Cultural and Individual Differences in Metaphorical Representations of Time

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Cultural and Individual Differences in Metaphorical Representations of Time

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Abstract

Abstract concepts cannot be directly perceived through senses. How do people represent abstract concepts in their minds? According to the Conceptual Metaphor Theory, people tend to rely on concrete experiences to understand abstract concepts. For instance, cognitive science has shown that time is a metaphorically constituted conception, understood relative to concepts like space. Across many languages, the "past" is associated with the "back" and the "future" is associated with the "front". However, space-time mappings in people's spoken metaphors are not always consistent with the implicit mental metaphors they are using to conceptualize time in their minds, suggesting a dissociation between temporal language and temporal thought. Beyond the influences of language, the Temporal Focus Hypothesis proposes that people's spatial conceptions of time are shaped by their attentional focus on temporal events. In general, people conceptualize the past as being in front to the extent that their culture is past-oriented, and the future as being in front to the extent that their culture is future-oriented. Recent lines of research have provided preliminary evidence that people's implicit space-time mappings are malleable and likely result from multiple factors related to temporal focus, ranging from those relating to contextual features, such as cultural attitudes toward time, to those more tightly tied to the individual, such as age-related differences. By building upon and extending these findings, the overall aim of this thesis is to ascertain the generalizability of the Temporal Focus Hypothesis and further investigate the range of factors that may influence people's spatializations of time, focusing specifically on previously unexplored within-cultural differences (Study 1), political ideology (Study 2), religion (Studies 3-6), real life experiences (Studies 7 to 9), pregnancy (Study 10),

temporal landmarks (Studies 11 to 13), circadian rhythms and chronotype (Studies 14 to 16), and personality (Studies 17 to 19). Together, these studies demonstrate that people's implicit space-time mappings may vary according to their temporal focus, which can be explained by the Temporal Focus Hypothesis. The findings of these studies also shed new light on the Temporal Focus Hypothesis by extending the range of factors that may influence people's conceptions of time, and reveal the malleability and flexibility of time representations.

Table of Contents

Abstract i

List of tables viii

List of figures ix

Acknowledgments xi

Declaration xiii

Chapter 1. Spatial representations of time 1

1.1 Introduction 1
1.2 The alignment of temporal language and temporal thinking 4
1.3 The dissociation of temporal language and temporal thought 7
1.4 Temporal Focus Hypothesis (TFH) 10
1.5 Thesis overview 14

Chapter 2. Time perspectives 19

2.1 Introduction 19
2.2 Spatial experience 23
2.3 Direction of movement during gestures 25
2.4 Emotion 28
2.5 Event valence 29
2.6 Personality 31
2.7 Stimuli presentation 33
2.8 Flexibility of time representation on other axes 34
2.9 Summary 37

Chapter 3. Within-Cultural differences 39

3.1 Introduction 39
Study 1: Implicit space-time mappings in southern and northern Vietnamese people 44
3.2 Method 45
3.2.1 Participants 45
3.2.2 Materials and procedure 45
3.3 Results 46
3.4 Chapter discussion 48

Chapter 4. Political differences..... 52

4.1 Introduction **52**
Study 2: Conservatives vs. Liberals **54**
4.2 Methods **54**
4.2.1 Participants 54
4.2.2 Materials and procedure 54
4.3 Results and discussion **55**
4.4 Chapter discussion **57**

Chapter 5. Religious differences: Buddhists vs. Taoists..... 60

5.1 Introduction **60**
Study 3: Buddhists and Taoists' implicit space-time mappings and temporal focus **61**
5.2 Method **61**
5.2.1 Participants 61
5.2.2 Materials and procedure 62
5.3 Results and discussion **62**
Study 4: Expanding the sample **64**
5.4 Method **65**
5.4.1 Participants 65
5.4.2 Materials and procedure 65
5.5 Results and discussion **65**
Study 5: A causal role of religion in shaping space-time mappings in Buddhists **67**
5.6 Method **68**
5.6.1 Participant 68
5.6.2 Materials and procedure 68
5.7 Results and discussion **69**
Study 6: A causal role of religious experience in shaping space-time mappings in a non-religious group **70**
5.8 Method **71**
5.8.1 Participants 71
5.8.2 Materials and procedure 71
5.9 Result and discussion **72**
5.10 Chapter discussion **73**

Chapter 6: Real life experiences 77

6.1 Introduction **77**
Study 7: Education background **79**
6.2 Method **79**
6.2.1 Participants 79
6.2.2 Materials and procedure 80
6.3 Results and discussion **81**
Study 8: Living experiences **83**
6.4 Method **83**

6.4.1 Participants 83
6.4.2 Materials and procedure 84
6.5 Results and discussion 84
Study 9: Visiting experiences 86
6.6 Method 86
6.6.1 Participants 86
6.6.2 Materials and procedures 87
6.7 Results and discussion 87
6.8 Chapter discussion 89

Chapter 7: The experience of pregnancy 93

7.1 Introduction 93
Study 10: pregnant vs. non-pregnant women 95
7.2 Method 95
7.2.1 Participants 95
7.2.2 Materials and procedures 95
7.3 Results and discussion 95
7.4 Chapter discussion 97

Chapter 8 Temporal landmarks 99

8.1 Introduction 99
Study 11: Personally-related events: final examination vs. the start of a new semester 100
8.2 Method 101
8.2.1 Participants 101
8.2.2 Materials and procedure 102
8.3 Results and discussion 102
Study 12: Festival: Spring Festival vs. Tomb Sweeping Day 104
8.4 Method 105
8.4.1 Participants 105
8.4.2 Materials and procedure 105
8.5 Results and discussion 106
Study 13: A causal role for temporal landmarks in influencing temporal focus and space-time mappings 107
8.6 Method 108
8.6.1 Participants 108
8.6.2 Materials and procedure 108
8.7 Results and discussion 109
8.8 Chapter discussions 111

Chapter 9 Time-of-Day and Chronotype 115

9.1 Introduction 115
Study 14: the relationship between time of day and space-time mappings 118

9.2 Method **118**
9.2.1 Participants 118
9.2.2 Materials and procedure 118
9.3 Results and discussion **118**
Study 15: the causal role of time of day **120**
9.4 Method **120**
9.4.1 Participants 120
9.4.2 Materials and procedure 120
9.5 Results and discussion **120**
Study 16: The interaction between time-of-day, chronotype and implicit space-time mappings **123**
9.6 Method **123**
9.6.1 Participants 123
9.6.2 Materials and procedure 123
9.7 Results and discussion **124**
9.8 Chapter discussion **126**

Chapter 10 Personality 131

10.1 Introduction **131**
Study 17 Self report **133**
10.2 Method **134**
10.2.1 Participants 134
10.2.2 Materials and procedure 134
10.3 Results and discussion **134**
Study 18 Submission time **136**
10.4 Method **136**
10.4.1 Participants. 136
10.4.2 Materials and procedure 137
10.5 Results and discussion **137**
Study 19 Time of arrival **138**
10.6 Method **138**
10.6.1 Participants 138
10.6.2 Materials and procedure 139
10.7 Results and discussion **139**
10.8 Chapter Discussion **140**

Chapter 11. Discussion 143

11.1 Introduction **143**
11.2 Overview: Part II **145**
11.2.1 Chapter 3: 145
11.2.2 Chapter 4: 146
11.2.3 Chapter 5: 147
11.2.4 Chapter 6 148
11.2.5 Chapter 7 150

11.2.6 Chapter 8 150
11.2.7 Chapter 9 152
11.2.8 Chapter 10 154
11.2.9 General remarks 155
11.3 Limitations 158
11.4 Future research 161
11.5 Conclusion 165

References 167

Appendix 1 188

Vietnamese version of the Time Diagram Task 188

Appendix 2 189

Vietnamese version of the Temporal Focus Questionnaire 189

Appendix 3 191

Appendix 4 192

List of tables

Table 1. Results of Study 1. Counts and percentage of past-in-front and future-in-front responses in Southern Vietnamese and Northern Vietnamese people. 47
Table 2. Results of Study 2. Counts and percentage of past-in-front and future-in-front responses in Chinese Conservatives, Neutrals and Liberals. 56
Table 3. Results of Study 3. Counts and percentage of past-in-front and future-in-front responses in Chinese Buddhists, Taoists and Atheists. 63
Table 4. Results of Study 4. Counts and percentage of past-in-front and future-in-front responses in Chinese Buddhists, Taoists and Atheists. 66
Table 5. Results of Study 5. Counts and percentage of past-in-front and future-in-front responses in Buddhists primed with the pictures of Dipamkara and Maitreya. . 69
Table 6. Results of Study 6. Counts and percentage of past-in-front and future-in-front responses in Chinese university students primed with the videos of Buddhism and Taoism and control group. 72
Table 7. Results of Study 7. Counts and percentage of past-in-front and future-in-front responses in Chinese HI &AR and CS & EE students 81
Table 8. Results of Study 8. Counts and percentage of past-in-front and future-in-front responses in Chinese Hutong and Apartment residents. 84
Table 9. Results of Study 9. Counts and percentage of past-in-front and future-in-front responses in Chinese ACBAE and MPE visitors. 88
Table 10. Results of Study 10. Counts and percentage of past-in-front and future-in-front responses in Chinese pregnant and non-pregnant women. 96
Table 11. Results of Study 11. Counts and percentage of past-in-front and future-in-front responses in Chinese student examiners and registrants. 103
Table 12. Results of Study 12. Counts and percentage of past-in-front and future-in-front responses in Chinese people tested on the Spring Festival and Tomb Sweeping Day. 106
Table 13. Results of Study 13. Counts and percentage of past-in-front and future-in-front responses in Chinese participants assigned to past-focused and future-focused conditions 109
Table 14. Results of Study 14. Counts and percentage of past-in-front and future-in-front responses in Chinese participants signing up for the morning and afternoon sessions. 119
Table 15. Results of Study 15. Counts and percentage of past-in-front and future-in-front responses in Chinese participants randomly assigned in the morning and afternoon sessions. 121
Table 16. Results of Study 16. Counts and percentage of past-in-front and future-in-front responses in larks randomly assigned in the morning and afternoon sessions. 124
Table 17. Results of Study 16. Counts and percentage of past-in-front and future-in-front responses in owls randomly assigned in the morning and afternoon sessions. 125

List of figures

Figure 1 Three axes of human body.....21
Figure 2 Schematic drawing of moving time metaphor.....22
Figure 3 Structuring of Moving Observer Metaphor.....22
Figure 4 The time diagram presented to the participants.....46
Figure 5. Average agreement with the past- and future-focused statements on the Temporal Focus Questionnaire, separately for Southerners and Northerners of Vietnamese.....48
Figure 6 Average agreement on a scale of 1 to 7 with the past- and future-related statements in the conservatives, liberals and neutrals.....57
Figure 7 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for Atheists, Buddhists and Taoists. 64
Figure 8 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for Atheists, Buddhists and Taoists. 67
Figure 9 Average agreement with the past- and future-focused statements on the Temporal Focus Questionnaire, separately for HH/AR students and CS/EE students. 82
Figure 10 Average agreement with the past- and future-focused statements on the Temporal Focus Questionnaire, separately for HT vs. AB inhabitants.....85
Figure 11 Average agreement with the past- and future-focused statements on the Temporal Focus Questionnaire, separately for ACBAE and MPE visitors 88
Figure 12 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for pregnant and non-pregnant women 97
Figure 13 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for student examinees and registrants. 103
Figure 14 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for participants tested on the New Year's Day and Tomb Sweeping Day.....107
Figure 15 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for participants reading temporal landmark associated with the past and future. 110
Figure 16 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for participants in the morning and afternoon sessions.....119
Figure 17 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for participants who were randomly assigned to the morning and afternoon sessions.....122
Figure 18 Morning participants' average agreement with the past- and future-focused statements on the Temporal Focus Scale in the morning and afternoon sessions. 126
Figure 19 Evening participants' average agreement with the past- and future-focused statements on the Temporal Focus Scale in the morning and afternoon sessions. 126
Figure 20 Average agreement on Temporal Scale for participants choosing the

future-in-front mapping and past--in-front mapping in Study 17 135
Figure 21 Average agreement on Temporal Scale for participants choosing the future-in-front mapping and past--in-front mapping in Study 18 138
Figure 22 Average agreement on Temporal Scale for participants choosing the future-in-front mapping and past--in-front mapping in Study 19 140

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Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas and contributions from the work of others.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the Faculty of Arts and Social Sciences Ethics Committee at Northumbria University.

I declare that the Word Count of this Thesis is 56, 305.

Signature:

heng li

Date: 15th April 2018

Chapter 1. Spatial representations of time

1.1 Introduction

Recall your favorite memory: the moment you received the perfect birthday gift from your parents; the night you threw a surprise party for your friends; the summer holiday you spent with your lover. Imagine your bright future: the moment you will move into your own house; the first sights of your child's face; the day you will start a new career path.

In addition to thinking about things that are remote in space or time, people can also communicate about things that are not immediately present spatially or temporally. This unique capacity of human language is referred to as displacement and it is not found in most animal communication systems (Hockett, 1960). However, unlike concrete concepts with tangible aspects of reality, abstract concepts such as time are not based on perceptual experiences and cannot be embodied through sensory-motor processes (Kövecses, 2017). If so, how can people talk about time in their languages?

For a long time, linguists have observed that there is a strong tendency to talk about time concepts in terms of spatial words across languages and cultures (see Clark, 1973; Evans, 2004; Haspelmath, 1997; Huumo, 2017; Moore, 2014; Núñez and Cooperrider, 2013; Yu, 1998; but see Sinha et al., 2011 for an exception). According to Conceptual Metaphor Theory (CMT), metaphors allow people to rely on concrete, familiar knowledge, such as spatial experience, to understand abstract concepts like time (Gibbs, 2006; Lakoff, 1990, 1993; Lakoff and Johnson, 1980; Kövecses, 2015). In the past few decades, cross-linguistic research has shown that time is spatially represented in both spoken and signed languages. For example, in many languages throughout the world, the future is ahead and the past is behind. This pattern is revealed in linguistic expressions like "*I'm looking forward to the future*" and "*I look*

back on the past". On one proposal, this future-front/past-back metaphor is grounded in human bodily experience; when people walk along a path, places which they have already passed lie behind them, and places which they have yet to reach lie ahead of them (Clark, 1973). This sagittal representation of time has also been found in many signed languages. For instance, in American Sign Language, British Sign Language and Polish Sign Language, the sign for the "past" is produced with a hand moving backward over the shoulder and the one for the "future" is a hand moving forward. In these instances, future times are in front of the observer and past times are behind the observer (Brennan, 1983; Emmorey, 2001; Sutton-Spence and Woll, 2010; Taub, 2001; Wilcox, 2000; Nilssen, 2015).

However, in a study conducted by Núñez and Sweetser (2006), it is found that in contrast to the pattern found in English, Aymara exhibited the reversed space-time mapping, which mapped the past to the front and the future to the back. For its motivation, Núñez and Sweetser (2006) suggested that this past-in-front mapping is associated with another universal aspect of bodily experience, that is "knowing is seeing"; the past is the time we already know and which can be "seen" clearly, whereas the future is full of unlimited possibilities and therefore it cannot be "seen" definitely. The pervasiveness of this KNOWING IS SEEING metaphor in Aymara is possibly mediated by the visually based grammatical distinctions. This is because a verbal suffix for evidentiality is widely used in Aymara to profile "personal knowledge", which typically suggests that the speaker visually witnessed the events (Núñez and Sweetser, 2006: 440).

The systematicity and coherence of spatial metaphors for time in language have given rise to research investigating whether these metaphors are cognitively real. Several studies have now demonstrated that people tend to gesture about time as their language suggests, providing supporting evidence for the psychological reality of spatio-temporal metaphors. For instance, English speakers use the sagittal axis (front/back) when producing co-speech gestures, gesturing forward for future times

and backward for past times (Cooperrider and Núñez, 2009; Walker and Cooperrider, 2016). Núñez and Sweetser (2006) also find that elderly Aymara speakers often gesture forward for the past and backward for the future. The findings in both English and Aymara suggest that people think about time the way they talk about in their spoken metaphors.

Yet, recent lines of work have shown that mental representations of time may be absent from spoken language, or space-time mappings in the mind may contradict those in language, suggesting that linguistic metaphors are not the sole factor influencing people's thinking. Instead, the separable influences of our linguistic, cultural, and bodily experiences may combine to shape our minds (Casasanto, 2008, 2016). For instance, while Moroccan speakers of Darija place the future in front and the past behind in their spoken metaphors, they tend to gesture according to the past-in-front mapping overwhelmingly more often, suggesting a striking dissociation between temporal language and temporal thinking (de la Fuente et al., 2014).

If Moroccans' spatialization of time cannot be traced to their language, what factor(s) would influence space-time mappings in their mental models? de la Fuente et al. (2014) proposed an alternative; that is the Temporal Focus Hypothesis (TFH). The TFH suggests that people's implicit associations of the "past" and "future" with the "front" and "back" should be shaped by their temporal focus, namely, the attention individuals devote to thinking about the past and future (Shipp et al., 2009). Through a series of experiments, de la Fuente et al. (2014) showed that cultural and age-related differences in attentional focus can influence people's implicit space-time mappings. Yet, the TFH is supported by only one published study. Moreover, the database of the study only compared Spanish and Moroccan populations. The question, thus, arises as to the generalizability of the findings. A conceptual replication and novel extension of de la Fuente's results are essential for validating the TFH. Thus, the first goal of the current thesis is to directly test the TFH in Chinese and Vietnamese cultures. Additionally, people's attentional focus on temporal events may be subject to a broad

range of internal and external factors. The second goal of the current study is to identify the independent contribution of these factors to people's temporal focus and the resulting implicit space-time mappings. In the next two sections, evidence will be broadly reviewed to show the possible alignment and dissociation between temporal language and temporal thought. The remainder of the introduction discusses the TFH. I argue that the TFH, a unified theoretical model, can predict variation in implicit space-time mappings across cultures and across individuals. After this background, I lay out the organization of the thesis.

1.2 The alignment of temporal language and temporal thinking

There is ample evidence that people think about time the way they talk about in their spoken metaphors. One of the most paradigmatic examples of this is illustrated by the findings that cross-linguistic differences in linguistic space-time metaphors predict corresponding differences in people's implicit spatializations of time (Boroditsky, 2001). For instance, English uses front/back spatial terms to talk about time, associating "earlier" with "back" and "later" with "front". Unlike English speakers, Mandarin speakers can also systematically use vertical spatial terms to talk about time, associating "earlier" with "*shang* (up)" and "later" with "*xia* (down)" (Scott, 1989). Based on the assumption that language is a powerful tool in shaping habitual thought, Boroditsky (2001) hypothesized that Mandarin speakers would be more likely to think about time in a vertical way than would English speakers. In a priming task used in Boroditsky's study, participants were asked to perform two spatial judgment tasks, which arranged two objects either horizontally or vertically before a temporal judgment task consisting of questions on the spatial relationship between two temporal entities (e.g., ''March comes *earlier* than April''). As predicted, Boroditsky (2001) found that Mandarin speakers responded faster to temporal sentences with spatially neutral words (earlier/later) following a vertical prime than a horizontal prime, while English speakers responded to the sentences faster following a

horizontal prime than a vertical prime, suggesting that different time metaphors in languages can yield different construals of time.

However, the nature of the above studies comparing behavior across different linguistic groups is quasi-experimental. In other words, the participants were already English or Mandarin speakers when they participated in the experiment. People with different spatial metaphors for time may also differ along other cultural dimensions, which may influence their spatial construals of time as confounding factors. To test the causal role of temporal language in determining temporal thought, in a recent study conducted by Hendricks and Boroditsky (2017: Experiment 1), English speakers were taught to talk about time using a vertical linguistic metaphor which is absent in their language, being told things such as "*breakfast is above the dinner/dinner is below the breakfast*" or "*dinner is above the breakfast/breakfast is below the dinner*". Other people learned the opposite system of metaphors talking about time, which earlier events happen below later ones. The results showed that newly learned metaphors can help participants form new space-time mappings in a nonlinguistic task. Those who learned that earlier events take place above later ones were more likely to associate earlier events with higher position than later events and vice versa, suggesting that linguistic metaphors play a causal role in shaping temporal thinking.

Other lines of independent evidence about the coupling between temporal language and temporal thought come from gesture studies (see e.g., Gu et al. 2017; Walker and Cooperrider, 2016). For instance, recent initial lines of research on temporal gesture have been used to re-evaluate Boroditsky's (2001) claim that vertical metaphors in Chinese can cause speakers to think about time vertically. Gu et al. (2013) conducted a series of experiments to investigate Chinese temporal gestures. In one production experiment, the authors found that participants were more likely to produce vertical gestures when defining time phrases containing explicit lexical references to verticality (especially when using deictic vertical metaphors) than those in the neutral

words condition, suggesting that using time phrases with vertical spatial metaphors exert an influence on the production of vertical gestures. Further experiments investigated late Chinese-English bilinguals. In these studies, participants were asked to define four deictic time-related concepts and their English counterparts (Gu et al., 2014). The results showed that the number of vertical gestures for wordlists with vertical spatial metaphors was significantly higher in Chinese than that in the English translation, providing more evidence for the effect of temporal language on temporal thought.

More recently, relying on more controlled laboratory experiments, Li (2017, experiment 2) found that when Chinese speakers produced co-speech gestures spontaneously, they use the vertical axis, gesturing upward for earlier times and downward for later times; thus, it indicates that vertical metaphors in spoken metaphors predict the patterns of temporal gesture. Yet, Chinese speakers were less likely to use the vertical axis than lateral axis overall, suggesting that they did not show a vertical bias in their conception of time. By contrast, they were more likely to think about time horizontally. However, it is notable that the use of temporal gesture by Chinese speakers is consistent with the linguistic pattern of their language in which front/back spatial metaphors were used more frequently than the up/down spatial metaphors (Chen, 2007). Thus, it provides some supporting evidence for the linguistic influence on temporal thought.

In addition to Chinese, one study from Núñez and his colleagues suggests that spatial expressions across cultures play a role in fostering divergent conceptualizations of time (Núñez et al., 2012). The language of Yupno, an indigenous group in a remote mountain range of Papua New Guinea, favors geocentric ways of talking about space (e.g. "*The tree is uphill from the house*") over our more familiar egocentric system (e.g. "*The tree is on the right side of the house*"). Furthermore, a study on temporal gesture has shown that the topographic system pervades Yupno's linguistic expressions about time; when talking about the future, they point upwards towards the

river's source, which lies uphill from their village. By contrast, they gesture downhill to signal events in the past. This pattern of findings suggest that spatial languages help motivate temporal conceptualizations. Taken together, these results suggest that temporal thinking is consistent with the space-time metaphors in language.

1.3 The dissociation of temporal language and temporal thought

While temporal language may reflect or even exert an enormous influence on temporal thought as a large body of the published literature suggests, an emerging line of research suggests that people may not think about time as their language suggests (Casasanto, 2016; Casasanto and Jasmin, 2012). For instance, linguists have documented that no known spoken language talks about time in terms of spatial words – left and right[1] (Clark, 1973). However, there is ample evidence that people have an implicit mental timeline that runs along the lateral axis (Cienki, 1998; Ouellet et al., 2010; Torralbo et al., 2006; Weger and Pratt, 2008), which suggests that language is not the sole factor determining which mental metaphors people may use.

In a now-classic publication, Tversky et al. (1991) sought to investigate the idea that the direction of writing in a language influences the way people graphically lay out time. By noting the universal metaphorical associations of quantity and lateral space, Tversky et al. (1991) reasoned that the writing direction may affect mental representation of temporal sequences. In one experiment, they asked English (written from left to right, LR), Arabic (written from right to left, RL) and Hebrew (RL) adults and children to place stickers corresponding to temporal sequences of natural events (e.g., breakfast, lunch and dinner) on a page. The results showed that whereas English speakers tended to place the earlier events to the left of the midpoint and the later

[1] Casasanto and Jasmin (2012) mentioned that speakers in some particular English-speaking communities, i.e., members of military army and workers, may use left and right to talk about time as graphic conventions for time (e.g., calendar). For instance, when workers are rescheduled for an early shift, it is common to say they are "shifting left," and when they are rescheduled for a later shift that they are "shifting right." However, such casual observations should be interpreted with some caution pending further empirical and systematical analysis.

events to the right of the midpoint, Arabic speakers showed a strong tendency to align these temporal events in an opposite direction, consistent with the direction of reading and writing as well as graphic conventions (like lateral organization of time on calendars) in English-speaking and Arabic-speaking cultures respectively. Hebrew speakers' responses were mixed because they had more extensive exposure to English language than Arabic-speaking Israelis.

Building on Tversky et al.'s (1991) findings, Furhman and Boroditsky (2010) devised a series of non-linguistic experiments to investigate whether cultural-specific writing directions affects people's reasoning about time. In a 3D-pointing task, English and Hebrew speakers were asked to point to the hypothesized location of events relative to a reference point (Furhman and Boroditsky, 2010: Experiment 1). The results showed that when pointing along the lateral axis, English speakers were more likely to lay out time from left to right, while Hebrew speakers preferred the opposite pointing pattern, which replicated previous findings showing the effect of writing direction on people's explicit spatial layout of time.

These preliminary results have been extended by using reaction time tasks, with demonstration that these culturally specific representations of time can be automatically activated. In one study, Furhman and Boroditsky (2010: Experiment 3) asked participants to make a rapid temporal judgment after watching triplets of pictures. Each triplet represented different stages of an event with an ‘‘early’’, ‘‘middle’’, and ‘‘late’’ time-point. The participants were presented with the ‘‘middle’’ picture as reference point followed by either the earlier or the later time points picture. Participants were instructed to judge whether the second picture showed a conceptually earlier or later time-point than the first picture. The results showed that “earlier” and “later” judgments facilitated left and right manual responses, respectively, for English speakers. However, Hebrew speakers showed the opposite pattern.

Similarly striking dissociations between temporal language and temporal thought have also been found in people's spontaneous gestures. Casasanto and Jasmin (2012) found that English speakers tend to produce gesture on the lateral axis when talking about time. They gesture leftward for earlier times and rightward for later times even when using front/back metaphors in their narrative language. This lateral mental timeline in gestures is consistent with the rightward flow of time in English-speaking graphic conventions. While the majority of research investigating the lateral axis mapping of time used visual tasks, another line of research presented stimuli in auditory modality to exclude printed words as additional source of spatial biases. In a study, Ouellet, Santiago, Israeli and Gabay (2010) asked Spanish (LR) and Hebrew speakers to discriminate temporal reference (past or future) of auditorily presented words. The results showed that for past words, Spanish participants were faster responding with the left effector, whereas for future words with the right effector. Hebrew participants showed the reverse pattern, thus suggesting that orthography direction may play a role in influencing the spatial representation of time.

Another unique example was studied by Boroditsky and Gaby (2012) showing that an indigenous group, the Pormpuraawans of Australia, tend to talk about time according to the cardinal directions, i.e., east to west. Based on the observations that the Pormpuraawans make extensive use of cardinal directions (north, south, southeast, etc.) to represent spatial relationships in everyday parlance, Boroditsky and Gaby (2012) hypothesized that the absolute spatial representation would also influence the representation of time among Pormpuraawans. To test this, participants were asked to complete a series of temporal-ordering tasks. In the first experiment, i.e., "card-arrangement" task, each card set showed four stages of a natural entity, like a fruit (a banana being eaten), from the earliest to the latest stages. Participants were instructed to arrange the cards in a sequential order (from the earliest to the latest). The second experiment was a "dot-drawing" task in which participants were asked to place dots corresponding to temporal periods. For example, the experimenter placed a dot on the ground in front of the participants and said, "If this here is today, where

would you put yesterday? And where would you put tomorrow?" For two tasks, each participant was tested while facing in different cardinal directions, separated by 180° or 90°. The findings showed that the Pormpuraawns tended to arrange sequential time in a westward orientation. In other words, earlier events were placed further to the east in the linear arrays while later event to the west. It appears that the Pormpuraawns' strategy cannot be traced to their language, since it possesses a rich temporal vocabulary. However, people do not use cardinal direction terms to describe temporal relationships in their speech. Boroditsky and Gaby (2012) proposed that this cardinal-direction organization for time in the Pormpuraawns stems from the motion of the sun; that is earlier events correspond to the east where the sun rises and later events correspond to the west where the sun sets. However, this correspondence is absent from their language, suggesting a dissociation between temporal language and temporal thought.

1.4 Temporal Focus Hypothesis (TFH)

According to linguistic relativity, the categories and distinctions of each language affect its speakers' world view or cognition (Whorf, 1956). Although this strong Whorfian view – that language determines thought – has long been abandoned in the field, many weaker views, such as The Metaphoric Structuring View proposed by Boroditsky (2000), are still entertained. Under this weak version, repeated use of spatial metaphors to talk about time encourages structural alignment between the two domains and provides relational structure from space to time. Consistent with this assertion, many studies reviewed above have shown that spatial metaphors for time not only reflect the structure of people's temporal thought, but also shape how people spatialize time in their minds (e.g., Boroditsky, 2001; Boroditsky et al., 2011; Fuhrman et al., 2011; Lai and Boroditsky, 2013; Miles et al., 2011).

However, as demonstrated, an important emerging line of research has provided

preliminary evidence that people may not think about time as their language suggests. More recently, a striking dissociation between temporal language and temporal thought was noted in an informal observation that speakers of Darija (a Moroccans dialect of Modern Arabic) demonstrated a strong tendency to gesture about time according to the "past-in-front" mapping but using "future-in-front" metaphors in their speech (de la Fuente et al., 2014). If Moroccans' spatialization of time cannot be traced to their language, what factor(s) would influence space-time mappings in their mental models? According to the TFH, people's implicit associations of the "past" and "future" with "front" and "back" should be shaped by their attentional focus on the past and future.

A series of experiments were conducted to test this hypothesis by employing the basic paradigm of the "Time Diagram Task", in which participants were presented with a sheet depicting a cartoon character seen from above with a box ahead of the character and another behind him. Participants were told that the character visited a friend who loved plants yesterday, and tomorrow he would be going to visit a friend who loves animals (or vice versa, as event-to-space assignment was counterbalanced). Participants were asked to place "plant" and "animal" in the boxes.

In the first experiment, the directions of the front-back time mapping in Spanish and Moroccan populations were tested. The results showed that Spanish speakers were more likely to put the future event in the front box and the past event in the box behind. Yet, the Moroccans exhibited the reversed pattern. In discussing the implications of their findings, de la Fuente et al. (2014) hypothesized that the difference between Moroccans' and Spaniards' conceptions of time does not derive from their native languages; indeed, the two groups of speakers use similar future-in-front/past-in-back mappings in their spoken metaphors. Instead, the researchers proposed a cultural explanation that people's implicit space-time mappings are shaped by their cultural attitudes toward time. The researchers argued that Moroccans' culture encourages them to be more past-focused, while Spaniards'

culture places more value on the future. In experiment 2, a Temporal Focus Hypothesis Questionnaire which consisted of 21 assertions denoting opinions about past- and future-related topics was designed to quantify the proposed difference in temporal focus between Spaniards and Moroccans. As predicted, results revealed that the former agreed more with the past-focused statements (e.g., "*Young people must preserve the traditions*"), while the latter agreed more with the future-focused statements (e.g., "*Technological and economic advances are good for society*").

Building on the findings of experiment 1 and 2, experiment 3 investigated whether temporal focus influences implicit space-time mappings within a single culture. de la Fuente et al. (2014) propose that while university students tend to be more future-focused because they keep themselves ambitiously working, planning, and competing for a better life, senior citizens may focus more on the past because they tend to have increased recollection for events occurring in their youth (known as the *reminiscence bump*). In view of these age-related differences, these researchers hypothesized that older Spaniards should produce a greater proportion of past-in-front responses than younger Spaniards on the temporal diagram task. As predicted, results showed that young adult Spaniards tended to conceptualize the future as in front of them and past behind them. Meanwhile, older Spaniards were more likely to conceptualize the past as in front of them than younger Spaniards, but performed at chance levels.

Using a within-subjects design, in experiment 4 de la Fuente et al. (2014) corroborated the results of Experiments 1-3 with new samples of young Spaniards, elderly Spaniards and young Moroccans, aiming to test whether individuals' responses on the Temporal Focus Questionnaire predicted their implicit space-time mappings. Responses on the Temporal Focus Questionnaire replicated the results of future-oriented thinking of the young Spaniards and past-oriented thinking of young Moroccans as found in experiment 2. Meanwhile, Spanish elders performed at an intermediate level between the other two groups, showing equally high agreement

with future focus and past focus statements. The results of the time diagram task also replicated the previous findings that young Spaniards tended to think about time according to the future-in-front mapping, while young Moroccans tended to think about time according to the past-in-front mapping. The elderly Spaniards' judgments were reportedly at an "intermediate" place between the young Spaniards and the Moroccans. To further establish the link between individuals' responses on the Temporal Focus Questionnaire and their responses on the temporal diagram task, a Temporal Focus Index (TFI) was created. The results showed that TFIs were a significant predictor of responses on the time diagram task; lower TFIs were associated with more past-in-front responses, and higher TFIs with more future-in-front responses, which is consistent with the TFH.

To determine whether temporal focus plays a causal role in influencing people's implicit front-back time mappings, in their final experiment, de la Fuente et al. (2014: experiment 5) asked participants to perform a temporal focus writing exercise before they completed the time diagram task. Spanish university students were assigned to the future-focus training condition (writing about their future, e.g. "*Do you think you will be happy as an old person?*") or past-focus training condition (writing about their past, e.g. "*Were you happy as a child*") before their implicit space-time mappings were measured. The results showed that a few minutes of writing about one's future increased participants' tendency to conceptualize the future as in front of them even though this tendency was already very strong in Spaniards. Moreover, the past-focus trained Spaniards produced a far greater proportion of past-in-front responses than the future-focus trained participants. Thus, these findings provide further evidence that temporal focus can play a causal role in determining people's representations of time in their mental models, supporting the TFH.

In sum, the rigorous study by de la Fuente et al. (2014) provided an exceptionally portable and simple paradigm – the Time Diagram Task – that can be used to reveal the direction of front-back time mappings in people's minds with diverse populations.

Moreover, this preliminary line of work has demonstrated that people's cultural or individual differences related to certain temporal focus may influence their spatializations of time. However, to date, the TFH is supported by only one published study comparing Spaniards and Moroccans, which raises questions as to the generalizability of the findings. A conceptual replication and novel extension of de la Fuente's results are crucial for the validity of the TFH.

1.5 Thesis overview

While the TFH appears to provide a powerful theoretical account that could explain cross-cultural and cross-individual variation in spatial mappings for time on the sagittal axis, the generalizability of these findings is limited because the sample only consisted of two cultures in Europe and Africa. In addition, it only focused on one individual difference, namely, age. However, separate lines of evidence have shown that individual differences in emotions, lifestyle and personality traits may influence people's perspectives on the movement of events in time and their concomitant interpretation of ambiguous statements about time (e.g., Duffy and Feist, 2014; Hauser et al., 2009; Richmond et al., 2012; see also Lee and Ji, 2014; Margolies and Crawford, 2008; Ruscher, 2011), which suggests a high malleability of human time cognition system. Thus, by extending beyond the range of cross-cultural and age-related differences that may influence people's representations of time, the overall aim of this thesis is to shed light on the validity of the TFH.

It should be noted that most studies reported in the current thesis were quasi-experimental, which were used to estimate the causal role of a factor on its target population without random assignment (Derue et al., 2012; William et al., 2002). Although it may not be possible to convincingly demonstrate a causal link between the treatment condition and observed outcomes, it can be very useful in identifying general trends from the results when true experimental designs are

sometimes impractical or impossible (i.e., pregnancy). In addition, the research can effectively be carried out in natural settings. For this reason, external validity is increased in quasi-experimental research.

In the current thesis, I sought to test an array of previously unexplored contextual and individual factors that may influence temporal focus and the resulting implicit space-time mappings, providing a more fully explanatory framework for the metaphoric representation of time. This aim will be addressed throughout the following chapters:

CHAPTER 2: TEMPORAL PERSPECTIVE

Despite various types of spatial metaphors for time, a majority of research focused on those structured around the relative placement of ego and events in time. A large body of experimental findings has shown that people's adoption of temporal perspectives may be malleable, influenced by a complex of factors. Thus, in order to frame the current study within the broader context of the existing literature, Chapter 2 provides a detailed overview of factors influencing how people think about the movement of events in time.

CHAPTER 3: WITHIN-CULTURAL DIFFERENCES

Previous research testing the TFH mainly used cross-cultural comparison in which the cultures compared differ not only in attentional focus on temporal events, but may also differ in other cultural values. Thus, the specific role of cultural attitudes toward time has not been tested. In Chapter 3, Study 1 compared Southern and Northern Vietnamese, who have many aspects in common but demonstrate cultural differences in attitudes toward the past and the future, aiming to test whether within-culture variation of attentional focus on time can influence people's implicit spatial conceptions of time.

CHAPTER 4: POLITICAL DIFFERENCES

Culture is a term with many layers (Eliot, 2010). For instance, a culture can be both past-focused socially and politically and future-focused technologically and economically. Previous research suggested that conservatives tend to endorse traditions and are more past-focused while liberals prefer progressive change and are more future-focused (Robinson et al., 2015). In Chapter 4, Study 2 investigates the association between politic ideology and people's implicit space-time mappings.

Chapter 5: RELIGIOUS DIFFERENCES

As previous studies have demonstrated that culture exerts an important influence on people's implicit spatializations of time, Chapter 5 focuses specifically on religion, a prominent layer of culture, as a potentially additional influence on space-time mappings. In Study 3 and 4, I compare differences in implicit space-time mappings between Buddhists and Taoists. In Study 5, to determine the causal role of religious experience in determining the direction of front-back mappings, I administer a religion prime, in which Buddhists are randomly assigned to visualize the picture of the Buddhas of the Past (Buddha Dipamkara) or the Future (Buddha Maitreya). Study 6 aims to reveal an analogous effect to Study 5 in a non-religious population.

CHAPTER 6: REAL LIFE EXPERIENCES

In other lines of research, it has also been shown that people's implicit space-time mappings can be rapidly modulated by life experiences (see Boroditsky and Ramscar, 2002; Casasanto, 2008; Casasanto and Bottini, 2014). Thus, drawing on these findings, in Chapter 6, three studies investigate whether real life experiences – namely, education background (Study 7), living environment (Study 8) and museum visiting experience (Study 9) influence how people spatialize the past and future in their minds.

CHAPTER 7: PREGNANT EXPERIENCE

One of the most striking characteristics of pregnant women noted by previous research is their future-oriented thought. In Chapter 7, Study 10 test whether

pregnancy can affect Chinese women's temporal focus and thereby influence their space-time mappings.

CHAPTER 8: TEMPORAL LANDMARKS

While the majority of research investigating spatial representations of time has thus far been primarily focused on investigating the influence of cultural and individual differences on space-time mappings, scant attention has been paid to temporal landmarks that may play a role in how people represent time in their mental models. In Chapter 8, three studies investigate how different types of temporal landmarks, namely, academic cycle (Study 11) and festival (Study 12), influence space-time mappings in people's minds. Extending beyond the correlational evidence, Study 13 tests whether temporal landmarks play a causal role in determining the direction of front-back time mappings.

CHAPTER 9: TIME OF DAY AND CHRONOTYPE

People shifting their behaviors during the waking day have been observed by a number of prior studies in the field of psychology. Much anecdotal and empirical evidence suggest that people's temporal focus appears to vary over time. In Chapter 9, Study 14 and 15 are conducted to investigate whether time-of-day influence people's spatial representations of time by a quasi-experimental and an experimental approach. Study 16 factors chronotype into designs and examines the interaction between a person's chronotype, time-of-day and spatial conceptions of time.

CHAPTER 10: PERSONALITY

Based on the findings about the interplay between personality traits and temporal reasoning, Chapter 10 investigates whether individual differences in conscientiousness exert additional influences on student and non-student adults' implicit spatializations of time in laboratory (Study 17) and field settings (Studies 18 and 19).

CHAPTER 11: GENERAL DISCUSSION

An overview of the findings of these studies is presented. Theoretical, methodological and practical implications for cognitive science are discussed, as are the strengths and limitations of the thesis. In addition, to foster a genuine transdisciplinary interchange between theoretical and experimental research in the field of cognitive linguistics (Núñez, 2007; Callies et al., 2011), new interesting directions are suggested for further study.

Chapter 2. Time perspectives

2.1 Introduction

In metaphor studies, the CMT argues that metaphor is not only a rhetorical device but a way of thinking (Lakoff and Johnson, 1980; Lakoff, 1993). According to the CMT, there is an interactive relationship between source and target domain structure when we understand metaphorical language. Through a systematic mapping, properties are transferred across seemingly unrelated concepts. In the past few decades, cognitive linguists have done important work on cognitive universality and cultural variation in the conceptual structure of metaphor.

On the one hand, linguists have documented that many conceptual metaphors appear in diverse languages, suggesting that there may be some universal basis for the same metaphors. Lakoff and Johnson (1999) argued that bodily experiences shared by human beings lead to the emergence of these (near-) universal metaphors. That is, our mind is metaphorical and embodied in the profound sense that the very structure of our thoughts is influenced and shaped by our body. For example, the HAPPINESS IS UP conceptual metaphor are not only evidenced in linguistic expressions such as "happiness welled up inside him" in English (Lakoff and Johnson, 1980), but also can be found in other typologically unrelated language such as Mandarin Chinese (a Sino-Tibetan language), and Hungarian (a Finno-Ugric language) (see Kövecses, 2000 for a discussion). Since the three languages are unrelated genetically, a tenable explanation seems to be that some "universal bodily experiences" are likely to produce these conceptual metaphors (Johnson, 1987; Lakoff, 1987; Lakoff and Johnson, 1999; Gibbs, 2006). For instance, there are basic experiences associated with different emotions; when we feel happy, we tend to be physically up, moving around or even jumping up, and smiling (i.e., lifting the corners of the mouth), as opposed to being physically down (droop mouth corners) and inactive.

On the other hand, Kövecses (2000, 2015, 2017) proposed that different languages and cultures may not attend to the same physiological reactions associated with some abstract concepts, suggesting that the universality of essential physical experiences is not the sole basis for conceptual metaphors. For instance, while English and Hungarian show equal tendency to use the rise of body temperature and blood pressure to conceptualize the concept of anger, Chinese tends to use the presence of pressure as the source domain in the metaphorical conceptualization of anger (Gevaert, 2001, 2005; Yu, 1998). This indicates that different languages and cultures may not attend to the same physiological reactions associated with anger. In sum, although the human body is a potentially universal basis for metaphors structuring abstract concepts, culture may exert additional pressure in the course of metaphorical conceptualization.

Abundant evidence has shown that spatial metaphors for time show both cognitive universality and cultural specificity. Linguistic research has shown that the use of spatial language to talk about time is prevalent in an overwhelming number of languages throughout the world (Clark, 1973; Evans, 2004; Haspelmath, 1997; Lakoff and Johnson, 1980; Moore, 2014; Núñez and Cooperrider, 2013; Bender and Beller, 2015). Across languages and cultures, the human body plays an important role in the emergence of spatio-temporal metaphors. For instance, time metaphors tend to depend on the axes of movement (see Figure 1), namely, the sagittal axis (dividing the body into front and back halves), the lateral axis (dividing the body into left and right halves), and vertical axis (dividing the body into superior and inferior halves). However, the particular ways in which time is spatially represented differ across languages, suggesting that it is also shaped by cultural contexts. For instance, English uses front/back spatial terms to talk about time, associating “earlier” with “back” and “later” with “front”. Unlike English speakers, Mandarin speakers can also systematically use vertical spatial terms to talk about time, associating “earlier” with “shàng (上，up)” and “later” with “xià (下，down)”. These cultural-specific metaphors possibly arise from the cultural experiences that certain aspects of the past are

believed to be good in Chinese traditional culture. Previous research suggests that positive objects or ideas are associated with physical highness, whereas negative objects or ideas are related to physical lowness (Gottwald et al. 2015; Lakoff and Johnson 1980). Since Chinese people show more reverence for the past, they tend to map it onto the upper vertical axis (Dancygier and Sweetser, 2014).

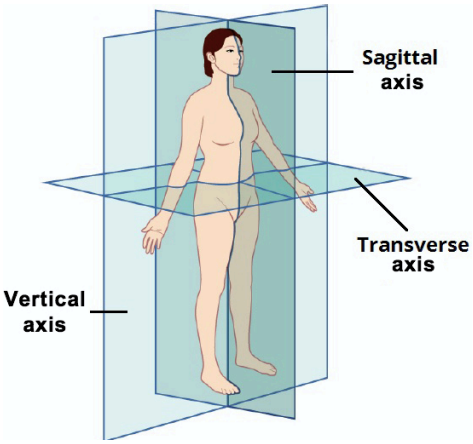

Figure 1 Three axes of human body

Although there seems to be linguistic preference for the use of some axes over others, showing wide cross-linguistic and cross-cultural variations, the sagittal axis appears to be much more focal in the studies of spatial metaphors for time. Across many languages and cultures, speakers tend to associate the "past" and "future" with the spatial concepts of "front" and "back" in their spoken metaphors (Clarks, 1973; Evans, 2004; Haspelmath, 1997; Moore, 2014; Núñez and Cooperrider, 2013; Bender and Beller, 2014; Yu, 1998). For instance, English speakers can either talk about time moving toward or away from their placement in space, as in "Christmas is quickly approaching us", or the active ego moving forward through time, as in "We're coming up to Easter holiday". In the literature, these two deictic space-time metaphors are referred to as Moving Time and Moving Ego respectively (Clark, 1973; Boroditsky, 2000). In Lakoff and Johnson's term (1999: 141), In the Moving Time (or time-moving) metaphor, the observer is stationary and time is conceived as entities moving towards or from the observer (see Figure 2). In the Moving Ego metaphor (or ego-moving), time is conceived as a stationary landscape in which the active ego

moves towards future time (see Figure 3).

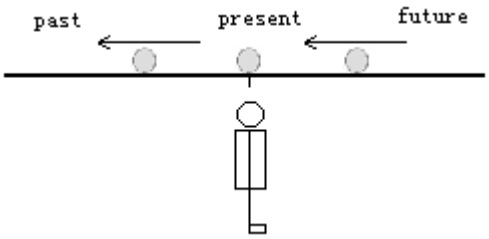

Figure 2 Schematic drawing of moving time metaphor

(Adapted from Yu, 1998: 105)

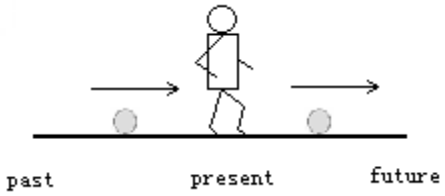

Figure 3 Structuring of Moving Observer Metaphor

(Adapted from Yu, 1998: 105)

Extending beyond linguistic analysis, the results of several psycholinguistic experiments have confirmed the psychological reality of these two metaphors. In a seminal study conducted by McGlone and Harding (1998), three groups of participants were tested. Two groups were primed with the Moving Ego metaphor (e.g. we passed the deadline two days ago) or the Moving Time metaphor (e.g. the deadline passed two days ago) and the third group served as control. At the end of the block of priming statements, they were asked to interpret ambiguous statements such as "The meeting originally scheduled for next Wednesday has been moved forward two days" and indicate the day of the week on which the event in question would occur. The results showed that participants provided priming-consistent responses. Those, who were primed with Moving Ego metaphors, tended to answer "Friday" and those, who were primed with Moving Time metaphors, tended to answer "Monday"; thus, it provides supporting evidence for the psychological reality of these two metaphors.

Building on McGlone and Harding's (1998) findings, subsequent studies have revealed that a person's conceptualization of time likely results from an accumulation of factors (e.g. spatial experience, emotion, cultural artefacts, etc.), which suggests that the human cognition system may be highly adaptive and malleable. This chapter will begin by reviewing a range of factors that may exert significant influence on people's interpretations of ambiguous temporal statements. Next, a detailed overview of the dynamicity of time representations on other axes is provided. In doing so, I will show the malleability and flexibility of the human time cognition system across the axes and, thereby, frame the current research within the broader scholarly and historical context of the existing literature.

2.2 Spatial experience

The CMT suggests that our understanding of time is based on spatial knowledge and experience (Lakoff and Johnson, 1980). Based on the claim that time and space share relational similarities and conceptual structure, Boroditsky and her colleagues conducted a series of experiments to investigate whether getting people to think about space in a particular way might influence their temporal thought (Boroditsky, 2000; Boroditsky and Ramscar, 2002). In one experiment, participants completed a questionnaire with pictures that primed either ego-moving, or time-moving frame of reference. Following the primes, participants read the ambiguous "next Wednesday's meeting" question and were asked to indicate to which day the meeting had been rescheduled. Reasoning that abstract domains such as time are structured through metaphorical mappings from more concrete and experiential domains such as space, it was hypothesized that participants primed in the ego-moving spatial condition should be able to reuse this perspective for time and answer that the meeting will be on Friday, whereas participants primed in the object-moving spatial condition should prefer the Moving Time perspective and answer that the meeting will be on Monday. As predicted, the majority of participants disambiguated the question in a manner

consistent with the metaphor structure that they had been primed with (ego-moving priming led to more "Friday" responses and time-moving priming led to more "Monday"). These results lend support to the view that different ways of spatial thinking influence thinking about time.

These preliminary findings have been extended in a larger and more comprehensive study incorporating a range of real life contexts. In one study, Boroditsky and Ramscar (2002) asked people waiting in a lunch line the ambiguous question about Wednesday's meeting. The results showed that the further along in a lunch line participants were (and hence the more forward spatial motion they had experienced), the more they were likely to perceive the Wednesday's meeting as moved to Friday in line with the Moving Ego perspective. In a similar vein, participants who had just boarded a train and thus tended to be engaged with the notion of their journey, were more likely to respond 'Friday' than participants who were in the middle of their journey and thus more likely to mentally disengage from the journey. This pattern of results suggests that people's thinking about time is firmly grounded in their spatial thinking and their spatial experiences. Furthermore, these findings provide supporting evidence for the claim that particular types of spatial-motion thinking may also unwittingly and dramatically influence people's thinking about time.

To date, the majority of research has investigated how spatial experiences influence temporal reasoning focused on actual motion. Other lines of work suggest that fictive motion, the metaphorical motion of object evidenced in linguistic expressions like "The road goes through the desert" and "The tattoo runs along this spine" (Matlock, 2004; Lakoff, 1987; Matsumoto, 1996; Talmy, 2000), similar to thinking about actual motion, can also influence people's thinking about time. In a study by Matlock et al. (2005), participants read either sentences including fictive motion (e.g., *The tattoo runs along his spine*) or no fictive motion (e.g., *The tattoo is next to this spine*) and drew the pictures representing what they imagined prior to answering the "Wednesday's meeting" question. The results showed that fictive motion sentences

caused participants to be more likely to answer “Friday” than “Monday” responses, but sentences without fictive motion yielded no reliable differences (see also Ramscar et al., 2010). A possible explanation is that fictive motion derives structure from the conceptual domain of actual motion and enables participants to conceptually “move” forward in time and provide a “Friday” response.

These findings have been extended, with demonstrations that even abstract motion, namely, sequences of numbers or letters can also influence interpretations of ambiguous temporal statements (see Langacker, 1986, 1987). In one experiment, Matlock et al. (2011) asked participants to fill in numbers in a forward order (*5 . . . 17*) or in a backward order (*17 ... 5*) before answering the “Next Wednesday meeting question”. The results showed that when participants were primed with forward abstract motion, they were more likely to adopt an ego-moving perspective and provide a “Friday” response, whereas when participants were primed with backward abstract motion, they showed no bias against “Monday” or “Friday”. As was the case with actual motion, Matlock et al. (2011) concluded that even abstract motion, can also influence the conceptualization of time.

Taken together, these findings thus lend further support to the idea that experiential-based domains, such as space and motion, exert a significant influence on the understanding of time (Boroditsky, 2000; Boroditsky and Ramscar, 2002). Specifically, even abstract spatial motion schemas and deictically-oriented fictive motion schemas which are conceptually linked through some experiential-based lending domain (actual motion) can also influence time reasoning.

2.3 Direction of movement during gestures

Gesture and speech form an integrated system both semantically and temporally in the speaker’s intended message (see e.g., Goldin-Meadow and Sandhofer, 1999; Hostetter,

2011; Kendon, 1994). Research has shown that people tend to produce co-speech gestures while talking about time. For instance, the gestures produced by English speakers show coherent space-time mappings with their accompanying speech (Cienki, 1998). That is, the forward motion of the hand is for the future and the backward motion represents events in the past. Based on naturalistic corpus data, Chui (2011) found that Chinese speakers exhibited two types of temporal perspectives in their temporal gestures as their language suggests. In the time-moving perspective, they moved their hands forward when talking about past. In the ego-moving perspective, they gestured backward when referring to yesterday, providing supporting evidence that the two temporal perspectives are cognitively real.

Extending beyond the findings that people adopt certain temporal perspectives when gesturing for time, some researchers further explored whether direction of movement during gestures influences the resolution of ambiguous temporal statements and the effects of addressees' perspective on comprehension of these gestures (Jamalian and Tversky 2012). If people use actions in space to express their conceptions of time, it can be hypothesized that actions in space would alter their perspectives on time. Specifically, when the speaker is using the spatiotemporal metaphor, the present is metaphorically co-located with the person and the future is in front of him. The speaker's interpretation of the "Next Wednesday meeting question" is concordant with this mental process. As the meeting is scheduled in the future, the speaker can move it to a location in front of himself, and then move the meeting forward farther into the future with a forward gesture away from himself. By contrast, he can move the meeting closer to the position of himself corresponding to the present with a backwards gesture. Thus, observing gestures moving away from the speaker should prime the ego-moving metaphor and gestures moving towards the speaker should prime the time-moving metaphor.

In a study conducted by Jamalian and Tversky (2012), participants were asked the ambiguous Wednesday's meeting question in one of two gesture conditions (gesture

away from speaker vs. gesture towards speaker). In both conditions, an experimenter, standing side by side with the participants, made a slice in the space in front of her body, with her palm facing her. Thus, the participants and experimenter had identical points of view. As predicted, when participants saw a gesture towards the speaker accompanying the utterance *was moved forward*, they were more likely to provide a "Monday" response (in line with the time-moving perspective). Conversely, when participants saw a gesture in a frontward direction away from the speaker, they were more likely to provide a "Friday" response (in line with the ego-moving perspective). This pattern of results suggests that representational actions, namely, gestures, dramatically altered temporal perspective-taking and their concomitant interpretation of a temporally ambiguous expression.

These findings have been replicated in Lewis and Stickles' (2017: experiment 1) research. The researchers found that the gesture away from the speaker, which evokes the metaphoric motion of the ego through time, would yield more Friday responses than Monday responses due to its congruence with the ego-motion metaphor. Taking a step further, Lewis and Stickles also investigated the role of perspective in the context of gesture comprehension. The results showed that irrespective of the speaker's perspective (shared perspective (side by side) vs. opposing perspective (face to face), addressees reliably interpreted metaphoric gestures from their own points of view. In other words, rather than taking the perspective of the speaker in the face-to-face conversation, addressees produced the same responses as those in the corresponding shared-perspective conditions; while the away-from-speaker gesture biased respondents toward the ego-moving perspective (responding "Friday"), the toward-speaker-gesture biased respondents toward the time-moving perspective (responding "Monday"). Taken together, these findings suggest that not only does gesture alter thinking about time in discourse interpretation, but also addressees effectively keep their own perspectives to interpret gestures, even when it is not shared with the speaker.

2.4 Emotion

Recent research investigating the perception of time and the resolution of temporally ambiguous utterances has extended beyond investigating spatial influences on temporal reasoning and has begun to consider language-external characteristics of the participants on the ways in which people perceive and understand time. For instance, some recent lines of research provided converging evidence for the role of emotion experiences in shaping people's reasoning about events in time (Richmond et al., 2012; Margolies and Crawford, 2008). According to the embodied simulation accounts, emotional experience is supported by an automatic sensory-motor simulation of the observed expression in one's own motor system (Gallese and Caruana, 2016). This proposal assumes that the processing of emotion involves the activation of emotion relevant sensory-motor and somatic states in the individual (Barsalou 1999, 2016; Carver and Harmon-Jones, 2007; Meier et al., 2012).

Building on the assumption that both the experience of time and emotion are grounded in the understanding of space, Hauser, Carter and Meier (2009) reasoned that anger is spatially represented by an approach-related motivation, causing the self to approach a victim or goal. Thus, if human's feelings and emotions are grounded in sensory experiences and bodily states, emotional states will tap into these metaphoric structures such that positive emotions should evoke approach tendencies in line with the ego-moving perspective, implying moving toward something, and negative emotions should evoke avoidance tendencies in line with the time-moving perspective, implying something coming at the self. Consistent with their prediction, Hauser, Carter and Meier (2009, Study 1) found that participants demonstrating higher degrees of anger were more likely to answer the temporally ambiguous *Next Wednesday's Meeting* question in line with the Moving Ego perspective (e.g. a "Friday" response), suggesting that individual differences in emotion may influence people's temporal perspectives.

More recently, Richmond et al. (2012) also investigated the connection between the seemingly unrelated but similarly embodied abstract domains of emotion and time. It was hypothesized that a happiness emotion-producing condition, grounded in approach motivations with their activation of goal-directed behaviors, would cause a higher likelihood of adopting an ego-moving representation of time where individuals perceive themselves as moving towards a future event (Higgins, 1997), and that anxiety- and depression-producing conditions, grounded in avoidance motivations with their activation of backward motion, would cause a higher likelihood of adopting a time-moving representation of time where a future event is moving towards individuals (Elliot and Thrash 2002). As predicted, the results of Richmond et al.'s study showed that happiness was more likely to evoke an ego-moving representation, while anxiety and sadness were more likely to evoke a time-moving perspective, suggesting that mental processes involve simulations of body-related perceptions and actions.

2.5 Event valence

As demonstrated, emotion activates, and is activated by, motoric behaviors, such that positivity is associated with approach toward a stimulus and negative affect is associated with avoidance-related responses. Based on this embodied account of affect, Margolies and Crawford (2008) hypothesized that the valence of events has similar effects on the spatial construal of time. It is predicted that positivity triggers approach in line with the ego-moving perspective, implying moving toward something, whereas negativity triggers avoidance in line with the time-moving spatiotemporal metaphor, implying something coming at the self. The results of Margolies and Crawford's experiments were only partially consistent with these predictions, with demonstrations that the positive events indeed made people more likely to endorse ‘‘I am approaching the event’’, while the negative events caused people to endorse ‘‘The event is approaching me’’. However, there is no evidence

showing that the valence of events had significant effect on the event which had been moved to Monday or Friday. It is possible that people do adopt the ego-moving perspective with positive events, thus pushing them to Friday, but that this effect is undermined by the tendency to want positive events to happen sooner, hence wishing them to be on Monday.

A similar pattern was found in children, which provided further evidence for the relationship between event valence and the directionality of time. Wyckoff et al. (2014) found that participants tended to adopt an ego-moving perspective when thinking about a pleasant event in order to actively approach the event as soon as possible. However, when thinking about an unhappy event, they preferred to adopt a time-moving perspective because they would like to stay away from the future event as long as they could. These findings suggest that event valence in a given context may cause different types of movements in people's mental models. When we experience positive emotions, we tend to feel more in control. By contrast, when we experience negative emotions, we tend to sense passivity or even lose the personal agency (Rutherford and Lindell, 2011).

However, it should be noted that there is an asymmetry effect of approach-avoidance tendencies related to event valence on temporal perspectives in past and future events. In a study conducted by Lee and Ji (2014), they found that anticipating a pleasant future actually prompted the ego-moving perspective, whereas anticipating an unpleasant future prompted the time-moving perspective, which is consistent with Margolies and Crawford's (2008) findings. Surprisingly, however, the results also showed that while recalling an unpleasant event from the past encouraged participants to adopt the ego-moving perspective, recalling a pleasant past event encouraged participants to the time-moving perspective. The cognitive mechanism underlying the asymmetry effect is possible that similar tendencies might exist in time, which may allow active psychological distancing. People dictate their psychological distance from different temporal events by reducing the distance from desirable experiences

and increasing the distance from undesirable experiences. Taken together, this pattern of results suggests that temporal reasoning is not only influenced by the valence of feelings evoked by an event but also whether the focal event is situated in the past or future.

2.6 Personality

As reviewed above, anger, both as an emotion and as a personality trait, drives the active self to approach a goal or situation and thus encourage participants to adopt the ego-moving perspective (Hauser et al., 2009). Building on these findings regarding the interplay between personality factors and temporal reasoning, Duffy and her colleagues conducted a series of experiments to investigate the relationship between personality differences and time reasoning. In one experiment, Duffy and Feist (2014: experiment 3) focused specifically on the link between extroversion-introversion and people's perspectives on the movement of events in time. Previous research (e.g., John, 1990; John and Srivastava, 1999; John et al., 2008) has revealed that extroverts tend to require a high level of stimulation and a large social network, exhibiting a more active approach towards the social interactions, much in the way that in the ego-moving metaphor. By contrast, introverts were found by the same line of research to have a tendency to be quiet, reflective and focused on the inner (mental) world, exhibiting a more passive perspective towards the social interactions, much in the way that in the Moving Time metaphor. Building on aspects of Conceptual Metaphor Theory, namely, that individual factors which share an embodied cognitive link with the Moving Ego and Moving Time metaphors, it can be hypothesized that the extroverts and introverts should exhibit differences in the resolution of Wednesday's meeting question. To be specific, the extroverts who adopts an active approach to time, should be more likely to respond "Friday" (consistent with the Moving Ego perspective). By contrast, the introverts who adopt a passive approach to time, should be more likely to respond "Monday" (consistent with the Moving Time perspective).

To test these predictions, Duffy and Feist (2014) asked participants to complete a questionnaire which measures degrees of extroversion-introversion (i.e., BFI; see John, 1990) prior to responding to the Wednesday's meeting question. As expected, participants, who adopted the Moving Ego perspective (answering "Friday") exhibited higher levels of extroversion compared to participants who adopted the Moving Time perspective (responding "Monday").

Extending the range of individual differences that may influence people's representations of time, in another study, Duffy and Feist (2014: experiment 2) focused on individual differences in procrastination and their relation to temporal perspective. According to Duffy and Fiest's definitions, procrastination entails an agent moving a task or set of tasks into the future, in line with the Moving Ego perspective, while the prioritisation is associated with conscientiousness and entails the movement of tasks towards the ego, in line with the Moving Time perspective. To test this, a questionnaire for measuring trait conscientiousness (see John, 1990) and trait procrastination, in addition to the Wednesday's meeting question, were administered. Consistent with the predictions, participants who adopted the Moving Time perspective evidenced significantly higher scores for conscientiousness than participants who adopted the Moving Ego perspective. Conversely, participants who adopted the Moving Time perspective evidenced significantly higher state and trait scores for procrastination than participants who adopted the Moving Ego perspective.

However, this study by Duffy and Feist relied on participants' self-reports regarding personality traits, which may not produce accurate information regarding personality traits. To address this issue, Duffy et al. (2014) moved beyond self-assessment of timeliness, investigating the relationship between objectively observable on-time behavior and resolution of a temporal ambiguity. In one experiment, Duffy et al. (2014: Study 3) compared the differences in temporal perspective between participants who arrived early for their appointment and participants who arrived late. In line with earlier findings, participants who met their obligations later on average

were more likely to adopt the Moving Ego perspective and, thus, confirming the generalizability of earlier findings with more objectively measureable behaviors. These findings, therefore, extend the range of individual differences that may influence people's temporal reasoning.

2.7 Stimuli presentation

As demonstrated, the majority of studies have thus far been primarily focused on investigating spatial experiences (e.g., spatial thinking and gesture), emotion and personality differences. More recently, some preliminary lines of research suggest that the ways and modalities of stimuli presentation may also influence their representations of time.

Tying together two separate lines of research on spatial representations of time, namely, research investigating spatial influences on temporal reasoning and research investigating cultural differences in space-time mappings, Duffy (2014) investigated the role of people's interactions with cultural artifacts in influencing interpretations of ambiguous metaphorical expressions about time. In one study, Duffy (2014: experiment 3) investigated the role of the analogue clock in the resolution of the ambiguous temporal statement (*Tomorrow's noon meeting has been moved forward by two hours*). In the task, participants were presented with a diagram of a clockwise clock or an anticlockwise clock and instructed to indicate the time of the rescheduled meeting by drawing the minute and the hour hands onto the face of the clock. It was predicted that there would be a mixed response to the Noon meeting question: some participants would be guided by the direction of the reverse temporal number line (anticlockwise), leading to a 2 p.m., whereas other participants would be guided by the customary direction of motion (clockwise), leading to a 10 a.m. response. As predicted, there was a significant difference between the responses of participants in the clockwise condition and others in the anticlockwise condition. Concretely, the

former showed a preference for depicting 2pm on the face of the clock (73.3%), whereas the latter provided mixed responses (46.3% depicting 2pm vs. 53.3% depicting 10 a.m.). Thus, the results provide evidence supporting the idea that the direction of stimuli presentation in cultural artefacts influences people's time reasoning.

In a more recent study, Stickles and Lewis (2017) investigated the effects of eye movement and stimuli presentation modality on comprehension of ambiguous temporal statement. Participants were tested in one of six experimental conditions, namely, audio with video, audio without video, single word text, paragraph text, regular scroll text, and reverse scroll text. Results showed that English speakers demonstrated a decreased preference for ego-moving perspective (responding "Friday") in the paragraph, regular scrolling, and reversed scrolling conditions, but they showed an increased preference for ego-moving perspective (responding "Friday") in the audio and video conditions (71% Fridays, vs. 63% in all text conditions); thus, it suggests that modality of the test material presentation may exert an additional influence on spatiotemporal metaphor use.

2.8 Flexibility of time representation on other axes

The reviewed research so far has provided strong evidence that people's conceptualizations of time cannot be attributed to a single factor, but instead, to a complex of factors. These highly flexible representations of time are not only found on the front-back axis; some preliminary lines of research have also suggested the same malleability on the lateral and vertical axes. For instance, Casasanto and Bottini (2014) showed that exposure to a new orthography can change the direction and orientation of the lateral timeline within minutes. People implicitly associate time with left–right space but the direction of this imaginary timeline is culture specific (Ouellet et al., 2010; Torralbo et al., 2006; Weger and Pratt, 2008). In the standard

orthography condition, Dutch speakers tended to place the earlier events to the left of the midpoint and the later events to the right of the midpoint as their reading and writing directions suggest. However, when participants judged temporal phrases written in mirror-reversed orthography, their mental timelines were reversed, accordingly; thus, it indicated that orthography plays a causal role in influencing people's implicit time representations.

Building on insights from Casasanto and Bottini's (2014) findings, Duffy (2014: Experiment 2) asked English participants to complete the ambiguous Wednesday's meeting question on an English (Normal Calendar Condition, LR) or Arabic calendar (Reverse Calendar Condition, RL). Based on the assumption that the inconsistent direction of orthography may cause interference, it was hypothesized that participants would produce a mixed response to the Wednesday's meeting question in the Reverse Calendar condition. As predicted, responses among participants in the Reverse Calendar condition were mixed, with 48.3% of participants responding "Monday" compared with 51.7% of participants responding Friday. This pattern of results suggests that people's space–time mapping can be rapidly shaped by the uncustomary direction of orthography.

A similar effect has also been found in people's vertical representations of time. In a recent study, Hendricks and Boroditsky (2017: Experiment 1) taught English speakers to talk about time using a vertical linguistic metaphor which is absent in their language, saying things like "breakfast is above the dinner" or "breakfast is below the dinner". The results showed that newly learned metaphors can help participants form new space-time mappings in a nonlinguistic task. In addition, it was also found that these newly learned representations were not susceptible to verbal interference. In discussing the implications of their results, Hendricks and Boroditsky concluded that "even representations of a fundamental conceptual domain like time are more dynamic and less etched in stone than previously supposed" (ibid: 16).

It should be noted, however, that the strength of the linkage between time and space appears to vary across the axes. Eikmeier and her colleagues devised a series of experiments to assess the strength of this linkage on the left-right axis and front-back axis. In one study, Eikemeier et al. (2013) compared the size of the space–time congruency effect on reaction time to a benchmark stimulus–response congruency effect. This benchmark congruency effect reflects the upper bound that the space–time congruency effect may attain. In the congruent condition, participants responded vocally with the word "future" to future-related stimuli and with the word "past" to past-related information. This assignment between stimuli and responses was reversed in the incongruent condition. The resulting benchmark congruency effect was compared with the space–time congruency effect obtained with the same stimuli and vocal responses but with space-related words "in front" and "behind". The results showed that the two congruency effects did not differ significantly. Therefore, this pattern of results suggests that there is a strong linkage between time and space for the front–back axis.

In a follow-up study, Eikemeier et al. (2015) extended this investigation to the left–right mental timeline by using the similar procedure and design. The results revealed a weaker linkage between time and space along the lateral mental timeline, because the congruency effects were smaller for the experimental than for the benchmark groups in control conditions. Together, these contrasting patterns on the two axes suggest that the spatial representations of time are less strongly linked for the left–right axis than for the back–front axis. It is possible that the front–back axis is more deeply rooted in our thinking about time because the front-back mental timeline may emerge from our perceptuo-motor interactions with the physical world, but the left–right mental timeline is associated with the reading and writing directions (Fuhrman and Boroditsky, 2010; Ouellet et al., 2010; Tversky et al., 1991).

Yet, these results were obtained by testing only German speakers, which raises questions regarding its generalizability. For example, Casasanto and Jasmin (2012)

found that English speakers tended to produce gesture on the lateral axis despite time flowing along the sagittal timeline dominantly in their speech, suggesting that the front–back mental timeline is not so privileged as expected in English. More recently, the flexibility of time representations has also been found even in 5-year-old children. Charras et al. (2017) investigated the developmental trajectories of sagittal and lateral mental timelines in children (5, 7, or 10 years old) and adults. Results showed that the perceived duration of the interval between 2 consecutive stimuli in a temporal bisection task was biased by distance in the sagittal as well as lateral axis across all age groups. Even the mere impression of distance in depth was sufficient to produce these effects. These findings suggest that there might be the same cognitive linkage between time and space in either sagittal or lateral planes from the age of 5 years and this even precedes the development of explicit timing mechanisms

Taken together, the existing literature indicates substantial flexibility in the metaphorical mappings of time onto space. However, the cognitive linkage between time and space appears to vary with the orientation of the mental timeline and may vary systematically across languages and cultures.

2.9 Summary

The claim that the human cognitive system is malleable and flexible has been tested by experimental data that accumulated over the last decade, with research showing short-term effects of novel metaphor learning on nonlinguistic representations (Dolscheid et al., 2013), with long-term neural plasticity in categorical perception (Athanasopoulos et al., 2010), and with findings showing that bilingual individuals' moral judgments are affected by the language in which they take a test (Cipolletti et al., 2016; Geipel et al., 2015).

By drawing on and building upon different lines of work, this chapter has evaluated

the malleability and flexibility of time representations. In particular, this chapter has focused on a range of factors that may exert influence on people's conceptualizations of time. To sum up, the reviewed research provides an important foundation for the understanding of time representations, demonstrating that while recruiting spatial experience to understand time is a universal cognitive mechanism, the spatializations of time in people's minds is also the consequence of nested factors, ranging from those relating to the situations in which people find themselves, e.g. how people engage in a particular way of spatial thinking, to those more tightly bound to the individual, e.g. personality traits, lifestyle and emotional states of being. Taken together, the implications of these research findings are consistent with the basic assumption of the TFH about the malleability of human's sagittal representations of time. That is, people's spatial conceptions of time are shaped by their attentional focus on temporal events which are contingent on their suitability to specific environments. While the majority of research in cognitive science has thus far been focused on investigating how ambiguous statements about time are interpreted, scant attention has been paid to implicit space-time mappings in people's mental models, and, in particular, what factor(s) influence how people associate the past and future with front and back in their minds. This issue will be addressed in Part II of the thesis.

Chapter 3. Within-Cultural differences

3.1 Introduction

As discussed previously, recent lines of research have provided evidence that people do not always think about time as their spoken metaphors suggest. For example, while Moroccans use the future-in-front mapping in their linguistic metaphors, they tend to produce the past-in-front mapping in their spontaneous gestures, suggesting a striking dissociation between the way they talk about time and the way they think about it (de la Fuente et al., 2014).

If language cannot determine Moroccan speakers' conceptions of time, what factor(s) would influence how people implicitly associate "front" and "back" with the "past" and "future"? de la Fuente et al. (2014: Experiment 2) proposed that cultural differences in temporal focus between Moroccans and Spaniards are responsible for variation in space-time mappings. Based on some sociology findings that Moroccans' advocates for the past times and emphasis on the preservations for tradition and Spaniards' advocates for future thinking and economic advancement as well as technological progress, de la Fuente et al. (2014) hypothesized that cross-cultural differences in attitudes toward the past and future may contribute to their implicit space-time mappings. Specifically, Moroccans should be more likely to conceptualize the past as ahead of them and the future as behind them because they have greater focus on the past, while Spaniards should exhibit the reversed pattern, conceptualizing the future as ahead of them and the past as behind them because they have greater focus on the future.

To investigate this relationship, a Temporal Focus Questionnaire which consisted of 21 assertions denoting opinions about past- and future-related topics was developed to test participants. As predicted, Moroccans tended to focus more on past times, while Spanish people tended to focus more on future developments, demonstrating that

cultural attitudes toward time are sufficient to determine which pole of the sagittal space is associated with the "past" and "future". This pattern of results suggests that cultural attitudes toward time play a role in influencing people's implicit space-time mappings, supporting the TFH.

The central assumption of the TFH that people's implicit space-time mappings are shaped by their cultural attitudes toward time has also been tested in other populations. Gu et al. (2016) administered the task in a similar vein to de la Fuente et al. (2014: Experiment 1) with Chinese participants. By comparing their data with the Spanish participants in de la Fuente et al.'s (2014: Experiment 1) study, they found that Chinese people were more likely to conceptualize the past as in front of them than Spaniards. According to Gu et al. (2016), Chinese people's past-in-front mapping was shaped by their linguistic and cultural experiences. On the one hand, there are more past-in-front mappings in Chinese spoken metaphors, consistent with the prediction of linguistic relativity proposals that differences between languages cause differences in their conceptualizations (Whorf, 1956). On the other hand, previous research suggests that Chinese people perceive the past as more valuable and are more past-focused than westerners (Ji et al., 2009), which appears to be in line with the TFH. However, Gu et al.'s experiments actually did not test participants' cultural attitudes toward time. Instead, they turned to Ji et al.'s (2009) findings for Chinese people's cultural values. It should be noted that Ji et al.'s (2009) research only compared Chinese and Canadian people's perceptions and representations of past information. The results showed that Chinese people attended to a greater range of past information than did Canadians. Yet, it is unclear whether people in the two cultures show the same differences in future-focused thinking.

There are several limitations of prior research that make it difficult to draw conclusions about the relationship between people's spatial conceptions of time and their cultural attitudes toward time. First, the TFH is supported by only one published study comparing Spaniards and Moroccans (i.e., de la Fuente et al., 2014), which

raises questions about the generalizability of the findings. A conceptual replication and novel extension of de la Fuente's results are crucial for the validity of the TFH. Thus, the first goal of the research reported here is to test the TFH in an Asian culture. Second, a key question concerning its methodology may arise for its further validation. de la Fuente et al. (2014) used cross-cultural comparison as a method to document different behavioral patterns. Although this approach allows a deep understanding of how different communities implicitly associate the "past" and "future" with different locations in front-back space, it also has a drawback in that the two cultures differ not only in their cultural attitudes toward time, but also in other dimensions, such as religion. Cohen et al. (2016) argued that studying country-based cultures may make it difficult to disentangle the country influences from other cultural influences. For instance, people should be cautious in characterizing large, heterogeneous groups of people (like China) as either past-focused or future-focused because there might be different religious groups within a single culture. The differences in religious concepts of time, among a host of other cultural variables, could affect differences in people's spatial conceptions of time.

For example, Islam is the constitutionally established state religion in Morocco and 99% of Moroccans are Muslims[2]. According to the doctrine of Islam, God's time stretches out to eternity while "the time of humans shrinks to a mere instant, a dot without duration" (Böwering, 1997: 61). That is, Islamists may tend to attach more value to an event in the past or present because the future belongs to Allāh. Thus, the fact that Moroccans focus more of their attention on past events may not arise from their cultural attitudes toward tradition but religious concepts of time. This also points to the necessity of thinking carefully before labeling Spaniards as being future-focused according to their cultural attitudes toward time. According to a survey by the Spanish Centre for Sociological Research in 2016, about 68% of Spaniards self-identify as Catholic Christians[3]. Despite different orthodox Christian beliefs (i.e., Catholics,

[2] https://www.cia.gov/library/publications/the-world-factbook/geos/mo.html.
[3] *Centro de Investigaciones Sociológicas* (Centre for Sociological Research) (July 2016). "Barómetro de juio de

Protestants, Baptists and other Christians) the core tenet of Christian belief is that there is an afterlife. Most believe in the idea of judgment after death, and that God will treat people in the afterlife according to the way they lived their life on earth (Segal, 2010). Thus, Spanish participants' strong tendency to be future-focused may also come from their religious beliefs rather than their preferences for social and economic development as de la Fuente et al. (2014) proposed.

To eliminate these possible confounding variables, it would be preferred to find populations within a single culture who largely share the same language, religious beliefs, traditions and much of their history, while differing to the extent possible only in their cultural attitudes toward time. To address this issue, Study 1 makes a novel contribution by looking at two closely matched populations – Southern and Northern Vietnamese – who, despite having many aspects in common, show different cultural differences in temporal focus. If all confounding variables are controlled for and cultural attitudes toward time can still affect people's implicit space-time mappings, it would provide more convincing evidence for correlations between cultural attitudes and spatial conceptions of time.

It has been long observed that there are highly discernable cultural differences between Southern and Northern Vietnam due to numerous wars and occupations that have ravaged this country. Being more Communist-influenced, Northern Vietnamese people are more conservative and less willing to change (Ralston et al., 1999). They tend to focus more on past times and to place more value on traditional culture. Southern Vietnamese people, by contrast, are more westernized and consider themselves to be more dynamic. They hold more liberal attitudes towards money and tend to focus more on future times (Engholm, 1995).

These preferences for temporal focus are also evident in the different functions and

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2016" (in Spanish). p. 26. Retrieved 10 April 2017.

roles of Northern and Southern Vietnam. Ho Chi Minh City, located in the south, is the most important economic center of Vietnam and accounts for a large proportion of the economy of Vietnam, which has led people in this region to focus more on social development (Gainsborough, 2003). By contrast, Hanoi, located in the north, is the political capital of Vietnam, which has many venerable cultural and historic monuments for visitors (Logan, 2005). For example, the Vietnamese idiom "*Sĩ phu Bắc Hà*" (lit. *knowledgeable person in the North*) indicates that Northern Vietnam is perceived as a cultural center attracting scholars throughout the country.

According to the TFH, if people's cultural attitudes toward time are responsible for their implicit spatial conceptions, it should be possible to observe a similar difference in spatial mappings of time within a single culture, in a comparison between groups who differ in their temporal focus. With their different cultural attitudes toward time, it can be predicted that Southern Vietnamese, who tend to focus more on future times, valuing economic and technological developments, will be more likely to think about time according to the future-in-front mapping. By contrast, as for Northern Vietnamese, who have greater focus on past times and place more value on tradition, it is predicted that they will be more likely to think about time according to the past-in-front mapping.

Alternatively, Consistent with linguistic relativity, if language exerts an important influence on shaping people's temporal thought, Southern and Northern Vietnamese should exhibit the same space-time mapping. For instance, in a seminal study by Boroditsky (2001), she found that Mandarin speakers were more likely to think about time vertically than horizontally due to more vertical metaphors for time in the language; thus, this provides supporting evidence for the role of language in influencing how people tend to think about time. To illustrate linguistic mappings between front-back space and time in Vietnamese, I conducted an analysis of 4000 randomly sampled instances of the word "*trước* (front)" and "*sau* (back)" used

temporally from the Vietnam Lexicography Center Corpus[4] (Trung tâm từ điển học Việt Nam). Following Núñez and Cooperrider's (2013) distinction of deictic time reflecting past/future relationships and sequence time[5] reflecting earlier/later relationships, the results showed that 1925 instances of "*trước*" were used to talk about the past (n = 1284, 64.2%) or earlier times (n = 641, 32%) and 1989 instances of "*sau*" were used to talk about the future (n = 1207, 60.3%) or later times (n = 782, 39.1%). However, only 75 (3.75%) instances of "*trước*" were used to communicate future times and 11 (5.5%) instances of "*sau*" for past times. Not a single example of "*trước*" is aligned with later events and "*sau*" is never found to align with earlier events. Thus, for deictic time, past times lie ahead of the speaker with future times lying behind the speaker in Vietnamese linguistic metaphors, while for sequence time, earlier times lie ahead of later times. If people's conceptions of time are determined by their spoken metaphors, as linguistic relativity suggests, then both Southern and Northern Vietnamese should think about time according to the past-in-front mapping.

Study 1: Implicit space-time mappings in southern and northern Vietnamese people

If culture plays a role in establishing implicit associations between sagittal space and time, Southern and Northern Vietnamese should exhibit different implicit space-time mappings. Alternatively, if these associations depend on spoken metaphors, alone, then implicit space–time mappings should be similar across the two cultures, despite differences in their attentional focus on temporal events. To distinguish these possibilities, Study 1 compared the mapping between space and time in Southern and Northern Vietnamese.

[4] http://www.vietlex.com

[5] Vietnamese speaker often employ sagittal (front-back) language to talk about deictic time (e.g., Hôm (day) trước (front) tôi (I) đi (go) xem (watch) phim (movie), English translation: I went to watch a movie yesterday) and sequence time (e.g., Trước (front) khi (时) ăn (eat) cơm (food) phải (should) rửa (wash) tay (hands), English translation: Wash hands before eating food).

3.2 Method

3.2.1 Participants

A total of 182 adults from Southern and Northern Vietnam participated in the experiment for a small reward. 90 Southern Vietnamese, with an age range of 18 to 40 and a mean age of 25.9 years, were tested in Ho Chi Minh City, which was known as the capital of the independent republic of South Vietnam (1955–1975). 92 Northern Vietnamese, with an age range of 18 to 41 and a mean age of 23.8 years, were tested in Hanoi, which was known as the capital of North Vietnam (1954–1976). All participants were matched for sex, ethnicity, and religious affiliation which were confirmed by their self-report. For instance, all of them were self-identified as Kinh ethnic group and atheists. All participants had no experience of going to other parts of Vietnam for more than a month. All of them were native speakers of Vietnamese.

3.2.2 Materials and procedure

Participants' implicit space-time mappings were measured using the Time Diagram Task (see Appendix 1), adapted from de la Fuente et al. (2014, Experiment 1). All participants were presented a cartoon character's head (named *An*[6] in the Vietnamese version), seen from above, with one empty box in front of him and another box behind him (Figure 4). Participants were told that the character went to visit a friend, who liked plants, last week and is going to visit another friend, who likes animals, next week (or vice versa, as the plant/animal and past and future events assignment were counterbalanced). Participants were asked to place the plant in the box indicating past events and the animal in the box indicating future events (or vice versa according to the different versions of the task material).

[6] It is one of the most popular given names for male in Vietnam.

After the time diagram task, participants completed the Temporal Focus Questionnaire (TFQ, see Appendix 2), adapted from de la Fuente et al. (2014, Experiment 4). TFQ consisted of 20 items regarding participants' opinions about past- and future-related topics. For example, the past-focus assertion (10 items) stated "*Traditions and old customs are very important for me*" and the future-focus assertion (10 items) stated "*It is important to innovate and adapt to the new changes*". Participants were required to indicate their degree of agreement with each statement on a 5 point Likert-type scale (from 1 = not at all to 5 = extremely). The questionnaire was presented in Vietnamese. Back-translation was adopted to ensure the semantic and cultural equivalence between the Vietnamese and the original version. It was first translated into Vietnamese by an experienced researcher with a first degree in translation studies and then checked by another translator, who were fluent in both English and Vietnamese.

Figure 4 The time diagram presented to the participants.

3.3 Results

In line with predictions based on cultural differences between the groups, the results showed that the majority of Southern Vietnamese people (72.2%) responded according to the future-in-front mapping, placing the future event in the box in front of the

character and the past event in the box behind him. However, about of the half of Northern Vietnamese people (48.9%) responded according to the future-in-front mapping. To determine whether the difference in responses between Southern Vietnamese and Northern Vietnamese people was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 182} = 10.34$, $p = .001$, Cramer's V = 0.238 (Table 1).

Group	Past-in-front-mapping	Future-in-front mapping
Southern Vietnamese people	25 (27.8%)	65 (72.2%)
Northern Vietnamese people	47 (51.1%)	45 (48.9%)

Table 1. Results of Study 1. Counts and percentage of past-in-front and future-in-front responses in Southern Vietnamese and Northern Vietnamese people.

According to an ANOVA with group (Southerner vs. Northerner) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between Southern Vietnamese and Northern Vietnamese people, as indicated by a significant interaction of temporal focus and group, $F(1, 180) = 82.36$, $p < .001$, $\eta_p^2 = .31$ (Figure 5). Post hoc comparisons revealed that Southern Vietnamese showed greater agreement with future-focused statements than Northern Vietnamese ($p < .001$). Northern Vietnamese showed greater agreement with past-focused statements than Southern Vietnamese ($p < .001$).

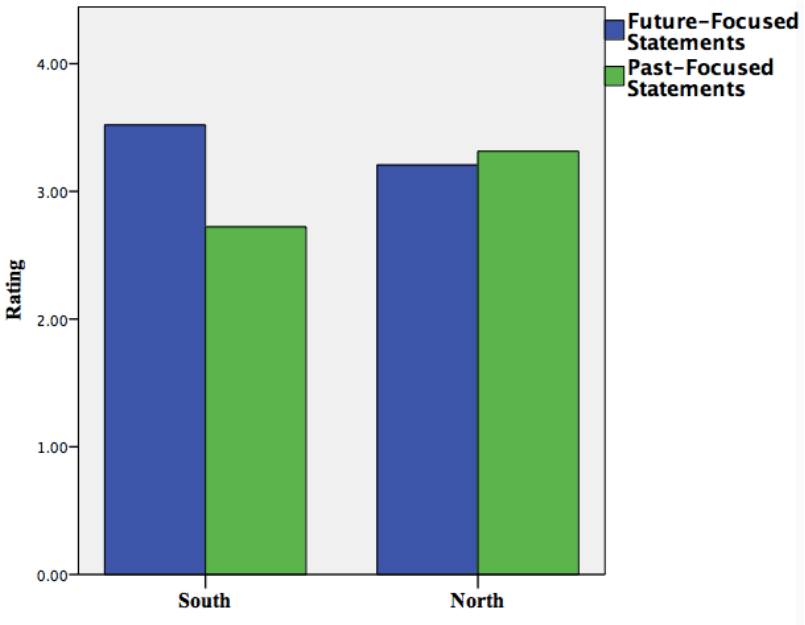

Figure 5. Average agreement with the past- and future-focused statements on the Temporal Focus Questionnaire, separately for Southerners and Northerners of Vietnamese.

3.4 Chapter discussion

Study 1 was conducted to examine whether within-culture variation of attentional focus on time influences people's implicit spatial conceptions of time. Southern and Northern Vietnamese, who share the same language (except for some differences in their phonological systems, see Brunelle, 2009), many cultural values and practices, and much of their social history, but significantly differ in their cultural attitudes toward time, provide a perfect testbed for the TFH. It is hypothesized that if people really think about time according to their temporal focus as the TFH suggests, then Northerners and Southerners in Vietnam should have different space-time mappings in their minds. As predicted, the results demonstrated that Southern Vietnamese were more likely to think about time according to the future-in-front mapping than Northern Vietnamese because the former attributed more importance to technological innovation, social and economic growth. Thus, this pattern of results extends de la Fuente et al.'s (2014) findings to the Vietnamese population.

A key methodological innovation in Study 1 was the use of two closely matched populations which excluded many relevant confounding variables. In previous cross-cultural studies which investigated spatial representations of time, the unit of analysis has typically been country (e.g., Morocco vs. Spain). That is, cultures have been assumed to reside exclusively within, or perfectly overlap with countries. This may lead to a lack of attention to within-country cultural variation (Taras et al., 2016). On the one hand, populations in different countries not only differ in their cultural attitudes toward time, but may differ along many other cultural dimensions such as religious experiences, which may also affect their mental operations. On the other hand, culture is a multi-faceted construct. Such a simplification makes it difficult to understand the full richness of cultural experience. To date, the only research investigating within-culture variation in space-time mappings is de la Fuente et al.'s (2014: Experiment 3) comparison of elderly and young Spaniards. However, the differences of space-time mappings in the two within-culture groups investigated may not be traced to their cultural attitudes toward time; they may rather be attributed to their temporal perspective in individual contexts such as different attitudes toward personal development. To the best of my knowledge, Study 1 is the first to explore the influence of within-culture variation of attitudes toward time on people's implicit space-time mappings, which provided more convincing evidence for the TFH.

If there are no known differences between Southern and Northern Vietnamese which may cause their different preferences for spatial representations of time, can the difference between their conceptions be traced to other factors such as spoken metaphors as previous research (e.g., Boroditsky, 2001; Lai and Boroditsky, 2013) suggests? According to the precepts of linguistic relativity, the particular language we speak affects the way we think about the world (Whorf, 1956). However, linguistic metaphors cannot predict Vietnamese speakers' conceptualizations of time. According to the results of the time diagram task, Southern Vietnamese speakers tended to conceptualize the future as ahead of them and Northern Vietnamese showed no bias

against the past- / future- in-front mapping. These data challenge linguistic relativity, which implies a striking dissociation between their temporal language and temporal thought.

In another study that deserves note, Sullivan and Bui (2016), examining naturally occurring temporal gestures in television talk shows, found that Vietnamese speakers produced forward gestures to indicate the "past", suggesting that Vietnamese tended to think about time according to the past-in-front mapping as their language suggests. These findings are seemingly at odds with the current results. A closer look at Sullivan and Bui's (2016) data suggests that they only investigated a limited number of temporal gestures (N = 42), which may affect the reliability of their results. To further put these numbers in perspective, they only found that 14 of the 18 past-reference gestures involved frontwards motion, but none of them involved backwards motion in reference to the future, providing no evidence for the psychological reality of the future-in-back mapping. In addition, because they mainly analyzed online videos, there is no way to know the demographic information (e.g., age, residential area: South vs. North) of the subjects, which may cause difficulty in interpreting the motivations for these gesture patterns. For this reason, a large quantity of data with controlled experiments, in which Southern and Northern Vietnamese are matched in terms of important characteristic (e.g., gender) that might affect performance, will be needed to reveal their implicit space-time mappings.

To conclude, these results showed that beyond explaining cross-cultural differences, cultural attitudes toward time can predict variation in space-time mappings within a single culture. Although additional studies are needed to investigate whether other factors may also affect spatial conceptions of time, the findings of Study 1 indicate that temporal focus can predict the implicit space-time mappings of Southern and Northern Vietnamese, increasing the scope of this research by examining within-cultural differences in cultural attitudes toward time. While a connection between temporal focus and space-time mappings has been attested in previous

research, some questions then arise regarding the definition of a past-focused or future-focused culture (Athanasopoulos et al., 2017). For instance, a culture can be both past-focused socially and future-focused technologically and economically like contemporary China. To address this issue, Chapter 4 aims to explore if and how other aspects of cultural experiences influence people's mental representations of time, focusing specifically on the role of political ideologies.

Chapter 4. Political differences

4.1 Introduction

As defined by the Cambridge English Dictionary, culture is "the way of life, especially the general customs and beliefs, of a particular group of people at a particular time". Culture is also a term with many layers, consisting of types of cuisines, clothing, language, customs, values, beliefs, etc. of the people within a particular geographical region (Eliot, 2010). For instance, politics and culture are intricately related. According to Almond and Verba (2015), a civic culture is a political culture characterized by acceptance of the authority of the state and a belief in participation in civic duties. Meanwhile, culture is an important factor in understanding and shaping political systems. There are various direct and indirect indications that political ideologies like cultural attitudes may also influence people's temporal focus regarding personal past, present and future. Conservatism and liberalism, for instance, are two of the most cited examples of the distinct temporal orientations within a political system. Research has shown that whereas conservatives tend to endorse tradition and conformity to a greater extent and prefer the certainty of the past to the uncertainty of the future, liberals tend to endorse "openness to change" values and focus on what is certain rather than uncertain (Caprara and Zimbardo, 2004; Jost et al., 2003). Thus, conservative individuals would be more past-focused because conservation values cherish a nostalgic longing for the way society was. For instance, according to public opinion surveys in the United States, conservatives consistently show stronger belief that the state of the society is on the decline (Gallup, 2015; Pew Research Center, 2016). By contrast, liberal individuals would be more future-focused because openness values are conceptualized in terms of replacing present society with a newer system. For instance, liberals are more concerned about climate change and global warming and more willing to take action against them than conservatives (Baldwin and Lammers, 2016).

Following up on these observations, Robinson et al. (2015: Study 1) hypothesized that whereas posts to conservative news websites should refer to the past to a greater extent than the future, posts to liberal news websites should refer to the future to a greater extent than the past. As predicted, conservative posts were more likely to use past tense verb forms than future tense verb forms, while the opposite pattern was true of posts to liberal news websites. In another study, a conceptually parallel interaction was also found in the addressees of Republicans vs. Democratic U.S. presidents (Robinson et al., 2015: Study 2); the former refer to the past to a greater extent than the latter in their State of Union addresses. Thus, this pattern of results provided converging evidence for the distinct differences in temporal focus between conservatives and liberals.

In view of these differences, and in view of the basic theoretical assumption of the TFH, which posits that people's implicit space-time mappings depend on their temporal focus, I hypothesize that these differences may influence people's spatial conceptions of time; more specifically, I maintain that conservative individuals, who focus more on the past and on preserving traditions, may conceptualize time quite differently to those who have greater focus on the future and prefer progressive change, such as liberal individuals. To test this proposal, Study 2 asks whether a person's political ideologies contribute to their temporal focus, and hence, to their implicit space-time mappings. Noting that China's political structure is different from the two-party system pervading American politics, it might be argued that Robin et al's (2014) findings cannot be transferred to a completely different culture and completely different political system. However, it has been found that Chinese university students' self tabulated political orientation also functions as an internalized label that puts one's own ideology into play (Kelly, 2006). As such, with their distinct temporal orientations, it can be hypothesized that Chinese conservative individuals would be more past-focused because of their desire to defend the status quo against progressive change, showing a preference to produce a past-in-front mapping. By contrast, liberals, whose thinking is marked by a motivation to focus on

ongoing changes, would be more likely to produce a future-in-front mapping.

Study 2: Conservatives vs. Liberals

4.2 Methods

4.2.1 Participants

The target population of the present study is university students. This is because students have played an important role in shaping the politics of China throughout history (Lin et al., 2015). A total of 350 Chinese undergraduate students (181 females) participated in this study (average age 21.7 years, range 18-24). They received a small reward for their participation. All participants were native speakers of Chinese.

4.2.2 Materials and procedure

After providing consent, participants first answered demographic questions requesting their age, gender, native language, and nationality. Three measures of political ideology (i.e., in general, on economic issues and social issues) were embedded in this questionnaire. Participants separately indicated their general, economic and social ideologies on a 7 point Likert scale (1 = very liberal, 4 = moderate, 7 = very conservative), modeled after Gromet, Hartson and Sherman (2015). Then, responses on the three items were averaged to provide an overall measure of political ideology.

Next, participants were instructed to complete a Chinese version of the time diagram task (see Appendix 3), adapted from de la Fuente et al. (2014: Experiment 1), which was used to measure the directions of space-time mappings. In the Time Diagram Task, participants saw a cartoon character's head in the center of the screen between two empty boxes, one in front of the participant and the other at his back (see Figure 1). They were told that the character, named Li Hua in the Chinese version, has visited a friend who likes animals yesterday and will visit another friend who likes

plants tomorrow (or vice versa, as animals and plants are counterbalanced between yesterday and tomorrow). Participants were asked to indicate in which box Li Hua would put the animal and in which box he would put the plant. The order in which participants were asked to locate the animal and plant was counterbalanced, to ensure that any associations between space and time were not confounded with numerical or temporal order.

After finishing the temporal diagram task, participants were asked to respond to the Temporal Focus Scale (TFS, see Appendix 4), which contained 8 items that described thinking about the past (4 items) and future (4 items) time periods, modeled after Shiip, Edwards and Lambert (2009). For example, the past-focus statement stated, "*I think back to my earlier days*" and the future-focus statement stated, "*I think what tomorrow will bring for me*". Participants were required to indicate the frequency with which the respondent thought about the time frame indicated by the item on a 7-point Likert scale (1 = never; 3 = sometimes; 5 = frequently; 7 = constantly). The scale was presented in Chinese. Back-translation ensured the equivalence between the Chinese and the original version.

4.3 Results and discussion

To examine the role that this ideological divide plays in influencing people's spatial conceptions of time, the participants who identified themselves as "conservative" (a score of 5 or higher on the ideology measure, n = 96) were compared to those who identified themselves as "liberal" (a score of 3 or lower, n = 132), as well as those who identified themselves as "moderate" in the questionnaire (a score of 3.01-4.99, n = 122).

In line with predictions based on political differences between the conservatives and liberals, the results showed that the majority of conservatives (68.8%) responded

according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind him. By contrast, the majority of liberals (80.3%) responded according to the future-in-front mapping, placing the future event in the box in front of the character and the past event in the box behind him. The neutrals' judgments were intermediate between the conservatives and the liberals. Concretely, about half of the neutrals (48.4%) responded according to the past-in-front mapping. To determine whether the difference in responses between the conservatives and liberals was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 218} = 55.56$, $p < .001$, Cramer's V = 0.494 (Table 2).

Group	Past-in-front-mapping	Future-in-front mapping
Conservatives	66 (68.8%)	30 (31.2%)
Neutrals	26 (19.7%)	106 (80.3%)
Liberals	59 (48.4%)	63 (51.6%)

Table 2. Results of Study 2. Counts and percentage of past-in-front and future-in-front responses in Chinese Conservatives, Neutrals and Liberals.

According to an ANOVA with group (conservatives, liberals, neutrals) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly among the conservatives, neutrals and liberals, as indicated by a significant interaction of temporal focus and group, $F(2, 347) = 28.93$, $p < .001$, $\eta_p^2 = .14$ (Figure 6). According to post-hoc comparisons, the conservatives agreed more with past-focus than future-focus statements ($p < .001$), whereas the liberals agreed more with future-focus than past-focus statements ($p < .001$). The neutrals were intermediate, showing equally high agreement with future focus and past focus items ($p = .383$).

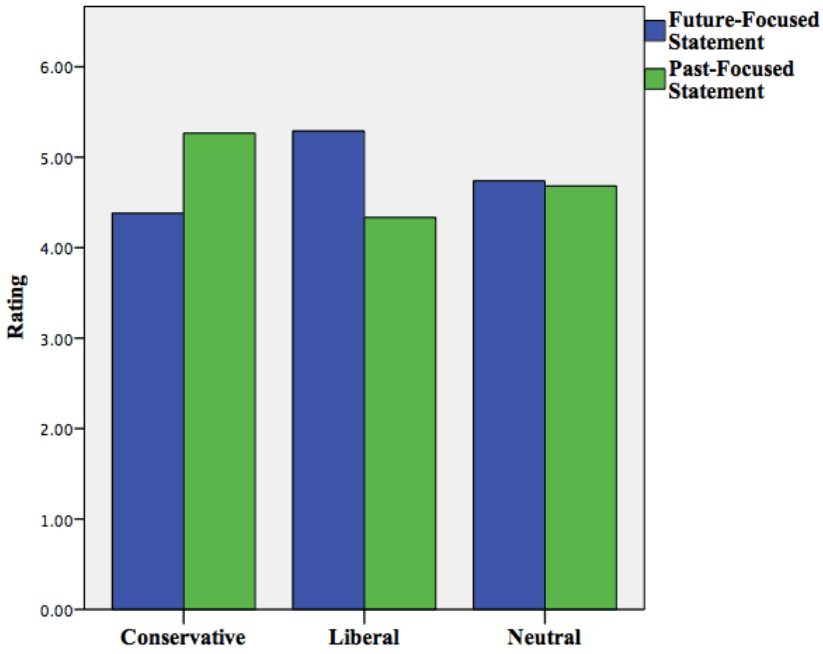

Figure 6 Average agreement on a scale of 1 to 7 with the past- and future-related statements in the conservatives, liberals and neutrals.

Thus, Study 2 provides the empirical evidence that political ideology may play a role in influencing people's attitudes toward time and their responses to a temporal diagram task. Consistent with the TFH, the results showed that, conservatives, who demonstrated more agreement with future-focused statements, were more likely to place the future event in the box behind the character and the past event in the box ahead of them. In contrast, compared with conservatives, liberals, who showed more agreement with future-focused statements, were more likely to place the future event in the box behind the character and the past event in the box ahead of them.

4.4 Chapter discussion

Study 2 advances the literature by examining the relationship between political ideologies and spatial representations of time in Chinese population. The findings fit nicely with the TFH, revealing the link between temporal focus and implicit space-time mappings. The results showed that compared with liberals, conservatives tended to be past-focused, conceptualizing the past as in front of them. By contrast,

compared with conservatives, liberals tended to be future-focused, conceptualizing the future as in front of them. These findings provide the first empirical evidence showing that metaphorical associations between space and time divide along ideological lines.

Study 2 also provides further evidence for the political aspect of temporal focus. Recent linguistic research has shown that conservatives tend to refer to the past and liberals tend to refer to the future in their news posts and presidential addresses (Robinson et al., 2015). The current study is a replication of Robinson et al.'s (2015) research and also provides psychological evidence for the differences between conservatism and liberalism in their temporal orientations such that the former orients towards the past whereas the latter orients toward the future.

The findings of Study 2 also suggest a relationship between political ideology and people's spatializations of time. Most obviously, the difference between conservatives and liberals' conceptions of time in Chinese people cannot be traced to their languages, since participants with different political ideologies use similar metaphors in their speech, suggesting a possible dissociation between temporal language and temporal thought (for more discussions see Casasanto and Jasmin, 2012; Casasanto, 2016). For instance, previous linguistic research has shown that time metaphors in Chinese are predominantly in line with a time-moving perspective system in which the past is in front of the speaker and the future is behind (Alverson, 1994; Ahrens and Huang, 2002; Ng et al., 2017). However, the varying pattern found in Chinese conservatives and liberals tells us that language is not the sole factor influencing people's representations of time. Since individuals within a single culture share the same bodily experiences, there must be other factors including differences in political ideology that may lead to the differences in spatializations of time.

Previous research has also shown that cultural attitudes toward time play an important role in shaping space-time mappings in people's minds. Meanwhile, the pattern of

implicit space-time mappings may also vary across laboratory and daily-life settings when the temporal focus is manipulated as a "cultural-external factor". For instance, older Spaniards tended to be more past-focused than younger Spaniards and also showed a greater tendency to conceptualize the past as in front of them although their culture might encourage them to be future-focused (de la Fuente et al. 2014: Experiment 3). The findings of Study 2 that both conservatives and liberals within a single culture showed different mental mappings of time, indicated that political ideology can, at least in Chinese university students, influence people's spatial conceptions of time. Thus, rather than being attributed to a single factor, a person's implicit space-time mappings likely result from a complex of factors such as age- and political-related differences in our attentional focus on temporal events.

In Study 2, a specific dimension of culture, namely political ideology, has been investigated. These preliminary results thus extend the range of cultural differences that may influence people's conceptions of time. However, political ideology does not represent all facets of culture. Thus, the findings of Study 1 and 2 raise further questions regarding the multidimensional nature of culture. In Chapter 5 (Study 3-6), I focus specifically on religious experiences as potential contributors to people's spatializations of time.

Chapter 5. Religious differences: Buddhists vs. Taoists

5.1 Introduction

In many societies, religion plays an important role in shaping their cultures. One of the most paradigmatic examples of this is illustrated by the ways in which many American regulations and laws are based on concepts and principles articulated in the Bible (Welch, 2002). For instance, in his inaugural address, Barack Obama described the United States as a nation "of Christians and Muslims, Jews and Hindus, and the nonbelievers"[7]. Similarly, China has been a multi-religion country since the ancient times. This chapter (Studies 3-6) investigated the role of religious experience in shaping people's spatial conceptions of time, focusing specifically on Buddhism and Taoism, who differ in their attitudes toward time according to their religious doctrines.

As two of the most influential religions in Mainland China, Buddhism and Taoism show different preferences on time. The theory of Karma, the law of moral causation, is a fundamental doctrine in Buddhism (Prebish and Keown, 2010). Buddhists tend to believe that the intent and actions of an individual (cause) influence the future of that individual (effect) and thus the past is more important for them. By contrast, immortality and transcendence are the critical components of Taoism (Girardot, 1988). Taoists tend to spend a lot of time understanding the flow of time and constantly devote themselves to pursuing immortality from present to future. Thus, the eternal life in the future appears to be more significant for Taoists than past experiences. As such, Buddhists, influenced by Karma, should tend to focus more on past times and place more value on past practices. Taoists, by contrast, appear to have greater focus on the future, placing their hope on a future life.

Since Buddhism and Taoism may have different views of time, it raises the possibility

[7] https://www.nytimes.com/2009/01/20/us/politics/20text-obama.html

that additional religion-related differences may play important roles in shaping their believers' temporal focus, thereby influencing space-time mappings in people's mental models. To explore this, four experiments were conducted investigating whether previously unexplored religious differences influence a person's temporal focus and their concomitant conceptualizations of time. This chapter first sought to investigate the difference between Buddhists' and Taoists' conceptions of time (Studies 3 and 4). Then, I tested whether religion can play a causal role in determining temporal focus, thereby influencing the direction of space-time mappings in religious and non-religious participants' minds (Studies 5 and 6).

Study 3: Buddhists and Taoists' implicit space-time mappings and temporal focus

With their emphasis on the spiritual principle of cause and effect in life, it can be hypothesized that Buddhists will be more likely to focus their attention on the past, showing a preference for the past-in-front mapping. In contrast, Taoists, who devote themselves to pursuing eternal life, will be more likely to focus their attention on the future, showing a preference for the future-in-front mapping.

5.2 Method

5.2.1 Participants

Overall, 127 adults participated in Study 3. Due to religious reasons, all participants were males. 41 Buddhists were recruited in 4 different temples in the southwestern and southeastern provinces of China, with an age range of 31 to 42 and a mean age of 36.5 years. They had converted to Buddhism and lived in the Buddhist temple for at least 7 years from the day they shaved their heads, which symbolizes one's departure from the earthly world and the official conversion to Buddhism (average conversion 10.2 years).

Their daily life in the temple included reading the Buddhist Scriptures, learning Buddhist ideas and meditating. 43 Taoists were recruited in 4 different Taoist temples in the southwestern provinces of China, with an age range of 32 to 43 and a mean age of 38.6 years. They had converted to Taoism and lived in the Taoist temple for at least 7 years (average conversion 9.8 years), which symbolizes the official start of converting to Taoism from the day they officially served an apprenticeship with a master. Their daily life included reading Taoist books, learning Taoist ideas and doing Taoist rituals. 43 adult atheists were recruited from southwestern and southeastern provinces of China as a control group, with an age range of 30 to 40 and a mean age of 35.3 years. Each participant of the nonbelievers group was paid 20 Chinese Yuan for time compensation. Due to religious reasons, 20 Chinese Yuan was donated on behalf of each Buddhist and Taoist to the temples. All participants were native speakers of Mandarin Chinese.

5.2.2 Materials and procedure

The participants' implicit space-time mappings and temporal focus were tested by the temporal diagram task and Temporal Focus Scale as used in Study 2.

5.3 Results and discussion

In line with predictions based on religious differences between the Buddhists and Taoists, the results showed that the majority of Buddhists (73.2%) responded according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind him. By contrast, the majority of Taoists (86%) responded according to the future-in-front mapping, placing the future event in the box in front of the character and the past event in the box behind him. The Atheists' judgments were intermediate between the Buddhists and the Taoists. 39.5% of the Atheists responded according to the past-in-front mapping. To determine whether the difference in responses between the Buddhists and Taoists was significant, a chi-square

test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 84} = 30.05$, $p < .001$, Cramer's V = 0.59 (Table 3).

Group	Past-in-front-mapping	Future-in-front mapping
Buddhists	30 (73.2%)	11 (26.8%)
Taoists	6 (14%)	37 (86%)
Atheists	17 (39.5%)	26 (60.5%)

Table 3. Results of Study 3. Counts and percentage of past-in-front and future-in-front responses in Chinese Buddhists, Taoists and Atheists.

According to an ANOVA with group (Buddhists, Taoists, Atheists) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly among the Buddhists, Taoists, Atheists, as indicated by a significant interaction of temporal focus and group, $F(2, 124) = 55.81$, $p < .001$, $\eta_p^2 = .47$ (Figure 7). Post hoc comparisons revealed that Buddhists agreed more with past-focused than future-focused statements ($p < .001$), whereas Taoists agreed more with future-focused than past-focused statements ($p < .001$). Atheists were intermediate as they showed equally high agreement with future-focused and past-focused items ($p = .70$).

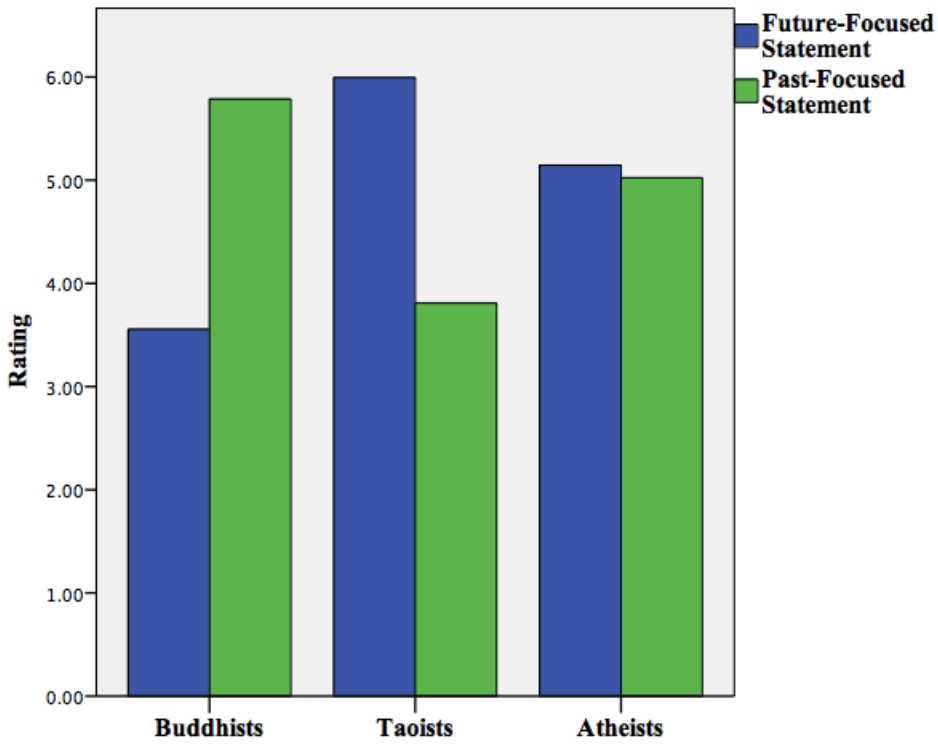

Figure 7 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for Atheists, Buddhists and Taoists.

These results indicate an influence of religion on people's attitudes toward time and their responses to a temporal diagram task; Buddhists, profoundly influenced by Karma, tended to attach more value to past-experience, and thus, were more likely to adopt the past-in-front mapping. In contrast, Taoists, pursuing an eternal life and believed to have a more predominant future focus, were more likely to adopt the future-in-front mapping. Study 3 thus provides initial evidence that religious differences may influence people's attitudes toward time and the resulting implicit space-time mappings.

Study 4: Expanding the sample

Study 3 provided preliminary evidence that Buddhists and Taoists showed differences in their conceptions of time. This suggests that religion may affect the space-time mappings in people's metal models. However, it might be argued that the time diagram task is not sensitive enough to capture what might be small differences between

religious groups. To conduct a second and more powerful test of cross-religious differences, the sample size was expanded in Study 4, several months apart from Study 3.

5.4 Method

5.4.1 Participants

A new sample of 315 male adults participated in Study 4. The screening rules of (non-) religious participants were the same as Study 2. 98 Buddhists were recruited in 6 different temples in the northwestern and southwestern provinces of China, with an age range of 30 to 43 and a mean age of 37.4 years. 102 Taoists were recruited in 5 different Taoist temples in the southwestern and central provinces of China, with an age range of 31 to 42 and a mean age of 37.7 years. 115 adult atheists were recruited from southwestern and central provinces of China as control group, with an age range of 30 to 41 and a mean age of 36.8 years. All of them were native speakers of Chinese.

5.4.2 Materials and procedure

Materials and procedure were the same as in Study 3.

5.5 Results and discussion

In line with predictions based on religious differences between the Buddhists and Taoists, the results showed that the majority of Buddhists (65.3%) responded according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind him. By contrast, the majority of Taoists (79.4%) responded according to the future-in-front mapping, placing the future event in the box in front of the character and the past event in the box behind him. The neutrals' judgments were intermediate between the conservatives and the liberals. About half of the Atheists (42.6%) responded according to the past-in-front mapping. To determine

whether the difference in responses between the Buddhists and Taoists was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 127} = 40.90$, $p < .001$, Cramer's V = 0.452 (Table 4).

Group	Past-in-front-mapping	Future-in-front mapping
Buddhists	64 (65.3%)	34 (34.7%)
Taoists	21 (20.6%)	81 (79.4%)
Atheists	49 (42.6%)	66 (57.4%)

Table 4. Results of Study 4. Counts and percentage of past-in-front and future-in-front responses in Chinese Buddhists, Taoists and Atheists.

According to an ANOVA with group (Buddhists, Taoists, Atheists) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly among the Buddhists, Taoists, Atheists, as indicated by a significant interaction of temporal focus and group, F (2, 310) = 80.51, $p < .001$, $\eta_p^2 = .34$ (Figure 8). Post hoc comparisons revealed that Buddhists agreed more with past-focused than future-focused statements ($p < .001$), whereas Taoists agreed more with future-focused than past-focused statements ($p < .001$). Atheists were intermediate as they showed equally high agreement with future-focused and past-focused items ($p = .73$). Thus, the pattern of results replicated the findings of Study 3, indicating an influence of religion on people's attitudes toward time and their responses to a temporal diagram task.

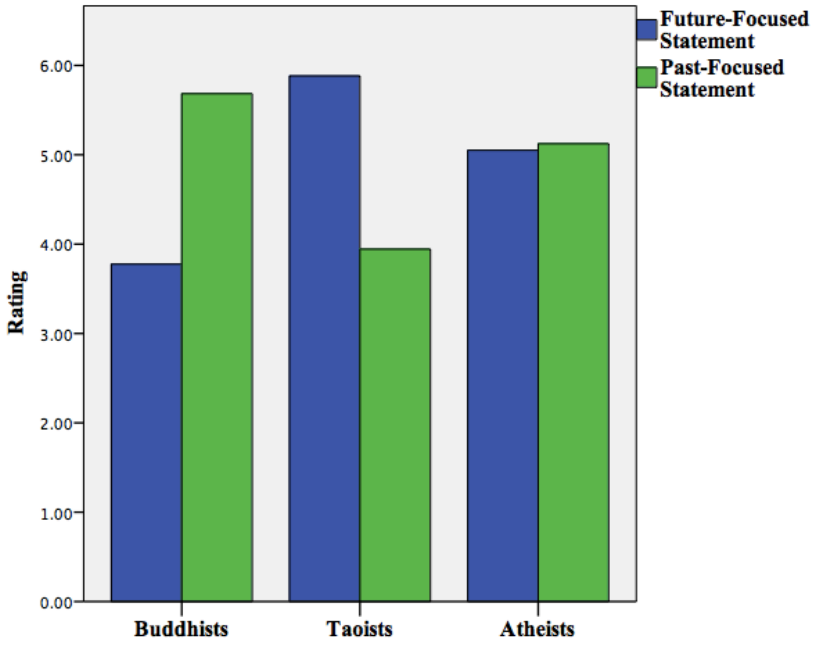

Figure 8 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for Atheists, Buddhists and Taoists.

Study 5: A causal role of religion in shaping space-time mappings in Buddhists

Although Study 3 and 4 showed some religious specificity of time conceptualization between Buddhists and Taoists, it is possible that past-focused people would be more likely to convert to Buddhism and future-focused people would be more likely to convert to Taoism. In short, there is no way to determine the causal role of religion in influencing believers' temporal focus. To address this, Study 5 used a priming task to test whether a short period of specific religious exposure could change people's attentional focus and thereby influence their space-time mappings.

Buddhists believe that there has been a succession of many Buddhas in the distant past and that many will appear in the future. That is, each Buddha is responsible for a life cycle. Chinese Buddhism tends to honor Dipamkara as Buddha of the Past and Maitreya as Buddha of the Future (Strong, 2004). If religion was responsible for believers' temporal focus, then in the present experiment Buddhists primed with the pictorial icon of Buddha Maitreya should be more likely to produce a future-in-front

mapping on the diagram task than participants primed with the pictorial icon of Buddha Dipamkara.

5.6 Method

5.6.1 Participant

A new group of 180 Buddhists from 9 different temples in the northwestern, southwestern and central provinces of China participated in this experiment, with an age range of 30 to 43 and a mean age of 37.3 years. Due to religious reasons, all participants were male. Their daily life in the temple includes reading the Buddhist Scriptures, learning Buddhist ideas and meditating. Twenty Chinese Yuan was donated on behalf of each monk to the temples where they lived, because they could not receive money in return to their participation due to religious reasons. All participants were native speakers of Chinese.

5.6.2 Materials and procedure

Participants were randomly assigned to one of two conditions (past-focused vs. future focused). Every participant was given a 4-page test booklet, with each test on a separate sheet of paper. Participants were not allowed to go back to previous parts of the test. There was no time limit for each section.

Participants were seated at a table with a picture of Buddha Dipamkara or Maitreya sitting on a lotus flower printed on the first page of the booklet. The picture was half colored, with the Buddha in golden color according to the conventions and the lotus flower uncolored. Participants were instructed to color the lotus that the Buddhas are sitting on so as to round out the picture. Following this, participants finished the temporal diagram task and Temporal Focus Scale as in Study 3 and 4 on the second and

third page of the booklet. Finally, all participants were asked to write down the names of Buddhas which were printed on the cover on the last page for the purpose of manipulation check. Participants were informed that if they felt the experiment was against their religious beliefs, they could quit the experiment at any moment. Debriefing responses indicated that none of the participants reported any suspicion regarding the link between the religious prime and the time diagram task.

5.7 Results and discussion

All participants completed the experiment. The results confirmed that all participants wrote the names of the Buddhas correctly and thus our manipulation was indeed successful. The results showed that, 91.1% of the participants assigned to color the picture of Dipamkara placed the past in the front box. However, 55.6% of the participants assigned to color the picture of Maitreya placed the future in the front box. To determine whether the difference in responses between the two groups was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 180} = 44.87$, $p < .001$, Cramer's V = 0.499 (Table 5).

Group	Past-in-front-mapping	Future-in-front mapping
Buddha Dipamkara	82 (91.1%)	8 (8.9%)
Buddha Maitreya	40 (44.4%)	50 (55.6%)

Table 5. Results of Study 5. Counts and percentage of past-in-front and future-in-front responses in Buddhists primed with the pictures of Dipamkara and Maitreya.

The proportion of future-in-front responses in the future-focus primed Buddhists was not as high as in the Taoists tested in Experiments 1 and 2 (55.6% vs. 81.4 %; $\chi^2 = 18.2$, $p < .001$, Cramer's V = 0.28), raising the possibility that a few minutes of visualizing the Buddha of the future is not comparable to long-term faith practices of Taoism. Yet, after this brief exposure of Buddha Maitreya, the Buddhists in the future-focused condition not only produced a far greater proportion of future-in-front responses than the Buddhists in the past-focused condition (55.6% vs. 8.9%), they also produced a far

greater proportion of future-in-front responses than the Buddhists in the unprimed condition from Experiments 1 and 2 combined (55.6% vs. 32.4%; $\chi^2 = 12.1$, $p = .001$, Cramer's V = 0.23). Furthermore, the exposure of Buddha Dipamkara increased participants' tendency to conceptualize the past as in front of them compared to the Buddhists from Study 2 and 3 combined, even though this tendency was already very strong (91.1% vs. 67.6%; $\chi^2 = 16.9$, $p < .001$, Cramer's V = 0.27). Thus, these results provide evidence that religion can play a causal role in determining temporal focus in space-time mappings. These findings contribute to a dynamic view of time in which its conceptualization is contextually and situationally dependent (Casasanto and Bottini, 2014; Duffy and Feist, 2016).

Study 6: A causal role of religious experience in shaping space-time mappings in a non-religious group

Study 5 provided evidence that religious experiences can play a causal role in determining how Buddhists spatialize the past and future in their minds. However, it should be noted that the participants of Study 5 were a sample of extreme religiosity. It is possible that the effect may be much smaller or even non-existent in atheists. Recent lines of research suggest that a few minutes of exposure to religion can also influence people's implicit metaphorical mappings. For instance, Li and Cao (2017: Study 2) showed that the morality-verticality congruency effects were more detectable in atheists after they were primed with God-related words than those in control condition. To explore this, Study 6 aimed to reveal an analogous effect to Study 5 in a non-religious population.

5.8 Method

5.8.1 Participants

120 students from a Chinese university participated in Study 6, with an age range of 19 to 25 and a mean age of 22.6 years. 60 participants were males and 60 were females. They were divided into 3 groups, each of which consisted of 40 students. All participants were native speakers of Chinese from Mainland China. Before the experiment, a survey was administered on their religious beliefs. The results showed all participants were nonbelievers of any religions.

5.8.2 Materials and procedure

The experimental treatment included 2 video clips (length = 30 min.), extracted from documentaries about Buddhism and Taoism. The 2 video clips consisted of 3 parts. Part 1 (length = 5 min.) introduced the origin and historic development of Buddhism or Taoism. Part 2 (length = 20 min.) explained the core beliefs of Buddhism or Taoism and their religious attitudes toward time. Part 3 (length = 5 min.) presents the daily life of Buddhists and Taoists in the temples of modern China.

Different groups of participants were called together to 3 separate rooms to finish experiment tasks. Participants were instructed to carefully watch the video clip of Buddhism or Taoism respectively. They were told that they should understand the core beliefs of Buddhism or Taoism for a cultural knowledge test later. The control group of participants received no experimental treatment. After watching the video clip, all participants finished the temporal diagram task as the participants in Study 2 did. The participants in this study were informed that the experimenter was investigating students' attitudes towards religions in universities. If the video induced any uncomfortable feelings, they could stop watching and quit the experiment immediately. Debriefing responses indicated that no participant guessed there was any

connection between the videos and the diagram task.

5.9 Result and discussion

All participants completed the experiment. The results showed that 75% of the participants assigned to watch video clips about Buddhism placed the past in the front box. By contrast, 84.4% of the participants watching video clips about Taoism placed the future in the front box. To determine whether the difference in responses between the two groups was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 80} = 29.09$, $p < .001$, Cramer's V = 0.603 (Table 6), supporting the causal role of religion for atheists' temporal focus in determining space-time mappings.

Group	Past-in-front-mapping	Future-in-front mapping
Video of Buddhism	30 (75.0%)	10 (25.0%)
Video of Taoism	6 (20.6%)	34 (84.4%)
Control group	16 (40.0%)	24 (60.0%)

Table 6. Results of Study 6. Counts and percentage of past-in-front and future-in-front responses in Chinese university students primed with the videos of Buddhism and Taoism and control group.

The responses of the control group participants demonstrated no bias against past- or future-in-front mappings (sign test on 16 vs 24, $p = .26$). The proportion of past-in-front responses in the Buddhism priming condition was significantly higher than that of the control group ($\chi^2 = 10.65$, $p < .001$). The proportion of future-in-front responses in the Taoism priming condition was significantly higher than that of the control group ($\chi^2 = 4.31$, $p = .038$).

In summary, inducing non-religious Chinese individuals to focus their attention on past experiences during a Buddhism priming test caused a dramatic increase in the rate of past-in-front responses; inducing them with Taoism priming to focus on future experiences caused an increase in the rate of future-in-front responses, compared to

the control group. These results provide evidence that religion can play a causal role in determining the direction of front-back time mappings even in atheists.

5.10 Chapter discussion

Based on the TFH, which suggests a relationship between temporal focus and space-time mappings, it is hypothesized that religion may exert an important influence on an individual's temporal focus and resulting space-time mappings. Studies 3 and 4 compared the responses of Buddhists with those of Taoists in an implicit time diagram task. The results showed that Buddhists, characteristically believing in karma (the past affects one's future) and assigning greater value to the past, were more likely to conceptualize the past as ahead of them and the future as behind them. By contrast, Taoists, who consider immortality as a more achievable goal and attribute more importance to the future, were more likely to conceptualize the future as ahead of them and the past as behind them. Extending beyond correlational evidence, Study 5 investigated the causal role of religion in determining religious people's space-time mappings. Buddhists who were assigned to visualize the picture of Buddha Dipamkara showed a tendency to attribute more importance to past events and later associated the "past" with "front" in a subsequent time diagram task. By contrast, Buddhists who were assigned to visualize the picture of Buddha Maitreya showed a tendency to attribute more importance to future events and give a future-in-front response on the subsequent time diagram task than the Buddhists in the past-focused condition. In Study 6, the causal effect of religion on implicit space-time mappings was replicated in a non-religious population. The results demonstrated that atheists who were assigned to watch episodes about Buddhism practices were more likely to think about time according to the past-in-front mapping, whereas those who were assigned to watch episodes about Taoism practices were more likely to think about time according to the future-in-front mapping. Together, these results provide converging evidence that religion can exert an important influence on people's spatial representation of time.

This research contributes to the literature in several important ways. First, the results from these experiments provide further validation of the TFH's assertion that people's implicit associations of the "past" and "future" with "back" and "front" should depend on their temporal focus. For instance, non-religious Chinese people in Studies 3 and 4 showed no preference for either past-in-front or future-in-front mappings in the Time Diagram Task, as predicted by their equally high agreement with future focus and past focus items. Therefore, this pattern of results suggests that space-time mappings in people's minds are conditioned by their temporal focus, which extends de la Fuente et al.'s (2014) findings to Chinese population. However, the findings about Chinese atheists' non-preference for past appear to be contradictory to some previous research which suggests that Chinese culture, influenced by the strong Confucian norms, encourages more positive thinking of past times and old generations (Brislin and Kim, 2003; Kluckhohn and Strodtbeck, 1961). One possible reason for this is that in Studies 3 and 4 non-religious Chinese participants were all younger adults and, hence, probably focused their attention on future-oriented thoughts and activities more than other people in the same culture do.

Second, the results extend prior work by providing first evidence that religious beliefs, previously unexplored in this context, may also influence people's temporal focus and thereby shape their spatialization of time. This hypothesized role of religion for temporal focus in determining space-time mappings was supported in two experiments. In Studies 3 and 4, Buddhists and Taoists demonstrated a different tendency to conceptualize time according to the temporal focus enshrined in their religions despite the fact that they were within the same Chinese culture. Building on the results of Studies 3 and 4, which provided correlational evidence demonstrating that religion might influence the direction of the space-time mapping in people's minds, Study 5 tested the causal role of religion in determining Buddhists' spatial conceptions of time. The findings showed that Buddhists primed with the pictorial icons of the Buddhas of the past or the future beforehand ascribed more importance to the corresponding

temporal events, in line with the TFH on front-back time mappings conditioned by the allocation of attention to a particular time period. Extending a step further, the results of Study 6 showed that the effect of religiosity was still robust even in non-religious participants, and thus provided converging evidence for the causal role of religion in shaping spatial conceptions of time.

Third, the results contribute to a growing body of evidence that temporal focus can be rapidly modulated by context. For instance, Guo et al. (2012) found that when induced to think about and focus on the future, Chinese individuals attached more importance to the future than the past, just like Euro-Canadians; when induced to think about and focus on the past, Euro-Canadians attached more importance to the past more than the future, just like the Chinese. In another study, de la Fuente et al.'s (2014, Experiment 5) examined the roles of a short-term writing exercise in influencing people's space-time mappings. Spaniards were asked to perform a writing exercise that focused their attention on either the past or the future. The results showed that the participants tended to produce space-time mappings which were consistent with the writing exercise; the participants who completed past-focus exercises conceptualized the past in front of them more frequently although Spanish culture is more future-focused, suggesting that people's conception of time is highly flexible. Yet, in de la Fuente et al.'s (2014) study, many words like "*past*", "*last year*", "*some day*" and "*next year*" which were independent of cultural context were used to direct participants' attention to the past or future. That is, being more past- or future-focused might possibly be traced to a linguistic priming effect. In the present experiment, temporal focus was not linked to explicit linguistic cues that may focus individuals' attention on thinking about the past or future. The pictorial icons of Buddhas of the Past and the Future appeared to be responsible for the temporal focus in participants' space-time associations in Study 5, providing supporting evidence that religion plays a causal role in influencing people's conceptions of time.

Taken together, the different temporal orientations of Buddhists and Taoists in Studies

3 and 4, Buddhists primed with pictures of Buddhas representing different life circles in Study 5 and atheists primed with Buddhism and Taoism documentaries in Study 6 suggest that religion factors may carry through to temporal focus, leading to differences in the associations of space and time. In sum, the series of experiments reported here provide converging evidence of a causal relationship between religion and temporal focus that has not been covered before. While cultural differences in political ideology and religion may exert an influence on attention focus and the resulting space-time mappings, these findings raise the question of whether individual differences may also play a role in influencing the ways in which people think about time. Indeed, other lines of research have shown that the human time cognition system may be highly adaptive and malleable and results from a complex of factors. Preliminary findings suggest that a range of individual differences, such as age, lifestyle, personality and emotional state, may influence people's perspective on the movement of events in time (e.g., de la Fuente et al., 2014; Duffy and Feist, 2014; Richmond et al., 2012; Margolies and Crawford, 2008). Inspired by these findings, the following chapters will explore how individual differences tied to temporal focus influence people's spatializations of time.

Chapter 6: Real life experiences

6.1 Introduction

Thus far, a range of cultural differences have been shown to contribute to a person's temporal focus and the resulting implicit space-time mappings. However, other lines of research investigating metaphorical representations of time indicate that individual differences may also influence how people spatialize time. Abundant evidence has shown that people's adoption of temporal perspectives is highly flexible and intimately interlinked with spatial experience (Clark, 1973; Lakoff and Johnson, 1980; Evans, 2013). For example, Boroditsky and her colleagues conducted a number of experiments to investigate how different spatial experience might prime different construals of time. In one experiment, participants, who were at the beginning or the end of a train journey, were more likely to adopt a Moving Ego perspective than participants in the middle of their journey (Boroditsky and Ramscar 2002). One appealing explanation is that people are more likely to be engaged in thinking about their journey when they have just board on the train and when they are approaching the destination, which is analogous to the Moving Ego perspective defined by the movement of the self through time. This pattern of results suggests that people recruit spatial concepts to understand time and, thus, provides preliminary evidence for the unprecedented levels of malleability in human cognition.

Extending beyond the earlier work on investigating how spatial experiences influence people's time cognition, recent lines of research have provided preliminary evidence that individual differences such as life styles and emotions may also influence how people reason about events in time (Hauser et al., 2009; Richmond et al.. 2012; Duffy, 2014). For instance, Duffy and Feist (2014: Experiment 2) showed that procrastinators were more likely to adopt a Moving Ego perspective, while conscientious individuals were more likely to adopt a Moving Time perspective, suggesting that personality may be linked to time via shared spatial schemas. One

possible explanation is that procrastinated tasks get moved "forward" along a direction defined by the movement of the self through time—in a direction consistent with the Moving Ego perspective. Further experiments conducted in a range of real life settings have confirmed these preliminary findings (Duffy et al., 2015).

Like temporal perspectives, some initial evidence has demonstrated that culture is not the only factor influencing people's temporal focus and their implicit space-time mappings. de la Fuente et al. (2014: Experiment 3), in their study of older and younger Spaniards, observed that there was an age-related difference in space-time mappings within a single future-focused culture[8]. Their results showed that older Spaniards were more likely to conceptualize the past as in front of them than younger Spaniards due to the seniors' tendency to have increased recollection for events occurring in their youth (known as the *reminiscence bump*), suggesting that temporal focus tends to alter dynamically with age. More recently, Waliński (2016) investigated temporal focus reflected in the frequency of expressions denoting temporal distance in Polish speakers. The results showed that the younger adults (aged 26 to 30) tended to adopt a future-oriented view because they view time from longer perspectives of their individual, social and career development. However, a drop of the frequency of adverbials referring to longer temporal horizons can be observed among 41-50 year olds. Collectively, these findings suggest that rather than being attributed to a single factor, space-time mappings entrenched in people's minds likely result from an an accumulation of factors.

In this chapter, three studies are reported; these were conducted to investigate whether previously unexplored real life experiences concerning the past and future may influence people's spatializations of time. Previous studies have mainly sampled students studying psychology (i.e., de la Fuente et al., 2014: Experiment 5), whose major does not require them to pay special attention to the past or future. However,

[8] One may argue that people of different ages may also have different cultural experiences. However, in de la Fuent et al.'s (2014) study, they considered young and older Spaniards were living in the same culture but showed age-related differences in temporal focus. Thus, age is a kind of individual differences in their definition.

turning to factors more tightly bound to the individuals' temporal focus, Study 7 reported below investigated whether educational backgrounds with different time preferences might influence people's space-time mappings by comparing students with different disciplinary focuses. In addition to intermediate-term temporal experiences, such as education background, two other studies reported in this chapter also focused on real life experiences on other time scales, investigating whether long-term living experiences (Study 8) and short-term visiting experiences (Study 9) might influence people's attitudes toward time. The results from these three studies will provide evidence that differences in real life experiences may have additional potential influences on temporal focus in determining implicit space-time mappings, revealing the high flexibility of the human conceptualization system.

Study 7: Education background

The academic training of history (HI) and archeology (AR) students requires them to focus on past events and the historical development of human society. By contrast, the academic training of computer science (CS) and electronic engineering (EE) students encourages them to focus on new technology in the information era. If students from those different majors are influenced by their learning experience to be past- or future-focused respectively, it can be hypothesized that HI and AR students should be more likely to focus on the past and thus tend to conceptualize the past as in front of them. By contrast, CS and EE students should be more likely to focus on the future and thus tend to conceptualize the future as in front of them.

6.2 Method

6.2.1 Participants

To investigate the relationship between educational background and people's temporal

focus, Chinese-speaking undergraduate and graduate students from different departments of three universities in Mainland China were recruited to take part in this research. To accommodate any possible data deletion, the sample size was 40% larger than that of de la Fuente et al. (2014). The total number of participants was 179; of these, 88 were studying history or archeology and 91 were studying computer science or electronic engineering. For all participants, the average time spent in academic training is 5.7 years (min. = 4.5 years, max = 8 years). Before the temporal focus test, a screening protocol was applied to measure to what degree they liked their studies so as to filter out the students who disliked their majors to any extent. The screening protocol is a 5-point Likert scale from 1 (dislike very much) to 5 (like very much). Any participant who scaled under 4 was ruled out. This procedure was to make sure that the participants' time focus preference was not interfered by their personal attitudes toward their majors. The final participant pool included 71 HI/AR students (38 male, 33 female), with an age range of 22 to 27 and a mean age of 23.9 years and 68 CS/EE students (40 male, 28 female), with an age range of 21 to 27 and a mean age of 23.3 years. The mean score of how much they liked their majors is 4.3. Participants received gum or chocolate as compensation.

6.2.2 Materials and procedure

Following informed consent, all participants completed the questionnaire using pen and paper while sitting at a table. The questionnaire consisted of two parts: 1) Time Diagram Task; 2) Temporal Focus Questionnaire. The Time Diagram Task in Part 1 is a Chinese version of de la Fuente et al. (2014, Experiment 1) as used in Study 2.

For Part 2 of the Questionnaire, a Chinese version of the Temporal Focus Questionnaire adapted from de la Fuente et al. (2014, experiment 2) was used to quantify the proposed difference in temporal focus between HI/AR students and CS/EE students. Back-translation ensured the translation equivalence between

Chinese and English. It was first translated into Chinese by an experienced researcher with a first degree in translation studies and then checked by another translator, who were fluent in both English and Chinese. The questionnaire consisted of 21 questions about past or future-related statements, such as "*I think that people were happier some decades ago than nowadays(我认为几十年前的人们比现在要快乐得多)*" (past focus) and "*I think that globalization is very positive(我认为全球化是积极的)*" (future focus). Participants were asked to rate their agreement of each statement from 1 (not agree at all) to 5 (completely agree).

6.3 Results and discussion

In the Time Diagram Task, the HI/AR students (74.6%) responded according to the past-in-front mapping, assigning the past-related event in the box in front of the character. On the contrary, CS/EE students (82.4%) were more likely to place the future-related event in the box in front of the character and the past event in the box behind him. To determine whether the difference in responses between the HI/AR students and CS/EE students was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 139} = 45.33$, $p < .001$, Cramer's V = 0.571 (Table 7).

Group	Past-in-front-mapping	Future-in-front mapping
HI and AR students	53 (74.6%)	18 (25.4%)
CS and EE students	12 (17.6%)	56 (82.4%)

Table 7. Results of Study 7. Counts and percentage of past-in-front and future-in-front responses in Chinese HI &AR and CS & EE students

According to an ANOVA with group (HH/AR students, CS/EE students) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between HH/AR students and CS/EE students, as indicated by a significant interaction of temporal focus

and group, $F(1, 135) = 260.67$, $p < .001$, $\eta_p^2 = 0.66$ (see Figure 9). Post hoc comparisons revealed that HI/AR students were more past-focused than CS/EE students ($p < .001$) and CS and EE students were more future-focused than HI and AR students ($p < .001$).

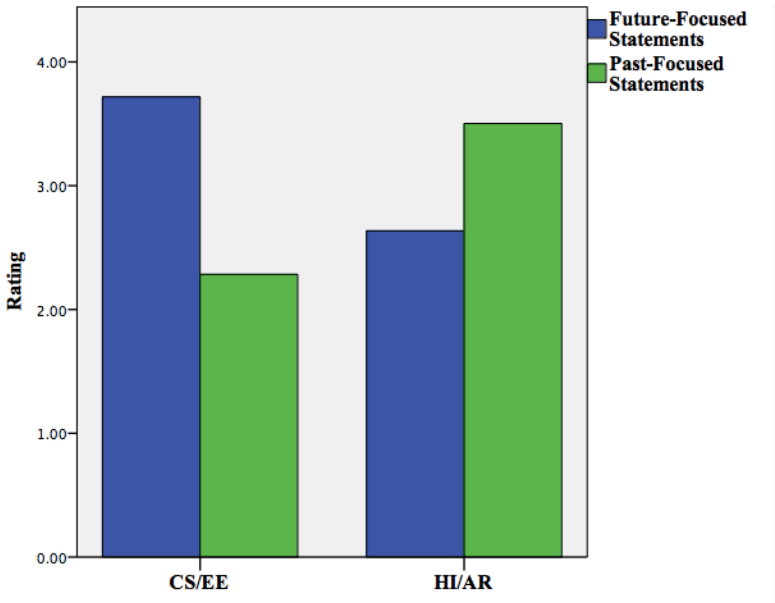

Figure 9 Average agreement with the past- and future-focused statements on the Temporal Focus Questionnaire, separately for HH/AR students and CS/EE students.

Data from this study provide supporting evidence for TFH (de la Fuente et al., 2014). That is, the direction of the front-back time mapping in people's mental models is consistent with their temporal focus. Extending upon TFH, these results indicate an influence from individual differences in educational experiences on people's preferred temporal focus. HI/AR students, engaged in an intermediate-term training with the ability to identify different types of sources of historical knowledge, allocated more importance to the past and, hence, used more past-in-front/ future-in-back mappings. In contrast, CS/EE students, who are sensitive to the rapid development and the innovation of the information era, appeared to have greater focus on the future. Study 7 thus provides initial evidence that real life experiences influence people's temporal focus and the resulting space-time mappings.

Study 8: Living experiences

Employing a larger and more diverse sample, Study 8 sought to extend Study 7, investigating whether long-term living experiences can also influence people's temporal focus. Hutong, with a history of more than 800 years, is the ancient street extending to the residential area in Beijing. It is conceived and preserved as the symbol of the long history of Beijing city and hundreds of thousands of people are still living in Hutong area (Johnston, 2014). Meanwhile, with the advancement of Chinese society, more and more people move into modern apartment buildings located in the newly-developed areas in Beijing. These apartment buildings are fashionably designed and well equipped, representing the modern lifestyle. Based on these observations, it can be hypothesized that people residing in the Hutong (HT) areas should be more past-focused and thus think about time according to the past-in-front mapping, whereas people living in apartment buildings (AB) should be more future-focused and thus think about time according to the future-in-front mapping.

6.4 Method

6.4.1 Participants

A knock-on-the-door protocol was applied and data collection was stopped when interviews were finished in five HT and AB communities respectively. The residents were asked to provide information regarding their age and length of residence. 209 adults from Beijing participated in this experiment. 102 participants were HT residents (52 male and 50 female), with an age range of 20 to 45 years and a mean age of 31.79 years. 107 participants were AB residents (54 male and 53 female), with an age range of 20 to 45 years and a mean age of 30.86 years. All participants were native speakers of Chinese. Each participant received 20 Chinese Yuan for time compensation.

6.4.2 Materials and procedure

Materials and procedures are the same as in Study 7.

6.5 Results and discussion

In the Time Diagram Task, the HT residents (60.8%) responded according to the past-in-front mapping, assigning the past-related event in the box in front of the character. On the contrary, the AB residents (75.7%) were more likely to place the future-related event in the box in front of the character and the past event in the box behind him. To determine whether the difference in responses between the HT and AB residents was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 139} = 28.52$, $p < .001$, Cramer's V = 0.571 (Table 8).

Group	Past-in-front-mapping	Future-in-front mapping
HT residents	62 (60.8%)	40 (39.2%)
AB residents	26 (24.3%)	81 (75.7%)

Table 8. Results of Study 8. Counts and percentage of past-in-front and future-in-front responses in Chinese Hutong and Apartment residents.

According to an ANOVA with group (HT residents vs. AB residents) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between HT residents and AB residents, as indicated by a significant interaction of temporal focus and group, F (1, 207) = 139.15, $p < .001$, $\eta_p^2 = 0.40$ (see Figure 10). Post hoc comparisons revealed that HT residents were more past-focused than apartment residents ($p = .002$) and AB residents were more future-focused than HT residents ($p = .001$).

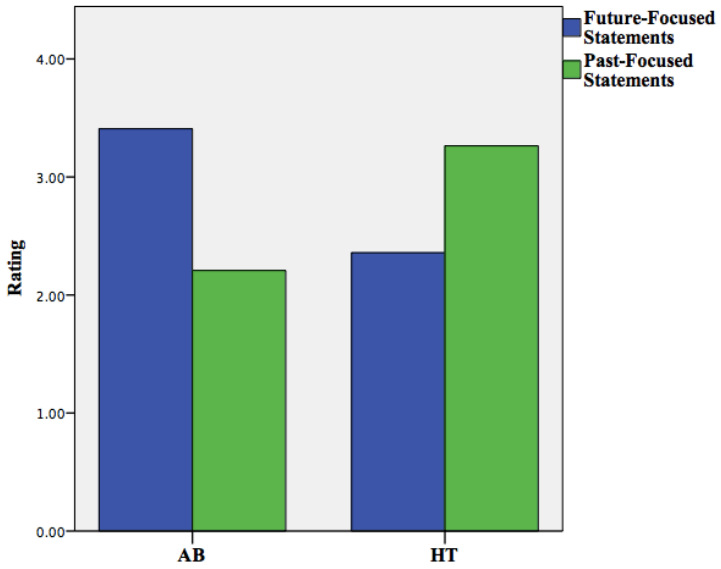

Figure 10 Average agreement with the past- and future-focused statements on the Temporal Focus Questionnaire, separately for HT vs. AB inhabitants.

Here, in Study 8, a larger and more diverse sample than that in Study 7 was tested. The results provided further evidence that individual differences in real life experience play a role in influencing people's temporal focus and their implicit space-time mappings. As predicted, the results showed that HT residents living in ancient architectures allocated more importance to the past and, hence, were more likely to think about time according to the past-in-front mapping. In contrast, AB residents whose home environment embodied the modern life style appeared to have greater focus on the future and, thus, think about time according to the future-in-front mapping.

Studies 7 and 8 examined the roles of intermediate and long-term real life experiences in influencing spatial conceptions of time. As noted above, de la Fuente et al., (2014: Experiment 5) provided initial evidence that after a brief past-focus training exercise, Spaniards were more likely to conceptualize the past as in front of them than the future-focus trained participants. However, it is unclear whether short-term living

experiences can influence people's attitudes toward time. To answer this question, Study 9 investigated whether short-term visiting experiences would influence people's temporal focus.

Study 9: Visiting experiences

Previous research has revealed that different art works and exhibitions may convey or cause different temporal experiences (Noy and Noy-Sharav, 2013). For instance, visiting an ancient art exhibition which recalls memories and meanings from the past would encourage people to be more nostalgic, while visiting a modern art exhibition which uses the arts and creativity to enable and empower social change would encourage people to be more future-focused. In line of these differences, it can be hypothesized that people who enjoy antiques should show a greater tendency to be past-focused and conceptualize the past as in front of them. By contrast, people who enjoy contemporary art should be more likely to be future-focused and conceptualize the future as in front of them.

6.6 Method

6.6.1 Participants

Visitors to the Ancient China Bronze Art Exhibition (ACBAE) in the National Museum of China and visitors to the Modern Painting Exhibition (MPE) in the Hive Center for Contemporary Art in Beijing were invited to help with the Time Diagram Task and Temporal Focus Questionnaire. All the participants volunteered to take part in the research. 135 Chinese-speaking ACBAE visitors and 127 Chinese-speaking MPE visitors were asked to finish the temporal diagram task and the temporal focus questionnaire as conducted in Study 7. The ACBAE includes pieces of ancient bronze, which were made thousands of years ago. The MPE contains hundreds of modern

paintings, which come from Chinese modern artists. In order to examine this possible influence, the experiment was conducted at the exit of the exhibition halls. To make sure all the visitors had already been immersed in the environment and to minimize the interference from their personal attitudes, two questions were asked: 1) how long have you stayed in this exhibition? 2) Please score how much you are interested in this exhibition (from 1 not interested at all to 5 extremely interested). Only data from those who spent at least 0.5 hour and scored at least 4 for interestedness were retained. Finally, the data of 112 ACBAE visitors (55 male, 57 female), with an age range of 23 to 42 and a mean age of 30.9 years and 103 MPE visitors (51 male, 52 female), with an age range of 24 to 45 and a mean age of 29.3 years) were retained. All participants received a 20-yuan café coupon in the exhibition area for time compensation.

6.6.2 Materials and procedures

Materials and procedures are the same as in Study 7.

6.7 Results and discussion

In the Time Diagram Task, the ACBAE visitors (61.6%) responded according to the past-in-front mapping, assigning the past-related event in the box in front of the character. On the contrary, the MPE visitors (66.0%) were more likely to place the future-related event in the box in front of the character and the past event in the box behind him. To determine whether the difference in responses between the ACBAE visitors and MPE visitors was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1,\ 215} = 16.39$, $p < .001$, Cramer's V = 0.369 (Table 9).

Group	Past-in-front-mapping	Future-in-front mapping
ACBAE visitors	69 (61.6%)	43 (38.4%)
MPE visitors	35 (34.0%)	68 (66.0%)

Table 9. Results of Study 9. Counts and percentage of past-in-front and future-in-front responses in Chinese ACBAE and MPE visitors.

According to an ANOVA with group (ACBAE visitors vs. MPE visitors) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between ACBAE visitors and MPE visitors, as indicated by a significant interaction of temporal focus and group, F (1, 213) = 214.67, p < .001, η_p^2 = 0.50 (see Figure 11). Post hoc comparisons revealed that ACBAE visitors exhibited a more past-focused mindset than MPE visitors (p = .004) and MPE visitors exhibited a more future-focused mindset than ACBAE visitors (p = .006).

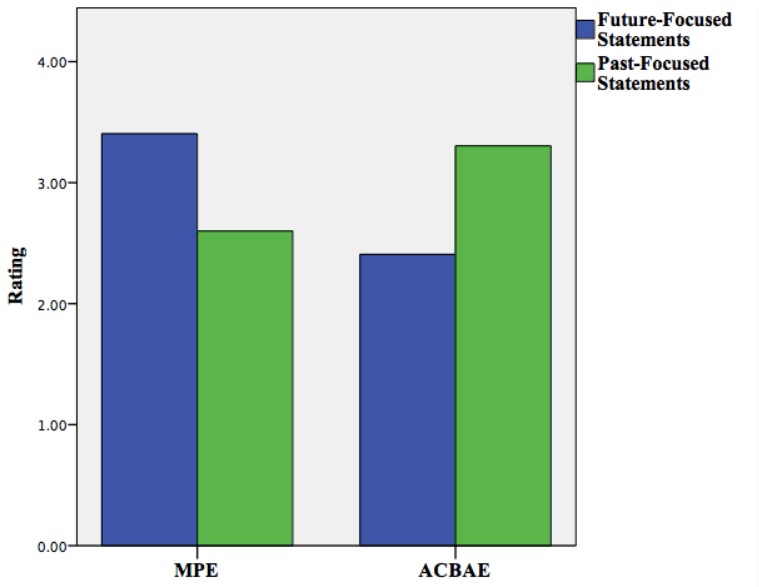

Figure 11 Average agreement with the past- and future-focused statements on the Temporal Focus Questionnaire, separately for ACBAE and MPE visitors

Thus, Study 9 provides further evidence that even short-term experiences can exert an important influence on space-time mappings in people's mental models. Once again, it appears that people's temporal focus is tied to their real life experiences. The difference between the two groups of participants' conceptions of time cannot be traced to their cultural attitudes since both groups are within the same single Chinese

culture. Nor can the differences in temporal thinking be traced to linguistic differences since the participants in both groups share the same native language (Mandarin).

6.8 Chapter discussion

Research investigating spatiotemporal metaphors has chiefly been concerned with the role of people's cultural attitude toward time in influencing space-time mappings. However, other lines of research have also shed light on a number of additional factors, such as age and short-term training, which may also influence people's temporal focus and their resulting spatial conception of time, revealing some malleability in human time cognition (de la Fuente et al., 2014: Experiment 3, 5). Drawing on preliminary lines of research in the laboratory, this chapter provides first support for the hypothesis that real life experiences may also play a role in influencing people's temporal focus determining their implicit space-time mappings.

To begin with, Study 7 sought to investigate the extent to which an intermediate-term educational experience would influence students' temporal focus in modulating their space-time mappings. HI and AR students, who primarily focus their attention on the study of human activities in the past through the recovery and analysis of the material culture that have been left behind, were more past-focused. By contrast, CS and EE students, who devote more to entrepreneurial activities that produce innovative computing products and services, were more future-focused. Consistent with the TFH, HI and AR students were more likely to conceptualize the past as ahead of them and the future as behind them, while CS and EE students tended to conceptualize the future as ahead of them and the past as behind them. These findings suggest that differences in real life experiences have additional potential influences on people's temporal focus and thereby affect their implicit space-time mappings.

Probing further the interrelations between real life experiences and space-time mappings, Study 8 examined the effect of a long-term living experience on a cohort of inhabitants' attentional focus on the past and the future. In line with earlier findings in environmental psychology on the effects of home environment on people's cognition (see e.g., Graham et al., 2015), this study showed that participants living in the traditional Hutong area, featuring classical architectures and traditional lifestyle, were more likely to be past-focused, whereas participants residing in apartment buildings, featuring modern lifestyle, were more likely to be future-focused. In sum, the results from Study 8 provide additional evidence that a person's living experience contributes to their temporal focus and, hence, to their space-time mappings. Based on these findings, Study 9 specifically focused on the relationship between temporal focus and a short-term visiting experience. It was found that, in contrast to the participants visiting ancient art exhibitions, who showed a higher likelihood of being past-focused and tended to think about time according to the past-in-front mapping, participants who visited modern art exhibitions were more likely to be future-focused and tended to think about time according to the future-in-front mapping.

The finding that temporal focus may arise from an interaction between a range of factors, including cultural attitudes toward time, age, and real life experiences raises the question of whether some factors may play a more prominent role than others in shaping people's spatial representations of time. Firstly, the results showed that participants tended to focus their attention on the past or future according to their individual experiences despite all being immersed in Chinese culture. This suggests that real life experiences, at least in this context, override the cultural attitudes that influence people's temporal focus. Secondly, de la Fuente et al. (2014: Experiment 3) found that, there is an age-related difference in space-time mappings in older and younger Spaniards. That is, age differences can, in this context, also override the effects of culture on temporal focus. Taken together, these findings suggest that individual differences (e.g., age and real life experiences) may sometimes override the influence of culture on temporal focus and implicit space-time mappings (cf. Duffy

and Evans, 2016).

Focusing on short-, intermediate- and long-term real life experiences, the current findings demonstrated that the three types of real life contexts can significantly change people's space-time associations. Moreover, the results extend the prior work, with a demonstration that culture is not the sole factor that determines people's attitude toward time. It appears that people's temporal focuses are also conditioned by their real-life experiences which help people attend to past or future events and, thereby, influence their implicit spatialization of time. Further, the results strengthen the idea that implicit space-time mappings are more flexible than explicit spatial metaphors for time in language (de la Fuente et al., 2014). Thus, these findings suggest the psychological reality of a highly adaptive and flexible human conceptualization system (Athanasopoulos et al., 2015; Casasanto and Lupyan, 2015).

In sum, in an attempt to gain further insight into the factors influencing the directions of front/back-time mappings, the focus of the investigation in this chapter was turned to real life experiences in question, probing factors that may contribute to people's temporal focus. By looking into real life experiences on different time scales, it was shown that personal attitudes toward time correlated with implicit space-time mappings and, thus, this shed further light on the TFH.

Building on insights from these findings, one question is whether other factors more tightly bound to the individual would also exert influence on how people implicit associate the past and future with front and back in their mental models. For instance, Li et al. (2015) found that pregnant women focused more on future events. This mindset promoted future-orientation and a greater preference for a larger and later reward in intertemporal choice. However, it is not clear whether the pregnant experience would influence women's spatial conceptions of time. To explore this, the following chapter will investigate the relationship between the experience of pregnancy and women's attentions to past and future events and specifically how they

influence women's implicit space-time mappings, which will extend research on the TFH in a new direction.

Chapter 7: The experience of pregnancy

7.1 Introduction

The old saying of "don't cry over spilt milk" is a common belief in the Western culture. It tells us that rehashing the past would not change anything and moving forward to the future is more significant. Yet, the belief is different in the Eastern culture. Influenced by Confucianism, Chinese culture seems to encourage more positive thinking about past times and old generations (Chung and Lin, 2012). To wit, the further you can look backward, the further you can see forward. According to the TFH, temporal focus appears to play an important role in determining the direction of space-time mappings in people's mental models (de la Fuente et al., 2014). Specifically, while past-in-front mappings are found in people who assign more attention to past events, future-in-front mappings are found in those who assign more attention to future events.

As discussed, the TFH proposes that people's implicit space-time mappings are shaped by their cultural attitudes (de la Fuente et al., 2014). For instance, as shown in Study 1, people who place more value on tradition are more likely to think about time according to the past-in-front mapping. By contrast, people who value economic development, globalization and technological development are more likely to think about time according to the future-in-front mapping. In addition to this, other lines of research have also suggested that individual differences in temporal focus can also predict people's tendency to locate the past or future in front. For instance, as shown in Study 7, an intermediate-term educational experience would influence students' temporal focus in modulating their space-time mappings. However, the role of differences more tightly bound to the individual has not been investigated. To address this issue, Study 10 aims to explore the independent contribution of pregnant experience, an internal change, to people's temporal focus.

Pregnancy is a time of a great physical and psychological change for women. Everything from the amount of gained weight to hormonal fluctuations will change over the nine months, leading up to childbirth. One of the most striking characteristics of pregnant women noted by previous research is their future-oriented thought. Previous research has suggested that future orientation and planning motivate the behavior of every individual over a life time (Bandura, 1986; Neisser, 1976). Moreover, research from nursing research demonstrates that future thinking is particularly important for pregnant women for several reasons. First, pregnant women pay much attention to the expected development of their children, such as the health status of the fetus, which may crucially influence their decisions on the continuation of pregnancy or future caring (Sjögren, 1997). In one study, Yamamoto (1996) investigated the relationship between time perception and maternal role in 140 pregnant Japanese women. The results showed that future orientation of time perception is not only an indicator of positive expectation about the future of their children but also a contributor to the development of their maternal behaviors.

Second, pregnant women have to think about the balance between motherhood and work. Future orientation and planning may help them improve their efficiency at parenting, continue with education and influence their later career decisions. By adopting cross-sectional mixed methods design, Bell et al. (2014) compared three groups of teenage girls: antenatal, termination of pregnancy and never pregnant. A mixture of open-ended and Likert scale questions were used to measure participants' future orientation relating to their cognitive, motivational and behavioral component of Seigner's Future Orientation model (Seigner, 2015). It was found that pregnant women developed clearer long-term plans for the future with a focus on career.

Taken together, the reviewed research provides an important foundation for the understanding of space-time mappings, demonstrating that people's temporal focus is not only modulated by culture but also by their real life experiences such as pregnancy. Given the clear relationship between pregnancy and being future-focused

and the causal role of temporal focus in determining spatialization of time, the present study was designed to compare the space-time mappings in pregnant and non-pregnant women. I hypothesized that pregnant women should be more likely to conceptualize future as in front of them because they are more future-focused.

Study 10: pregnant vs. non-pregnant women

7.2 Method

7.2.1 Participants

Sample sizes varied with the availability of participants. Overall, there were 162 participants and these were tested in two cohorts, several months apart. The first cohort, which consisted of 35 pregnant women with an age range of 25 to 33 and a mean age of 27.8 years and 35 women without any experience of pregnancy with an age range of 22 to 33 and a mean age of 26.3 years. The second cohort, which consisted of 40 pregnant women with an age range of 23 to 33 and a mean age of 25.8 years and 52 women without any experience of pregnancy with an age range of 24 to 33 and a mean age of 25.9 years.

7.2.2 Materials and procedures

The members of the two cohorts were asked to finish a Chinese version of the Temporal Diagram Task and the TFS as in Study 2.

7.3 Results and discussion

As predicted, the majority of pregnant women (84.0%) responded according to the future-in-front mapping. By contrast, about half of the non-pregnant women (55.2%)

responded according to the future-in-front mapping. To determine whether the difference in responses between pregnant and non-pregnant women was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 162} = 26.50$, $p < .001$, Cramer's V = 0.404 (Table 10).

Group	Past-in-front-mapping	Future-in-front mapping
Pregnant women	63 (84.0%)	12 (16.0%)
Non- pregnant women	39 (44.8%)	48 (55.2%)

Table 10. Results of Study 10. Counts and percentage of past-in-front and future-in-front responses in Chinese pregnant and non-pregnant women.

The tendency for pregnant women to place the future in front of the character was significant in each cohort analyzed separately, which provided an internal replication of the future-in-front mapping in pregnant women (Cohort 1 (N = 35): 85.7% future-in-front-response, $p < .001$; Cohort 2 (N = 40): 82.5% future-in-front-response, $p < .001$). Meanwhile, non-pregnant women consistently showed no bias toward past and future in each cohort analyzed separately (Cohort 1 (N = 35): 57.1% future-in-front-response, $p = .499$; Cohort 2 (N = 52): 53.8% future-in-front-response, $p = .678$).

According to an ANOVA with group (pregnant women vs. non-pregnant women) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between pregnant and non-pregnant women, as indicated by a significant interaction of temporal focus and group, $F(1, 160) = 76.62$, $p < .001$, $\eta_p^2 = 0.32$ (Figure 12). Post hoc comparisons revealed that women in the pregnant group showed greater agreement with future-focused statements than those in the non-pregnant group ($p < .001$). Non-pregnant women showed equally high agreement with future focus and past focus items ($p = .47$)

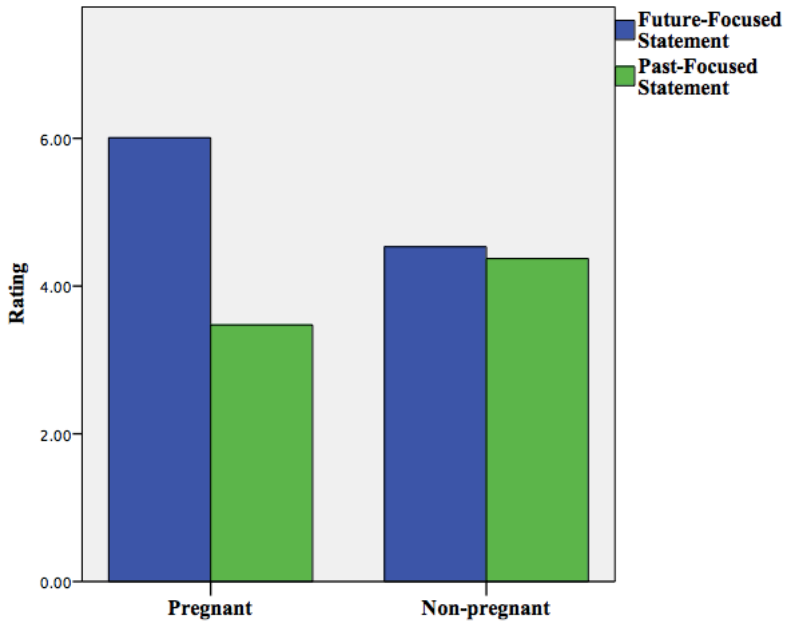

Figure 12 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for pregnant and non-pregnant women

7.4 Chapter discussion

This chapter demonstrates that the experience of pregnancy can exert an important influence on women's temporal focus and thereby shape their space-time mappings. First, the results fit nicely with the TFH, which suggests that space-time mappings in people's mental models are conditioned by their attentional focus. The difference between pregnant and non-pregnant women's conceptions of time cannot be traced to language since both groups were native speakers of Chinese. The findings about no default bias in space-time mappings in non-pregnant women, as predicted by their equally high agreement with future focus and past focus items, suggest that space-time mappings in people's minds are shaped by individual differences in temporal focus; thus, this pattern of results extends de la Fuente et al.'s (2014) findings to Chinese population.

Study 10 represents the first attempt to show that pregnancy may serve as a potential contributor to space-time mappings in women's minds. This finding contributes to the time cognition literature by offering a new perspective that personal experiences such

as pregnancy might also influence people's spatialization of time. Previous research mainly focuses on cultural factors and age in predicting the direction of space-time mappings in people's mental models. Thus, the comparison of pregnant and non-pregnant women reported here is complementary to de la Fuente et al.'s (2014) old-young comparison insomuch as the non-standard group becomes more future-focused in the former study and more past-focused in the latter study.

In sum, Study 10 demonstrated that pregnant women were more likely to think about time according to the future-in-front mapping, suggesting that pregnancy, an internal change and important temporal landmark in women's life, may contribute to their change of temporal focus and thereby influence the implicit space-time mappings. However, in real life, people do not only have temporal landmarks denoting the beginning of the new cycle like pregnancy but have those referring to summaries of past events. It is unclear whether other points of time, beyond pregnancy, are associated with space-time mappings. To date, a systematic investigation focusing on the influence of temporal landmarks on temporal focus has received very little attention, notwithstanding its potential influence on people's implicit space-time mappings. Therefore, in order to gain further insight into the roles of temporal landmarks in influencing people's implicit space-time mappings, the focus of the investigation in the following chapter will be turned to how different types of temporal landmarks influence how people spatialize time.

Chapter 8 Temporal landmarks

8.1 Introduction

According to the TFH, people's implicit associations of "past" and "future" with "back" and "front" should be shaped by their temporal focus, namely, the attention individuals devote to thinking about the past and future (Shipp et al., 2009). As demonstrated previously, people's spatializations of time are a consequence of numerous factors ranging from those relating to the situations, such as residential environment (Study 8), to those more tightly bound to the individual, such as the age-related differences (de la Fuente et al., 2014). Thus, in addition to examining future-related temporal landmarks such as the experience of pregnancy (Study 10), additional insights into factors that influence the ways in which people spatialize time in their minds might be gained by probing other types of temporal landmarks.

Some preliminary research suggests that temporal landmarks, including both personally-related events (e.g., birthday) and reference points on calendars (e.g., New Year), segregating life into numerous, distinct mental accounting periods, can also influence people's conceptions of time (Dai et al., 2015; Waliński, 2016). One of the most paradigmatic example of this is the "New Year's Effect" (Marlatt and Kaplan, 1972; Norcross et al., 2002), which suggests that people are more likely to be future-focused and start a fresh clean slate at the beginning of the year. For instance, Dai, Milkman and Riis (2014) found that Google searches for terms denoting aspirational behaviors like "diet" and "gym visit" increase at the start of "new epochs" initiated by the incidence of temporal landmarks including the beginning of a new week, month, year and school semester as well as immediately following a public holiday, a school break or a birthday. These results suggest that some temporal landmarks can encourage people to separate from their imperfect past selves and enable them to pursue their aspirations.

Although the aforementioned research revealed that temporal landmarks may motivate aspirational behaviors, sparse research has investigated its effect on people's space-time mappings. However, in real life, people do not only have temporal landmarks denoting the beginning of the new cycle, but also have those referring to summaries of past events. It is unclear whether other points of time, beyond New Year and pregnancy, are associated with space-time mappings. To date, systematic investigations focusing on the influence of temporal landmarks on temporal focus have received very little attention, notwithstanding its potential influence on people's implicit space-time mappings. In light of these considerations, this chapter, for the first time, systematically explores the relationship between temporal landmarks and people's spatial conceptions of time by conducting a large-scale study in Chinese populations. As predicted by the TFH, it can be hypothesized that different temporal landmarks will cause people to exhibit different space-time mappings. Specifically, Study 11 investigated whether personally-related events, namely final examination and the start of a new semester, would influence students' conceptions of time. Then, Study 12 used a larger and more diverse sample to investigate whether socially constructed calendar partitions (Chinese Spring Festival vs. Tomb Sweeping Day) would motivate people to think about time according to the corresponding space-time mappings. Study 13 extended such an effect to daily life situations using a laboratory experiment so as to determine the causal role of temporal landmarks in influencing people's temporal focus and their spatializations of time.

Study 11: Personally-related events: final examination vs. the start of a new semester

During the academic cycle, final examinations are tests given to high school, college and university students at the end of a course or training. The purpose of the test is to make a final review of the topics covered and assessment of each student's knowledge of the subject. It has also been long established that the grades of final examinations

usually reflect, and are influenced by, the experience and achievements of one's past study (Halperin and Abrams, 1978). By contrast, the beginning of a new academic semester is a salient temporal landmark for students to conduct aspirational behaviors (Robinson, 1986; Soster et al., 2010). For instance, Dai et al. (2014) found that engagement in an important aspirational behavior was more frequent; for example, exercise increases significantly at the beginning of a new academic semester, suggesting that the first few days listed on the university's academic calendar are linked to goals that students consider pursuing in the future. Could these different associations between personal temporal landmarks with past or future time periods influence people's space-time mappings? It is predicted that if final examinations are more related to past experiences, students tested on the final exam day should be more likely to place the past in front of them than students tested on the day of a new academic semester, which is more related to a fresh start of future.

8.2 Method

8.2.1 Participants

Permissions forms were sent to 132 high school students from three classes (selected randomly), who would take part in final examinations a month later. They were asked whether they would be interested in participating in an experiment on the final exam day for a small gift. A total of 107 (81%) students returned permission forms. Of these, 14 refused to participate in the study, leaving a sample of 93 in total. Of these 93 student examinees, 42 were males and 51 were females, with an age range of 16 to 19 years and a mean age of 17.1 years. Permission forms were also sent to 137 students from three classes (selected randomly), who would register again at the same high school for a new semester a month later. They were asked whether they would be interested in participating in an experiment on the registration day for a small gift. A total of 110 (80%) students returned permission forms. Of these, 14 refused to participate, leaving a sample of 96 in total. Of these 96 student registrants, 43 were

males and 53 were females, with an age range of 16 to 19 years and a mean age of 16.8 years. All participants were native speakers of Chinese.

8.2.2 Materials and procedure

Student examinees were tested on a final exam day. After they had finished their own final examination sheets, they were invited to complete the paper-and-pen-administered questionnaires. Student registrants were tested on the registration day of a new semester. After they had successfully completed their registration, they were invited to perform the same pen-and-paper tasks as student examinees. All participants were asked to finish a Chinese version of the Temporal Diagram Task and the Temporal Focus Scale.

8.3 Results and discussion

In line with predictions based on the differences between the two temporal landmarks, the results showed that the majority of student examinees (66.7%) responded according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind him. By contrast, the majority of student registrants (65.6%) responded according to the future-in-front mapping, placing the future event in the box in front of the character and the past event in the box behind him. To determine whether the difference in responses between student examiners and registrants was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 189} = 19.70$, $p = .001$, Cramer's $V = 0.323$ (Table 11).

Group	Past-in-front-mapping	Future-in-front mapping
Student examiners	62 (66.7%)	31 (33.3%)
Student registrants	33 (34.4%)	63 (65.6%)

Table 11. Results of Study 11. Counts and percentage of past-in-front and future-in-front responses in Chinese student examiners and registrants.

According to an ANOVA with group (examinee vs. registrant) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between student examiners and registrants, as indicated by a significant interaction of temporal focus and group, $F(1, 187) = 26.02$, $p < .001$, $\eta_p^2 = .12$ (Figure 13). Post hoc comparisons revealed that student examinees agreed more with past-focused statements than student registrants ($p < .001$), whereas student registrants agreed more with future-focused statements than student examinees ($p < .001$).

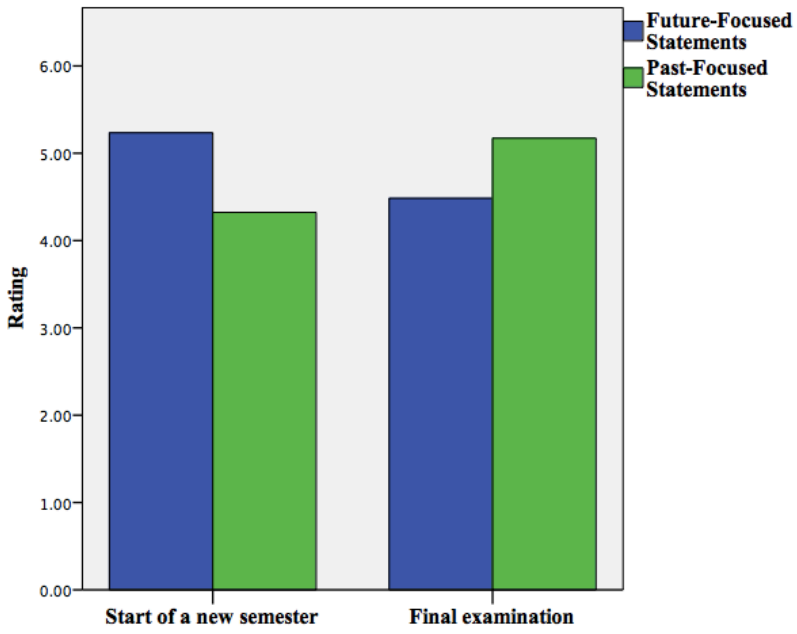

Figure 13 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for student examinees and registrants.

These results indicate an influence of personally-related events on people's preferred temporal focus and consequent space-time mappings: As predicted, results showed that students tested on the final exam day were more likely to associate the past with the front because they focused more on the past, but students tested on the registration day showed the opposite association of future with the front because they tended to

focus more on future times. Study 11 thus provides initial evidence that temporal landmarks differences may influence people's conceptions of time.

Study 12: Festival: Spring Festival vs. Tomb Sweeping Day

Study 11 asked whether the reference points on the calendar contributes to a person's temporal focus and, hence, to their conceptions of time. In addition to personally-related events, reference points on the calendar are another prototypical example of temporal landmarks (Shum, 1998). In addition, it should be noted that the sample of Study 11 was student-biased. In recent years, some scholars have argued that it might be difficult to make broader claims about all human behavior only from student participants (Henrich et al., 2010). For instance, Duffy and Feist (2014) found that there were differences in temporal reasoning between university students and administrators because the former had more control over time and temporal flexibility in their daily lives and the latter were primarily structured by external demands and were regimented by the clock. In order to address this issue, Study 12 took another field study by using a larger and more diverse sample, focusing specifically on the effect of two different types of festivals related to past and future time periods respectively on Chinese people's space-time mappings.

Throughout the world, the beginning of the year might seem like a time for people to commit themselves to initiate aspirational behaviors (Marlatt and Kaplan, 1972). For instance, Chinese people tend to do a thorough housecleaning, pay off debts and return borrowed objects before the Spring Festival, the Chinese traditional New Year (Bodde, 1979). This suggests a widely shared belief that we have opportunities to start fresh with a clean slate on the New Year's Day. By contrast, other holidays are a time for a variety of commemoration events. In China, the Tomb Sweeping Day is an opportunity for celebrants to remember and honor their ancestors at grave sites. As a family obligation, Chinese people tend to consider it as a time of reflection and give

thanks to their forefathers. Therefore, generally speaking, for Chinese people, the Spring Festival is more future-related and the Tomb Sweeping Day is more past-related. In view of these differences, it can be hypothesized that people's conceptions of time may vary according to different festivals, with the result that Spring Festival with its emphasis on fresh starts may motivate people to conceptualize the future as in front of them, while Tomb Sweeping Day, a holiday for remembering the past, may motivate people to conceptualize the past as in front of them.

8.4 Method

8.4.1 Participants

388 adults (197 male) with an age range of 18 to 60 years[9] and a mean age of 38.6 years participated in this experiment. To obtain an unbiased sample that is truly representative of the entire population, a broad cross-section of society was sampled. For instance, the participants' occupations ranged from freelancers with flexible timetables to investment bankers with an intense time pressure. All participants were native speakers of Chinese. They received a small reward for their participation.

8.4.2 Materials and procedure

201 participants (102 male, average age 40.8 years, range 18-60) tested on the Chinese New Year's Day were approached in a city square, where large scale public events were held for celebration. 187 participants (95 male, average age 36.4 years, range 18-60) tested on the Tomb Sweeping Day were approached in three cemeteries, where many celebrants went to sweep the tombs and offered food and libations to those who had passed away. Following informed consent, all participants completed the same time diagram task and Temporal Focus Scale individually, as in Study 11, at

[9] In de la Fuente et al.'s (2014) Experiment 3, people with an age range of 17 to 60 years were selected as one group and those were believed to share similar temporal focus. I followed the same screening rule to avoid the possible influence of age on temporal focus.

a table and chair that the experimenter had set up in advance.

8.5 Results and discussion

In line with predictions based on the differences between the two temporal landmarks, the results showed that the majority of participants tested on the Spring Festival (62.7%) responded according to the future-in-front mapping, placing the future event in the box in front of the character and the past event in the box behind him. By contrast, the majority of participants tested on the Tomb Sweeping Day (63.1%) responded according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind him. To determine whether the difference in responses between the two groups of participants, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 388} = 19.70$, $p = .001$, Cramer's V = 0.323 (Table 12).

Group	Past-in-front-mapping	Future-in-front mapping
Spring Festival	75 (37.3%)	126 (62.7%)
Tomb Sweeping Day	118 (63.1%)	69 (36.9%)

Table 12. Results of Study 12. Counts and percentage of past-in-front and future-in-front responses in Chinese people tested on the Spring Festival and Tomb Sweeping Day.

According to an ANOVA with group (Spring Festival vs. Tomb Sweeping Day) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between participants tested on the Spring Festival and the Tomb Sweeping Day, as indicated by a significant interaction of temporal focus and group, $F(1, 386) = 69.93, p < .001, \eta_p^2 = 0.15$ (Figure 14). Post hoc comparisons revealed that participants tested on the New Year's Day agreed more with future-focused statements than those tested on the Tomb Sweeping Day ($p < .001$), whereas participants tested on the Tomb Sweeping Day agreed more with past-focused statements than those tested on the New Year's Day ($p < .001$).

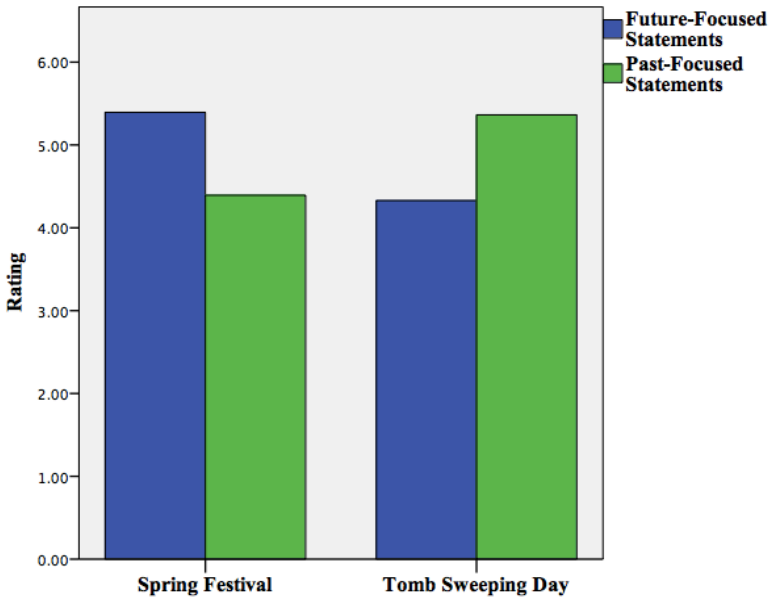

Figure 14 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for participants tested on the New Year's Day and Tomb Sweeping Day.

These results indicate an influence of reference points on calendar on people's preferred temporal focus and consequent space-time mappings. As predicted, results showed that participants tested on the Chinese New Year's Day were more likely to associate the future with the front because they focused more on the future, but participants tested on the Tomb Sweeping Day showed the opposite association of the past with the front because they tended to focus more on past times. Study 12 thus provides converging evidence that temporal landmarks differences may influence people's conceptions of time.

Study 13: A causal role for temporal landmarks in influencing temporal focus and space-time mappings

In Studies 11 and 12, the results showed the influence of temporal landmarks on implicit space-times in two cohorts of participants from different sections of society. Because these two experiments were observational in nature, it was not possible to infer causality. In other words, it is possible that future-focused people would be more

likely to observe the Chinese Spring Festival and past-focused people would be more likely to observe the Tomb Sweeping Day. Studies that experimentally manipulate temporal landmarks will now be required to understand the causal influence of temporal landmarks on people's conceptions of time. To this end, Study 13 tested whether temporal landmarks can play a causal role in determining temporal focus and thereby influence the direction of the space-time mapping in people's mental models. By doing so, the psychological meaning associated with a temporal mark was manipulated.

8.6 Method

8.6.1 Participants

Native speakers of Chinese were recruited through flyers that were distributed on campus. A total of 220 students (105 females) from two Chinese universities participated, in exchange for a small gift. Participants were randomly assigned to either a past- or future-focused condition. 110 were assigned to temporal landmarks with past time periods (mean age = 23.5, range from 18-35) and 110 were assigned to temporal landmarks with future time periods (mean age = 22.6, range from 17-34).

8.6.2 Materials and procedure

The design, materials, and procedure were identical to those used in Studies 11 and 12 with the following exceptions: In the temporal landmarks with a past time period, participants read that Li Hua was awarded a 20-year service medal for his contribution to the company, and in the temporal landmarks with a future time period, participants read that Li Hua will soon move to another city because of a new position at work. Because he loved planting flowers, yesterday a friend gave him a potted jasmine (*Moli* 茉莉) as a gift and tomorrow another friend will give him a potted azalea (*Dujuan* 杜鹃) as a gift (or vice versa, as jasmine/azalea to past/future

assignment was counterbalanced). Participants were asked to imagine the scenes and place the jasmine (writing the Chinese character "茉") in the box corresponding to past events, and the azalea (writing the Chinese character "杜") in the box corresponding to future events (or vice versa). The order in which participants were asked to locate jasmine and azalea was counterbalanced to ensure that any associations between space and time were not confounded with numerical or temporal order. Debriefing responses indicated that no participant guessed the real purpose of the diagram task.

8.7 Results and discussion

As predicted, the results showed that the majority of the participants assigned to the past-focused condition (66.3%) responded according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind him. By contrast, the majority of participants assigned to the future-focused condition (64.5%) responded according to the future-in-front mapping, placing the future event in the box in front of the character and the past event in the box behind him. To determine whether the difference in responses between the two groups of participants, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 220} = 21.02$, $p = .001$, Cramer's V = 0.309 (Table 13).

Group	Past-in-front-mapping	Future-in-front mapping
20-year service medal	73 (66.3%)	37 (33.7%)
Moving to a new city	39 (35.5%)	71 (64.5%)

Table 13. Results of Study 13. Counts and percentage of past-in-front and future-in-front responses in Chinese participants assigned to past-focused and future-focused conditions .

According to an ANOVA with group (past-focused vs. future-focused) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between participants

assigned to the past- and future-focused condition, as indicated by a significant interaction of temporal focus and group, $F(1, 218) = 26.43$, $p < .001$, $\eta_p^2 = .11$ (Figure 15). Post hoc comparisons revealed that participants reading temporal landmark with a past time period showed more agreement with past-focused statements than those reading temporal landmarks with a future time period ($p < .001$), whereas participants reading temporal landmarks with a future time period showed more agreement with future-focused statements than those reading temporal landmarks with a past time period ($p < .001$).

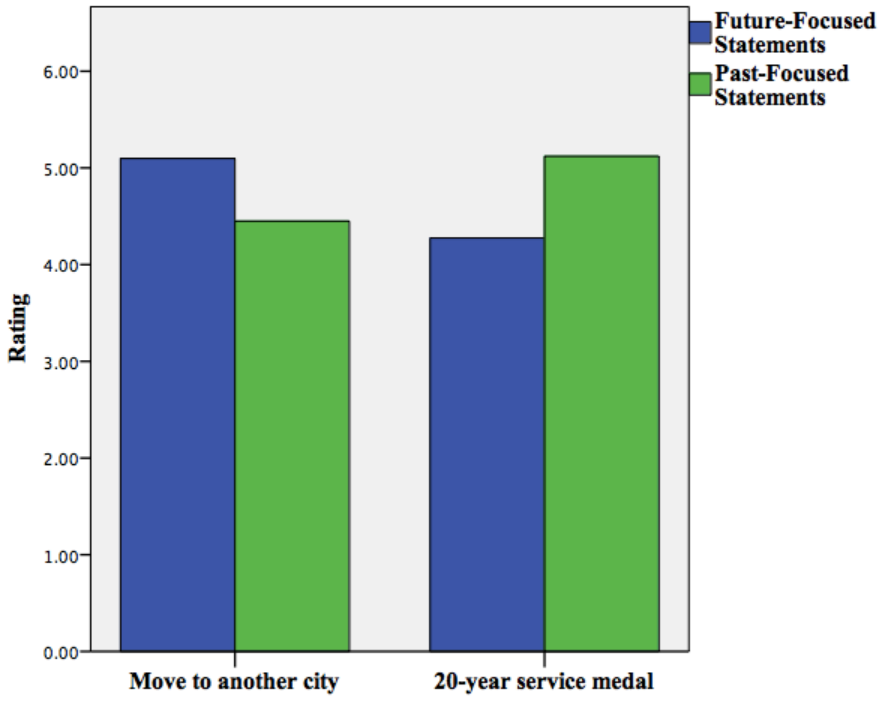

Figure 15 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for participants reading temporal landmark associated with the past and future.

To sum up, the findings showed that temporal landmarks associated with past events, such as 20-year service awards, encouraged participants to be more past-focused and caused an increase in the rate of past-in-front responses. By contrast, temporal landmarks associated with future events, such as moving to a new city, encouraged participants to be more future-focused and caused an increase in the rate of future-in-front responses. Thus, these results provide evidence that temporal

landmarks can play a causal role in in determining how people spatialize the past and future in their minds.

8.8 Chapter discussions

The TFH assumes that space-time mappings in people's minds are conditioned by their attentional focus. Recently, an increasing number of studies testing this emerging hypothesis have revealed that both cultural factors and individual differences influence the implicit space-time associations (de la Fuente et al., 2014). In addition, Study 11 have provided initial evidence that temporal landmarks may also influence people's temporal focus in determining their space-time mappings, suggesting that people's spatializations of time may be attributed to a complex of factors. Drawing on these earlier findings, which suggests that some salient temporal landmarks motivate aspirational behaviors, this chapter systematically investigated how different types of temporal landmarks might influence a person's conceptions of time. Across three experiments, the results demonstrated that temporal landmarks played an important role in influencing people's spatializations of time.

To begin with, Study 11 sought to investigate whether personally-related events would influence a student's conceptualizations of time. The results showed that students tested on the final exam day tended to be more past-focused and were also more likely to produce a past-in-front mapping. By contrast, students tested on the registration day tended to be more future-focused and were also more likely to produce a future-in-front mapping. In Study 12, by using a larger and more diverse sample, I asked whether reference points on the calendar, another typical type of temporal landmarks, would influence people's temporal focus and the resulting space-time mappings. It was found that participants tested on the Chinese New Year's Day, a symbol of a fresh start, demonstrated a greater tendency to conceptualize the future as in front of them, while those tested on Tomb Sweeping Day, an opportunity for celebrants to remember and honour their ancestors, were more likely to

conceptualize the past as in front of them.

Finally, Study 13 provided converging evidence that temporal landmarks play a causal role in influencing how people spatialize the past and future in their minds. Two scenarios representing past or future landmarks, namely a twenty-year-service anniversary and moving to a new city, had been presented to participants before their temporal focus and space-time mappings were measured. The findings showed that the temporal landmark associated with past periods caused an increase in the rate of past-in-front responses and the temporal landmark associated with future periods caused an increase in the rate of future-in-front responses.

The effect of temporal landmarks on people's spatializations of time is consistent with two fundamental psychological processes. First, in accordance with the TFH, I found that temporal focus induced by a set of temporal landmarks can affect space-time mappings in people's minds. Since no control data were collected in the studies, one may argue that Chinese people would favor one direction of front-back mappings rather than the other in the absence of any temporal-landmark stimuli. However, I do not find this explanation compelling. In one study, Chinese participants were asked to perform the Time Diagram Task with real entities (Gu et al., 2016: Experiment 1). The results showed that they showed no bias toward the past or future. Additionally, Study 10 compared the spatializations of time between Chinese non-pregnant and pregnant women using the same Time Diagram Task. The results showed that non-pregnant women did not show any bias against past-/future-in-front mappings (sign test on 39 vs. 48, $p = .391$). Taken together, these results provide evidence that Chinese showed no bias toward the past or future.

Second, space-time mappings in people's mental models are highly adaptive and flexible, which likely results from multiple contextual factors. Extending beyond demonstrating the influence of cultural and individual differences on individual's spatial conceptions of time, it is shown for the first time that temporal landmarks may

serve as a potential contributor to people's temporal focus, thereby influencing their space-time mappings. That is, people may associate the past and future with front-back space differently on some special occasions, compared with how they conceptualize time during other time periods, which suggests human's remarkable representational flexibility (Boroditsky, 2001; Boroditsky and Ramscar, 2002; Casasanto and Bottini, 2014; Hendricks and Boroditsky, 2017; Santiago et al., 2011).

The present findings have also important methodological implications for the study of individual differences in conceptualizations of time. Some preliminary lines of research have shown that age could influence people's temporal focus. Previous research testing the TFH was mainly based on cross-sectional data which possibly faces the problem of unobserved heterogeneity (e.g., cohort effects). For instance, older Spaniards were more past-focused possibly because they received education which emphasized the preservation of traditions in their early age rather than their temporal focus altering dynamically with age. To minimize this concern, in Study 11 the space-time mappings of high school students who shared similar social, educational and economical backgrounds were investigated. The results showed that they still demonstrated differences in temporal focus and the directions of space-time mappings, which provides further evidence for the role of temporal landmarks in determining people's conceptions of time.

Despite best efforts to control for the most theoretically prominent alternative explanations in Study 11, cross-sectional survey designs still cannot establish the causal direction of observed associations. To address this concern, Study 13 employed an experimental design. People were randomly assigned to read a socially constructed temporal landmark that focused their attention on either the past or the future. As predicted, the results showed that temporal landmarks can play a causal role in determining people's temporal focus and their resulting space-time mappings.

The findings from Chapter 7 and 8 have showed that people's temporal focus changes

with life stages (or temporal landmarks). On the basis of these results, it is possible that even the time landmark on a small-time scale, namely time of day, can also affect space-time mappings in people's minds – that people's temporal focus may exhibit variations as the day progresses. This might be because our lives follow the cycles of the earth, responding primarily to light and darkness in an organism's environment. The time of day is central to our life and culture, which prescribe when we work, eat, sleep and do other activities. For instance, our circadian rhythms are physical, mental and behavioral changes that follow the 24-hour cycle. It brings about daily activities to ensure healthy lives and promote wellbeing for all at all ages (Vitaterna et al., 2001). To explore this factor, the following chapter aims to investigate the influence of time-of-day on people's temporal focus and their resulting space-time mappings.

Chapter 9 Time-of-Day and Chronotype

9.1 Introduction

Life on Earth is adapted to the rotation of our planet. For many years it has been known that living organisms, including humans, have an internal, biological clock that helps them anticipate and adapt to the regular rhythm of the day. Using fruit flies as a model organism, the 2017 Nobel Prize was awarded to Jeffrey C. Hall, Michael Rosbash and Michael W. Young for their discoveries about a gene that controls the normal daily biological rhythm.

Indeed, people shifting their behaviors during the waking day have been observed by prior research in psychology (Blake, 1967; Lawrence and Stanford, 1998). In one study, reasoning that the gradual fatigue and expending physical energy associated with everyday activities can exert a negative influence on one's moral behavior, Kouchaki and Smith (2014) predicted that people would be more likely to commit ethical behavior in the morning than later in the day. Participants were presented with word fragments such as "_ _RAL" and "E_ _ _ C_ _". The results showed that the morning participants tended to form the words "moral" and "ethical," while the afternoon participants were more likely to form the words "coral" and "effects," which provided supporting evidence for the effect of time-of-day on ethical engagement.

Much anecdotal and empirical evidence suggests that people's temporal focus appears to vary over time. For instance, the beginning of the year is widely considered as a time which presents people with new opportunities to achieve their goals, such as praying for a good harvest, saving more money and quitting a bad habit (Marlatt and Kaplan, 1972). On the basis of these observations, Dai, Milkman and Riis (2015), reasoning that certain dates motivate future-orientated behaviors when they signal new beginnings or the opening of new time periods (i.e. New Year), investigated the

relationship between temporal landmarks and goal pursuit. Consistent with the prediction, they found that more participants would choose to receive a message reminding them to initiate goal pursuit on the first of spring than participants in the control condition (an ordinary date). These results strengthen the idea of a highly adaptive and malleable human's cognitive system of time.

People's temporal focus may even shift at different times throughout the day. There are many examples of social groups in which people tend to be more future-focused in the morning. For instance, in western cultures, many of the people who engage in morning prayers habitually and consistently tend to focus their time and attention on seeking God's plan for the day ahead (Ochs, 2006; Bader-Saye, 2017). According to the Bible, "In the morning, O LORD, hear my voice. In the morning I lay my needs in front of you, and I wait (Psalm 5:3)". In Pueblo tribes, people renew their desire to honor the Creator and ask for a good day for themselves and for their communities in the morning (Swamp and Printup, 1995). In Chinese, the old saying goes, "一年之计在于春，一天之计在于晨 (*Make your whole year's plan in the spring and the whole day's plan in the morning*)". The proverb comes from the fact that people are usually most energetic in the morning and highlight the importance of being proactive. Since morning is the time for new beginnings, it is a good opportunity to experience something new.

These examples highlight the relationship between the 24-hour cycle and the temporal focus of social members. However, the role of time of day in influencing people's implicit space-time mappings has yet to be empirically tested. Drawing on the TFH that people's spatial representations of time are shaped by their temporal focus, the first conceptualization and hypothesis can be summarized as follows:

Hypothesis 1: when people are tested in the morning, they should be more future-focused and be more likely to produce a future-in-front mapping, compared with people tested in the afternoon (I refer to this as the morning future-minded

effect).

However, it is worth noting that not every person's biological clock keeps the same time or even the same pace. Based on general morningness and eveningness preferences, different people fall into different classifications, called "chronotypes" (Adan et al., 2010). Much evidence has been found to indicate that chronotype plays an important role in influencing human's behaviors. For instance, Gunia, Barnes and Sah (2014) observed a chronotype morning morality effect, whereby morning people ("larks") behave more ethically in the morning than in the evening, evening people ("owls") showed the reversed pattern. Chronotype may also influence people's temporal focus; evening people are thought to be more energetic and productive at night than in the morning. This means that they should be more likely to make plans and start their working in the evening, compared with morning people (Adan et al., 2012). Based on this observation, it can be predicted that evening people's attention should be more strongly directed to future events in the afternoon than in the morning. This led to the second hypothesis:

Hypothesis 2: the effect of time-of-day on temporal focus and space-time mappings should be mediated by chronotype processes. Evening people should be more future-focused and be more likely to produce a future-in-front mapping in the afternoon than in the morning.

Studies 14 and 15 test Hypothesis 1, investigating whether people are more likely to think about time according to the future-in-front mapping in the morning than in the afternoon. Study 16 then probes the interaction between time-of-day, chronotype and spatial conceptions of time. Specifically, Study 16 investigates whether the strength of chronotype will significantly influence the direction of front-back time mappings in evening people's minds, which is a test for Hypothesis 2.

Study 14: the relationship between time of day and space-time mappings

9.2 Method

9.2.1 Participants

A total of 190 adults participated in the experiment for 20 Chinese Yuan, with an age range of 18-46 years and a mean age of 29.6 years. 87 participants were male and 103 were female. All of them were native speakers of Chinese from Mainland China. 92 participants signed up for a morning session (between 9 a.m. and noon) and 98 participants signed up for an afternoon session (between noon and 5 p.m.). These sessions were timed to reflect typical working hours in Mainland China.

9.2.2 Materials and procedure

All participants were asked to complete a Chinese version of the Temporal Diagram Task and the Temporal Focus Scale.

9.3 Results and discussion

In line with the predictions, the results showed that more than half of the participants signing up for the morning sessions (60.9%) responded according to the future-in-front mapping, placing the future in the front box. By contrast, only 39.1% of the participants signing up for the afternoon sessions produced a future-in-front response. To determine whether the difference in responses between the participants signing up for the morning sessions and those for the afternoon sessions was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 190} = 4.26$, $p = .047$, Cramer's V = 0.15 (Table 14).

Group	Past-in-front-mapping	Future-in-front mapping
Morning session	56 (60.9%)	36 (39.1%)
Afternoon session	45 (45.9%)	53 (54.1%)

Table 14. Results of Study 14. Counts and percentage of past-in-front and future-in-front responses in Chinese participants signing up for the morning and afternoon sessions.

According to an ANOVA with group (morning session vs. afternoon session) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between the participants signing up for the morning sessions and those for the afternoon sessions, as indicated by a significant interaction of temporal focus and group, $F(1, 188) = 68.41$, $p < .001$, $\eta_p^2 = .27$ (Figure 16). Post hoc comparisons revealed that participants in the morning sessions showed greater agreement with future-focused statements than participants in the afternoon sessions ($p < .001$). Participants in the afternoon sessions showed equally high agreement with past- and future-focused statements ($p = .49$).

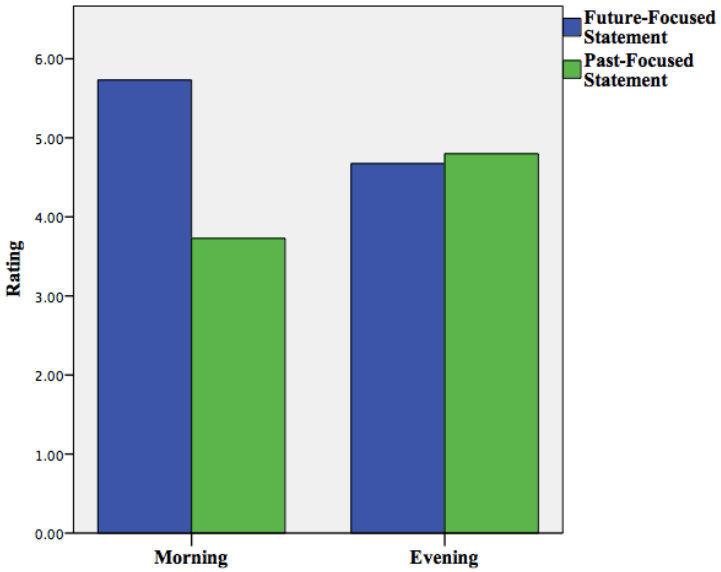

Figure 16 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for participants in the morning and afternoon sessions.

These findings are consistent with the prediction that people, on average, tend to be

more future-focused in the morning than in the afternoon and thus are more likely to conceptualize the future as in front of them in the morning, supporting the TFH. However, it should be noted that the design of Study 14 is quasi-experimental – participants self-selected a morning or afternoon session. An alternative explanation for these findings is that people focus more on future events, in general, are more likely to sign up for morning sessions than past-focused people. To distinguish these possibilities, Study 15 below randomly assigned people to morning and afternoon conditions.

Study 15: the causal role of time of day

9.4 Method

9.4.1 Participants

A total of 192 adults participated in the experiment for 20 RMB, with an age range of 18-45 years and a mean age of 30.4 years. 91 participants were male and 101 were female. All of them were native speakers of Chinese from Mainland China.

9.4.2 Materials and procedure

Participants were randomly assigned to morning (9 a.m. – noon) and afternoon sessions (noon - 5 p.m.). All participants were instructed to complete the time diagram task and TFS as in Study 14.

9.5 Results and discussion

The analyses reported here included the data from 186 participants; 6 participants were excluded (4 in morning sessions and 2 in afternoon sessions) because they did not show up on time as requested. In line with the predictions, the results showed that more than

half of the participants signing up for the morning sessions (62.0%) responded according to the future-in-front mapping, placing the future in the front box. By contrast, only 53.2% of the participants signing up for the afternoon sessions produced a future-in-front response. To determine whether the difference in responses between the participants signing up for the morning sessions and those for the afternoon sessions was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 186} = 4.29$, $p = .041$, Cramer's V = 0.15 (Table 15).

Group	Past-in-front-mapping	Future-in-front mapping
Morning session	57 (62.0%)	35 (38.0%)
Afternoon session	44 (46.8%)	50 (53.2%)

Table 15. Results of Study 15. Counts and percentage of past-in-front and future-in-front responses in Chinese participants randomly assigned in the morning and afternoon sessions.

According to an ANOVA with group (morning session vs. afternoon session) as a between-subjects factor and temporal focus (past, future) as a within-subjects factor, ratings of past- and future-related statements differed significantly between the participants signing up for the morning sessions and those for the afternoon sessions, as indicated by a significant interaction of temporal focus and group, $F(1, 184) = 79.9$, $p < .001$, $\eta_p^2 = .30$ (Figure 17). Post hoc comparisons revealed that participants assigned to the morning sessions showed greater agreement with future-focused statements than participants assigned to the afternoon sessions ($p < .001$). Participants assigned to the afternoon sessions showed equally high agreement with past- and future-focused statements ($p = .11$).

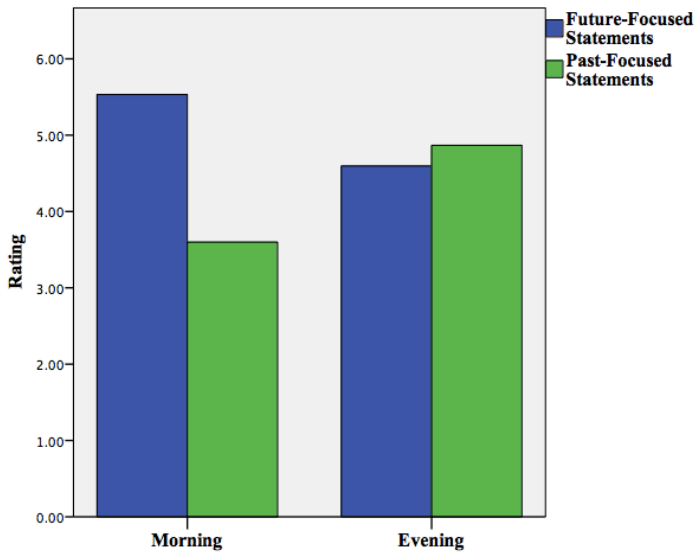

Figure 17 Average agreement with the past- and future-focused statements on the Temporal Focus Scale, separately for participants who were randomly assigned to the morning and afternoon sessions.

To further increase statistical power, the two groups in Study 15 were pooled together with the participants in Study 14, rendering a total sample of 184 participants in the morning session and 192 participants in the afternoon session. The morning future-minded effect was again significant in the morning group (113 future-in-front vs. 71 past-in-front responses, $p = 0.0024$ by Sign test), but not significant in the afternoon group (89 future-in-front vs. 103 past-in-front responses, p = .348 by Sign test). Moreover, the difference between the two groups was significant ($\chi^2_{1,\ 376} = 8.57$, $p = .004$, Cramer's V = 0.15).

As predicted, participants in the morning were more likely to be future-focused than were those in the afternoon. Moreover, people in the morning produced a greater proportion of future-in-front responses than those in the afternoon, supporting the TFH. These findings thus provide support for the prediction regarding the causal role of time of day in influencing how people spatialize the past and future in their minds.

One limitation of Studies 14 and 15 was that they did not factor chronotype into designs. This may mask the fact that not every person's biological clock keeps the same time or

even the same pace. For instance, evening people may not demonstrate their preference for future-focused thinking in the morning. Since evening types are inactive in the morning and stay awake at night, they should be more likely to make their plans in the afternoon in contrast to morning types. Thus, to further investigate the role that chronotype plays in influencing how people think about time, Study 16 examines the interaction between a person's chronotype, time-of-day and spatial conceptions of time. It is predicted that chronotype processes would influence people's implicit space-time mappings by mediating the morning future-minded effect for evening people.

Study 16: The interaction between time-of-day, chronotype and implicit space-time mappings

9.6 Method

9.6.1 Participants

Participants were 184 individuals from a pool of undergraduate and graduate students at two large Chinese universities. Participants were selected from a pretest according to their morningness or eveningness preference; half of them were morning-types (45 females and 47 males) and the remaining half comprised the evening-types group (43 females and 49 males). Participants were randomly assigned to one of two sessions (morning vs. afternoon). There were 46 participants in each experimental condition. They were rewarded 20 RMB for their participation.

9.6.2 Materials and procedure

The Chinese version of the Morningness–Eveningness Questionnaire (MEQ; Horne and Ostberg, 1976; Zhang, Hao and Rong, 2006) was used to assess participants' chronotype. The MEQ scores range for evening-types was 16-49 (Mean = 33.12, SD =

8.36) and for morning-types 63-86 (Mean = 69.75, SD = 7.33). The morning and evening people were randomized into one of four conditions in a 2 (chronotype: morning vs. evening) × 2 (session: morning (9 a.m. – noon) vs. afternoon (noon – 5 p.m.). All participants were instructed to complete the Time Diagram Task and Temporal Focus Scale as in Study 14.

9.7 Results and discussion

As predicted on the basis of the TFH, 69.6% of the participants assigned to the morning sessions responded according to the future-in-front mapping, placing the future in the front box. By contrast, only 43.5% of the participants assigned to the afternoon sessions produced a future-in-front response. To determine whether the difference in responses between the participants signing up for the morning sessions and those for the afternoon sessions was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1, 92} = 6.37$, $p = .02$, Cramer's V = 0.26 (Table 16).

Group	Past-in-front-mapping	Future-in-front mapping
Lark in the morning	14 (30.4%)	32(69.6%)
Lark in the afternoon	26 (56.5%)	20 (43.5%)

Table 16. Results of Study 16. Counts and percentage of past-in-front and future-in-front responses in larks randomly assigned in the morning and afternoon sessions.

However, eveningness participants exhibited the opposite pattern. As predicted on the basis of the TFH., almost half of the participants assigned to the morning sessions (47.8%) responded according to the future-in-front mappings, placing the future in the front box. By contrast, 71.7% of the participants assigned to the afternoon sessions produced a future-in-front response. To determine whether the difference in responses between the participants signing up for the morning sessions and those for the afternoon sessions was significant, a chi-square test for independence was used. The

chi-square test revealed a significant relationship: $\chi^2_{1, 92} = 5.47$, $p = .033$, Cramer's V = 0.24 (Table 17).

Group	Past-in-front-mapping	Future-in-front mapping
Owl in the morning	24 (52.2%)	22 (47.8%)
Owl in the afternoon	13 (28.3%)	33 (71.7%)

Table 17. Results of Study 16. Counts and percentage of past-in-front and future-in-front responses in owls randomly assigned in the morning and afternoon sessions.

For morning people, there is a two-way interaction between the time of the session (morning vs. afternoon) and temporal focus (past, future), $F(1, 90) = 34.99$, $p < .001$, $\eta_p^2 = 0.28$ (Figure 18). Post hoc comparisons revealed that they showed greater agreement with future-focused statements in the morning sessions than past-focused statements ($p < .001$). Participants in the afternoon sessions showed equally high agreement with past- and future-focused statements ($p = .06$). For evening participants, there is a two-way interaction between the time of the session (morning vs. afternoon) and temporal focus (past, future), $F(1, 90) = 47.05$, $p < .001$, $\eta_p^2 = 0.34$ (Figure 19). Post hoc comparisons revealed that participants in the afternoon sessions showed greater agreement with future-focused statements than participants in the morning sessions ($p < .001$). Participants in the afternoon sessions showed equally high agreement with past- and future-focused statements ($p = .55$).

These findings show that morning people were more likely to think about time according to the future-in-front mapping in the morning than in the afternoon, replicating the findings of Studies 14 and 15. Evening people, however, were more likely to think about time according to the future-in-front mapping in the afternoon than in the morning, suggesting there is an interaction between a person's chronotype and time-of-day.

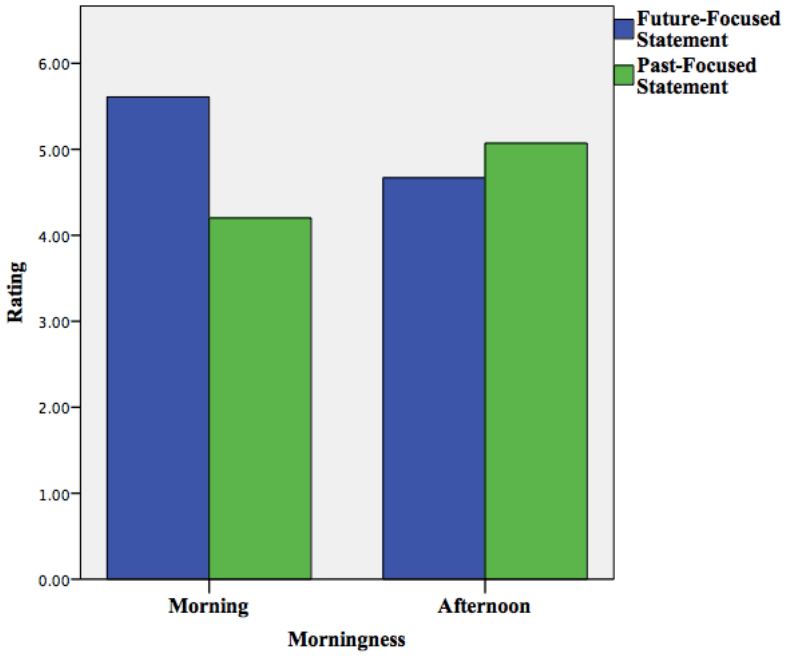

Figure 18 Morning participants' average agreement with the past- and future-focused statements on the Temporal Focus Scale in the morning and afternoon sessions.

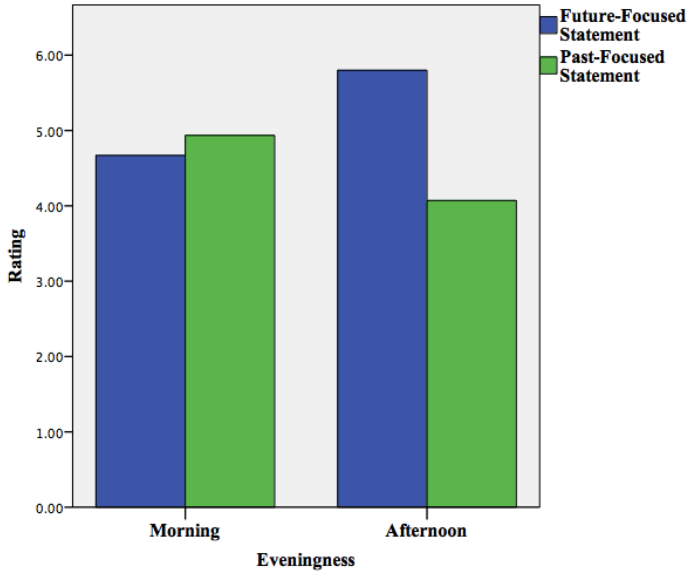

Figure 19 Evening participants' average agreement with the past- and future-focused statements on the Temporal Focus Scale in the morning and afternoon sessions.

9.8 Chapter discussion

In examining the factors influencing how people spatialize the past and future in their minds, researchers have chiefly focused on cultural and individual differences related

to temporal focus (de la Fuente et al., 2014). The three studies in this chapter examined the novel possibility that time-of-day and chronotype can influence people's temporal focus, and thereby affect their implicit space-time mappings. The results showed that people were more likely to be future-focused in the morning than in the afternoon. It was further demonstrated that this morning future minded effect did not hold true for evening people, who go to bed and wake up late and tend to plan their work in the late afternoon and evening hours.

To begin with, Study 14 sought to investigate whether time-of-day plays a role in influencing people's temporal focus and their implicit space-time mappings, with a quasi-experimental research design. To do this, the responses of participants tested in the morning and those of participants tested in the afternoon by the Time Diagram Task and Temporal Focus Scale were compared. In line with Hypothesis 1, the results showed that participants in the morning (between 9:00 am and 12:00 pm) were more likely to be future-focused and also tended to conceptualized the future as in front of them compared to those tested in the afternoon (between 12:00 pm and 5:00 pm). This phenomenon is dubbed as the morning future-minded effect.

Extending beyond correlational evidence provided by Study 14, Study 15 tested whether time-of-day can play a causal role in determining people's attention focus and, hence, the direction of the front-back time mappings in their mental models. The findings showed that morning participants demonstrated a greater tendency to think about time according to the future-in-front mappings than individuals in the afternoon, providing convergent evidence for the morning future-minded effect.

Study 16 selected the participants by chronotype, focusing on those who fell on either side of the Horne-Ostberg scale — those who preferred morning and those who preferred night. It was found that morning people demonstrated the morning future-minded effect. Evening people, however, who tended to be more future-focused in the afternoon, were also more likely to produce a future-in-front mapping

accordingly. This pattern of results suggests a boundary condition for the morning future-minded effect. Taken together, the findings across studies suggest a potential convergence between the roles of time-of-day and chronotype in determining how people spatialize past and future in their minds.

These results also suggest that people's representations of time are highly dynamic and quickly change with context (Boroditsky, 2001; Casasanto, 2008; Casasanto and Bottini, 2014; Santiago, Román and Ouellet, 2011; Torralbo, Santiago and Lupiáñez, 2006). However, how could people's temporal focus significantly and quickly be shaped by the surrounding context? I propose that the flexibility of attentional focus on time is contingent on its suitability to specific environments. Temporal focus, associated with the past, present and future, serves as a filter in how people allocate their attentional resources and evaluate events wisely based on their temporal significance. From an evolutionary perspective, the adjustment and alignment of internal temporal focus with the external demands of the environment are vital to human life (Gibson et al., 2007; Huy, 2001). For instance, pregnant women have to think about the balance between motherhood and a successful career. Focusing on the future may increase their preparation for parenting and influence their later career decisions (Bell et al., 2014).

This environment dynamism, which can be characterized by the rate and unpredictability of change in environmental variables, may lead people's mental representations of time to be shaped by multiple factors (Nadkarni and Chen, 2014). In one study, Duffy and Evans (2017: Experiment 1) investigated the interaction between personality differences in extroversion-introversion, event valence and the interpretation of a temporally ambiguous question: *Next Wednesday's party has been moved forward two days. What day has the event been rescheduled to*? They found that although extroverts would be more likely to imagine themselves approaching a social event (in line with the Moving Ego perspective) and introverts would be more likely to imagine a social event approaching themselves (in line with the Moving Time

perspective), there was no reliable difference in self-reported extroversion scores between participants adopting the Moving Ego perspective (answering "Friday") and those adopting the Moving Time perspective (answering "Monday"), suggesting that the valence of an event may trump the life experiences of the comprehender influencing the interpretation of an ambiguous temporal question.

In a similar vein, findings from previous chapters in this thesis have shown that an array of cultural and individual factors, such as cultural attitudes toward time, age, real life experiences and life stages influence people's spatial conceptions of time. The finding that both the person (chronotype) and the situation (time-of-day) influence spatial conceptions of time raises the question of what factors may exert more significant influences on the mental representations of time. For example, women's implicit space-time mappings may not simply be attributed to their cultural attitudes toward time but to other temporal focus related factors such as the undergraduate or graduate majors they are studying, the place in which these tests are taken, the bodily state in relation to pregnancy and the time of the testing session during the day. These cultural, social, temporal and bodily experiences may interact in complex and non-linear ways shaping our minds (Gibbs, 2014, 2017).

In sum, combining a quasi-experimental and an experimental approach to examine how circadian rhythm and a person's chronotype influence spatial conceptions of time, this chapter found that people tended to be more future-focused in the morning in comparison with individuals tested in the afternoon, but the morning future-minded effect was to be found reversed in people with higher eveningness scores. Specifically, evening people had a greater tendency to conceptualize the future as in front of them in the afternoon than in the morning, suggesting that spatial conceptions of time may arise from an interaction between time-of-day and chronotype processes. According to the TFH, one possible explanation suggests that the chronotype future-minded effect is due to people's highly dynamic attentional focus on time. These findings highlight a role for even subtle factors such as time of day caused by the physical world and chronotype

by the bodily experience, which can have important implications for mental mappings of time.

Thus far, the thesis has explored the role that a number of factors, namely, within-cultural differences, political ideology, religion, real life experiences, pregnancy, temporal landmarks, circadian rhythms and chronotype, play in influencing people's temporal focus and their implicit space-time mappings. The following chapter serves to bridge a gap in the existing literature between two areas of research that have received scant attention in the fields of cognitive science and personality psychology; more specifically, these are individual differences in conscientiousness and spatial conceptions of time. Previous findings on personality research suggests that people who score highly on conscientiousness demonstrate a tendency to set challenging goals for themselves and think carefully before acting for those goals for the future. In general, high levels of conscientiousness are positively associated with future-oriented thought (e.g., Carter et al., 2016; Colquitt and Simmering, 1998; DeYoung, Peterson and Higgins, 2002). However, there is no research to date designed to directly investigate the role of conscientiousness in determining the direction of space-time mappings in people's minds. To test this, the following chapter directly investigates the relationships among conscientiousness, temporal focus and implicit space-time mappings.

Chapter 10 Personality

10.1 Introduction

Recent theories of human cognition posit that there is a tight coupling between perceptual and conceptual representation (Gibbs, 1994.; Lakoff and Johnson, 1980, 1999). According to embodied cognition theories, our abstract thought is fundamentally grounded in the sensory-motor experience that derives from our body's morphology and internal states in the cultural and physical environment (Barsalou, 1999, 2008; Williams et al., 2009). For example, the mental representations of time are structured by concrete experience with space (including experience with culturally specific spatial and linguistic cues). In addition to time, a variety of abstract domains also depend upon the concrete domain of space, including affect, social status, personality traits, etc. (Lakoff and Johnson, 1980), raising the possibility that these domains may be connected to time via shared spatial schemas. Thus, if people understand abstract concepts, such as personality or time, in terms of more concrete domains, such as space, and if multiple abstract concepts can borrow from the same source domain, it can be predicted that there should be a link between the seemingly unrelated but similarly embodied abstract domains of personality and time.

Interestingly, few investigations have attended to personality factors that could potentially influence implicit space-time mappings. However, a separate line of research on the resolution of ambiguous temporal statements suggests that individual differences in personality play a role in influencing how people think about time. In one study, Duffy and Feist (2014: Experiment 2) focused on individual differences in procrastination and their relation to temporal perspective. According to their definitions, procrastination entails an agent moving a task or set of tasks into the future, in line with the Moving Ego perspective, while prioritisation is associated with conscientiousness which entails the movement of tasks towards the ego, in line with the Moving Time perspective. To test this, the researchers administered a

questionnaire for measuring trait conscientiousness (John, 1990) and trait procrastination, and the Next Wednesday's meeting question (e.g., *Next Wednesday's meeting has been moved forward 2 days. Which day is the meeting now that it's been moved?*, cf. McGlone and Harding, 1998). Consistent with the predictions, participants who adopted the Moving Time perspective (responding "Monday") evidenced significantly higher scores for conscientiousness than participants who adopted the Moving Ego perspective (responding "Friday").

Further experiments conducted in a range of real life settings (e.g., travelling to work on time, submitting assignments on time) have confirmed these preliminary findings. For instance, Duffy, Feist and McCarthy (2014) moved beyond self-assessment of timeliness, investigating the relationship between objectively observable on-time behavior and resolution of a temporal ambiguity. In one experiment, Duffy, Feist and McCarthy (2014: Study 3) compared the differences in temporal perspective between participants who arrived early for their appointment and those who arrived late. In line with earlier findings, participants who met their obligations later on average were more likely to adopt the Moving Ego perspective than those who adopted the Moving Time perspective. Thus, this confirmed the generalizability of earlier findings with more objectively measureable behaviors.

It should be noted that conscientiousness does not only involve the movement of tasks "forward" toward the present (in line with the Moving Time perspective), but also involves regularly thinking about future consequences before making a decision (Thompson, 2008; Zimbardo and Boyd, 2008). Past studies have consistently demonstrated that there is a strong connection between conscientiousness and future time perspective – an individual's view of his or her psychological future existing at a given time. In a seminal study, Zimbardo and Boyd (1999) investigated the connection patterns between time perspective and Five Factor personality traits. Results showed that future time perspective had positive correlation with conscientiousness. Similar findings were reported in subsequent studies (see e.g.,

Adams and Nettle, 2009; Dunkel and Weber, 2010; Zhang and Howell, 2011). Conscientiousness is also a strong predictor for people's future-oriented behaviors in real life. For instance, a direct health benefit of being a highly conscientious individual is the greater tendency to choose long-term health management, which is associated with his or her career success and longevity (Kern and Friedman, 2008; Kern et al., 2009).

Although the aforementioned research reveals that conscientiousness is associated with future-oriented thinking, sparse research has investigated its effect on implicit space-time mappings. If people's spatial conceptions of time are conditioned by their temporal focus as the TFH proposes, it can be hypothesized that people who conceptualize the future as in front of them should evidence higher conscientiousness scores than those who conceptualize the past as in front of them. To test this, three studies were conducted in laboratory and field settings. In Study 17, I investigated the relationship between self-reported conscientiousness scores and implicit space-time mappings. In Studies 18 and 19, to investigate whether these relationships have force in real life, I examined the role of conscientiousness in affecting students' and non-students' implicit space-time mappings by measuring individuals' punctuality, which is one of the most important behaviors associated with conscientiousness (see e.g., Ashton, 1998; Back, Schmukle and Egloff, 2009; Church et al., 2007; Duffy, Feist and McCarthy, 2014; Roberts et al., 2004).

Study 17 Self report

Based on the findings about the interplay between personality trait and temporal reasoning and in conjunction with insights from earlier lines of research suggesting a link between conscientiousness and future-oriented thought, Study 17 investigates whether individual differences in conscientiousness contribute to a person's temporal focus and, hence, to the direction of implicit space-time mappings. It is predicted that

people who tend to be more future-focused and think about time according to the future-in-front mapping will score higher on the trait of conscientiousness than those who are more past-focused and think about time according to the past-in-front mapping.

10.2 Method

10.2.1 Participants

120 undergraduate and graduate students participated in this experiment for a small reward, with an age range of 17 to 24 years and a mean age of 20.5 years. 57 participants were male and 63 were female. All participants were native speakers of Chinese.

10.2.2 Materials and procedure

Following informed consent, all participants completed a three-part questionnaire using pen and paper while sitting down in a quiet room. Part 1 of the questionnaire was a Chinese version of the Time Diagram Task adapted from de la Fuente et al. (2014, Experiment 1). In Part 2 of the questionnaire, all participants rated their agreement with 9 conscientiousness statements such as "*I make plans and follow through with them*" on a five-point Likert scale from '1 = Strongly disagree' to '5 = Strongly agree', from a Chinese version of the Big Five Inventory (Leung et al., 2013). The final part of the questionnaire consisted of the TFS.

10.3 Results and discussion

46.7% of participants responded according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind

him. This rate was not significantly different from chance, p = .52 (a sign test, N = 120), which suggests that Chinese people showed no bias for the past/future-in-front mapping. Participants' responses to conscientiousness statements were analyzed using t-test. The results showed that participants who conceptualized the future as in front of them averaged significantly higher conscientiousness scores (M = 3.60; SD = 0.67) than participants who conceptualized the past as in front of them (M = 3.23; SD = 0.42), t (118) = 3.54, p < .001, d = 0.65, in line with the predictions.

According to a mixed ANOVA with Group (past-in-front mapping vs. future-in-front mapping) as a between-subjects factor and Temporal Focus (Past focus vs. Future focus) as a within-subjects factor, temporal focus differed significantly between the past-in-front mapping group and the future-in-front mapping group, as indicated by a significant interaction of Temporal Focus and Group, $F(1,118) = 20.43$, $p < .001$, η_p^2 = .15 (Figure 20). Consistent with the TFH, the past-in-front mapping group showed greater agreement with past-focused statements than the future-in-front mapping group (p = .002), and the future-in-front mapping group showed greater agreement with future-focused statements than the past-in-front mapping group (p =.001).

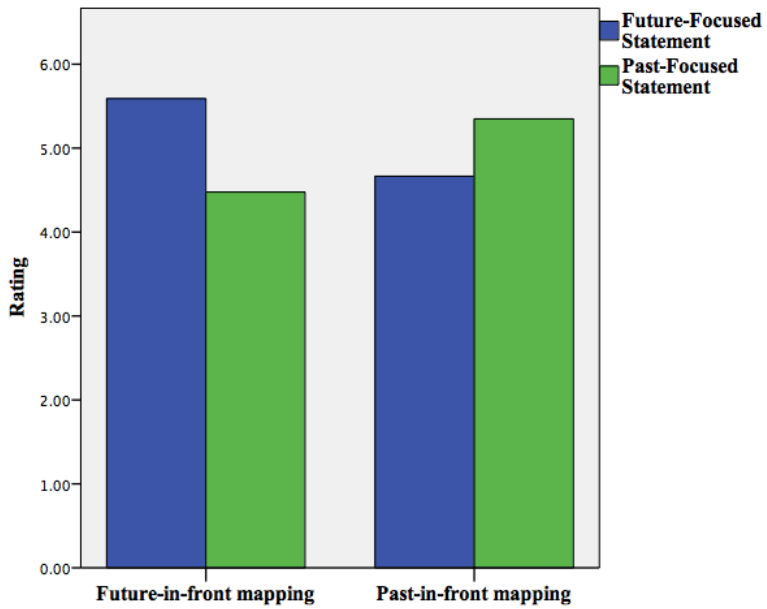

Figure 20 Average agreement on Temporal Scale for participants choosing the future-in-front mapping and past--in-front mapping in Study 17

Study 18 Submission time

Although Study 17 provides initial evidence that conscientiousness is associated with the future-in-front mapping, it suffers one important limitation; that is, the reliance on participants' self-reports. Participants may be dishonest or lack the introspective ability to provide an accurate response to questions regarding their personality traits (Austin et al., 1998; Balakrishnan, 1999). Thus, it would be more convincing to use objectively observable a real-world reflex of conscientiousness. To this end, Study 18 made use of on-time submission of assignments data, an objective measure of conscientiousness that was used in Duffy, Feist and McCarthy (2014: Experiment 2) to investigate the relationship between conscientiousness and implicit space-time mappings.

Study 18 investigated whether students submitting their assignment further in advance of the deadline would spatialize time differently from students submitting their assignment closer to the deadline. Consistent with the correlations between conscientiousness and future-oriented thought and with the results of Study 17, it is predicted that students who tend to be more future-focused and think about time according to the future-in-front mapping will be more likely to submit their assignment further in advance of the deadline than those who think about time according to the past-in-front mapping

10.4 Method

10.4.1 Participants.

160 undergraduate and graduate students participated in this experiment, with an age range of 17 to 24 years and a mean age of 20.1 years. 79 participants were male and

81 were female. All participants were native speakers of Chinese from Mainland China.

10.4.2 Materials and procedure

All participants were required to submit their essay writing assignments via emails for mid-term examinations. Following informed consent, participants were asked to complete the Time Diagram Task and the Temporal Focus Scale as in Study 17.

10.5 Results and discussion

46.9% of participants responded according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind him. This rate was not significantly different from chance, p = .48 (a sign test, N = 160), which also suggests that Chinese people showed no bias for the past/future-in-front mapping. Participants' submission times were analyzed using t-test. The results showed that participants who conceptualized the future as in front of them were submitting their assignment more in advance of the deadline (M = 91 min prior; SD = 42 min) than participants who conceptualized the past in front of them (M = 55 min prior; SD = 36 min), t (158) = 5.78, $p < 0.001$, d = 0.91.

According to a mixed ANOVA with Group (past-in-front mapping vs. future-in-front mapping) as a between-subjects factor and Temporal Focus (Past focus vs. Future focus) as a within-subjects factor, temporal focus differed significantly between the past-in-front mapping group and the future-in-front mapping group, as indicated by a significant interaction of Temporal Focus and Group, $F(1,158) = 18.06$, $p < .001$, η_p^2 = .10 (Figure 21). Consistent with the TFH, the past-in-front mapping group showed greater agreement with past-focused statements than the future-in-front mapping

group (p = .004), and the future-in-front mapping group showed greater agreement with future-focused statements than the past-in-front mapping group (p = .002).

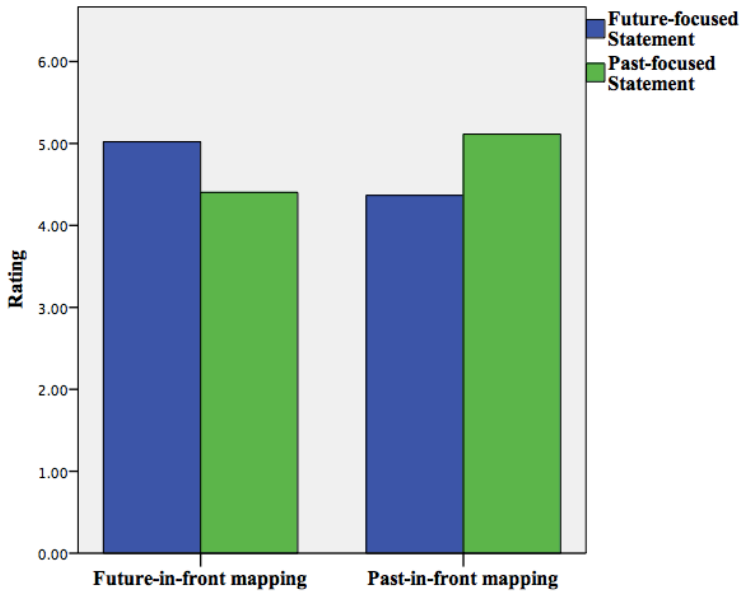

Figure 21 Average agreement on Temporal Scale for participants choosing the future-in-front mapping and past--in-front mapping in Study 18

Study 19 Time of arrival

In Studies 17 and 18, the connections between conscientiousness scores and implicit space-time mappings have been observed in laboratory and real life contexts. However, the two experiments only sampled student populations, who may not be representative of the adult population at large (Henrich, Heine and Norenzayan, 2010). In order to more clearly focus on the role of conscientiousness in this study, participants were recruited from a more diverse cross-section of society.

10.6 Method

10.6.1 Participants

180 non-student adults participated in this experiment, with an age range of 18 to 60

years and a mean age of 37.4 years. 87 participants were male and 93 were female. All participants were native speakers of Chinese from Mainland China.

10.6.2 Materials and procedure

Participants were asked to arrive at a specified meeting point at the required time. The arrival time of each participant was recorded by the experimenter. Following Duffy, Feist and McCarthy (2014: Experiment 3), lateness was calculated by time-lag minutes between the experiment appointment time and the time of each participant's arrival and earliness was calculated by time-lag minutes between the experiment appointment time and the time of each participant's arrival multiplied by -1 (cf. Back et al., 2006); hence, positive scores indicate late arrival and negative scores indicate early arrival (e.g., 10 min late; 0 min on time; -10 min early). Following informed consent, participants were asked to complete the Time Diagram Task and the TFS as in Studies 17 and 18.

10.7 Results and discussion

The time of arrival ranged from 20 min early to 22 min late. On average, participants arrived 1.42 min before their appointment time (SD = 7.78). 101 participants were early, 0 were exactly on time, and 79 were late. 42.2% of participants responded according to the past-in-front mapping, placing the past event in the box in front of the character and the future event in the box behind him (p = .044 by sign test, N = 180). Participants who conceptualized the future as in front of them arrived earlier on average (M = -3.69; SD = 6.95) than participants who conceptualized the past as in front of them (M = 1.69; SD = 7.69), t (178) = 4.85, p < .001, d = 0.73. According to a mixed ANOVA with Group (past-in-front mapping vs. future-in-front mapping) as a between-subjects factor and Temporal Focus (Past focus vs. Future focus) as a within-subjects factor, temporal focus differed significantly between the past-in-front

mapping group and the future-in-front mapping group, as indicated by a significant interaction of Temporal Focus and Group, $F(1, 178) = 22.16$, $p < .001$, $\eta_p^2 = .11$ (Figure 22). Consistent with the TFH, the past-in-front mapping group showed greater agreement with past-focused statements than the future-in-front mapping group ($p = .004$), and the future-in-front mapping group showed greater agreement with future-focused statements than the past-in-front mapping group ($p = .003$).

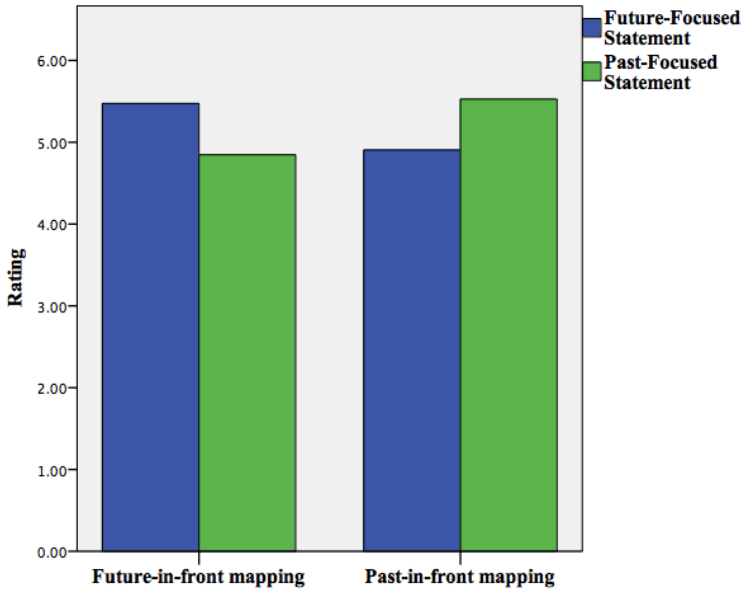

Figure 22 Average agreement on Temporal Scale for participants choosing the future-in-front mapping and past--in-front mapping in Study 19

10.8 Chapter Discussion

Across the three studies, it was found that a high level of conscientiousness was generally associated with the future-in-front mapping in people's mental models. In Study 17, I investigated whether self-reported conscientiousness scores positively correlate with a person's spatial conceptions of time. The findings showed that participants who tended to think about time according to the future-in-front mapping evidenced higher degrees of conscientiousness, whereas participants who tended to think according to the past-in-front mapping evidenced lower degrees of conscientiousness. In Studies 18 and 19, I moved beyond self-assessment regarding

personality traits, investigating whether the relationship between conscientiousness and implicit space-time mappings has force in real life. Relying on the objectively measureable on-time behavior, while Study 18 examined whether students submitting their essays further in advance of the deadline would spatialize time differently from students submitting their essays closer to the deadline, Study 19, focusing specifically on a new non-student population, examined the relationship between conscientiousness and implicit space-time mappings for a scheduled appointment. Consistent with earlier findings, I found in both cases that participants who conceptualized the future as in front of them met their obligations earlier on average than participants who conceptualized the past as in front of them and, thus, extending earlier findings to real life contexts.

Recently, an emerging body of recent research has begun to investigate the effects of personality on time representations. For instance, Hauser, Carter and Meier (2009) showed that individuals demonstrating higher degrees of anger were more likely to adopt the Moving Ego perspective in the interpretation of ambiguous temporal statement. In a more recent study, Duffy and Feist (2014) showed that extroverts and introverts exhibit differences in the resolution of Wednesday's meeting question; while the former who adopted an active approach to time were more likely to respond "Friday" (consistent with the Moving Ego perspective), the latter who adopted a passive approach to time were more likely to respond "Monday" (consistent with the Moving Time perspective). Based on the interplay between personality and temporal reasoning, this chapter has provided first evidence for the association between conscientiousness and implicit space-time mappings.

This research contributes to the time cognition literature by offering a new perspective that personality factors such as conscientiousness related to future time perspective can potentially affect implicit space-time mappings. This chapter thus expands the scope of possible factors (e.g., conscientiousness) that could influence people's spatializations of time and explains why people who evidence a higher level

of conscientiousness are more likely to conceptualize the future as in front of them.

According to the TFH, people's implicit space-time mappings are shaped by their attentional focus. In line with earlier findings, the current research showed the effect of conscientiousness on future time perspective. Moreover, the results showed that temporal focus can predict variation in space-time mappings. Across all three experiments, people with a higher level of conscientiousness, who were more likely to be future-focused compared to individuals with low levels of conscientiousness, were also more likely to produce a future-in-front mapping; thus, it provides converging evidence for the TFH.

Nevertheless, some caution is warranted in interpreting these results, given the limitations of the correlation study. First, the results confirm previous findings that the overall proportion of past-in-front or future-in-front responses in Chinese people was not significantly different from chance (Gu et al. 2016). It is thus possible that the findings reported here depend critically on the use of Chinese samples, because they fall at about the middle of the scale in the Time Diagram Task. For people in other cultures, their strong bias for certain space-time mapping (e.g., the percentage of future-in-front mapping is over 80% in Spaniards, see de la Fuente et al. 2014) may leave less room for individual differences. Future studies might investigate whether these findings are generalizable to other cultures where there is a greater polarization in space-time mappings. Second, the quasi-experimental designs are incapable of establishing proof of a causal relationship in observed associations. Finally, although punctuality has been demonstrably related to associated with conscientiousness in previous research, it only represents a dimension of conscientiousness. It is certainly true that conscientiousness is not solely evidenced by punctual behaviors but also seen in many other facets such as competence, order, dutifulness, achievement striving, self-discipline, and deliberation (Costa, McCrae and Dye, 1991).

Chapter 11. Discussion

11.1 Introduction

According to the CMT, conceptual metaphor is at the center of a complex theory of how the physical activity in the brain gives rise to human concepts and human language, and how cognition is shaped by aspects of the body (Croft and Cruse, 2004; Kövecses, 2002, 2015; Lakoff and Johnson, 1980, 1999). A conceptual metaphor, with a set of correspondences, involves the understanding of one conceptual domain, a source domain, in terms of another conceptual domain, namely a target domain. Metaphorical thinking enables us to reason and talk about abstract concepts in terms of the knowledge and language associated with concrete processes (Lakoff, 1993; Lakoff and Johnson, 1980). In other words, conceptual metaphors, with their cross-domain mappings, directly link two kinds of experience: perceptuo-motor interactions with the physical world (e.g., SPACE) and subjective experience (e.g., TIME) that co-occur regularly in our daily life, giving rise to a mental mapping between two conceptual domains. Thus, for instance, when we pass through the physical space, our sense of distance is related to time which yields the conceptual metaphor "TIME IS SPACE".

The results of previous studies investigating the psychological reality of CMT provided supporting evidence for the universality of spatial metaphors for time (e.g., Boroditsky, 2000). However, the findings reported in the current thesis argue against the assumption made by Lakoff and Johnson (1980), in which the directions of space-time mappings in people's minds are universal and fixed across cultures and individuals. By contrast, the data presented in this thesis demonstrate crosslinguistic, cross-cultural, and cross-individual variation in spatial mappings for temporal experience. For instance, the conceptual mappings between space and time that are deeply entrenched and highly automatic can be changed or even reversed in a matter of minutes.

In the past few decades, cognitive scientists and social psychologists have carried out a large number of experimental studies that confirm various experiential correlations between space and time as being cognitively real. Such correlations between these two kinds of embodied experience can be summarized as three over-arching manifestions (Athanasopoulos et al., 2017: 295). The first type is "motion through time" in which ego-moving metaphors and time-moving metaphors exert an influence on time reasoning (e.g., Boroditsky, 2000; Duffy and Feist, 2016; Hauser et al., 2009; Núñez, 2007; Richmond et al., 2012; Sullivan and Barth, 2012). The second is "temporal succession" and its representations on the sagittal, lateral and vertical axes used to sequence events (e.g., Boroditsky, 2000; Bottini et al., 2015; Miles et al., 2010, 2011; Sell and Kaschak, 2011; Stocker et al., 2016; Núñez and Cooperrider, 2013). The third is "temporal duration", which focuses on the metaphors used to describe the duration of a given event and their influence on event individuation (e.g., Bylund and Athanasopoulos, 2017; Casasanto and Boroditsky, 2008). In general, the results of these experimental studies, despite with somewhat different interpretations, consistently lend support to the basic assumption of the CMT that time as an abstract concept is dependent on our embodied conceptualization (e.g., Gallese and Lakoff, 2005; Gibbs, 2006; Lakoff, 2012; Matlock, 2004; Zwaan, 2009; Zwaan and Taylor, 2006).

More recently, the TFH posits that the directions of front/back-time mappings are shaped by people's attentional focus, according to which thinking abstractly involves mental simulation of bodily experiences in metaphorical terms. That is, in people's mental models, they should place in front of them whichever pole of the space-time continuum they tend to "focus on" metaphorically – locating it where they could focus on it literally with their eyes as though events in time were visible objects (de la Fuente et al., 2014). In addition to this, a body of research lays testament to the ways in which cultural and individual differences systematically shape how people think about time. For instance, it has been shown that people tend to spontaneously create space-time mappings that are consistent with cultural attitudes toward time, such that

Moroccans tend to conceptualize the past as in front of them because they focus more on the past, whereas Spaniards will tend to conceptualize the future as ahead of them because they have a greater focus on the future (de la Fuente et al., 2014: Experiment 1).

While the original research testing the TFH has been focused primarily on comparing Spaniards and Moroccans, other lines of research investigating the factors motivating our understanding of metaphoric statements about time provide converging evidence that human's conceptualizations of time are highly adaptive and result from a combination of contextual and individual factors. Combining these two separate lines of research, namely research investigating factors influencing mental representations of time and research investigating the high malleability of the time cognition system, this thesis extends prior work on the spatializations of time, uncovering the cognitive mechanism of time representations. In this thesis, a series of studies were conducted to examine further the range of factors that may influence the ways in which people implicitly associate the concepts "past" and "future" with "front" and "back", focusing specifically on cultural and individual differences. In this chapter, an overview of the findings of these studies will be presented. The theoretical, methodological and practical implications for cognitive science are discussed, as are the strengths and limitations of the thesis. In addition, in efforts to cultivate transdisciplinary interchange between theoretical and experimental research in the field of cognitive linguistics, new directions for further study are suggested.

11.2 Overview: Part II

11.2.1 Chapter 3:

The original research testing the TFH mainly used cross-cultural comparisons in which the cultures compared differ in attentional focus on temporal events (de la Fuente et al., 2014). However, these populations may also differ along other cultural

dimensions, among a host of other cultural differences that may affect differences in spatial conceptions of time. Thus, the specific role of cultural attitudes toward time has not been tested. To address this issue, Study 1 compared Southern and Northern Vietnamese people who have many aspects in common but demonstrate cultural differences in attitudes toward the past and the future. The results showed that the two groups of participants tended to think about time according to their temporal focus respectively. Specifically, Southern Vietnamese people, who were more likely to be future-focused compared to Northern Vietnamese people, were also more likely to produce a future-in-front mapping. This pattern of results showed that within-cultural differences in temporal focus can also predict variation in space-time mappings, which provided further supporting evidence for the TFH and extended the generalizability into an Asian population.

11.2.2 Chapter 4:

Next, based on the predictions made by some psychologists (see e.g., Caprara & Zimbardo, 2004; Jost et al., 2003) who suggest that conservatives tend to endorse tradition and are more past-focused while liberals prefer progressive change and are more future-focused, Study 2 hypothesized that these differences may influence people's spatializations of time. The predicted result was that conservative individuals, who focus more on the past and preserve traditions, may conceptualize time quite differently to those who have greater focus on the future and prefer progressive change, such as liberal individuals. As predicted, Chinese conservatives, who showed more agreement with past-focused statements, were more likely to conceptualize the past as in front of them, whereas liberals, who showed more agreement with future-focused statements, were more likely to conceptualize the future as in front of them. These results support the TFH and reveal a relationship between political attitudes and implicit space-time mappings.

11.2.3 Chapter 5:

Whereas previous studies have demonstrated that culture exerts an important influence on people's spatialization of time (see e.g., de la Fuente et al., 2014), Chapter 4 demonstrated that a specific dimension of culture such as politics, may show the same effect. Building on this, in Chapter 5, four studies were conducted, focusing specifically on religion, another prominent layer of culture, as potential additional influences on space-time mappings. To begin with, Studies 3 and 4 compared the patterns of implicit space-time mappings in two religious groups, namely Buddhists and Taoists. It was predicted that Buddhists characteristically believing in karma (the past affects one's future) and assigning greater value to the past, were more likely to conceptualize the past as ahead of them and the future as behind them. By contrast, Taoists, who consider immortality as a more achievable goal and attribute more importance to the future, were more likely to conceptualize the future as ahead of them and the past as behind them. As predicted, the results showed that Buddhists tended to be more past-focused and more frequently conceptualized the past as ahead of them and the future as behind them. By contrast, Taoists, who were more likely to be future-focused, tended to exhibit the opposite space-time mapping, conceptualizing the future as in front of them and the past behind. Moving beyond correlational evidence, Study 5 investigated the causal role of religious experiences in influencing the direction of front-back time mappings in Buddhists' minds. To test this, Buddhist were randomly assigned to visualize the picture of the Buddhas of the Past (Buddha Dipamkara) or the Future (Buddha Maitreya). Results showed that the pictorial icon of Dipamkara increased participants' tendency to conceptualize the past as in front of them. By contrast, the pictorial icon of Maitreya induced participants to focus more on the future, causing a dramatic increase in the rate of future-in-front responses. In Study 6, the causal effect of religion on implicit space-time mappings was replicated in atheists. In sum, the results from Chapter 5 provide further evidence of the range of cultural differences that may influence how people associate temporal events with front-back space in their minds, confirming the hypothesized causal role

of religion for temporal focus in determining space-time mappings.

11.2.4 Chapter 6

Moving beyond factors that are tied to culture or subculture differences, other lines of research investigating the metaphoric representation of time have suggested that individual differences, and specifically age-related differences may also influence how people spatialize time in their mental models, thus providing new insights on the relationship between attention focus and its resulting space-time mappings (de la Fuente et al. 2014: Experiment 3). In Chapter 6, three studies were conducted to investigate the relationship between real life experiences, temporal focus and implicit space-time mappings.

To begin with, Study 7 investigated whether educational backgrounds with different time preferences might influence people's space-time mappings, by comparing the students in the departments of history and archeology, who are likely more engaged in the notion of past, with those from the departments of computer sciences and electronic engineering, who are likely more engaged in the notion of future. Consistent with the predictions, students majoring in history and archeology, engaged in an intermediate-term training with the ability to identify different types of sources of historical knowledge, allocated more importance to the past showing a tendency to produce a past-in-front mapping. In contrast, students majoring in computer sciences and electronic engineering, who are sensitive to the rapid development and the innovation of the information era, were more likely to focus more attentions on the future and thus tended to produce a future-in-front mapping, supporting the TFH.

Employing a larger and more diverse sample, Study 8 turned to a long-term living experience investigating its role in influence people's attitudes toward time. Hutong, the symbol of the long history of Beijing city, is the ancient street extending to the

residence area in Beijing. By contrast, Modern apartment buildings, fashionably designed and well equipped, represent the modern lifestyle. In light of these differences, it is predicted that Hutong residents should be more likely to be past-focused and produce a past-in-front mapping, whereas residents in modern apartment buildings should be more likely to be future-focused and produce a future-in-front mapping. As predicted, the results showed that Hutong residents conceptualize time according to the past-in-front mapping, while residents in modern apartment buildings appeared to conceptualize time according to the future-in-front mapping.

Studies 7 and 8 examined how intermediate and long-term real life experiences may influence people's attitudes toward time and the resulting space-time mappings. The earlier study also suggests that short-term training may likewise be responsible for the temporal focus and thus the space-time mappings (de la Fuente et al. 2014: Experiment 5). Building on these findings, Study 9 investigated whether a short-term visiting experience would also influence people's spatial conceptions of time. Based on the assumptions that ancient art exhibitions are rooted with history and modern art exhibitions are full of forward-thinking, it was hypothesized that participants visiting the former should show a higher likelihood of being past-focused, whereas participants visiting the latter should show a higher likelihood of being future-focused. In line with earlier findings, while the participants visiting ancient art exhibitions tended to conceptualize the past as in front of them, participants who visited modern art exhibitions were more likely to conceptualize the future as in front of them.

In sum, building on recent research findings, and the basic assumption of the TFH that people's implicit space-time mappings are shaped by their attentional focus, the results from Chapter 6 provide further evidence of the range of individual differences that may influence how people implicitly associate the past and future with space, while also providing initial evidence that individual differences in real-life contexts at different time scales may influence how people spatialize time; thus, it suggests that

previously unexplored real life experiences concerning past and future events may play a role in influencing people's conceptualization of time.

11.2.5 Chapter 7

The focus of Chapter 7 turned to factors that are more tightly tied to the inner change of individuals. Study 10 tested whether pregnancy can affect Chinese women's temporal focus and thereby influence their space-time mappings. One of the most striking characteristics of pregnant women noted by previous research is their future-oriented thought, because they pay much attention to the expected development of their children, such as the health status of fetus (Sjögren, 1997; Yamamoto, 1995). Based on this, it was predicted that pregnant women should be more future-focused. Concordant with this prediction, the results showed that pregnant women tended to be more future-focused than non-pregnant women and also demonstrated a greater tendency to conceptualize the future as in front of them, supporting the TFH. The current research offers a new perspective that culture-external factors such as pregnancy can also influence people's spatializations of time.

11.2.6 Chapter 8

Study 10 provides preliminary evidence that pregnancy as a temporal landmark may contribute to women's change of temporal focus and thereby influence their spatializations of time. However, in real life, people do not only have temporal landmarks denoting the beginning of a new cycle but have others referring to occurrences of past events. In light of these considerations, in Chapter 8, three studies were conducted to explore the relationship between temporal landmarks and people's spatial conceptions of time by conducting a large-scale test in student and non-student Chinese populations.

To begin with, Study 11 investigated students' temporal focus and space-time mappings on the final exam's day and the registration day of a new semester, which served as distinct temporal landmarks in the academic cycle. Specifically, a final examination is a test given to high school, college and university students at the end of a course or training. The purpose of the test is to make a final review of the topics covered and assessment of each student's knowledge of the subject. In addition, grades of final examinations usually reflect and are influenced by the experience and achievements of one's past study (Halperin and Abrams, 1978). By contrast, the frequency of engagement in aspirational behavior such as physical exercise increases significantly at the beginning of a new academic semester, suggesting that the first few days listed on the academic calendar are linked to goals that students consider pursuing in the future. The results showed that there was a difference between the student examinees and student registrants, with the former showing a likelihood to think about time according to the past-in-front mapping and the latter doing so according to the future-in-front mapping. These findings suggest that these different associations between personal temporal landmarks with past or future time periods influence people's space-time mappings.

Next, by using a larger and more diverse sample, Study 12 explored the influence of calendar markers on people's temporal focus and the resulting space-time mappings. The results showed that the participants tested on the Chinese New Year's Day, a symbol of a fresh start, demonstrated a greater tendency to conceptualize the future as in front of them, while those tested on the Tomb Sweeping Day, an opportunity for celebrants to remember and honor their ancestors, were more likely to conceptualize the past as in front of them.

Finally, to further test the causal role of temporal landmarks in influencing people's implicit space-time mappings, Study 13 manipulated the psychological meaning associated with a temporal mark. Two scenarios representing past or future landmarks correspondingly, namely twenty-year-service anniversary and moving to a new city,

had been presented to participants before their temporal focus and space-time mappings were measured. Concordant with earlier findings, the results showed that the past-focused scenario caused an increase in the rate of past-in-front responses; the future-focused scenario caused an increase in the rate of future-in-front responses. Taken together, the results from Chapter 8 suggest that people's conceptions of time may vary according to temporal landmarks and those changes could be explained by the TFH.

11.2.7 Chapter 9

The aim of Chapter 9 was twofold. The first aim was to investigate whether time of day influences people's implicit space-time mappings. The second aim of the study was to examine a possible mediating role of chronotype processes. There are many examples of social groups in which people tend to be more future-focused in the morning. These examples highlight the relationship between the 24-hour cycle and the temporal focus of social members. Based on these observations, it was predicted that when people are tested in the morning, they should be more future-focused and thus be more likely to produce a future-in-front mapping, compared with people tested in the afternoon.

To begin with, in Study 14, participants voluntarily signed up for a morning session (between 9 a.m. and noon) or an afternoon session (between noon and 5 p.m.) to complete the Time Diagram Task and Temporal Focus Scale. Of the participants signing up for the morning sessions, more than half (61%) responded according to the future-in-front mapping, placing the future in the front box. By contrast, of the participants signing up for the afternoon sessions, only 45.9% produced a future-in-front response. These findings of the study, although preliminary, provide evidence that Chinese people, on average, tend to be more future-focused in the morning than in the afternoon and thus are more likely to conceptualize the future as

in front of them in the morning, supporting the TFH.

However, the design of Study 14 is quasi-experimental – participants self-selected a morning or afternoon session. An alternative explanation for these findings is that people who focus more on future events, as compared to past-focused people, are more likely in general to sign up for morning sessions. To distinguish these possibilities, Study 15 randomly assigned people to morning and afternoon conditions, aiming to replicate the findings of Study 14. In line with earlier findings, the results showed that of the participants assigned to the morning sessions, 62% responded according to the future-in-front mapping, placing the future in the front box. By contrast, of the participants assigned to the afternoon sessions, only 46% produced a future-in-front response, as predicted on the basis of the TFH.

It should be noted that Study 14 and 15 did not factor chronotype into designs, which may mask the fact that not every person's biological clock keeps the same time or even the same pace. For instance, evening people may not demonstrate their preference for future-focused thinking in the morning. Since evening types are less active in the morning and stays awake at night, they should be more likely to make their plans in the afternoon in contrast to morning types. Study 16 examined the interaction between a person's chronotype, time-of-day and spatial conceptions of time. It was predicted that chronotype processes would influence people's implicit space-time mappings by mediating the morning future-minded effect for evening people. As predicted, morning people were more likely to think about time according to the future-in-front mapping in the morning than in the afternoon, replicating the findings of Studies 14 and 15. Evening people, however, were more likely to think about time according to the future-in-front mapping in the afternoon than in the morning. Taken together, the findings from Chapter 9 provide additional evidence that people's representations of time may arise from an interaction between a person's chronotype and time-of-day, a phenomenon that is referred to as the chronotype future-minded effect.

11.2.8 Chapter 10

Prior work suggests that individual differences in personality play a role in influencing how people think about time (Duffy et al., 2014; Hauser et al., 2009; Richmond et al., 2012). In other lines of research, it has also been shown that conscientiousness is associated with future-oriented thinking (Adams and Nettle, 2009; Dunkel and Weber, 2010; Zhang and Howell, 2011; Zimbardo and Boyd, 1999). If people's spatial conceptions of time are conditioned by their temporal focus as the TFH proposes, it can be hypothesized that people who conceptualize the future as in front of them should evidence higher conscientiousness scores than those who conceptualize the past as in front of them. To test this, Chapter 10 investigates whether individual differences in conscientiousness exert additional influences on implicit spatializations of time. To begin with, Study 17 investigated whether individual differences in conscientiousness contribute to a person's temporal focus and, hence, to the direction of implicit space-time mappings. It was predicted that people who tend to be more future-focused and think about time according to the future-in-front mapping will score higher on the trait of conscientiousness than those who are more past-focused and think about time according to the past-in-front mapping. In line of the predictions, the results showed that the participants who conceptualized the future as in front of them averaged significantly higher conscientiousness scores.

Although Study 17 provides preliminary evidence that conscientiousness is associated with the future-in-front mapping, the participants' conscientiousness scores were mainly tested according to their self-report. One limitation of this research is external validity. It is unclear whether this effect has the same force in real life context. To address this question, Study 18 made use of on-time submission of assignments as an objective measure of conscientiousness to investigate the relationship between

conscientiousness and implicit space-time mappings. The results showed that the students conceptualizing the future as in front of them were more likely to submit their essays earlier than those who submitted their essays later.

In Studies 17 and 18, the connections between conscientiousness scores and implicit space-time mappings have been observed in laboratory and real life contexts. However, the two experiments only sampled student populations, who may not be representative of the adult population at large (Henrich et al., 2010). In order to more clearly focus on the role of conscientiousness, participants were recruited from a more diverse cross-section of society in Study 19. The results showed that the participants who arrived early for their appointments exhibited a higher degree of conscientiousness than those who arrived late for their appointments, suggesting that a high level of conscientiousness was generally associated with the future-in-front mapping in people's mental models.

11.2.9 General remarks

Despite the ample evidence for the influence of temporal language on temporal thought based on the preponderance of the published literature (e.g., Boroditsky, 2001; Boroditsky et al., 2011; Fuhrman et al., 2011; Lai and Boroditsky, 2013; Miles et al., 2011), an emerging body of research suggests that people may not think about time as their language suggests (Casasanto, 2016; Casasanto and Jasmin, 2012). To elucidate this striking dissociation, de la Fuente et al. (2014) turned to aspects of attentional focus as a means of exploring the observed dissociation between space-time mappings in people's language and thought. Research has provided evidence that cultural attitudes can influence how people implicitly associate temporal events and sagittal space, providing supporting evidence for the TFH. In a further test of the TFH, the results showed that beyond explaining cross-cultural differences, temporal focus can also predict age-related differences in space-time mappings within a culture.

By building on and extending the findings of prior research, this thesis serves to shed new light on the fluid nature of time representations, aiming to evaluate and advance the current version of the TFH. This research contributes to the literature in three important aspects. First, the results demonstrate that the direction of the front-back time mapping in people's minds is shaped by a convergence of factors, ranging from (sub)cultural differences and contextual features (e.g., temporal landmarks) to individual differences (e.g., pregnant experience), as well as their interactions. These findings are concordant with other lines of cognitive linguistic research investigating people's interpretation of an ambiguous temporal question, which demonstrate that a person's conceptualization of time likely results from a complex of factors.

In line with earlier findings that culture and age-related differences can influence the ways in which people associate past and future events with front-back space, this thesis represents the first attempt to reveal a range of unexplored factors such as religion, political ideology, temporal landmarks as potential contributors to the direction of space-time mappings in people's minds. For instance, there have been sporadic publications on time metaphors in religious populations (Happel, 2002). The present thesis constitutes the first study investigating these varieties of space-time mappings in which they have emerged, from both linguistic and psychological perspectives.

Second, the present work contributes to the cognitive psychology literature by providing converging evidence for the highly fluid nature of the human cognition system. There are no metaphorical mappings between space and time that are stable across time and shared across individuals. The findings from the present thesis have shown that space-time mappings may vary: 1) from person to person and group to group; 2) from one moment to the next; 3) from one pattern to the next within an individual. These experimental data demonstrating cross-cultural, cross-linguistic and cross individual variations in space-time mappings appear to be at odds with the basic

tenet of Conceptual Metaphor Theory that primary metaphors are based on fixed conceptual mappings between two distinct dimensions of recurring and universal embodied experiences (Lakoff and Johnson, 1999: 47, 56-57).

Contrary to the view regarding the space-time mappings in a context-independent manner, a spate of recent findings put emphasis on the importance of context and a dynamic pattern of language and thought (e.g., Barsalou, 1982, 1987, 2009; Churchland, 1986; Clark, 1996, 1997; Elman, 2004, 2009; Evans, 2009; Hampton, 2012; Machery, 2009; Prinz, 2002; Rogers and McClelland, 2004; Spivey, 2007; Taylor and Zwaan, 2009). On these theoretical accounts, mental representations of time are flexible and can be rapidly remodulated when people are exposed to new patterns of experience such as learning a foreign language, encountering another culture or being aware of a peculiar bodily experience. It can be concluded that the human conceptualization system is highly adaptive and flexible. The state of such a system at any given time is critically dependent on the interactions with physical, social and linguistic contexts in which it is instantiated.

Third, the current thesis sheds light on the cognitive mechanisms of ad hoc cognition, providing a more fully explanatory framework for the metaphoric representation of time. How can these space-time mappings form and change so quickly in response to verbal, non-verbal (e.g., hand gestures), exogenous (e.g., temporal landmarks) or endogenous (e.g., pregnancy) experiences? According to the Hierarchical Mental Metaphor Theory, the remarkable flexibility of the mental metaphors of time arises from the existence of a hierarchy of implicit associations based on different influences of human linguistic, cultural and bodily experiences (Casasanto and Bottini, 2014). The space-time mappings that people use at a particular moment are members of a superordinate family of mappings. The superordinate family is typically constructed on the basis of the correspondence between space and time in moving objects, which may not result from a metaphoric construction processes mediated by learning to flexibly use words (Srinivasan and Carey, 2010). As shown in de Hevia et al.'s (2014)

experiments, neonates tend to relate both numerical and durational quantity to spatial extent when these dimensions vary in the same direction (number or duration increases as length increases), but not in opposite directions (number or duration increases and length decreases); this suggests that the representations of the abstract concepts of number, space, and time and their links are readily available from birth. Yet, at the top of the hierarchy is the overhypothesis in which the association between space and time should be constructed on the basis of source–target relationships in the natural world (Casasanto, 2017). Once people are exposed to different patterns of experience, one specific hypothesis may be constructed in memory transiently in response to internally generated or external cues.

11.3 Limitations

There are practical difficulties and limitations that must be acknowledged. First, why do we believe that the Time Diagram task indexes implicit space–time mappings? It is possible that participants could have produced these results without actively thinking about time in terms of space. In other words, they may simply follow ordinal conventions that are also spatially represented. Given the forced choice between "back" and "front" in the time diagram, participants may then choose to put the "past event" in the "front" box because the front box is the one in Li Hua's visual field. Hence, the front box holds the place of attention/salience, and therefore corresponds to the past for those with past-oriented temporal focus. In this interpretation of the results, participants are NOT conceptualizing the past as in front, or truly using the "past-in-front mapping". While this is a possibility, there are reasons to believe that this is unlikely the case. If participants tended to put the temporal events fitting the ordinal mappings, they should show the same tendency for placing the animal/plant they think of first in the same order (e.g., from top (front) to bottom (back)). Contrary to this prediction, participants across studies showed different preferences for filling the front or back box first. Thus, it is unlikely that participants put the most salient

temporal event in their cognitive system into the response option that fits the ordinal mappings of all cultures tested.

Although Time Diagram Task that requires explicit judgment can reveal implicit space-time associations, potential task demands might be repeated across different experiments. Numerous online tasks such as reaction time task, ERP, as well as eye tracking technology should be used in future studies to investigate how people process temporal concepts. Extending the range of mediums would also be valuable to test the generalizability of the findings.

Second, due to the feasibility of experiments (e.g., time availability of participants), the Temporal Focus Questionnaire and Temporal Focus Scale were used alternatively. Although both of them are reliable and valid measures, using a different scale may lead to different results. In addition, the measures of individual differences such as political attitudes were mainly based on self-report, which may permit the assessment of subjective dispositions and lack external validity. For instance, holding more liberal opinions on same-sex marriage may cause people to feel distant from the mainstream values in China. Future research could adopt the implicit-association test (IAT) to detect a person's political preferences.

Third, one question that arises is the interaction between a range of factors, including cultural and individual differences. For instance, the current findings and previous research have shown that individual differences can override culture in exerting an influence on space-time mappings in people’s mental models. For instance, despite living in the same culture, Chinese people show cross-individual variation in spatial mappings for time in response to different temporal experience. In their studies on the factors motivating the interpretation of an ambiguous temporal question, Duffy and Evans (2017) found that event valence can trump personality. Similarly, the findings from Rothe-Wulf et al. (2015) suggest that the language of communication can override spatial priming. However, as relevant research on individual differences and

implicit space-time mappings is comparatively scarce, it is unclear which one of these two factors plays a more prominent role than the other. Follow-up research might build upon these preliminary findings by disentangling factors motivating the spatial representation of time. In other words, a complete understanding of space-time mappings in mental models might only be achieved through the joint consideration of individual factors as well as cultural determinants.

Fourth, the nature of many studies reported in this thesis is observational. That is, cultural and individual differences related to their temporal focus predict the patterns of space–time mappings in their minds. Given the correlational nature of these studies, causal mechanisms and directionality of relationships between cultural and individual differences and spatial conceptions of time cannot be determined. For instance, whenever studies compare space-time mappings across different cross-cultural groups, the design is necessarily quasi-experimental. It is not possible to randomly assign participants to be Chinese or Vietnamese as they are already Chinese or Vietnamese, and with these differences come a potentially infinite set of other confounding factors.

Fifth, the findings from the present thesis are mainly based on Chinese and Vietnamese populations. The generalizability of the results outside of the populations has yet to be formally tested. On the one hand, the generalizability of some findings should be investigated in Western populations. For instance, there are great differences of political attitudes between Western and Eastern Asian societies. One of the distinctive characteristics of the political process is that people in Western societies may engage more in political life (Lane, 1965). If so, the effect of political ideology on spatial conceptions of time should be more detectable in westerners. On the other hand, the observed effect may not be found in other populations. For instance, Study 8 only tested Chinese pregnant women whose future-oriented mindset possibly comes from their stronger beliefs about the role of parenting in children's school success as compared to European and American mothers (Chao, 1996). It is still unclear whether pregnant women in other cultures with different parental

caregiving preferences show the same pattern attested in their Chinese counterparts.

Finally, the TFH suggests a unidirectional relationship between temporal focus and implicit space-time mappings. Based on this theoretical assumption, the current thesis only investigates how attentional focus influences the direction of space-time mappings in people's minds. However, some research provided preliminary evidence that space-time mappings in spoken metaphors can also influence how people allocate their attention to temporal events. In one study, Hömke et al. (2013) trained native English speakers to use reversed space-time mappings, with the future being behind the body (out of visible space) and the past being ahead of the body (within visible space). After the linguistic training, the participants were asked to complete a temporal focus measure. The results showed that the participants who received the non-canonical training considered past events and or immediate past events to be more relevant, suggesting that the visibility of space-time mappings influences temporal focus. These findings pave ways for future research exploring whether the same linguistic training can alter people's attention to future events and a possible existence of the bidirectional relationship between space-time mappings and temporal focus.

11.4 Future research

11.4.1. *Implications for cross-linguistic research*

Recently, the special theme of The Fourteenth International Cognitive Linguistics Conference (ICLC-14) was "Linguistic Diversity and Cognitive Linguistics". It aimed to promote the relevance of Cognitive Linguistics to a wide range of languages and to encourage papers that draw data from less known languages and language families. A wealth of research on spatial metaphors for time has begun to investigate a range of languages and dialects within one particular language. Examples include: American Sign Language (Emmorey, 2001), Amondawa (Sinha et al., 2011), Aymara (Núñez

and Sweetser, 2006), Finnish (Huumo, 2015), Isbukun Bunun (Huang, 2016), Mian (Fedden and Boroditsky, 2012), Pormpuraaw (Boroditsky and Gaby, 2010), Polish Sign Language (Kosecki, 2016), Tzeltal (Brown, 2012), Vedic Sanskrit and Homeric Greek (Bartolotta, 2018), Vietnamese (Sullivan and Bui, 2016), Yélî Dnye (Levinson and Majid, 2013), Yucatec Mayas (Le, Guen and Balam, 2012) and Yupno (Núñez et al., 2012). Based on these results from the thesis, as well as previous studies, it is shown that people's tendency to locate the past or future according to their temporal focus has also been found in speakers of typologically unrelated languages (e.g., Spanish, a Romance language; Darija, a Semitic language; Chinese, a Sino-Tibetan language; Vietnamese, an Austroasiantic language). Taken together, there is preliminary evidence across a selection of languages and cultures (or subcultures) to suggest the generalizability of the TFH. In the future, speakers from other typologically unrelated languages should be tested for comparison. This would allow for more reliable generalizations.

However, the question remains why some communities tend to think about time according to the future-in-front mapping, while others tend to think about time according to the past-in-front mapping. According to Clark (1973), this future-in-front mapping arises from our interactions with the physical world. That is, we usually walk forward rather than backward because our eyes are on the front of us and help us see where we are going. Because of the intrinsic front of our body, we move towards points that will be reached in the future and leave behind the points passed in the past.

Despite the prevalence of future-in-front/past-in-back mappings, some languages manifest the opposite space-time mappings (e.g., Klein, 1987, for Toba; Sullivan and Bui, 2016, for Vietnamese), suggesting that the bodily experience of walking forward is not the sole factor influencing how people associate front-back space and time. One of the most cited examples of this is Aymara, an indigenous language spoken in the Andes, in which speakers tend to associate the "future" with "back" and the "past" with "front". According to Núñez and Sweetser (2006), this past-in-front mapping

may stem from another universal aspect of bodily experience (i.e., "knowing is seeing"). Because past and future events are usually conceived as known and unknown, respectively, it follows that the past and future are placed in front of and behind the observer, respectively (Coëgnarts and Kravanja, 2015; Núñez and Sweetser, 2006).

Although these hypothetical explanations suggest different motivations for space-time mappings in speech, they cannot explain why in some communities people tend to think about time as their language suggests, while findings in other communities suggest a dissociation between the way people talk about time and the way they think about it (e.g., Moroccans). One possibility is that language is not the sole factor determining how people associate the past and future with front and back in their minds. According to the TFH, people's implicit space-time mappings are shaped by their attentional focus. For instance, Aymara speakers place the past in front of them possibly because they focus their attention on it. People can also place the future in front even though it cannot be known (de la Fuente et al., 2014). Thus, the TFH can provide a unified theoretical framework to explain cross-linguistic and cultural differences and even variation in space-time mappings within a single culture.

11.4.2. *Implications for neural studies of metaphor*

While abundant evidence from behavioral studies of metaphor has suggested that people recruit spatial experience to mentally construct time, recent lines of research has begun to investigate the neural basis of spatiotemporal metaphor (Bonato et al., 2016; for a review, see Winter et al., 2015). For instance, Coull and Nobre (1998) compared the neural systems involved in directing attention to spatial versus time magnitudes. Brain-imaging data revealed the spatial and temporal orientation of attention tasks activated many brain regions in common, suggesting a partial overlap between neural systems involved in the performance of spatial locations versus temporal intervals.

Evidence from clinical studies lends further support to a shared representation of space and time. Based on previous findings that healthy people who read words from left to right are generally faster at making judgments about earlier or past events with the left side but faster with their right hand for later or future events (e.g., Fuhrman and Boroditsky, 2010; Ouellet et al., 2010), Saj et al. (2014) hypothesized that deficits in left-right representation (as a function of left hemispatial neglect) also result in deficits in representing temporal events along the sagittal mental time line. As predicted, they found that right-hemisphere stroke patients with left hemispatial neglect showed a specific deficit in representing events that are associated with the past and, thus, fall to the left side of their mental time line. This pattern of results suggests that representations of space and time share some neural substrates (e.g., in posterior parietal cortical areas) and that representations of temporal information have specific spatial components (e.g., the sagittal plane).

In another study, Parkinson, Liu and Wheatley (2014) investigated whether the ubiquitous spatial metaphors for temporal distance (e.g., distant future) and social distance (e.g., close friend) are rooted in a common neural computation by analyzing human functional Magnetic Resonance Imaging (fMRI) data. Results showed that above-chance decoding in the domains of spatial distance, temporal soon-ness and social familiarity were possible in the right inferior parietal lobule (IPL), suggesting that the right IPL may contain a parsimonious encoding of proximity to self in spatial, temporal and social distance domains. More recently, to gain high anatomical specificity, Peer et al. (2015) used high-resolution 7-Tesla fMRI to investigate the neurocognitive system underlying orientation in space, time and social relations. The results demonstrated that activations for the three domains showed a similar pattern inside the precuneus and IPL nodes of the default-mode network (DMN), suggesting a common functional core for orientation across domains. Since the focus of current research has largely been centered on left-right time metaphors or time duration, the question remains of whether representations of space and time along other axes (e.g., sagittal and vertical) also share neural underpinnings.

It also should be noted that spatial representations of time do not happen in a kind of ecological vacuum. Although previous research has sought to identify neural underpinnings shared for the representation of external spatial information and the representation of temporal information, it appears that the researchers tend to investigate time cognition in a way that excludes social contextual factors and individual differences. In the past few decades, neurobiological social cognitive neuroscience and cultural neuroscience research has demonstrated that culture and individual factors contribute fundamentally to cognitive and neuro differences through experience-dependent plasticity of the nervous system (Ochsner and Lieberman, 2001; LeDoux 2002; Blakemore and Choudhury, 2006; Lieberman, 2007).

Such findings can be used to stimulate the development of new hypotheses and study designs that push beyond identification of the neural substrates underlying the spatial representation of time, and better capture the contingent and socially embedded nature of human time cognition. For instance, it would be valuable to investigate whether many aspects of brain involving temporal information processing can be altered in response to new patterns of cultural and individual experiences (as shown in this thesis) and the degrees and extent of neuroplasticity (e.g., microscopic changes in individual neurons or larger-scale changes such as cortical remapping).

11.5 Conclusion

Janus, the god of time in ancient Roman religion and myth, is usually depicted as having two faces; one face looks backward to what is behind and the other looks forward to what lies ahead. Therefore, he could look both backward to the past and forward to the future at the same time. Although humans only have one face and thus possibly can look in only one direction at a time, the results from our research suggest

that people's conceptions of time may vary from time to time and those changes could be explained by the TFH. According to the TFH, space-time mappings in people's minds are shaped by their attentional focus on past or future events. While some previous studies have shown that culture value and individual differences influence people's attitudes toward time, this thesis expands the scope of possible factors that could influence people's spatializations of time along the sagittal space. Taken together, the results reported in this thesis contribute to the time cognition literature by offering many new perspectives, which should be of interest to linguists, especially for specialists in cognitive linguistics, (neuro) psychologists and anthropologists. They also leave open several avenues for future research. In sum, this thesis highlights both the complexity and malleability of the human cognition system. That is, our spatial representations of time appear to be the outcome of an intricate interplay between linguistic, cultural, individual (e.g., personality) and bodily experiences.

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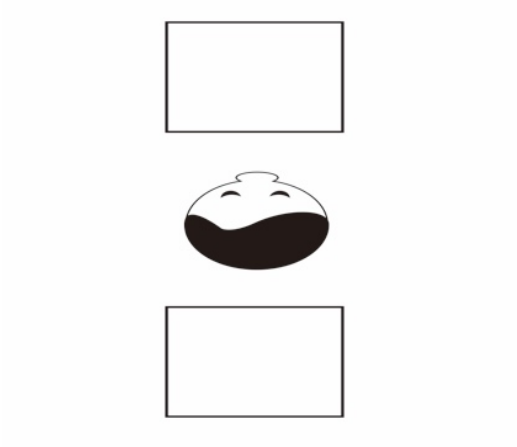
Appendix 1

Vietnamese version of the Time Diagram Task

Bối cảnh： Hôm qua An đến thăm một người bạn rất thích thực vật, người bạn này tặng An một chậu cây. Ngày mai An sẽ đi thăm một người bạn rất yêu thích động vật, người bạn này sẽ tặng cho An một con vật nuôi trong nhà.



Câu hỏi： Trước mặt và phía sau An đều có 1 cái vali (như hình vẽ), bạn hãy đặt con vật nuôi bạn An tặng (ký hiệu là D) và chậu hoa (ký hiệu là P) vào chiếc vali bạn cho là hợp lý (mỗi vali chỉ đặt một thứ)

Appendix 2

Vietnamese version of the Temporal Focus Questionnaire

Bạn đồng ý ở mức độ nào với những cách nói sau, xin hãy đánh số để thể hiện quan điểm của bạn. 1= rất không đồng ý, 2= không đồng ý, 3= không chắc, 4= đồng ý, 5= rất đồng ý.

1. Phong tục truyền thống rất quan trọng với bạn. ☐
2. Thanh niên phải giữ gìn phong tục truyền thống. ☐
3. Tôi cho rằng người xưa sống vui hơn chúng ta hiện nay. ☐
4. Thanh niên hiện nay phải duy trì các giá trị của cha ông. ☐
5. Làm việc theo cách thức truyền thống mới là cách làm việc tốt nhất. ☐
6. Tôi rất khó chấp nhận những thay đổi về văn hóa những năm trở lại đây. ☐
7. Thanh niên thời xưa biết tiêu khiển hơn thanh niên thời nay. ☐
8. Cách sống truyền thống xưa tốt hơn cách sống hiện đại ngày nay. ☐
9. Những tiến bộ trong kinh tế, khoa học hiện đại gần đây gây ra nhiều tác động xấu cho xã hội. ☐
10. Mất đi sự tôn trọng với truyền thống văn hóa là vô cùng tai hại. ☐
11. Các giá trị văn hóa đang dần thay đổi, chúng ta phải thích nghi với những sự thay đổi đó. ☐
12. Các giá trị văn hóa đang càng ngày được hiện đại hóa, đây là dấu ☐

hiệu tốt.

13. Tôi cho rằng toàn cầu hóa là vô cùng tốt.

14. Những tiến bộ của khoa học kỹ thuật vô cùng có lợi cho sự phát triển của xã hội. ☐

15. Giá trị quan của người trẻ chắc chắn phải khác với người già. ☐

16. Người trẻ không cần phải học hỏi người già. ☐

17. Người trẻ cần quan tâm đến tương lại, chứ không phải hiện tại. ☐

18. Văn hóa truyền thống đã không còn tác dụng với hiện tại và tương lai. ☐

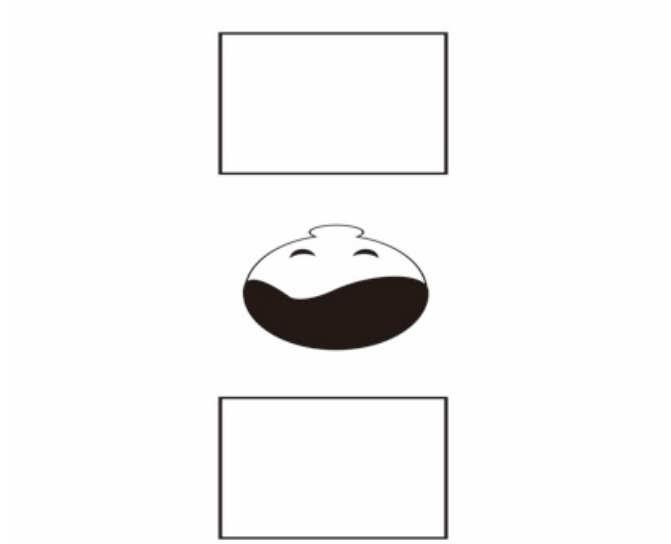
19. Sáng tạo và thích nghi với những thay đổi mới là vô cùng quan trọng. ☐

20. Những thay đổi về văn hóa xã hội sẽ khiến con người hạnh phúc hơn. ☐

Appendix 3

请阅读以下场景，然后给出你的答案。请不要花太多时间思考正确与否，也不要修改你的答案，我希望得到你的第一反应，非常感谢！

李华昨天去拜访了一位喜欢植物的朋友，这位朋友送了他一盆植物；他明天会去拜访另一位喜欢动物的朋友，这位朋友会送他一只动物。从上往下看，李华身体的前方和后方各有一个箱子（见下图），请你将植物（用“植”表示）放在表示昨天发生事情的箱子里，将动物（用“动”表示）放在另一个箱子里表示明天发生的事情。



Appendix 4

过去焦点：

1. 我回想过去的记忆。 I replay memories of the past in my mind
2. 我反思生命中发生过的事情。I reflect on what has happened in my life
3. 我考虑过去的事情。I think about things from my past
4. 我想回到我从前的日子。I think back to my earlier days

未来焦点：

1. 我思考我的未来会发生什么。I think about what my future has in store
2. 我思考即将到来的时代。I think about times to come
3. 我关注我的未来。I focus on my future
4. 我想象明天会为我带来什么。I imagine what tomorrow will bring for me