the age of arrival in the L2 environment. They then looked at the participant's age of arrival and how this factor influenced their proficiency in the two languages, determining which language was the more dominant one (Pavlenko & Malt, 2011). Results showed that the naming conventions of participants who arrived in the L2 environment later in life were closer to that of native Russian speakers, while Russian L1 speakers who began living in an L2 English environment earlier in life were more similar to native English speakers.

These second language acquisition and crosslinguistic studies serve as a repertoire of evidence supporting linguistic relativity, crosslinguistic influence, and conceptual transfer. It is, therefore, easy to conclude that there is an interesting way learning languages influences both perception of fundamental domains and concepts, as well as how multiple languages interact and impact the dominance of the other(s) in the minds of bi- and multi-linguals. There is a (somewhat obvious) trend that indicates the amount of time spent either studying the language or living in an L2 environment is a key factor in displaying the effects of crosslinguistic influence.

The methods used in these cognitive studies typically focused on one domain through which the crosslinguistic influence is exhibited. Athanasopoulos, et al. (2015) used a nonverbal method of testing that relied on the participants' categorization of video clips shown to them based on end-goal orientation. While Brown and Gullberg's (2008) experiment did require the subjects to utilize speech for post-experiment analysis, they also observed gestures—nonverbal, almost subconscious habits—which displayed a difference between speakers of different languages and influence of L2 on L1. Finally, Pavenklo and Malt (2011) relied on the participant's description, or naming, rather, of pictures of objects. Therefore, there was no language primer, simply verbal production of terms by the participants.

### **2.6.1 Language and Mental Representations of Time: Mandarin & English**

Fuhrman, et al. (2011) examined how both English and Mandarin speakers conceptualize time through space, relating the two groups of speakers' patterns of thinking to cultural and linguistic patterns. While in English spatiotemporal metaphors are fairly limited to the horizontal axis, or, rather, no particular axis, in Mandarin vertical (as well as sagittal) spatial metaphors are more frequently used when talking about time (e.g., last week is “up week,” next week is “down week”, and two weeks ago is “two weeks in front”—see more examples below). Fuhrman, et al. (2011) designed an experiment with two tasks for participants to complete that compared and measured how English and Mandarin speakers spatialized time in three-dimensional space amongst the sagittal (front/back), transverse (left/right), and vertical (up/down) axes. Results showed that people automatically created spatial representations during temporal reasoning and these representations corresponded with patterns in language, even during non-linguistic tasks (Fuhrman, et al., 2011). While both groups of speakers showed a tendency to use horizontal

representations—in accordance with writing direction—only Mandarin speakers displayed vertical patterns which corresponded to their use of vertical space-time metaphors. Moreover, the experiment found that bilinguals’ representations of time depended on both length of time spent studying and using the L2 and proximal aspects of language experience, i.e., bilinguals were more likely to display vertical conceptualization of time if they were tested using Mandarin and vice versa.

In another study, Lai and Boroditsky (2013) conducted two experiments. The first explored whether the three test groups (English native speakers, Mandarin native speakers, and Mandarin-English bilinguals) were more or less likely to take an ego-moving perspective of time based on linguistic analyses. Results showed that English speakers were more likely to take an ego-moving perspective, which means that they would be more likely to visualize, “We are approaching the deadline,” rather than, “The deadline is approaching” (Lai & Boroditsky, 2013). They also found that subjects displayed crosslinguistic influence effects of L1 on L2, but also L2 on L1, which they did not entirely expect. The second experiment, and the one on which the current study is based, tested the effects of metaphor use on mental representations of time. Mandarin speakers use both horizontal terms such as *qián* “front” and *hòu* “back,” and vertical terms like *shàng* “up” and *xià* “down” to talk about temporal events (Lai & Boroditsky, 2013). Lai and Boroditsky (2013) displayed this example:

- a. 上        一        个        礼 拜  
 shang    yi        ge        li-bai  
 up        one     classifier-ge    week  
 “Last week”

- b. 前        一        个        礼拜  
qian      yi        ge        li-bai  
front     one     classifier-ge   week  
“Last week”
- c. 下        一        个        礼拜  
xia        yi        ge        li-bai  
down     one     classifier-ge   week  
“Next week”
- d. 后        一        个        礼拜  
hou        yi        ge        li-bai  
back     one     classifier-ge   week  
“Next week”

Previous research suggests that Mandarin speakers are more likely than English speakers to discuss time using vertical metaphors, but attributing crosslinguistic difference in spatialization to metaphor differences is complicated because several aspects have shown to influence and shape people’s temporal reasoning, e.g., linguistic, cultural, and personal experiences as seen in Fuhrman, et al. (2011). Lai and Boroditsky (2013) stated that, to overcome this difficulty, one approach would be to manipulate the metaphors in a language to examine whether metaphors can “in-the-moment” influence how people spatialize time—and since Mandarin Chinese uses both front-back and up-down metaphors regularly to talk about time, it is possible to do this (Lai & Boroditsky, 2013). Results showed that metaphors did in fact influence how participants arranged time. Mandarin speakers were twice as likely (40%) to arrange time vertically when prompted with up-down metaphors than when prompted with front-back metaphors (19%), and vice versa (Lai & Boroditsky, 2013). Fuhrman, et al. (2011)

compared English and Mandarin speakers using the same experimental task, but instead used non-spatial language (e.g., yesterday, today, tomorrow) as prompts instead of spatial metaphors, which resulted in English speakers arranging time on the left-right axis (93.5%) while Mandarin speakers were equally likely to arrange time on the left-right axis (46.8%) and the up-down axis (43.6%). This signified that, without spatial metaphors as directional primers to in-the-moment influence mental representations of time, English speakers – due to language, culture, or other fundamental factors – visualized time on a left-to-right horizontal axis, while Mandarin Chinese speakers were inherently not as limited in their conceptualization of space-time.

I would like to point out that in Lai and Boroditsky's (2013) study, the participants were described as Mandarin-English bilinguals, however the study did not explicitly state whether the participants were L1 Mandarin/L2 English speakers or otherwise. Sixty-six were tested in California with a mean Mandarin proficiency of 4.48 and a mean English proficiency of 4.01 on a self-reported scale from 1 to 5, and 32 were tested in Taiwan with a mean Mandarin proficiency of 5 and mean English proficiency of 2.71. From these proficiency ratings, we can assume that all the participants tested in Taiwan were Mandarin NS, and, of the participants tested in California, it is safe to say that the vast majority tested were either first-generation Mandarin NS immigrants or second-generation Mandarin and English NS who grew up speaking both languages. For the purposes of this paper and ease of reference, I will just call the group "Mandarin NS."

### **2.6.2 Need for Further Study**

The majority of previous research and studies in this field have been centered around L1 crosslinguistic influence on L2 or simply focused on showing the differences in domain

conceptualization between speakers of different languages. For instance, if I am a native L1 English speaker learning L2 Korean, it is expected that my experience in and knowledge of the L1 language would influence how I use the L2. There have been few studies that have explored the opposite effect, such as L2 crosslinguistic influence on L1 or L2 influence on cognitive conventions established by the L1. The current study aims to solely focus on the testing results of bilinguals, i.e., native English speakers who are advanced learners of L2 Mandarin Chinese. The previous studies largely focused on native speakers of different languages displaying contrasting mental representations of time and space based on linguistic dissimilarities. Moreover, the bilinguals tested in the above two studies were predominantly, if not completely, L1 Mandarin, L2 English bilinguals. The study in this thesis gives insight as to how learning Mandarin Chinese influences native English speakers' conceptions of time, thus providing further empirical evidence testing the linguistic relativity theory and conceptual crosslinguistic influence.

### **Chapter 3. Methodology**

This chapter first gives an overview of the research questions that the study attempts to answer as well as my hypotheses. It describes the participants involved in the experiment, the different language groups utilized, and some general statistics (average age of participants, test score averages of L2 Mandarin speakers, etc.). The chapter then explains the methodology utilized, i.e., the three-dimensional pointing paradigm, along with four sample questions, and the procedure of the experiment carried out with each participant. The chapter finishes with the ethical considerations involved and the steps I took to prepare the raw data for SPSS analysis.

#### **3.1 Research Questions**

The overarching question that this study posits and attempts to answer is the following: How do the spatiotemporal metaphors in Mandarin Chinese influence immediate and habitual mental representations of time in English L2 Mandarin learners? More specific to the experiment and methodology discussed in detail in Section 3.3, my research questions are as follows: 1) How do front-back space-time metaphor primers influence the way L2 Mandarin learners answer temporal questions on an imaginary axis? 2) How do up-down space-time metaphor primers influence the way L2 Mandarin learners answer temporal questions on an imaginary axis? 3) Without space-time metaphor primers, do L2 Mandarin learners still display crosslinguistic influence, i.e., exhibit tendencies in contrast with their English NS counterparts?

### 3.2 Participants

Altogether, 30 people participated in this experiment, and all were tested at the University of Mississippi. Fifteen of the total participants were (American) English natives and tested using English. The other 15 were English NS (L2 Mandarin group) who were students either in a Chinese major or in the Chinese Language Flagship Program (advanced track) at the University. All of the L2 Mandarin students were at the advanced level (400 or 500 course level) at the time of testing and were tested using Mandarin Chinese. On the background questionnaire the L2 Mandarin participants were asked to report their latest scores on the Oral Proficiency Interview (OPI)<sup>5</sup> and the

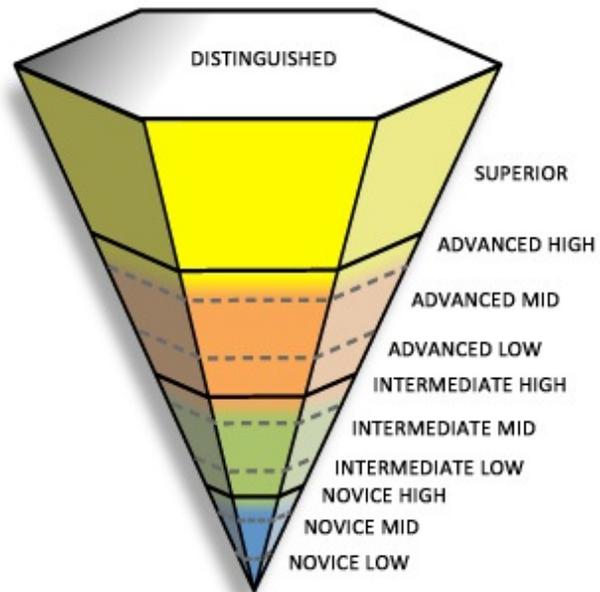


Figure 3.1 The ACTFL inverted pyramid of test scores (ACTFL)

<sup>5</sup> “The ACTFL Oral Proficiency Interview (OPI) is a valid and reliable means of assessing how well a person speaks a language. It is a 20-30 minute one-on-one interview between a certified ACTFL tester and an examinee. The interview is interactive and continuously adapts to the interests and abilities of the speaker. The speaker’s performance is compared to the criteria outlined in the ACTFL Proficiency Guidelines 2012 - Speaking or the Inter-Agency Language Roundtable Language Skill Level Descriptors – Speaking. The interview is double rated and an Official ACTFL Oral proficiency Certificate stating the candidate’s proficiency level is issued to the candidate” (ACTFL).

American Council on the Teaching of Foreign Languages (ACTFL) Listening<sup>6</sup> and Reading<sup>7</sup> Proficiency Assessments, which range from “novice-low” to “distinguished” as seen in the figure above. Each level is not only measured by skill of language use, it also has a corresponding level of cultural awareness, sensitivity, knowledge, etc.

The participants’ ages ranged from 18 years to 29 years, with an average age of 21.2. The L2 Mandarin group’s average number of years spent studying Mandarin was 4.2 years. Sixty percent of the L2 Mandarin learners had lived in Chinese-speaking country in the past; the average number of months lived in the country was 7.61. Eighty percent of the L2 Mandarin participants achieved an Advanced level on their OPI; twenty percent received an Intermediate level. A third of the L2 Mandarin participants achieved an Intermediate High, a third achieved an Advanced Low, and the last third achieved an Advanced Mid on their ACTFL LPT. As for the RPT, 6.67% achieved an Intermediate High, 46.67% achieved an Advanced Low, 40% achieved an Advanced Mid, and 6.67% achieved an Advanced High.

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<sup>6</sup> “The Listening Proficiency Test (LPT) is a standardized, computer-delivered test for the global assessment of listening ability in a language. LPTs measure how well a person understands spoken discourse as described in the ACTFL or ILR rating scales. The listening passages and multiple choice questions and answers are presented in the target language. Designed by testing experts, LPTs are carefully constructed assessments which evaluate Novice to Superior levels of listening ability. Most commonly, the test is administered to assess a specific range of proficiency from Novice Low to Intermediate Mid; Intermediate Mid to Advanced Mid, and Advanced Low to Superior” (ACTFL).

<sup>7</sup> “The Reading Proficiency Test (RPT) is a standardized, computer-delivered test for the global assessment of reading ability in a language. RPTs measure how well a person understands spoken discourse as described in the ACTFL or ILR rating scales. The reading texts and multiple choice questions and answers are presented in the target language. Designed by testing experts, RPTs are carefully constructed assessments which evaluate Novice to Superior levels of reading ability. Most commonly, the test is administered to assess a specific range of proficiency from Novice Low to Intermediate Mid; Intermediate Mid to Advanced Mid, and Advanced Low to Superior. Multiple language tests are available” (ACTFL).

### 3.3 Instrument

I used the three-dimensional pointing paradigm used in Fuhrman, et al. (2011) and Lai and Boroditsky (2013) with a minor adjustment: I asked the participant to place their own hand about a foot in front of their chest in a closed fist.<sup>8</sup> I then proceeded to ask the participant one of the test questions in Appendix C (samples below).

*Sample Non-spatial Language Question:* Assume this is today. Where is tomorrow? Where is yesterday?

假设	这	是	今天。	明天	在	哪里?
assume	this	is	today	tomorrow	located	where
昨天	在	哪里?				
yesterday	located	where				

*Sample Space-Time Metaphor (Front-back) Question:* Assume this is today. Where is the day after tomorrow? Where is the day before yesterday?

假设	这	是	今天。	后天	在	哪里?
assume	this	is	today	back-day	located	where
前天	在	哪里?				
front-day	located	where				

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<sup>8</sup> In Fuhrman, et al. (2011) and Lai & Boroditsky (2013), one of the experimenters put their own hand a foot in front of the participant. Their hand was in the Italian “che vuoi” gesture, with the palm up and thumb and fingers touching together, forming a sort of cone. For ease of instructions, I had the participants simply form a fist with their hand. Because this was a research project done by myself, I had the participants put their own fist in front of their chest so that I was free to take notes and record results.

*Sample Space-Time Metaphor (Up-Down) Question:* Assume this is Wednesday. Where is next Wednesday? Where is last Wednesday?

假设	这	是	星期三。	下	个	星期三
assume	this	is	Wednesday	down	CL-ge	Wednesday
在	哪里?	上	个	星期三	在	哪里?
located	where	up	CL-ge	Wednesday	located	where

*Sample Distractor Question:* Assume this is the school. Where is the house? Where is the movie theater?

假设	这	是	学校。	房子	在	哪里?
assume	this	is	school	house	located	where
电影院	在	哪里?				
movie theater	located	where				

There were 24 questions in total: six non-spatial (N), four front-back metaphor (FB), four up-down metaphor (UD), and ten distractor questions (D). The non-spatial language questions were designed to test how participants answered without spatiotemporal metaphors as immediate primers. These types of questions aimed to evaluate the long-term or chronic effects languages have on the mental representations of space-time. The second and third groups of questions, i.e., the front-back and up-down metaphor questions, were designed to evaluate the immediate effects using language has on the conceptualization of space and time. The first 12 questions were asked in the following pattern: N – FB – D, N – UD – D, N – FB – D, N – UD – D. I designed this pattern to observe whether there would be differences in the participants' answers to non-spatial and metaphor questions side-by-side without separation by distractor questions. After each set of two, however, I still placed a distractor question to prevent participants from figuring out a

pattern. The latter 12 questions of the test were mixed together and dispersed amongst the distractor questions.

### **3.4 Hypotheses**

For ease of reference, I will restate my research questions here: 1) How do front-back space-time metaphor primers influence the way L2 Mandarin learners answer temporal questions on an imaginary axis? 2) How do up-down space-time metaphor primers influence the way L2 Mandarin learners answer temporal questions on an imaginary axis? 3) Without space-time metaphor primers, do L2 Mandarin learners still display crosslinguistic influence, i.e., exhibit tendencies in contrast with their English NS counterparts?

Due to the prevalence of up-down and front-back temporal metaphors in Mandarin Chinese, advanced learners of Mandarin Chinese should show effects of crosslinguistic influence in their mental representations of time both from habitual use and direct context of the situation (i.e., if spatial metaphors are used). I hypothesized that when L2 Mandarin speakers are tested in Mandarin and prompted with spatial metaphors, i.e., when asked questions in groups two and three (see Section 3.3), their representations of time should be more similar to Mandarin NS results in previous studies, in large part due to the lexicon of the language. This means that, when primed with front-back space-time metaphors, the L2 Mandarin group should show significant preference for the sagittal axis and when primed with up-down space-time metaphors, they should display a preference for the vertical axis. When L2 Mandarin speakers are tested in Mandarin using non-spatial primers (group one questions), however, I hypothesized they should still display crosslinguistic influence in their mental representations of time, albeit in a weaker fashion, simply because they are using and thinking in Mandarin, meaning that they should show

some preference for axes other than the expected preferred axis for English NS, i.e., the transverse axis.

### **3.5 Procedure**

I conducted five pilot tests in total, two with English NS, two with Mandarin NS, and one with an English L2 Mandarin speaker. I did not have to make many changes to the experiment, itself, mostly just wording with the directions, grammar quiz, and test questions. I had to alter the wording of both the English and Mandarin directions for sake of clarity. Also, when designing the experiment questions, I initially used some nouns that are not typically taught in the curriculum here (mostly due to the nature of the textbooks utilized and focus of the program), so, referencing the program textbooks, I replaced some of the nouns with other ones. I ended up altering a couple of questions in the Mandarin grammar test, as well, due to some confusion and ambiguity with a couple of the questions.

Before conducting the experiment, all participants were first contacted via email with the link to the consent to participate and background questionnaire (Appendix A) form using Qualtrics for them to answer. Once the participant completed this first portion, if they were a L2 Mandarin speaker, the form then directed them to a link to complete the Mandarin grammar quiz (Appendix B) to ensure near-native comprehension of the words and phrases used in the experiment. Last, the participants signed up to meet with me on a day and time of their choosing on a Google Sheets spreadsheet. Once each participant signed up, I proceeded to contact them and determined a meeting place, either in an office, empty classroom, or study area in the campus library. When I met with each participant, I explained to him/her the instructions

(Appendix C) and how the experiment would work<sup>9</sup>. After this, I went through two practice questions with each participant to ensure they understood what was expected of them, and finally asked if the participant had any questions before we started.

I asked the participant to put out their non-dominant hand about 12 inches or 30 centimeters in front of their chest in a closed fist. I explained to them that this would be the reference point around which they frame their answers to the questions I ask. I then proceeded to ask a series of questions to which the participant answered using their fist as the reference point. They used their other (dominant) hand to point to any space around their fist, any direction around and any distance away from their fist being acceptable. I paused after asking each question to give the participant time to answer/point and to give me time to record their answer. After I finished asking all the test questions, I then thanked the participant for their participation in this study.

### **3.6 Ethical Considerations**

Due to the nature of the study in dealing with the observation of human subjects, before beginning the experiment I asked each participant to read and digitally initial a consent form that was designed by me and reviewed/approved beforehand by the University of Mississippi's Institutional Review Board (IRB). My application to conduct research with human participants (Protocol #17x-055) was approved as Exempt under UM Policy RSP.301.015 (Category #7).

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<sup>9</sup> When testing with English NS, English was used to conduct all parts of the experiment. When testing with the L2 Mandarin group, Mandarin Chinese was used to conduct all parts of the experiment.

### **3.7 Data Analysis**

When conducting the experiment, I recorded the participants' answers "L" for left, "R" for right, "U" for up, "D" for down, "F" for front, and "B" for back depending on where they pointed in relation to their fist. To convert these answers into numerical data for input, I simply recorded the frequency each participant answered on a specific axis (left/right=transverse, up/down=vertical, front/back=sagittal) for each type of question (non-spatial, up/down, front/back), i.e., what type of words with which each question prompted them. As you will see in the following chapter, I then used SPSS to conduct a two-way mixed ANOVA to observe the interaction effect of language and axis preferences, followed by a one-way repeated measures ANOVA conducted with each language group separately to see specifically how each language influenced axis preference.

## Chapter 4. Results

As mentioned previously, I hypothesized that when primed with either front-back or up-down metaphors, the L2 Mandarin group should display a conception of space-time contrary to the English NS group and instead resemble Mandarin NS because of their (long-term) exposure to and study of the Mandarin Chinese language. This chapter reports the priming effects<sup>10</sup> of space-time metaphors as well as a more general second-language effect between the three axes (transverse, vertical, and sagittal), and compares the interaction effect between the different language groups and their axis preference. A two-way mixed ANOVA test was conducted using SPSS to observe the interaction effect between language and axis preference. A one-way repeated measures ANOVA was then conducted to see how language influenced axis preference for each language group.

### 4.1 Front-back Metaphor Priming

The front-back metaphor priming questions (four total) were designed to test the immediate effects of space-time metaphors on the participants' mental representations of time. I hypothesized that when L2 Mandarin speakers are tested in Mandarin and prompted with these spatial metaphors, their representations of time should display crosslinguistic influence, causing them to associate these space-time priming words with specific axes, i.e., when primed with

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<sup>10</sup> I would like to point out that effects of metaphor priming only apply to the L2 Mandarin group due to the existence of space-time metaphors in Mandarin Chinese. For English, since there are no space-time metaphors, all questions are essentially treated as “non-spatial priming.” The structure of this chapter, however, is broken up nominally by front-back metaphor, up-down metaphor, and non-spatial priming, as the L2 Mandarin group is the focus group of the experiment.

front-back metaphors, L2 Mandarin speakers should show a relatively significant preference for the sagittal axis when answering the test questions.

Table 4.1

Front-back metaphor priming: Mean scores for axis preference;  $F^{11}$ ,  $p^{12}$ , and  $\eta^2_{p^{13}}$  values from a one-way repeated measures ANOVA.

	Transverse		Vertical		Sagittal		$F$	$p$	$\eta^2_{partial}$
	$M$	$SD$	$M$	$SD$	$M$	$SD$			
<b>English NS (n=15)</b>	3.53	1.06	.00	.000	.33	1.05	(1.02, 14.27) = 52.43	.000	.789
<b>L2 Mandarin (n=15)</b>	2.13	1.81	.07	.258	1.80	1.78	(1.03, 14.43) = 5.68	.031	.289

There was a significant Axis x Language interaction effect,  $F(1.03, 28.78) = 7.10$ ,  $p = .012$ ,  $\eta^2_{partial} = .202$ , which means that axis preference did significantly differ based on language group. This also supports my original hypothesis that language can influence mental representations of time.

<sup>11</sup> The *F-statistic* or *F-ratio* compares the amount of systematic vs unsystematic variance in the data tested, i.e., the ratio of the model to its error (Field, 2009).

<sup>12</sup> The *p value* tells us if the experimental effect is significant. If  $p < .05$ , the effect is significant (Field, 2009).

<sup>13</sup> *Partial eta squared* measures the effect size in ANOVA. It differs from *eta squared* in that it looks at the proportion of variance (not explained by the other variables in the analysis) that the variable explains (Field, 2009). Suggested norms for partial eta-squared: small = 0.02; medium = 0.13; large = 0.26 (Cohen, 1988). Effect size is imperative to calculate because it indicates how meaningful the observed effect is: just because a test statistic is significant does not indicate that the effect it measures is important (Field, 2009).

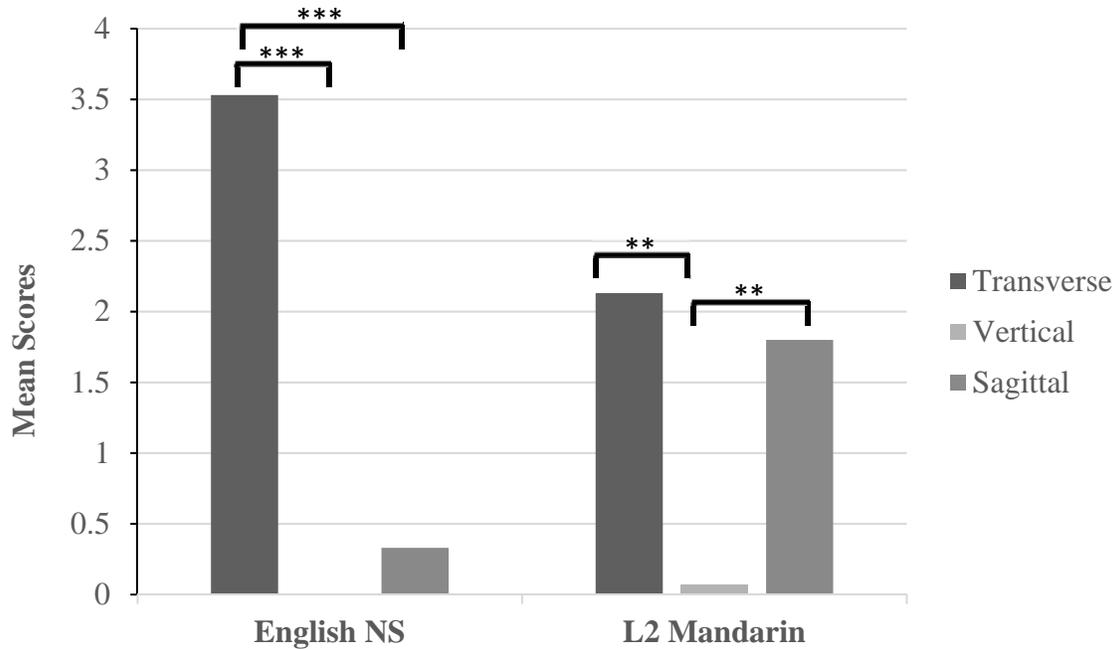


Figure 4.1 Front-back metaphor priming: Mean scores for axis preference for English NS and L2 Mandarin speakers. \* $p \leq .05$ ; \*\* $p \leq .01$ ; \*\*\* $p \leq .001$ .

English NS one-way repeated measures ANOVA results show a significant effect for axis preference,  $F(1.02, 14.27) = 52.43, p = .000, \eta^2_{partial} = .789$ . Bonferroni corrected post hoc tests indicate that, once again, the English NS group significantly preferred the transverse axis in all cases ( $p = .000$ ) with no significant preference difference between the vertical and sagittal axes ( $p = .713$ ). L2 Mandarin group results also show a significant effect for axis preference,  $F(1.03, 14.43) = 5.68, p = .031, \eta^2_{partial} = .289$ . The Bonferroni corrected post hoc tests show that there was a significant difference in preference between the transverse and vertical axes ( $p = .002$ ) and the vertical and sagittal axes ( $p = .002$ ), with the L2 Mandarin group preferring the transverse axis in the former case and the sagittal axis in the latter. There was not a significant difference in preference, however, between the transverse and sagittal axes ( $p = 1.000$ ), meaning that a L2

Mandarin speaker was just as likely to prefer thinking of time on the transverse axis as the sagittal axis when primed with front-back space-time metaphors, thus confirming my hypothesis.

#### 4.2 Up-down Metaphor Priming

Just like the front-back metaphor priming questions, the up-down metaphor priming questions (four total) were designed to test the immediate effects of space-time metaphors on the participants' mental representations of time. I hypothesized that when L2 Mandarin speakers are tested in Mandarin and prompted with these spatial metaphors, their representations of time should display crosslinguistic influence, causing them to associate these space-time priming words with specific axes, i.e., when primed with up-down metaphors, L2 Mandarin speakers should show a significant preference for the vertical axis when answering the test questions.

Table 4.2

Up-down metaphor priming: Mean scores for axis preference;  $F$ ,  $p$ , and  $\eta^2_p$  values from a one-way repeated measures ANOVA.

	Transverse		Vertical		Sagittal		$F$	$p$	$\eta^2_{partial}$
	$M$	$SD$	$M$	$SD$	$M$	$SD$			
<b>English NS (n=15)</b>	3.33	1.05	.07	.258	.40	1.06	(1.11, 15.52) = 43.68	.000	.757
<b>L2 Mandarin (n=15)</b>	2.13	1.60	.40	.74	1.47	1.51	(1.34, 18.75) = 4.28	.043	.234

Similar to the previous tests, there was a significant Axis x Language interaction effect,  $F(1.27, 35.58) = 5.29, p = .020, \eta^2_{partial} = .159$ . Axis preference did significantly differ between language groups when primed with up-down spatiotemporal metaphors, confirming my original hypothesis.

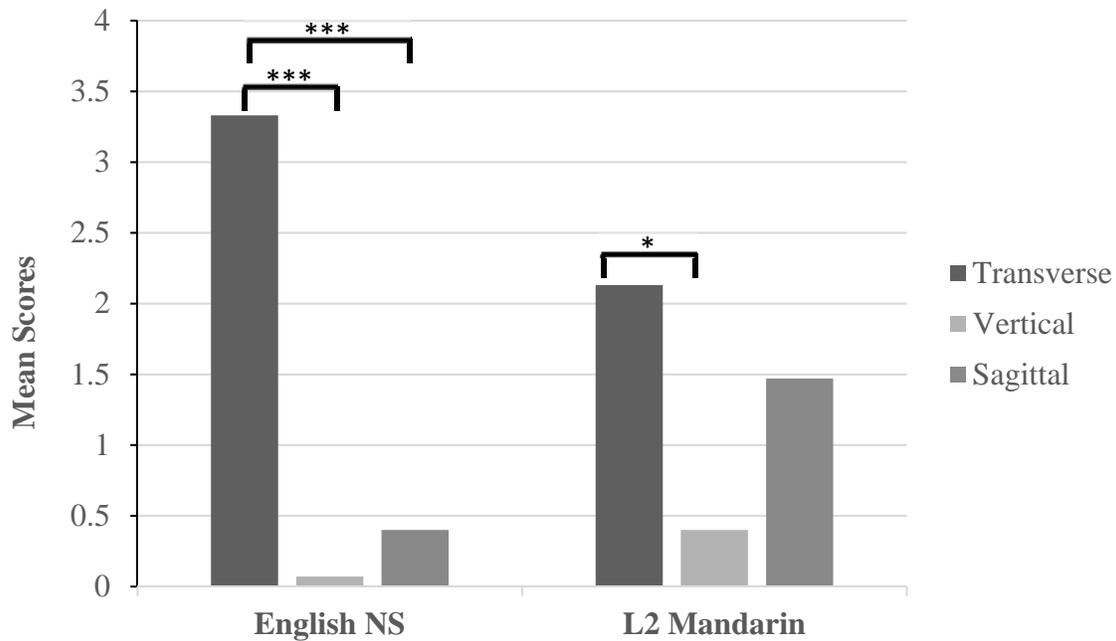


Figure 4.2 Up-down metaphor priming: Mean scores for axis preference for English NS and L2 Mandarin speakers.  $*p \leq .05$ ;  $**p \leq .01$ ;  $***p \leq .001$ .

A one-way repeated measures ANOVA for the English NS group indicated that there was, once again, a significant effect of axis preference,  $F(1.11, 15.52) = 43.68$ ,  $p = .000$ ,  $\eta^2_{partial} = .757$ . Bonferroni post hoc tests confirmed that, in all cases like the previous tests, English NS speakers prefer the transverse axis to both the vertical and sagittal axes ( $p = .000$ ), with no preference difference between the latter two axes themselves. For the L2 Mandarin speakers, the results also showed a significant effect of axis preference when primed with up-down space-time metaphors,  $F(1.34, 18.75) = 4.28$ ,  $p = .043$ ,  $\eta^2_{partial} = .234$ . The Bonferroni corrected post hoc tests revealed that the L2 Mandarin group significantly preferred the transverse to the vertical axis ( $p = .013$ ), but had no preference difference when comparing the transverse and sagittal axes ( $p = 1.00$ ) or the sagittal and vertical axes ( $p = .100$ ), which means that when primed with up-down metaphors, to a certain extent, L2 Mandarin speakers still preferred thinking of time on

either the transverse or sagittal axes rather than the vertical one. This is quite interesting because the results indicate there is still crosslinguistic influence, but not in accordance with my hypothesis which suggests that there should be a preference for the vertical axis if primed with up-down space-time metaphors. The L2 Mandarin group instead continued to show greater preference for the sagittal axis (along with the transverse axis), which received a mean score of 1.47 while the vertical axis had a mean score of .40. I will discuss the implications of this further in Chapter 5.

### 4.3 Non-spatial Priming

The non-spatial priming questions (six total) were designed to test the chronic or habitual effects of studying Mandarin Chinese long-term on mental representations of time. Due to the prevalence of space-time metaphors in the Mandarin Chinese language, while using this language and thinking within this lexical framework to answer these questions, I hypothesized that L2 Mandarin speakers should still display crosslinguistic influence in their mental representations of time when tested using non-spatial primers, albeit in a weaker fashion, e.g., show a slight tendency to choose something other than the hypothesized English NS preferred transverse axis.

*Table 4.3*

Non-spatial priming: Mean scores for axis preference;  $F$ ,  $p$ , and  $\eta^2_p$  values from a one-way repeated measures ANOVA.

	Transverse		Vertical		Sagittal		$F$	$p$	$\eta^2_{partial}$
	$M$	$SD$	$M$	$SD$	$M$	$SD$			
<b>English NS</b> ( <b>n=15</b> )	5.60	1.55	.00	.000	.40	1.55	(1, 14) = 61	.000	.813
<b>L2 Mandarin</b> ( <b>n=15</b> )	3.47	2.36	.53	1.36	2.00	2.27	(2, 28) = 5.15	.012	.269

Results from the two-way mixed ANOVA also indicate that there was a significant Axis x Language interaction,  $F(1.36, 38.18) = 6.4, p = .009, \eta^2_{\text{partial}} = .186$ . This signifies the preferences of the three axes significantly differed between the L2 Mandarin and English NS groups, supporting my original hypothesis.

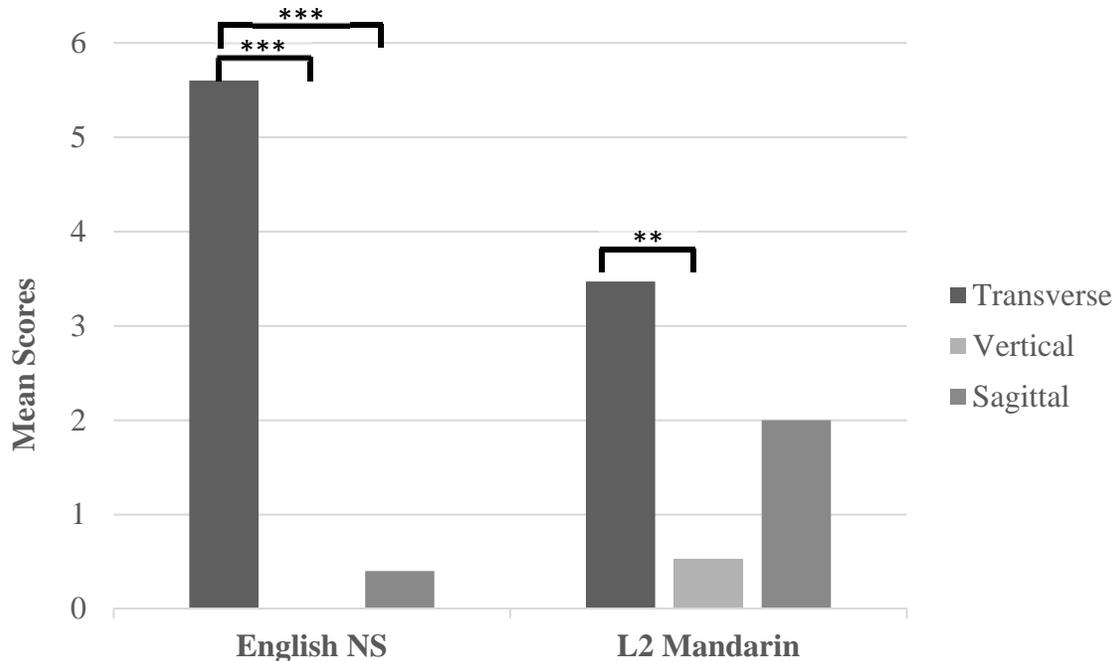


Figure 4.3 Non-spatial priming: Mean scores for axis preference for English NS and L2 Mandarin speakers.  $*p \leq .05$ ;  $**p \leq .01$ ;  $***p \leq .001$ .

Looking at the results from the one-way repeated measures ANOVA for the English NS group, we see that there was a significant effect of axis preference,  $F(1, 14) = 61, p = .000, \eta^2_{\text{partial}} = .813$ . Bonferroni post hoc tests indicate that there was a significant preference of the transverse axis over both the vertical and sagittal axis ( $p = .000$ ), and no difference in preference between the vertical and sagittal axes ( $p = 1.00$ ). For the L2 Mandarin group, we also see a significant effect of axis preference,  $F(2, 28) = 5.15, p = .012, \eta^2_{\text{partial}} = .269$ . The Bonferroni adjusted post hoc tests show that L2 Mandarin speakers significantly preferred the transverse

axis over the vertical axis ( $p = .008$ ), but did not have a significant preference between the transverse and sagittal axes ( $p = .659$ ) or the vertical and sagittal axes ( $p = .211$ ). The effect size for both tests were greater than the “large” threshold for partial eta squared.

## Chapter 5. Discussion

From the results in the previous chapter, my hypotheses were confirmed to some degree, but at the same time there were also unexpected results that occurred. Along with a general discussion of the results, this chapter also considers the implications of said results and touches on some of the more interesting findings that I discovered from the data analysis, as well as while carrying out the experiment with the participants.

### 5.1 Front-back Space-Time Metaphor Priming

My hypothesis for front-back spatiotemporal metaphor priming was that when L2 Mandarin speakers are prompted with these metaphors, they should show a relatively significant preference for the sagittal axis when answering the questions. Results did show this to be the case. As shown in Figure 4.1, the L2 Mandarin group significantly preferred the transverse ( $M = 2.13$ ) and sagittal ( $M = 1.80$ ) axes to the vertical axis ( $M = .07$ ). There was no significant difference in preference between the sagittal and transverse axes, meaning that L2 Mandarin speakers were almost just as likely to choose the transverse axis (53.25%) as they were the sagittal axis (45%) (while choosing the vertical axis merely 1.75% of the time). This indicates there was a significant immediate effect of front-back spatiotemporal metaphor priming on the mental representations of time in the L2 Mandarin group.

Comparing these L2 Mandarin results to the Mandarin NS group in Lai and Boroditsky (2013) where they chose the transverse axis 57% of the time, the front-back axis 24% of the time, and the vertical axis 19% of the time when prompted with front-back space-time metaphors, we can see some similarities between the two Mandarin-speaking groups, which suggests that L2 learners of Mandarin do indeed begin to think more like native Mandarin

speakers. The transverse axis was still the most preferred axis, and as previous literature suggests, this could be due to many factors, including writing direction. While this might cause a greater difference when looking at results from older Chinese generations (which my study did not include), as the Chinese language used to be read up-to-down and right-to-left, in modern day Chinese speaking societies, to include foreign learners of the language, reading left to right is now the norm, which could be a cause of this similarity between English NS, L2 Mandarin, and Mandarin NS in preference for the transverse axis even when primed with front-back space-time metaphors. The L2 Mandarin group in my study showed a much bigger preference for the sagittal axis when primed with front-back metaphors when compared to the Mandarin NS group in Lai and Boroditsky (2013). This could signify a unique interaction effect in English NS cognition after advanced study of the second language. It is also a possibility that if I continued to test a greater number of individuals, my results might begin to look more like those of Lai and Boroditsky (2013), showing greater variation in answers and preference, i.e., spreading out the preferences between the axes, displaying a larger tendency to choose the sagittal and vertical axes instead of the transverse axis.

## **5.2 Up-down Space-Time Metaphor Priming**

My hypothesis for the up-down space-time metaphor priming was similar to the front-back priming. I hypothesized that the L2 Mandarin group should show a relatively significant preference for the vertical axis. Results indicated that this was not the case. We do, however, see the highest percentage preference for the vertical axis amongst the different priming test scenarios at 10% (compared to the 1.75% for front-back priming and 8.83% for non-spatial priming). Referring to Figure 4.2 in Chapter 4, when primed with up-down spatial metaphors the

L2 Mandarin group significantly preferred the transverse axis (53.25%) to the vertical axis (10%), but there was no significant difference between the transverse axis and the sagittal axis (36.75%).

This finding could indicate one of two things: 1) that a significant number of participants in the L2 Mandarin group in my experiment might have had a pre-existing affinity for the sagittal axis regardless of priming effects or language used (there was at least one participant in the English NS group that displayed this, answering on the sagittal axis for every question), or 2) that there is some kind of interaction between the L2 Mandarin group's second language and their cognition. My first instinct when looking at the results of the data analysis, which produced significant results with large effect sizes, as well as observing the significant difference between the English NS group and the L2 Mandarin group is that the latter is more likely. Since only one out of fifteen English NS showed preference for the sagittal axis for everyone question, it is not likely that a large number of participants in the L2 Mandarin group also have this "preexisting affinity" for the sagittal axis, although further experimentation with a larger group size would be needed for greater certainty.

It could simply be that using a non-native language when thinking about and answering these questions forces them to focus more on the language and making sure they are comprehending (or translating, in some cases) it correctly, and thus causes them to be more erratic in their answers for time on an imaginary axis. This would suggest we might see a more randomized set of answers, however, so this may not be the case either, as there was a statistically significant equivalence in preference between the transverse and sagittal axes. Another possibility is that because English is their default language when dealing with time (calendars, agendas, phones, etc.) on a day-to-day basis, these preconditions for how most

English speakers would perceive time (on a left-to-right transverse axis) might be discarded, leaving the participants to take a more ego-centric view of time, seeing time on the same (sagittal) axis that they, themselves, are on where moving forward would be going into the future while physically going backwards would indicate the past. Again, further experimentation would need to be done with a greater number and variety of participants to gain more certainty.

### 5.3 Non-spatial Language Priming

For English NS, my hypothesis for the non-spatial priming questions (and, really, all the test questions regardless of space-time metaphor priming) was that they should significantly prefer the transverse axis. The results show this to be the case, confirming my hypothesis. Looking at Figure 4.3, you can see that the English NS group significantly preferred the transverse axis ( $M = 5.6$ ) to both the vertical axis ( $M = 0$ ) and the sagittal axis ( $M = 0.4$ ), with  $p$  values of 0 in both cases and a partial eta squared value of .813, which indicate extreme significance and a massive effect size. As stated previously in Chapter 2, English spatiotemporal metaphors are somewhat limited to the horizontal axis due to a plethora of linguistic and cultural factors, including writing direction, therefore it is no surprise that the English NS group displayed this preference for the transverse axis 93.3% of the time. Note that this is comparable to Fuhrman, et al. (2011) results mentioned in Chapter 2 that English speakers arranged time on the left-right axis 93.5% of the time.

For the L2 Mandarin group, which, if you recall from Chapter 3, is comprised of English NS who have been studying Mandarin Chinese for an average of 4.2 years and obtained an average ACTFL Listening Proficiency Assessment score of Advanced Low (Level 7 out of 10), my hypothesis was that when testing in Mandarin and not primed with space-time metaphors,

i.e., when primed with non-spatial language questions, they should still display crosslinguistic influence in their mental representations of time, but should only show a slight tendency to choose an axis other than the transverse axis on account of their exposure to and study of the Mandarin Chinese language. The results confirm my hypothesis. Referring back to Figure 4.3, we still see a significant preference for the transverse axis ( $M = 3.47$ ) to the vertical axis ( $M = .53$ ), but there is no significant difference between the transverse axis and the sagittal axis ( $M = 2.00$ ), which indicates that L2 Mandarin speakers were just as likely to prefer the sagittal axis as the transverse axis. I think it is also important not to overlook the slight preference shown for the vertical axis when compared to the English NS group. Although the preference did not significantly differ, it still shows that L2 Mandarin speakers at least showed some preference for that axis, whereas the English NS group showed none. To sum up these results in percentages, the L2 Mandarin group preferred the transverse axis 57.83% of the time, the sagittal axis 33.33% of the time, and the vertical axis 8.83% of the time when primed with non-spatial language questions. This signifies that, *ceteris paribus*, learning Mandarin Chinese played a significant role in influencing the L2 Mandarin group's mental representation of time.

Referring back to Chapter 2 and the Fuhrman, et al. (2011) experiment, the L2 Mandarin group in my experiment showed some similarities with the Mandarin speaking groups in their experiment. When prompted with non-spatial language, Mandarin speakers were equally likely to arrange time on the left-right axis (46.8%) and the up-down axis (43.6%). My results indicated that L2 Mandarin speakers tested in between English NS and Mandarin NS groups, which was expected. The difference, however, is that for some reason, the L2 Mandarin group in my experiment had a much higher preference for the sagittal axis than the vertical axis. This could simply be due to differences in personal experience, or it could point to an interaction effect that

Mandarin has on English NS cognition. This means that even without the immediate effect of spatiotemporal metaphors, L2 Mandarin speakers receive influence from their second language on their mental representations of time. This points to the possibility of long-term cognitive effects of language on conceptual perceptions.

## **Chapter 6. Conclusion**

This concluding chapter will first offer final comments and conclusions to the results of the study, followed by describing certain limitations that I encountered while designing and carrying out the experiment. The thesis concludes by discussing the contributions of this thesis and proposing suggestions for future studies in this field.

### **6.1 Conclusions**

The results of my experiment indicate, in accordance with previous literature, that language does have the power to influence cognition, and in this case, mental representations of time. From the results, this appears to be because of proximal, immediate effects of using the language due to the particular lexicon (in this study, the existence and usage of space-time metaphors) of the language, as well as due to long-term effects of using a second language on cognition as seen in the differences in responses between the English NS group and the L2 Mandarin group when primed with non-spatial language questions.

When primed with front-back spatiotemporal metaphors, L2 Mandarin speakers showed a significant preference for both the transverse and sagittal axes, with no preference distinction between the two. When primed with up-down spatiotemporal metaphors, L2 Mandarin speakers unexpectedly still showed significant preference for both the transverse and sagittal axes over the vertical axis, although noteworthy is that up-down metaphor priming resulted in the highest preference, albeit relatively small and statistically insignificant, in choosing the vertical axis compared to other types of priming questions. Lastly, the non-spatial language priming results suggest that there are long-term effects of learning Mandarin Chinese on English native speakers' concept of space-time; the results indicated that although the L2 Mandarin group

significantly preferred the transverse axis over the vertical axis, they did not statistically differentiate between the transverse and sagittal axes. Moreover, these results contrasted with the English NS group, which in this study acted as the control group, and statistically strictly preferred the transverse axis in all cases.

## **6.2 Limitations**

This study has shed some light in understanding the effects of L2 learning on mental representations of time; there were, however, several limitations in conducting this study. First, I did not have access to a constant experiment space, so I sometimes had to conduct the experiment in relatively noisy spaces which could have distracted the participants when answering questions.

Second, recruiting advanced L2 Mandarin speakers was an issue due to the University of Mississippi Chinese Language Flagship Program's relatively small size; the number of students with advanced proficiency in the language are few. Thus, the pool of participants may not be as varied and the quantity simply might not be enough to obtain robust statistical results. The limited number of participants was also a barrier when designing the breadth of my study. Ideally, with a larger pool of participants I would have wanted to ask a portion of the L2 Mandarin group and a portion of the L1 English group front-back metaphor questions only, one portion of each group up-down metaphor questions only, and so on and so forth. This limitation was the main reason for the "distractor questions" that I used.

Time was a limitation, as well. I originally planned on testing the L2 Mandarin speakers in both Mandarin Chinese and English to see if the same individuals preferred to answer using different axes depending on the language used when conducting the experiment. In order to do

this, however, I would have needed a relatively lengthy gap between the first and second experiments with the same individuals so they could not draw any connections between the two tests and thus influence the way they answered. Unfortunately, there was simply not enough time to conduct this kind of experiment.

Last, because I was the only one conducting the experiment, I had to alter the way the three-dimensional pointing paradigm was used compared to previous studies<sup>14</sup> where someone other than the individual asking the questions would put their hand a foot in front of the participant as the reference point. I had the participants, themselves, put their fist out, which seemed to lead to some confusion with some of the participants. Moreover, where I sat in relation to the participant seemed to affect some of the participants' answers, as I was also the one asking them the questions.

### **6.3 Suggestions for Future Studies and Significance**

For similar studies in the future, I would suggest that the three-dimensional pointing paradigm be altered or redesigned and the experiment slightly restructured. There were some instances in which participants pointed behind their own bodies in reference to concepts such as “yesterday” or “the past.” Different results might occur if you were to make the participant's own body, e.g., their head or their center of gravity, the reference point off which they base their answers. This way, they would be forced to place themselves on the timeline, instead of looking at the timeline in front of them. With the current pointing paradigm, it automatically assumes that concepts such as “now” or “today” are in front of the participant, which may have influenced how the participant then chose to place the past and the future, amongst other

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<sup>14</sup> See Fuhrman, et al. (2011) and Lai and Boroditsky (2013).

concepts. Finding a larger pool of advanced L2 Mandarin learners and designing the experiment with more time allotted to experimentation and data collection would be ideal for more robust results, as well.

Nevertheless, this study contributes to the understanding of how language can shape thought. Further studies similar to this one will enable us to better understand not only differences in how distinct linguistic groups vary in thought and how their thought processes might differ, e.g., how different peoples approach problem solving, or if different languages structure and restructure people's minds in ways that uniquely prepare them for certain types of thinking. Studying the effects of language learning on cognition also adds to the literature that signifies the importance and cognitive benefits of bilingualism and multilingualism. It would be most interesting to conduct a longitudinal study of the same participants over a period of time beginning from an advanced level and progressing to a distinguished (or even higher) level and then again observe the effects that the second language had on the participants' conceptual perceptions, not simply space-time, and cognition in general. The study of linguistic relativity in general, as well as studies of this nature which look at crosslinguistic influence on abstract concepts and perceptions of these concepts, is still in its infancy. The progress that has been made thus far, however, offers a promising outlook for future studies, and as technology and knowledge of the social sciences advance, it will be that much easier to observe and measure the effects of language learning on cognition.

## References

- (n.d.). (ACTFL) Retrieved October 8, 2016, from ACTFL: American Council on the Teaching of Foreign Languages: <https://www.actfl.org/assessment-professional-development/assessments-the-actfl-testing-office>
- Athanasopoulos, P., Damjanovic, L., Burnand, J., & Bylund, E. (2015). Learning to Think in a Second Language: Effects of Proficiency and Length of Exposure in English Learners of German. *The Modern Language Journal*, 99, 138-153.
- Berlin, B. (1972). Speculations on the Growth of Ethnobotanical Nomenclature. *Language in Society*, 1(1), 51-86.
- Berlin, B., & Kay, P. (1969). *Basic Color Terms: Their Universality and Evolution*. Berkely, California: University of California Press.
- Brown, A., & Gullberg, M. (2008). Bidirectional Crosslinguistic Influence in L1-L2 Encoding of Manner in Speech and Gesture: A Study of Japanese Speakers of English. *Studies in Second Language Acquisition*, 30(2), 225-251.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Edition ed.). Hillsdale, NJ: Erlbaum.
- Field, A. (2009). *Discovering Statistics Using SPSS* (Third Edition ed.). London: SAGE Publications Ltd.
- Fuhrman, O., McCormick, K., Chen, E., Jiang, H., Shu, D., Mao, S., & Boroditsky, L. (2011). How Linguistic and Cultural Forces Shape Conceptions of Time: English and Mandarin Time in 3D. *Cognitive Science*, 35(7), 1305-1328.
- Gumperz, J. J., & Levinson, S. C. (1991). Rethinking Linguistic Relativity. *Current Anthropology*, 32(5), 613-623.

- Hamm, F., & Bott, O. (2016). Tense and Aspect. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Summer 2016 ed.). Retrieved from Stanford Encyclopedia of Philosophy.
- Jarvis, S., & Pavlenko, A. (2008). *Crosslinguistic Influence in Language and Cognition*. New York, New York, USA: Routledge.
- Lai, V. T., & Boroditsky, L. (2013). The immediate and chronic influence of spatio-temporal metaphors on the mental representations of time in English, Mandarin, and Mandarin-English speakers. *Frontiers in Psychology, 4*.
- Lucy, J. A. (1992a). *Language diversity and thought: A reformulation of the linguistic relativity hypothesis*. Cambridge, UK: Cambridge University Press.
- Lucy, J. A. (1992b). *Grammatical categories and cognition: A case study of the linguistic relativity hypothesis*. Cambridge, UK: Cambridge University Press.
- Lucy, J. A. (2016). Recent Advances in the Study of Linguistic Relativity in Historical Context: A Critical Assessment. *Language Learning, 66*(3), 487-515.
- Majid, A., Bowerman, M., Kita, S., Haun, D. B., & Levinson, S. C. (2004). Can language restructure cognition? The case for space. *TRENDS in Cognitive Sciences, 8*(3).
- Mishra, R. C., Dasen, P. R., & Niraula, S. (2003). Ecology, language, and performance on spatial cognitive tasks. *International Journal of Psychology, 38*(6), 366-383.
- Murdock, G. P. (1959). Cross-Language Parallels in Parental Kin Terms. *Anthropological Linguistics, 1*(9), 1-5.
- Pavlenko, A., & Malt, B. C. (2011). Kitchen Russian: Cross-linguistic differences and first-language object naming by Russian-English bilinguals. *Bilingualism: Language and Cognition, 14*(1), 19-45.

Tardif, T., Fletcher, P., Liang, W., & Kaciroti, N. (2009). Early Vocabulary Development in Mandarin (Putonghua) and Cantonese. *Journal of Child Language*, 36(5), 1115-1144.

Whorf, B. L., & Carroll, J. (1998). *Language, Thought, and Reality: Selected Writings of Benjamin Lee Whorf*. Cambridge, Mass: MIT Press.

Wolff, P., & Holmes, K. J. (2011). Linguistic relativity. *WIREs Cogn Sci*, 2, 253-265.

## **Appendix A: Background Questionnaire and Consent to Participate**

Study Title: Influence of Language on Thought

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The purpose of this study:

The purpose of this study is to observe an individual's thought process in reaction to linguistic stimuli to deduce whether or not the language one speaks influences thought.

What you will do for this study:

1. Fill out a short background questionnaire regarding age, sex, ethnicity, education, and prior language experience.
2. (If English-Mandarin bilingual) Complete a short Chinese grammar quiz.
3. Receive verbal instructions from researcher to answer questions by pointing to a location around a closed fist a foot in front of your chest.

Time required for this study:

This study will take about 10-15 minutes altogether.

IRB Approval:

This study has been reviewed by The University of Mississippi's Institutional Review Board (IRB). The IRB has determined that this study is exempt from the human research subject protections obligations required by state and federal law and University policies. If you have any questions or concerns regarding your rights as a research participant, please contact the IRB at (662) 915-7482 or irb@olemiss.edu. Please ask the researcher if there is anything that is not

clear or if you need more information. When all your questions have been answered, then decide if you want to be in the study or not.

Statement of Consent: I have read the above information. I have had an opportunity to ask questions, and I have received answers. I consent to participate in the study.

Please digitally sign your name in the area provided on the next page if you agree to participate. Thank you!

Please digitally sign your name below if you agree to participate, e.g., John A. Smith

Please enter your email:

Please answer the following questions as truthfully and accurately as you can. Thank you in advance for your time! / 请诚实地并正确地回答接下来的问题。感谢您的帮助!

Please enter your age, e.g., 25 / 请您输入年龄, 如 25。

If Please enter your age, e.g.... Is Less Than 18, Then Skip To Thank you for your willingness to par...

Please choose the gender with which you identify. / 请您选择性别。

- Male / 男
- Female / 女
- Other / 其他

Please choose your ethnicity. / 请您选择种族。

- Caucasian / 高加索人
- Black or African American / 非洲裔美国人
- Native American or Alaska Native / 美洲原住民
- Asian / 亚洲人
- Native Hawaiian or Pacific Islander / 夏威夷原住民或太平洋岛民
- Other/Mix / 其他 / 混血

Please choose the amount of formal education completed. / 请您选择学历。

- Less than high school / 高中以下
- High school graduate / 高中毕业生
- Some college / 正在念大学
- 2 year degree / 两年学位
- 4 year degree / 四年学位
- Professional degree / 专业学位
- Doctorate / 博士
- Other / 其他

What is your native language? / 您的母语是什么?

- English / 英语
- Mandarin Chinese / 中文
- Other / 其他 \_\_\_\_\_

Answer If What is your native language? / 您的母语是什么? Mandarin Chinese / 中文 Is Selected

Do you study English as a second language? / 英语是您的第二语言吗?

- Yes / 是
- No / 否

Answer If Do you study English as a second language? / 英语是您的第二语言吗? Yes / 是 Is Selected

How many years have you studied English? (Please input a number.) / 您学习英语学了几年?  
(请输入数字。)

Answer If Do you study English as a second language? / 英语是您的第二语言吗? Yes / 是 Is Selected

What age did you begin learning English? (Please input a number.) / 您几岁开始学习英语?  
(请输入数字。)

Answer If What is your native language? / 您的母语是什么? English / 英语 Is Selected

Do you study Mandarin Chinese as a foreign language? / 中文是您的第二语言吗?

- Yes
- No

Answer If Do you study Mandarin Chinese as a foreign language? / 中文是您的第二语言吗?  
Yes / 是 Is Selected

How many years have you studied Mandarin Chinese? (Please input a number.)

Answer If Do you study Mandarin Chinese as a foreign language? / 中文是您的第二语言吗?  
Yes / 是 Is Selected

What age did you begin learning Mandarin? (Please input a number.)

Answer If Do you study Mandarin Chinese as a foreign language? / 中文是您的第二语言吗?  
Yes / 是 Is Selected

Are you currently taking a Chinese language course?

- Yes
- No

Answer If Are you currently taking a Chinese language course? / 您现在上中文课? Yes Is Selected

How many hours per week is your Chinese class? (Please input a number.)

Answer If Are you currently taking a Chinese language course? / 您现在上中文课? Yes Is Selected

Have you ever lived in a Chinese-speaking country?

- Yes
- No

Answer If Have you ever lived in a Chinese-speaking country? Yes Is Selected

How long did you stay in that country? (Please enter the number of months.)

Answer If Do you study Mandarin Chinese as a foreign language? / 中文是您的第二语言吗?

Yes Is Selected

What is the most recent score you received on your Oral Proficiency Interview (OPI)?

- Novice Low
- Novice Mid
- Novice High
- Intermediate Low
- Intermediate Mid
- Intermediate High
- Advanced Low
- Advanced Mid
- Advanced High
- Superior
- Distinguished

Answer If Do you study Mandarin Chinese as a foreign language? / 中文是您的第二语言吗?

Yes Is Selected

What is the most recent score you received on your ACTFL Listening Proficiency Test?

- Novice Low
- Novice Mid
- Novice High
- Intermediate Low
- Intermediate Mid
- Intermediate High
- Advanced Low
- Advanced Mid
- Advanced High
- Superior
- Distinguished

Answer If Do you study Mandarin Chinese as a foreign language? / 中文是您的第二语言吗?  
Yes Is Selected

What is the most recent score you received on your ACTFL Reading Proficiency Test?

- Novice Low
- Novice Mid
- Novice High
- Intermediate Low
- Intermediate Mid
- Intermediate High
- Advanced Low
- Advanced Mid
- Advanced High
- Superior
- Distinguished

If applicable, please list any other foreign languages you have studied and how long you have studied the language. E.g. Spanish - 3 years, Korean - 1 year. / 请您写下您学习过的其他语言和学习的时间。比如，西班牙语-3年、韩语-1年。

After completion of this survey, please read the text on the following screen and follow the links to the appropriate pages. Thank you!

Answer If Please enter your age, e.g., 25 / 请您输入年龄，如 25。 Text Response Is Less Than 18

Thank you for your willingness to participate in this study, but you do not meet the requirements necessary for participation. Have a great day!

**Appendix B: Mandarin Grammar Quiz**

1. 今天是星期三， \_\_\_ 天是星期五。
  - a. 前
  - b. 后
  - c. 上
  - d. 下
2. 他开心 \_\_\_ 跳起来了。
  - a. 的
  - b. 地
  - c. 得
  - d. 德
3. 今年是 2016 年， \_\_\_ 年是 2014 年。
  - a. 前
  - b. 后
  - c. 去
  - d. 明
4. 他不是王子，我 \_\_\_ 是！
  - a. 刚
  - b. 才
  - c. 就
  - d. 而
5. 现在是十月。 \_\_\_ 个月是九月。
  - a. 前
  - b. 后
  - c. 上
  - d. 下
6. 我很想毕业，不过我明年 \_\_\_ 毕业。

a. 刚

b. 才

c. 就

d. 而

7. 我以 \_\_\_ 当过老师，现在是医生。

a. 前

b. 后

c. 上

d. 下

8. 三个孩子玩 \_\_\_ 很开心。

a. 的

b. 地

c. 得

d. 德

9. 现在是下午一点，两个小时 \_\_\_ 是下午三点钟。

a. 前

b. 后

c. 上

d. 下

10. 我 \_\_\_ 发现我要当叔叔，我开心极了！

a. 就

b. 刚

c. 才

d. 而

### Appendix C: Instructions

1. I will ask you to put your non-dominant hand about a foot in front of your chest in a closed fist. This will be the reference point around which you frame and answer the questions I ask. 我会请您把不常用的那只手放在胸部前三十厘米处，保持握住拳头的姿势。这将是您回答问题的参考点。
2. I will then proceed to ask a series of questions. For example, I will say “Assume ‘this’ is a glass of milk. Where is a piece of chocolate? Where is a cookie?” The ‘this’ I am referring to will be your closed fist. 接下来，我会问您一系列问题，请您把拳头当作参考点。比如，我会说：“假设‘这’是一杯牛奶。巧克力在哪里？饼干在哪里？”我刚说的“这”就是您的拳头（的位置）。
3. To answer the questions, you will use your dominant hand to point to any space around your fist. Any direction and any amount of distance from your fist is acceptable. You don’t need to speak, simply point to where you think the other object or phrase should be in respect to your fist. I will pause after I ask each question to give you time to answer and then I will record your answer. 回答问题时，请您用您常用的那只手指向拳头（也就是参考点）周围的空  
间。任何方向、任何距离都行。您认为我说的第二和第三个词相对于参考点（拳头）  
在哪个方向，就用另一只手去指那个方向，不用说话。在我问完每个问题后，我会给  
您时间来回答，并且我将把您的答案记录下来。
4. Do you have any questions? 您有没有问题？
5. Okay, we will first do two practice questions. 好吧，我们先做两个练习题。
  - a. Assume this is a cup of coffee. Where is a muffin? Where is a cup of milk? 假设这是一杯咖

啡。玛芬蛋糕在哪里？一杯牛奶在哪里？

- b. Assume this is Thursday. Where is Wednesday? Where is Friday? 假设这是星期四。星期三在哪里？星期五在哪里？
6. Before we start, do you have any more questions? 我们开始之前，您有没有其他的问题？
7. Now, we will begin the experiment. 我们现在开始试验。

## Appendix D: Test Questions

### 非空间语言 Non-spatial Language

1. *Assume this is today. Where is tomorrow? Where is yesterday?*

假设	这	是	今天。	明天	在	哪里?
assume	this	is	today	tomorrow	located	where
昨天	在	哪里?				
yesterday	located	where				

2. *Assume this is lunch. Where is breakfast? Where is supper?*

假设	这	是	午餐。	早餐	在	哪里?
assume	this	is	lunch	breakfast	located	where
晚餐	在	哪里?				
supper	located	where				

3. *Assume this is October? Where is November? Where is September?*

假设	这	是	十月。	十一月	在	哪里?
assume	this	is	10-month	11-month	located	where
九月	在	哪里?				
9-month	located	where				

4. *Assume this is this year. Where is last year? Where is next year?*

假设	这	是	今年。	去年	在	哪里?
assume	this	is	this-year	last year	located	where
明年	在	哪里?				
next year	located	where				

5. *Assume this is 10am. Where is 11am? Where is 9am?*

假设	这	是	早上	十点。	十一点	在
assume	this	is	morning	10 o'clock	11 o'clock	located
哪里?	九点	在	哪里?			
where	9 o'clock	located	where			

6. *Assume this is March. Where is April? Where is February?*

假设	这	是	三月。	四月	在	哪里?
assume	this	is	March	April	located	where
二月	在	哪里?				
February	located	where				

时空隐喻 ( 前后 ) Space-Time Metaphors (Front-back)

1. *Assume this is today. Where is the day after tomorrow? Where is the day before yesterday?*

假设	这	是	今天。	后天	在	哪里?
assume	this	is	today	back-day	located	where
前天	在	哪里?				
front-day	located	where				

2. *Assume this is this year. Where is the year before last? Where is the year after next?*

假设	这	是	今年。	前年	在	哪里?
assume	this	is	this-year	front-year	located	where
后年	在	哪里?				
back-year	located	where				

3. *Assume this is this today? Where is one week from now? Where is one week ago?*

假设	这	是	今天。	后	一	个
assume	this	is	today	back	one	CL-ge <sup>15</sup>
星期	在	哪里?	前	一	个	星期
week	located	where	front	one	CL-ge	week
在	哪里?					
located	where					

4. *Assume this is nowadays (or the present). Where is the past? Where is the future?*

假设	这	是	如今。	以前	在	哪里?
assume	this	is	nowadays	in-past	located	where
以后	在	哪里?				
in-back	located	where				

时空隐喻 ( 上下 ) Space-Time Metaphors (Up-Down)

1. *Assume this is Friday. Where is next Friday? Where is last Friday?*

假设	这	是	星期五。	下	个	星期五
assume	this	is	Friday	down	CL-ge	Friday
在	哪里?	上	个	星期五	在	哪里?
located	where	up	CL-ge	Friday	located	where

2. *Assume this is midday. Where is the morning? Where is the afternoon?*

假设	这	是	中午。	上午	在	哪里?
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<sup>15</sup> CL stands for ‘classifier.’ In Mandarin Chinese, classifiers or measure words are required in noun phrases after numerals, quantifiers and demonstratives and are located right before a noun. ‘Ge’ in Mandarin Chinese is the ‘default’ or ‘general’ classifier that can be used for a large variety of nouns (Tardif, Fletcher, Liang, & Kaciroti, 2009).

assume	this	is	middle-noon	up-noon	located	where
下午	在	哪里?				
down-noon	located	where				

3. *Assume this is this month. Where is next month? Where is last month?*

假设	这	是	这	个	月。	下
assume	this	is	this	CL-ge	month	down
个	月	在	哪里?	上	个	月
CL-ge	monrth	located	where	up	CL-ge	month
在	哪里?					
located	where					

4. *Assume this is this season (fall). Where is next season? Where is last season?*

假设	这	是	现在(的)	季节	(秋天)	
assume	this	is	now	season	(fall)	
下	个	季节	在	哪里?	上	个
down	CL-ge	season	located	where	up	CL-ge
季节	在	哪里?				
season	located	where				

Distractor

1. *Assume this is a book. Where is a pen? Where is a cup of coffee?*

假设	这	是	一	本	书。	一
assume	this	is	one	CL-ben	book	one
支	笔	在	哪里?	一	杯	咖啡
CL-zhi	pen	located	where	one	CL-bei	coffee
在	哪里?					
located	where					

2. *Assume this is an apple. Where is a dog? Where is a cat?*

假设	这	是	苹果。	一	只	狗
assume	this	is	apple	one	CL-zhi	dog
在	哪里?	一	只	猫	在	哪里?
located	where	one	CL-zhi	cat	located	where

3. *Assume this is a desk. Where is a sofa? Where is a bed?*

假设	这	是	桌子。	沙发	在	哪里?
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assume	this	is	table	sofa	located	where
床	在	哪里?				
bed	located	where				

4. *Assume this is a pen. Where is a piece of paper? Where is a computer?*

假设	这	是	笔。	纸	在	哪里?
assume	this	is	pen	paper	located	where
电脑	在	哪里?				
computer	located	where				

5. *Assume this is a flower. Where is the tree? Where is the bird?*

假设	这	是	花。	树	在	哪里?
assume	this	is	flower	tree	located	where
小鸟	在	哪里?				
small bird	located	where				

6. *Assume this is a t-shirt. Where are shoes? Where is a hat?*

假设	这	是	T恤衫。	鞋子	在	哪里?
assume	this	is	t-shirt	shoes	located	where
帽子	在	哪里?				
hat	located	where				

7. *Assume this is a hamburger. Where is spaghetti? Where is fried rice?*

假设	这	是	汉堡包。	意大利面	在	哪里?
assume	this	is	hamburger	spaghetti	located	where
炒饭	在	哪里?				
fried rice	located	where				

8. *Assume this is Earth. Where is the sun? Where is the moon?*

假设	这	是	地球。	太阳	在	哪里?
assume	this	is	Earth	sun	located	where
月球	在	哪里?				
moon	located	where				

9. *Assume this is England. Where is America? Where is China?*

假设	这	是	英国。	美国	在	哪里?
assume	this	is	England	America	located	where
中国	在	哪里?				
China	located	where				

10. *Assume this is a movie theater. Where is a restaurant? Where is a library?*

假设	这	是	电影院。	餐馆	在	哪里?
assume	this	is	movie	restaurant	located	where

图书馆	在	哪里?	theater
library	located	where	