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The Metaphoric Representation of Time:

A Cognitive Linguistics Perspective

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The Metaphoric Representation of Time:
A Cognitive Linguistics Perspective

Sarah Elizabeth Duffy

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Dedicated, with love, to the three who have been here since the beginning of *my* time:

My parents, Elizabeth and Michael and my brother, Christopher

Abstract

It has long been observed that speakers systematically employ language from concrete and perceptually rich domains to talk about abstract concepts. One of the paradigm examples of this is the way in which the abstract domain TIME is metaphorically conceptualised in terms of the concrete domain SPACE in a wide range of languages throughout the world. In English, there are various types of spatial metaphors for time, including 'deictic' metaphors, which situate events in relation to the ego, 'sequential' metaphors, which position events in relation to one another, as part of a sequence and 'extrinsic' metaphors, which fix events in relation to the forward-moving flow of time. Of these, particular attention has been paid to two deictic space-time metaphors: the Moving Ego metaphor, which conceptualises the self as moving towards events in time, e.g. *We're approaching Christmas* and the Moving Time metaphor, which conceptualises events in time moving relative to the self, e.g. *Christmas is approaching*. In addition to linguistic evidence, a body of research has provided evidence for the psychological reality of these two metaphors, demonstrating that thinking about spatial motion under various circumstances can prime different construals of time. While research investigating abstract thinking about time has been primarily focused on examining the effects of spatial priming on temporal reasoning, recent research has extended beyond this, providing preliminary evidence that personality differences, emotional experiences and the valence of an event (positive or negative) may also influence people's perspectives on the movement of events in time. By building upon and extending these findings, the overall aim of this thesis is to shed light on the mechanisms at work during the interpretation of language in context, providing a more fully explanatory framework for the metaphoric representation of time. To do this, a series of studies were conducted to examine further the range of factors that may influence how people reason about events in time, focusing specifically on previously unexplored personality differences, lifestyle differences and behavioural differences (Studies 1 to 8). Next, the focus of the investigation turned to the interpretation and usage of metaphorical expressions about time in prescribed contexts (Studies 9 to 14). The

findings of these studies are reported and discussed in terms of the theoretical, methodological and practical issues they raise for the language sciences.

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S. E. D.

Newcastle-upon-Tyne

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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.

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CHAPTER SIX

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CHAPTER SEVEN

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Name: Sarah Elizabeth Duffy

Signature:

Date: 22/07/14

Days

What are days for?
Days are where we live.
They come, they wake us
Time and time over.
They are to be happy in:
Where can we live but days?

Ah, solving that question
Brings the priest and the doctor
In their long coats
Running over the fields.

PHILIP LARKIN

Part I:

Context

1. Spatial metaphors for time

1.1. Introduction

One of the most fundamental and enigmatic aspects of human experience, that forms part of its rich warp and weft, is that of time. We cannot see or touch time; yet, we can conceive of its passage in much the way we can conceive of any other worldly experience (Evans 2004). The reason for this, metaphor theorists propose, is that the sensory and motor representations that derive from interacting in the natural environment are recycled in order to support abstract thought (e.g. Kövecses 2000; Lakoff 1993; Lakoff and Johnson 1980, 1999). In the domain of time, for instance, these representations derive from the human experience of navigating through, orienting within and observing motion in space. Evidence for this reasoning comes, in part, from patterns observed in language: language from the relatively concrete and perceptually rich domain of space is recruited to talk about the abstract domain of time (Clark 1973; Evans 2004; Lakoff and Johnson 1999; Traugott 1978). As such, the conceptual correspondences between space and time are reflected in the common phrasal lexicon used to denote relations in the two domains (see Table 1).

Table 1   *Space-time metaphors in English (Haspelmath 1997; Lehrer 1990)*

SPACE	TIME
at the corner	*at* noon
from here to there	*from* two o'clock to four o'clock
through the tunnel	*through* the night
he was running *ahead of* me	he arrived *ahead of* schedule
she *is going to* the park	the rain *is going to* help the farmer
we are still far from the *end* of the queue	you will be tired at the *end* of the day
she wears a *long* scarf	the meeting was *long*

According to Clark (1973), these common phrasal parallels occur because temporal relations are predicated on a subset of those used for the description of objects in space. In particular, the applicable subset of spatial relations is determined by conceptualising time as a one dimensional, unidirectional and dynamic entity. For this reason, the spatial terms that are used to talk about time are also one dimensional, unidirectional terms such as *in front/behind* or *long/short*, as opposed to three dimensional, multidirectional terms such as *shallow/deep* or *left/right*.

1.1.1. *Deictic time*

While English exhibits an array of space-time metaphors, particular attention in the existing literature has been paid to two dominant spatial metaphors that are used in the representation of time: Moving Time and Moving Ego. In the Moving Ego metaphor, time is construed as a stationary landscape that the active ego moves across (e.g. *We're approaching Christmas*; *We've passed the deadline*) and in the Moving Time metaphor, time is conceptualised as a conveyor belt on which events move, from the future to the past, relative to a stationary ego (e.g. *Christmas is approaching*; *The deadline has passed*) (Clark 1973; Lakoff and Johnson 1999). For both of these space-time metaphors, the ego's location provides the reference point—a position which correlates with the present and metaphorically signifies the experience of *now*; hence, Moving Time and Moving Ego metaphors instantiate deictic time and are consistent with future/past relationships. Linguistically, these two metaphors can be used to depict events in the past, present and future:

	Moving Time	*Moving Ego*
Future	Summertime is approaching [us]	We're approaching summertime
Present	The moment of truth has arrived	We've arrived at the moment of truth
Past	The deadline has passed [us]	We've passed the deadline

Moreover, as demonstrated by the expressions above, the Moving Time and Moving Ego metaphors provide inverse perspectives: either the temporal event is depicted as moving relative to a stationary ego (which is not always explicitly encoded in natural speech), or the ego is depicted as moving relative to a fixed temporal event.

The systematicity and coherence of the Moving Ego and Moving Time metaphors in language have given rise to research investigating the psychological reality of these two metaphors. In a seminal study, McGlone and Harding (1998) developed a metaphor disambiguation paradigm, the interpretation of which depended upon the particular space-time metaphor that was being used. As such, this question provided an important tool for probing the conceptual metaphor active at the moment of comprehension. In their study, participants were primed with a series of context sentences that were phrased either in terms of 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*). At the end of the block of priming statements, participants read an ambiguous target statement, such as *The meeting originally scheduled for next Wednesday has moved forward two days* before being asked to indicate the day of the week on which the event would occur. The results showed that participants tended to interpret the question in prime-consistent manner, such that participants who were primed with Moving Ego metaphors more frequently interpreted 'moved forward' in line with the Moving Ego perspective (responding *Friday*), and participants who were primed with Moving Time metaphors more frequently interpreted 'moved forward' in line with the Moving Time perspective (responding *Monday*). In discussing the implications of their findings, McGlone and Harding (1998) concluded that people make use of perspective information in temporal language comprehension, such that the perspective adopted in the interpretations of unambiguous temporal statements may still be activated and thus available to exert an influence on the interpretation of subsequent ambiguous temporal statements.

Building on insights from McGlone and Harding's (1998) findings, Boroditsky (2000; Boroditsky and Ramscar 2002) sought to investigate whether, in addition to the psychologically real distinction between space-time metaphors, space and time also share deeper conceptual similarities. To test this, a series of studies were devised to examine whether engaging in thought about spatial motion under various circumstances could also prime different construals of time. In one study, participants were asked to imagine moving towards a stationary object or to imagine an object moving towards them before answering the ambiguous *Next Wednesday's meeting* question (Boroditsky and Ramscar 2002, Study 1). Based on the

assumption that our experience of time is grounded in our understanding of space (Lakoff 1993; Lakoff and Johnson 1980, 1999), it was hypothesised that imagining moving through space towards a stationary object is analogous to the Moving Ego perspective and imagining a moving object travelling through space towards the self is analogous to the Moving Time perspective. Thus, if space and time do share some relational structure, participants primed in the ego-moving spatial condition should 'reuse' this perspective for time and answer *Friday*, whereas participants primed in the object-moving spatial condition should adopt the Moving Time perspective and answer *Monday*. As predicted, participants tended to respond in a prime-consistent manner to the *Next Wednesday's meeting* question, suggesting that simply thinking about spatial motion is sufficient to influence how people reason about events in time and their concomitant interpretation of a temporally ambiguous question.[1] Further experiments conducted in a range of settings, such as airports, train stations and racetracks, have given support to these initial findings. For instance, Boroditsky and Ramscar (2002, Study 3) found that people who had just flown into the airport were more likely to adopt the Moving Ego perspective (responding *Friday*) than those who were waiting for someone to arrive. Taken together, this pattern of results suggests that different ways of thinking about motion in space can yield different construals of time, such that the perspective adopted in the interpretations of ambiguous temporal statements can be influenced by temporal, as well as spatial primes.

These preliminary results have been extended, with demonstrations that 'spatial schemas'[2] pertaining to fictive motion (Matlock et al. 2005; Ramscar et al. 2010), abstract motion (Matlock et al. 2011) and virtual reality (Alloway et al. 2006) can also influence the interpretations of ambiguous temporal statements. For example, Matlock et al. (2005) and Ramscar et al. (2010) conducted a series of experiments

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[1] Although participants made use of spatial information to think about time, by responding in a prime-consistent manner, the reverse was not found: participants were not influenced by temporal primes when interpreting questions about space (Boroditsky 2000). The effects of the priming parallel a well-established asymmetry in language: people tend to talk about the abstract in terms of the concrete more than the other way around (Lakoff and Johnson 1980). In other words, representations of time are asymmetrically dependent on representations of space and motion in space, as suggested by patterns in language.

[2] A spatial schema can be considered as a "condensed redescription of perceptual experience for the purpose of mapping spatial structure onto conceptual structure" (Oakley 2010: 215; cf. Johnson 1987).

to investigate whether thinking about fictive motion (FM), similarly to thinking about actual motion, would influence the ways in which people reason about time. To do this, participants were primed with one of two FM sentences, such as *The road goes all the way to New York* or *The road comes all the way from New York* (whereby the participants' location at Stanford was the implied starting point or end point) before responding to the *Next Wednesday's meeting* question. The results showed that when participants were primed with FM going away from them, from Stanford to New York, they were more likely to provide a *Friday* response, whereas when participants were primed with FM coming towards them, from New York to Stanford, they were more likely to provide a *Monday* response. As was the case with actual motion, Ramscar et al. (2010) concluded that simply thinking about fictive motion is sufficient to influence how people reason about events in time.

Probing this relationship further, Matlock et al. (2011) conducted a series of experiments to investigate whether, similarly to thinking about actual motion, thinking about subtler forms of motion, such as abstract motion,[3] may influence how people think about time and their concomitant interpretation of a temporally ambiguous expression. Through a series of experiments, participants completed tasks which required them to think about sequences of numbers or letters that proceeded in either ascending order (*5* to *17* or *G* to *P*) or descending order (*17* to *5* or *P* to *G*) before answering the ambiguous *Next Wednesday's meeting* question. The results showed that when participants were primed with forward abstract motion (ascending order), they were more likely to adopt the Moving Ego perspective and respond *Friday*, whereas when participants were primed with backward abstract motion (descending order), there was no reliable difference between the proportion of *Friday* and *Monday* responses. In discussing the implications of their findings, Matlock et al. (2011) reasoned that forward motion is deeply entrenched in everyday experience—e.g. through walking, cycling and driving—which may encourage participants to adopt the Moving Ego perspective and respond *Friday*. By contrast, as people are far less accustomed to engaging in backward motion, it is probably less clear which perspective to adopt; hence, responses to the ambiguous meeting question were mixed. Taken together, these

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[3] Abstract motion occurs in processes that involve mentally moving from symbol to symbol in an ordinal sequence (see Langacker 1986, 1987).

findings further substantiate the claim that when people engage in certain kinds of spatial-motion thinking, they may also unwittingly and dramatically change how they think about time.

Moving beyond spatial-motion thinking, Jamalian and Tversky (2012) reasoned that if people use actions in space to express their construals of time and gestures are abstracted actions in space that frequently accompany language, then observing gesture may likewise affect how people reason about events in time.[4] In one study investigating whether speech-accompanying gestures could be used to disambiguate the *Next Wednesday's meeting* question, Jamalian and Tversky (2012) found that participants who viewed a gesture moving away from them accompanying the utterance *was moved forward*, were more likely to adopt the Moving Ego perspective (responding *Friday*), whereas participants who viewed a gesture moving towards them were more likely to adopt the Moving Time perspective (responding *Monday*). Concordant with earlier findings, Jamalian and Tversky (2012) concluded that observing representational actions, namely gestures, also dramatically influence how people think about time. Moreover, information that is conveyed in gestures, but not in speech, can also alter people's conceptions of time and their concomitant interpretation of a temporally ambiguous expression.

1.1.2. *Sequential time*

In other lines of research, it has also been observed that temporal relations exhibit a number of complex patterns that cannot be accounted for by the Moving Time and Moving Ego metaphors alone (e.g. Moore 2006; Núñez et al. 2006; Núñez and Sweetser 2006). Firstly, not all spatial language for time is dynamic (e.g. *Christmas is in front of us*). Secondly, temporal events are not always conceptualised as moving relative to the ego: in an alternative set of conceptualisations, they are sequenced in relation to one another, depicting an earlier/later relationship (e.g. *New Year's Eve follows Christmas*). The differences between these two views of time

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[4] Gestures can provide evidence for a particular 'mental model' when the accompanying speech does not (Alibali et al. 1995) and have been shown to exert an influence on an addressee's comprehension of a spoken message (Goldin-Meadow and Sandhofer 1999; Thompson and Massaro 1994), including ambiguous passages of text, which can lead to more than one competing mental model (Johnson-Laird 1989).

can be traced back to the philosopher John McTaggart (1908), who proposed the fundamental distinction between two basic classifications of time. The first classification, 'A-series' (*deictic time*), characterises temporal events that are established in relation to the ego by virtue of being in the future, present or past; thus, deictic time depicts a constant change in the status of temporal events. The second classification, 'B-series' (*sequential time*), characterises temporal events that are established in relation to one another by virtue of being earlier or later; thus, sequential time depicts temporal events as a static chain, like beads strung together on a necklace, whose statuses never change. As such, as opposed to classifying temporal metaphors on the basis of which entity is moving—time or ego—and as a means of differentiating future/past from earlier/later, a fundamental re-classification was proposed—one which based temporal metaphors on the relevant Reference Point (RP). These were classified as Ego-Reference-Point (Ego-RP) metaphors (deictic time in current parlance) and Time-Reference-Point (Time-RP) metaphors (sequential time in current parlance) (Moore 2006; Núñez et al. 2006; Núñez and Sweetser 2006; cf. Evans 2004).

To this end, Núñez and colleagues sought evidence of the psychological reality of sequential time, by investigating whether ambiguous temporal statements may be interpreted using a temporal reference point other than the ego (Núñez 2007; Núñez et al. 2006). In relation to Boroditsky's findings (2000; Boroditsky and Ramscar 2002), they proposed that instead of indicating movement closer to the present (i.e. towards the ego), *Monday* responses to the *Next Wednesday's meeting* question could indicate that the meeting has been moved towards the front of a sequence of days (i.e. earlier than Wednesday), which just happens to be closer to the present (Núñez 2007; Núñez et al. 2006). As such, a *Monday* response could result from reasoning in terms of sequential time, as opposed to deictic time. Thus, to investigate the role of the ego—or, specifically the absence of the ego—in temporal reasoning, Núñez et al. (2006) conducted a series of experiments, in which participants were shown an array of squares moving horizontally across a screen before responding to an ambiguous target question pertaining to an event in the future (e.g. *Next Wednesday's meeting has been moved forward two days. On what day will the meeting now take place?*), or an event in the past (e.g. *Last Wednesday's meeting had been moved forward two days. On what day did the*

meeting take place?). The significance of depicting the meeting as an event in the past is that it forces people to choose between an interpretation relative to the ego's front and one relative to the sequence's front (i.e. the ego's front does not correlate with the front of a temporal sequence situated in the past). As such, it was hypothesised that as all of last week should be construed as behind the ego, moving forward relative to the ego's orientation should entail movement to a later time, which is closer to the present (i.e. moving last Wednesday's meeting to *Friday*). Whereas, if people respond *Monday* after observing ego-free lateral motion, it would suggest that moving forward is interpreted relative to the intrinsic orientation of the sequence, as opposed to relative to the ego (i.e. moving last Wednesday's meeting earlier in time). In line with their predictions, Núñez et al. (2006) found that participants in the primed condition were more likely to interpret 'moved forward' as earlier and respond *Monday* than participants in the control group (for whom the array of squares in the centre of the screen remained motionless), thereby establishing the psychological reality of sequential time.

1.1.3. *Extrinsic time*

More recently, an additional ego-free representation, extrinsic time, has been proposed (Kranjec 2006; Kranjec and McDonough 2011). In contrast to sequential time, which construes the intrinsic fronts of events as facing towards earlier times (with earlier events positioned in front of later ones), extrinsic time encompasses an abstracted path which leads from earlier to later times (with later events positioned in front of earlier ones), akin to the directionality of time on a calendar. Thus, to investigate the psychological reality of extrinsic time, Kranjec (2006) conducted a series of priming experiments by also using the *Next Wednesday's meeting* question. He predicted that if participants were primed with an extrinsic spatial schema, they should provide responses which are opposite to those expected if a sequential spatial schema was being used (i.e. opposite to those used in the studies of Núñez et al. 2006). To test this, participants were primed with extrinsic spatial schemas, such as the horizontal movement of a blue square over a rectangular bar across a screen before providing a response to the *Next Wednesday's meeting* question. In line with his predictions, participants in the primed condition tended to interpret 'moved forward' as later and respond *Friday*; thus, establishing the

psychological reality of an additional ego-free temporal representation: extrinsic time.

Deictic: Moving Ego		**Deictic: Moving Time**		
Non-deictic: Extrinsic		**Non-deictic: Sequential**		
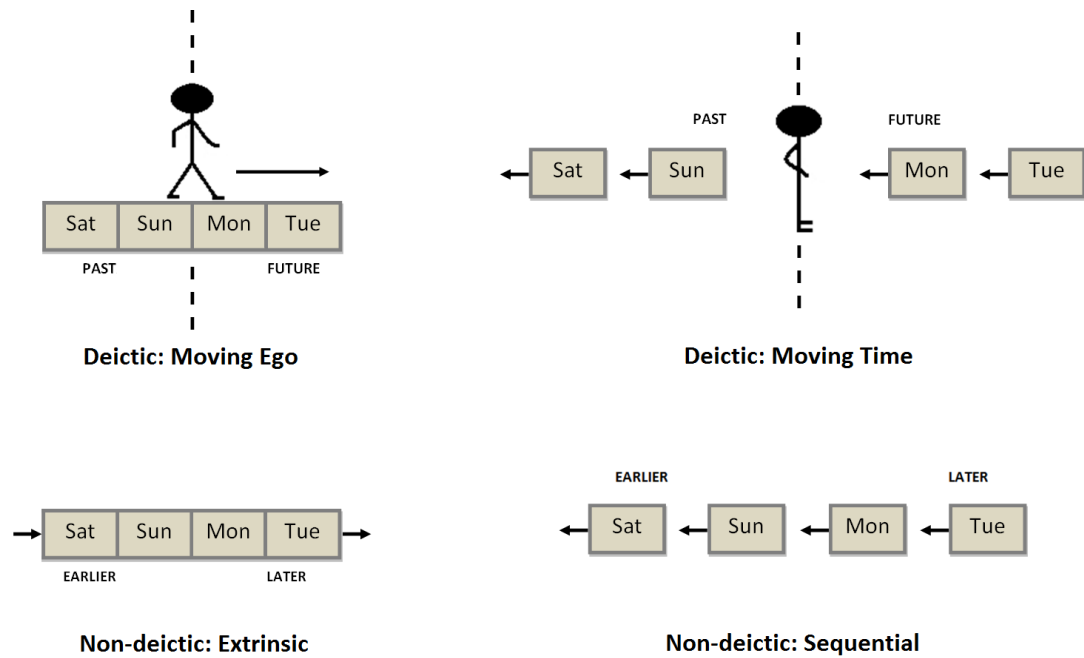
Figure 1   *Deictic and non-deictic spatial construals of time (adapted from Kranjec and McDonough 2011)*

1.2. Thesis overview

In sum, by adapting McGlone and Harding's (1998) *Next Wednesday's meeting* disambiguation paradigm, scholars in the cognitive sciences have provided evidence for the psychological reality of three distinct spatial construals of time, with demonstrations that deictic spatial schemas (Boroditsky 2000; Boroditsky and Ramscar 2002), sequential spatial schemas (Núñez 2007; Núñez et al. 2006) and extrinsic spatial schemas (Kranjec 2006) can be used to influence how people reason about time and their concomitant interpretation of an ambiguous temporal question. Moreover, the findings from these converging lines of research demonstrate that forward motion in the domain of time can be construed as movement to earlier times, later times, the past or the future. As such, *Monday* responses to the *Next Wednesday's meeting* question have been attributed to deictic, Moving Time as well as non-deictic, sequential space-time construals and *Friday*

responses have been attributed to deictic, Moving Ego as well as non-deictic, extrinsic reference space-time construals. The question, thus, arises of how the interpretation of metaphorical language about time in prescribed contexts may differ between individuals. If meaning is constructed in the act of communication and all possible interpretations are available to the comprehender, what factors may encourage one interpretation in favour of another?

While the "ingenious metaphor disambiguation technique" (Gentner et al. 2002: 556) has been an invaluable paradigm for establishing the psychological reality of three distinct spatial construals of time, the conclusions that can be made are largely limited by the reliance on the single experimental paradigm. Thus, by extending beyond the limitations of the *Next Wednesday's meeting* question and building on the findings of earlier research, the overall aim of this thesis is to shed light on the mechanisms at work during the interpretation of language in context, providing a more fully explanatory framework for the metaphoric representation of time. This aim will be addressed throughout the following chapters:

CHAPTER 2: TEMPORAL FRAMES OF REFERENCE

Recent theoretical developments have reformulated the temporal distinctions of deictic, sequential and extrinsic time in terms of a tripartite system by applying the theoretical construct *frames of reference* (Levinson 2003; Talmy 2000) to the domain of time (e.g. Bender et al. 2010; Evans 2013; Tenbrink 2011; Zinken 2010). Thus, in order to frame the current study within the broader context of the existing literature, Chapter 2 provides a detailed overview of temporal frames of reference.

CHAPTER 3: THE NATURE OF TIME

In an attempt to gain a greater understanding of the existence of time as an entity of and unto itself, Chapter 3 explores the nature of time, focusing specifically on the primary temporal experiences that underpin the human perceptual process, as well as some of the ways in which the conceptualisation of time differs in inter-subjectively reliable ways.

CHAPTER 4: INDIVIDUAL DIFFERENCES

As discussed, the majority of research on space-time metaphors has hitherto been focused primarily on investigating spatial influences on temporal reasoning. While spatial concepts largely constitute our conceptions of temporality, such that space is often useful and, arguably, necessary to structure how people think about time (Lakoff 1993; Lakoff and Johnson 1999), a person's conceptualisation of time is not merely dependent on their experiences of motion in space but rather a complex of factors. Building on insights from recent research, which have shed light on a number of additional influences on people's perspectives on the movement of events in time (e.g. Hauser et al. 2009; Richmond et al. 2012), in Chapter 4, six studies investigate whether previously unexplored personality differences (Studies 1 and 3), lifestyle differences (Study 2) and behavioural differences (Studies 4–6) may influence how people reason about events in time and their concomitant interpretation of an ambiguous temporal question.

CHAPTER 5: EVENT VALENCE

In other lines of research, it has also been shown that the valence of an event (positive or negative) and specifically the comprehender's affective orientation towards the event may also influence the ways in which people think about time and their resolution of temporal ambiguity (Lee and Ji 2014: Margolies and Crawford 2008). Thus, drawing on these findings and the findings from Chapter 4, in Chapter 5, two studies investigate whether the interpretation of a temporally ambiguous question may arise from an interaction between the valence of the event and aspects of the personality (Study 7) and lifestyle (Study 8) of the comprehender.

CHAPTER 6: GRAMMATICAL DIFFERENCES

Noting that, while much research has made use of McGlone and Harding's (1998) ambiguous meeting question, very little research has been conducted to uncover the linguistic contributors to the different interpretations of the question, in Chapter 6, the focus of the investigation is turned to the linguistic properties of individual

elements in the question; probing factors that may contribute to its inherent ambiguity (Study 9 and 10).

CHAPTER 7: CULTURAL ARTEFACTS

Cross-linguistic research demonstrates that conceptual metaphors are as much cultural as they are internally represented in the minds of individuals, with culture playing an instrumental role in shaping embodiment and, hence, metaphorical thought (cf. Gibbs 1999). Combining two separate lines of research on space-time mappings—namely, research investigating spatial influences on temporal reasoning and research investigating the culturally specific associations between space and time—in Chapter 7, three studies investigate the role of cultural artefacts, namely calendars and clocks, in the interpretation of metaphorical expressions about time (Studies 11, 12 and 13).

CHAPTER 8: SPATIAL METAPHORS IN NATURAL LANGUAGE

While the nature of the relationship between space and time has been scrutinised extensively by researchers in the cognitive sciences, one area that has received comparatively less attention is the usage of space-time metaphors in naturally-occuring temporal expressions. To address this, in Chapter 8, a brief corpus study is conducted to investigate the frequency and contexts of use of Moving Ego and Moving Time metaphors in the description of temporal motion events in natural language (Study 14).

CHAPTER 9: DISCUSSION

The thesis is drawn to a conclusion and the findings of these studies are reported and discussed in terms of the theoretical, methodological and practical issues they raise for the language sciences. In addition, with an aim of continuing the ongoing process of mutual feeding between theoretical and experimental research in the field of cognitive linguistics (Núñez 2007), new areas of research are suggested for further empirical testing.

2. Temporal frames of reference

2.1. Introduction

In language, distinctions are made between the underlying coordinate systems people use for delineating a spatial scene (Levinson 2003; Talmy 2000). A spatial frame of reference (s-FoR) provides a conceptual basis for locating objects with respect to a spatial coordinate system. Specifically, s-FoRs consist of at least three components: an object to be located (the figure); an object with a known location which is used to locate the figure (the ground); and a system for locating objects (the origin and orientation of the coordinate system). The notion of Frame of Reference takes into account the fact that a number of possible perspectives are available for describing a spatial scene. Levinson (2003) differentiates between three basic s-FoRs: *absolute*, *intrinsic* and *relative*. Whereas absolute s-FoRs rely on fixed bearings, such as cardinal points (e.g. the ball is *north* of the cat), intrinsic s-FoRs employ the orientational properties of the ground object (e.g. the ball is *in front* of the cat) and relative s-FoRs are dependent on the position and viewpoint of the observer (e.g. the ball is *to the left* of the cat).[5]

Recently, attempts have been made to extend Frames of Reference from the domain of space to the domain of time. The hypothesis is that if the structure of space is recruited to organise events in time then, analogous to the domain of space, the domain of time should also exhibit distinct reference strategies (e.g. Bender et al. 2010; Kranjec 2006; Tenbrink 2011; Zinken 2010). However, similarly to the spatial frames of reference literature, there is wide variation in the literature concerning the distinctions considered to be necessary for characterising temporal frames of reference. For instance, by building upon and systematically extending

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[5] It should be noted that the details of the relative projection vary between languages: in most world languages, including in English, the observer's coordinates are 'reflected' from the ground, as though the ground object was another observer facing the actual observer; however, there are a few documented cases of languages, such as Tongan, Marquesan and Hausa, in which the observer's coordinates are 'translated' onto the ground object (see Bennardo 2000; Cablitz 2006; Hill 1978, 1982, respectively).

Levinson's (2003) seminal account of spatial reference frames, Tenbrink (2011) has proposed a cross-domain framework for representing frames of reference in the domains of space and time. Crucially, for Tenbrink, the framework also accounts for dynamic spatial concepts, which she claims is prerequisite for conceptually transferring reference strategies from space to time. Her exhaustive framework distinguishes between 19 different FoRs in the spatial domain and eight in the temporal domain which vary in terms of: intrinsic, relative and absolute; external and internal relationships between entities; and static and dynamic situations. Whereas Tenbrink's (2011) framework is based exclusively on English, Bender et al. (2010) have developed a taxonomy of t-FoRs based on cross-linguistic variation in spatial reference strategies that is intended to account for culture-specific preferences; thereby, making it applicable cross-linguistically. Specifically, adapting Levinson's taxonomy of s-FoRs, Bender et al.'s (2010) taxonomy distinguishes between four FoRs in the domain of time: absolute (in the direction of later times, viewpoint independent); intrinsic (in the direction of earlier times, viewpoint independent); relative reflection (in the direction of the past, viewpoint dependent); and relative translation (in the direction of the future, viewpoint dependent). While Tenbrink's (2011) and Bender et al.'s (2010) taxonomies differ, both in terms of approach and purpose, there are a number of assumptions that both taxonomies converge on, the first of these being that it is possible and indeed desirable to systematically map FoRs from the domain of space onto the domain of time. Secondly, despite the fundamental differences between space and time, theoretical constructs for space are applicable to theoretical constructs for time. Indeed, Bender et al. (2010) propose that the directionality of time compensates for its deficiency in dimensions. In this respect, parallels between the underlying reference strategies that space and time employ can be drawn: relative reference strategies are anchored by the human experience (an observer in the spatial domain and the egocentric experience of now in the temporal domain); intrinsic reference strategies make use of the relationship deriving from an entity's relationship with another entity (object or event); and absolute reference strategies are anchored by culturally-determined systems, such as cardinal directions (in the spatial domain) or calendars (in the temporal domain).

Diverging from this train of thought, more recently, in a book-length treatment, Evans (2013) has developed a taxonomy of t-FoRs that is built upon a different doctrine entirely: despite acknowledging that an application of spatial frames of reference to time is insightful, his taxonomy focuses primarily on the claim that the two domains are fundamentally distinct. Specifically, although time and space may converge on a number of domain-general reference strategies, there are a number of fundamental domain-specific differences between the nature of spatial and temporal reference strategies; hence, the relations involved in spatial reference are also different to those involved in temporal reference. In this vein, noting that, while the systematicity of space-time metaphors has amassed a body of research, disanalogies between space and time have been comparatively neglected, this chapter will begin by reviewing the similarities and differences between the domains of time and space and, in doing so, will assess the suitability of using s-FoRs to develop t-FoRs. Next, a detailed overview of temporal frames of reference is provided; thereby, framing the current study within the broader context of the existing literature.

2.2. The configuration of time and space

Time and space constitute *homologous categories*. That is, they appear to share structural commonalities (Talmy 2000). In recent research, it has been proposed that the domains of time and space are comparable across four parameters: *magnitude*, *directionality*, *dimensionality* and *transience* (Galton 2011; cf. Evans 2013).[6] The finding that emerges from these lines of research is that the configuration of time and space is indeed quite distinct. To demonstrate, these parameters are considered in more detail in the following sub-sections:

MAGNITUDE

The parameter magnitude relates to the ways in which a *substrate*—the content of a conceptual domain—can be quantified. According to Talmy (2000), the substrate that exists in space is *matter*, which is present in two forms: as discrete solid objects

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[6] It should be noted, however, that although the domain of space exhibits other parameters, for the purpose of this discussion, the parameters of space that either overlap with, or are absent from the domain of time will remain the focus.

(e.g. a rock, an apple), and as continuous mass substances (e.g. water, air). The substrate that exists in time is *action*, which is also present in two forms: as a discrete action, also called an act (e.g. to dress), and as a continuous action, also called an activity (e.g. to sleep). Notably, the distinction between the domains of space and time is conveyed in grammatical structure: whereas entities in space are typically represented by nouns and noun phrases, entities in time are typically represented by verbs and verb phrases.

The substrate of a conceptual domain also exhibits certain properties pertaining to its disposition, which allows for the substrate to be quantified, or cut up into amounts. This is referred to as the *state of boundedness* and relates to *extension* in the spatial domain and *duration* in the temporal domain (Evans 2013; Talmy 2000). In application, the state of boundedness largely corresponds to the linguistic distinction between mass and count nouns in the spatial domain and to linguistic distinction between imperfective and perfective verbs in the temporal domain (Talmy 2000). This is exemplified by the examples below:

	Extension	**Distinction**	**State of boundedness**
i.	Mike bought *some* water	[mass]	unbounded
	Mike bought *a bottle* of water	[count]	bounded
ii.	**Duration**	**Distinction**	**State of boundedness**
	Liz *was singing*	[imperfective]	unbounded
	Liz *sang*	[perfective]	bounded

Because space and time can be conceived in terms of magnitude, it allows for *conceptual alternativity*, i.e. the possibility of conceptualising one domain in terms of another. For instance, in response to the question "How far is Newcastle from Leeds?", the distance between the two cities can be quantified in terms of extension or duration; thus, a person could reasonably answer "About a hundred miles" (spatial) or "About two hours" (temporal).

DIMENSIONALITY

The parameter dimensionality relates to the extent to which a substrate can be quantified. The substrate of space is exhibited by length (one dimension), area (two dimensions) and volume (three dimensions) and is quantifiable along three salient axes: sagittal (in front/behind), lateral (left/right) and coronal (up/down). In contrast, the substrate of time is by exhibited by linearity (one dimension). In addition to this, the domain of time is associated with *progression*, a concept which involves a continuum of successiveness, or a sequence of distinct representations that change from one instance to the next (Talmy 2000). As such, the substrate of time is quantified in terms of *succession* (Evans 2013), which is characterised as the sequential relationship that holds between distinct units and sub-units of action.

DIRECTEDNESS

The parameter directedness relates to the symmetricity of a substrate. That is, whether a domain is *asymmetric* (i.e. anisotropic) or *symmetric* (i.e. isotropic). The domain of time is asymmetrically organised and unidirectional; hence, it is anisotropic. Moreover, the anisotropic nature of time is commonly associated with the Arrow of Time, a term coined by Sir Arthur Eddington (1928), that relates to the thermodynamic property of matter: the second law of thermodynamics stipulates that the overall entropy of a system is greater at later times than at earlier ones, e.g. ice will melt in a warm room and will not spontaneously re-freeze again. In addition, it has also been argued that it is possible to distinguish between different varieties of the Arrow of Time. Notably, Le Poidevin (2003) proposes three such varieties: the *thermodynamic arrow* proceeds from lower to higher entropy; the *psychological arrow* entails the continuous movement of events in terms of anticipation (the future), current perception (the present) and memory (the past); and the *causal arrow* involves causes and effects, i.e. the causal event occurs before the event it affects. In contrast to the domain of time, the domain of space is isotropic: it symmetrically organised. Space is also multidirectional; thus, movement is possible in any direction, e.g. forward and back; side to side. Although space does not possess an intrinsic directionality comparable to that of time,

different directions in space can be distinguished from one another. For instance, there is a marked asymmetry between up and down, which is imposed by the earth's gravity. Furthermore, there is an asymmetry between front and back, which is imposed by the bilateral symmetry of the human body: we can see what is in front of us, but not what is behind (Clark 1973).

TRANSIENCE

One parameter that is exhibited by time, but not by space, is that of transience. According to Galton (2011), transience, which conveys the idea that a given moment only occurs once and fleetingly, can at most be attributed to space secondarily by direct correlation with time via motion. This is demonstrated by the apparent motion of the landscape rushing past the window when viewed from a moving train. Moreover, there are a number of expressions that are described in terms of spatial motion, such as *Here today*, *gone tomorrow* and *It came to pass*, that capture the notion of transience; however, as noted by Galton (2011), it is not a property of space that exhibits the transience of time but rather a property of motion. Specifically, motion can be described in terms of a change in position but it is the aspect of change, as opposed to position, that correlates with the transience of time. In this respect, Galton (2011) proposes that transience is the hallmark of time and hence is part of its *sui generis* character.

In sum, Galton (2011) proposes that the four parameters of time form an ordered series, whereby each parameter presupposes the one that comes before it: time cannot exhibit dimensionality without exhibiting temporal magnitude; it cannot exhibit directedness without exhibiting dimensionality; and it cannot exhibit transience without exhibiting directedness. Building on these insights, Evans (2013) proposes that transience is not, in fact, a discrete parameter; rather, time is manifested in terms of the parameters magnitude, directionality and dimensionality, each of which gives rise to a different type of transience: *duration*, *succession* and *anisotropicity*, respectively, as illustrated in Figure 2. Specifically, duration relates to the felt experience of the passage constituting an elapse; succession relates to the ability to assess the sequential order of temporal events and distinguish earlier

events from later ones; and anisotropicity relates to the egocentric experience of now, i.e. the conscious experience of the subjective present, which provides a basis for distinguishing between the anticipation of events (the future) and the memory of events (the past). As such, Evans (2013) argues that the striking feature of transience is that it does not exist as a monolith but, instead, forms part of a more complex set of temporal experiences which ground distinct types of temporal representation.

Transience

| TRANSIENCE TYPE | duration | succession | anisotropicity |
| PARAMETER | magnitude | dimensionality | directedness |
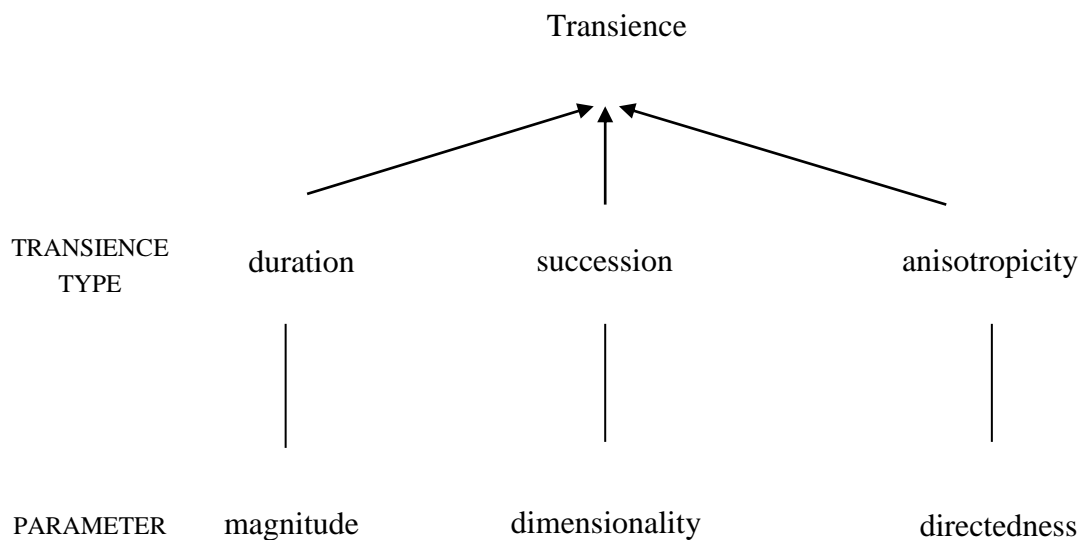
Figure 2   *Types of transience and their parameters* (Evans 2013: 67)

To this end, Evans (2013) proposes that, although an application of spatial frames of reference to time is insightful, such an application fails to recognise the essential nature of temporal reference—transience—a hallmark feature which is specific to the domain of time. Thus, his claim follows that reference strategies in space are fundamentally different to reference strategies in time and, hence, fulfil different purposes. Other lines of research lend support, in part, to this assumption. For instance, recent research conducted by Bender et al. (2012) has undermined the proposal made in earlier research that it is possible, and indeed desirable to provide a unified approach to FoRs in the spatial and temporal domains (Bender et al. 2010). In one experiment, the extent to which interpretations of *moved forward* co-vary across time and space was examined. Bender et al. (2012) hypothesised that, if s-FoRs map onto and structure t-FoRs, the preferences for specific FoRs in spatial

contexts would be carried over to corresponding temporal contexts. To test this, participants completed two tasks: one for assessing the preferred temporal interpretation of *moved forward* and another for assessing the preferred spatial interpretation. The temporal task consisted of two ambiguous temporal questions, including the *Next Wednesday's meeting* question and the spatial task entailed participants moving forward a game piece on a board game. Based on their 2010 taxonomy for t-FoRs (Bender et al. 2010), responses for both tasks were classified in terms of FoR preferences in which entities (spatial or temporal) were moved *away from* or *towards* the participant. Contrary to their predictions, the findings revealed that, in the spatial tasks, participants showed a clear preference for moving the game pieces further away from themselves, whereas in the temporal tasks, participants preferences were about evenly split between moving the events further away from the present (futurewards; *Friday*) and closer the present (pastwards; *Monday*). Thus, in contrast to the assumption that spatial schemas can be used to organise events in time, Bender et al.'s (2012) findings failed to demonstrate a link between referencing preferences in time and space. In discussing the implications of their findings, Bender et al. (2012) propose that this lack of cross-domain consistency might be attributed to FoR preferences being domain-specific and, perhaps, task-specific. For instance, earlier research investigating spatial representations of time has typically required participants to complete a variety of temporal tasks that were embedded within spatial contexts, such as arranging pictures depicting temporal sequences of events or making rapid temporal order judgments about pairs of images (e.g. Fuhrman and Boroditsky 2010; Tversky et al. 1991). Thus, it might be expected that the FoR preferences exhibited by responses to temporal tasks that also contain a shared spatial element would, by their very nature, be consistent with their corresponding FoR preferences in spatial contexts. By contrast, since the ambiguous *Next Wednesday's meeting* question is not embedded within a spatial context *per se* but, instead, taps into a person's mental representation of time, the FoR adopted for disambiguating the question might be less dependent than other temporal tasks on the spatial representation of time and more dependent on an online metaphor interpretation. Hence, while the preferred t-FoR in response to the *Next Wednesday's meeting* question may be influenced by spatial schemas, it is not dependent on them in the same way that arranging pictures depicting temporal sequences is dependent on them.

Taken together, the reviewed research provides an important foundation for the understanding of reference strategies in the domain of time, demonstrating that while space is often useful and necessary to support temporal thinking (e.g. Lakoff 1993; Lakoff and Johnson 1999), it does not necessarily follow that temporal FoRs pattern after, and hence should be modelled using, spatial FoRs (Evans 2013). Instead, it appears that the conceptual link between time and space may vary across levels of representation and processing (Bender et al. 2012). Thus, having assessed the similarities and differences between the domains of time and space, as well as the suitability of using s-FoRs to develop t-FoRs, in the following section, the focus will be turned to the nature of temporal reference.

2.3. The nature of temporal reference

As noted in Chapter 1, in earlier research on temporal reference, most notably Moore (2006) and Núñez et al. (2006), attempts were made to extend beyond temporal perspectives (Moving Time and Moving Ego), by integrating them with referencing systems (Ego-RP and Time-RP). However, a limitation of this particular approach has been highlighted by Zinken (2010), who argues that the terminology *Reference-Point* is somewhat ambiguous due to the fact that there is a secondary reference point in temporal reference—the origo—which provides the origin of the coordinate system. This follows, as temporal reference strategies arise from a number of distinct coordinates and, in the context of temporal cognition, are typified by the distinctions between the underlying coordinate systems that delineate a temporal scene (cf. Levinson 2003; Talmy 2000). In particular, Evans (2013) proposes that a t-FoR, as encoded linguistically, makes use of three coordinates: the *target event*, i.e. the event being fixed in time; the *reference point*, i.e. the event against which the temporal event is fixed; and the *origo*, i.e. the anchor of the coordinate system. As such, a t-FoR provides a means of fixing an event in time with respect to a temporal reference point which, in turn, is anchored by a temporal coordinate system.

To this end, by drawing on and building upon recent lines of research, in particular Evans' (2013) pioneering work, the following section provides a detailed account of

t-FoRs. While Evans (2013) provides evidence for the existence of three distinct t-FoRs that comes from modalities other than language, linguistic evidence provides the primary tool he deploys for exploring the nature of temporal representation. However, there are many aspects of our causal conceptual system of time that are not self-evident, such as, does time move forwards or backwards, left or right, up or down? Although language answers these questions, in part, in instances such as when we leave times of regret *behind* us, or look forward to the week *in front* of us, a fuller picture can be gained via non-linguistic evidence, such as spontaneous co-speech gestures, which verify the underlying embodiment of metaphorical thought and provide a window into the mental representations that underlie language (Goldin-Meadow 1999; McNeill 2000). Thus, in an attempt to consolidate the existing evidence for three distinct reference strategies in the domain time, this section will elaborate upon the non-linguistic evidence for deictic, sequential and extrinsic t-FoRs.

2.3.1. *Deictic t-FoRs*

Deictic t-FoRs make use of a coordinate system that is egocentric in nature, serving as a means of fixing an event in time (the target event) in relation to the ego (the RP) which, in turn, is anchored by the cogniser's awareness of now (the origo). As such, the temporal relation that is captured by deictic t-FoRs is that of past/future, whereby a temporal event is fixed in relation to the ego by virtue of being in the past, present or future (Evans 2013). In addition, linguistic evidence indicates that deictic t-FoRs also make use of spatial information, such that events that are fixed at different moments in time exhibit different properties depending on where they are situated: (i) *imminence* describes events that are fixed in the future; (ii) *synchronous* describes events that are fixed coincident with the present; and (iii) *occurrence* describes events that are fixed in the past, as illustrated by the expressions below:

Imminence	Summertime is approaching
Synchronous	The moment of truth has arrived
Occurrence	The deadline has passed

In this series of expressions, the target event, *Christmas*, is fixed in time with respect to the implicit RP, the ego's location. Notably, the temporal scene encoded by deictic temporal reference can be depicted from two perspective points: one in which the target event receives focal prominence, as shown above, and one in which an explicitly encoded RP receives focal prominence, as demonstrated by the expressions below:

Imminence	We're approaching summertime
Synchronous	We've arrived at the moment of truth
Occurrence	We've passed the deadline

As such, deictic t-FoRs provide a method of fixing events in such a way that is grounded in the human perceptual experience of future/present/past, which corresponds to tri-fold distinction between current perceptual processing (present), memory (past) and anticipation (future) (Evans 2013; cf. Gell 1992).

2.3.1.1. *Non-linguistic evidence for deictic t-FoRs*

Research on temporal gestures also provides evidence for deictic t-FoRs. For instance, speakers of English often make use of the sagittal axis for producing co-speech gestures to signal deictic temporal reference: future events are mapped onto locations in front of the ego, present events are co-located with the ego and past events are mapped onto locations behind the ego (Casasanto and Jasmin 2012; Cooperrider and Núñez 2009). While these well-established patterns have been attested in many languages, recent cross-cultural research has highlighted variation in the ways in which the sagittal axis is deployed for signalling deictic temporal reference. For instance, a range of linguistic and gestural evidence indicates that the Amerindian language of Aymara, which is spoken in the Andean region of Peru, Chile and Bolivia, elaborates past concepts ('front time') in terms of locations in front of the ego and future concepts ('behind time') in terms of locations behind the ego (Núñez and Sweetser 2006). This conceptualisation of time appears to be motivated, in part, by the significance that Aymara places on visual perception as a source of knowledge. Specifically, Aymara possesses a rich evidential system which grammatically marks whether a described event has been witnessed directly or via hearsay (Miracle and Yapita 1981). As such, it appears that the value

assigned to visual evidence may have consequences for the elaboration of deictic temporal concepts. Specifically, one proposal is that the conceptualisation of time in Aymara is experientially motivated by the metaphor KNOWLEDGE IS VISION: as the past has been directly experienced and hence witnessed, it lies to the front of the ego, whereas the future, which has not yet been experienced and hence seen, is located behind the ego (Johnson 1999; Sweetser 1990).

Evidence for deictic temporal reference strategies also comes from sign language research, which shows that different timelines facilitate distinct temporal functions (Emmorey 2001). For instance, the deictic timeline is generally adopted for describing events with respect to a particular time (by default, the time of the utterance). In American Sign Language (ASL), the deictic timeline extends forward from the signer's dominant shoulder and, concordant with the deictic t-FoR framework, the signer's body provides the reference point for the timeline. To refer to *next Friday*, signers would produce the sign FRIDAY with the arm extended, whereas to indicate *this Friday*, signers would point to a location on the timeline that is closer to the body and hence, closer to the present (Emmorey 2001). Moreover, similarly to cross-linguistic gestural research, it has also been observed that the representation of the deictic timeline varies between sign languages. For example, in Danish Sign Language (DSL), an event that took place in the past can be signalled as a location behind the signer (Engberg-Pedersen 1993). However, in ASL, a deictic reference to a location behind the signer cannot be temporal; it can only possess a spatial meaning (e.g. a location, person or object that is behind the signer). As such, if an ASL signer was referring to event in the past, such as *last Friday*, they would do so by producing the sign PAST FRIDAY in its citation form, which is approximately in the middle section of the (anterior) timeline (Emmorey 2001). In other lines of sign language research, it has also been observed that the coronal axis may be deployed for representing the deictic timeline. For instance, in Urubu Kaapor Sign Language (UKSL), which is used among the indigenous Urubu Kaapor Indians of Amazonian Brazil, the past is located in front of the signer and the future is located above the signer (Ferreira Brito 1983).

Taken together, the research reviewed demonstrates a widespread pattern in which deictic temporal reference is typically represented along a linear axis and grounded

in the front/back asymmetries of the body. However, recent research investigating the spatial representation of time among a number of indigenous communities has shown that this is not the case for all languages. A case in point is the Yupno, an indigenous community from the mountain range of Papua New Guinea, whose language makes extensive use of topographic contrasts (uphill/downhill) for describing spatial relations. In addition, a recent study conducted by Núñez et al. (2012) has shown that the topographic system the Yupno use for calculating spatial relations may also carry over into their construals of temporal relations. Specifically, by studying the spontaneous temporal gestures of the Yupno, Núñez et al. (2012) observed that speakers construe deictic temporal reference spatially in terms of allocentric topography, by gesturing downhill to signal events in the past and gesturing uphill to indicate events in the future. Converging linguistic evidence, such as *omoropmo bilak* (down-there-other-side year), which can be glossed as "a few years ago", substantiates the gestural evidence. Furthermore, Núñez et al.'s (2012) observations also show that when the Yupno are reasoning about deictic temporal reference, they gesture in approximately the same direction, irrespective of the orientation of their bodies: if they are facing downhill, the past is conceptualised as being in front of them and if they are facing uphill, the past is construed as being behind them.

In other lines of research, it has been shown that the Mayan language Tzeltal similarly makes use of topographic contrasts (uphill/downhill), as well as orthogonal crossways (sunrise/sunset), for spatial descriptions (Brown 2012). In addition, while topographic contrasts also carry over to the domain of time, with time extending uphill into the future, Brown's (2012) findings suggest that deictic temporal reference in Tzeltal is open to a variety of alternative construals, including ego-centred time (e.g. towards/away from the body) and time as a change-of-state or location (e.g. entering/exiting July).

2.3.2. *Sequential t-FoRs*

Sequential t-FoRs depict a temporal scene in which one temporal event (the target event) is fixed in relation to another temporal event (the RP) within a sequence of events (the coordinate system) which, in turn, is anchored by the origo. As such, the

temporal relation that is captured by sequential t-FoRs is that of earlier/later, whereby one event in time is established as being earlier or later than another event (Evans 2013). Moreover, the earlier/later relation holding between the events is an inherent feature of their sequence, such that the relation remains ordered and fixed, irrespective of when in time the temporal scene is viewed (by an egocentric viewer) or when in time it occurs (against an extrinsic temporal reference system).

Similarly to deictic t-FoRs, the temporal scene encoded by sequential temporal reference can be depicted from two perspective points (Evans 2013). The first relates to a temporal scene in which the perspective point is fixed at the earlier event, for example:

Earlier   Christmas is *before* New Year's Eve

In this expression, the target event, *Christmas*, is fixed in time with respect to the later event, *New Year's Eve*, which constitutes the RP. Moreover, as the earlier event, *Christmas*, receives focal prominence by virtue of being in the subject position, the perspective point is prospective: the earlier/later relation is viewed from the perspective point of the earlier event. The second temporal scene is of one in which the perspective point is fixed at the later event, for example:

Later   New Year's Eve is *after* Christmas

In this expression, the target event, *New Year's Eve*, is fixed in time in relation to the earlier event, *Christmas*, which constitutes the RP. As the later event, *New Year's Eve*, receives focal prominence by virtue of being in the subject position, the perspective point is retrospective: the earlier/later relation is viewed from the perspective point of the later event.

Similarly to intrinsic s-FoRs, which employ the orientational properties of a spatial landmark for describing a spatial scene (e.g. the ball is *in front* of the cat), sequential t-FoRs employ the orientational properties of a temporal landmark for describing a temporal scene (e.g. Christmas is *before* New Year's Eve). This similarity is well-motivated; the reason for this being that an extensive body of

research shows that the temporal concepts *before* and *after* are synchronically associated with the spatial concepts *in front* and *behind*, respectively, in a range of languages throughout the world (e.g. Clark 1973; Haspelmath 1997; Traugott 1975, 1978 for English; Hill 1982 for Hausa; Yu 1998 for Chinese; Shinohara 2000 for Japanese; Moore 2006 for Wolof; Núñez and Sweetser 2006 for Aymara). According to Haspelmath (1997), earlier/later relations are not sensitive to the deictic past/future distinction; indeed, no language is known to invert its *before* and *after* adpositions in past situations. Although *before* and *after* denote static relations, the same conceptualisation of spatial time can also be expressed in English using terms that relate to the motion of events (Zinken 2010). For example, the expression *Christmas **precedes** New Year's Eve* expresses an anteriority relation, which is achieved by locating Christmas 'in front of' New Year's Eve, in the form of *precedes*. Similarly, the expression *New Year's Eve **follows** Christmas* expresses a posteriority relation, which is accomplished by locating New Year's Eve 'behind' Christmas, in the form of *follows*.

2.3.2.1. *Non-linguistic evidence for sequential t-FoRs*
Similarly to deictic t-FoRs, evidence for sequential t-FoRs comes from research on temporal gestures (Casasanto and Jasmin 2012; Cooperrider and Núñez 2009). In particular, it has been observed that speakers of English often make use of the lateral axis for producing co-speech gestures to signal sequential temporal reference. Indeed, Casasanto and Jasmin assert that:

> Despite the total absence of left-right metaphors in spoken language, there is strong evidence that English speakers have an implicit mental timeline that runs along the lateral axis, with earlier times on the left and later times on the right of body-centered space. (2012: 4)

This pattern of organisation is also evident in signed languages. As discussed, different timelines in sign language appear to have distinct temporal functions. For instance, in ASL, the sequence timeline that runs parallel to the body, extends from left to right and corresponds to earlier to later periods or moments in time (Emmorey 2001). This timeline is generally adopted when signers converse about the temporal order of events, such as *The following Friday*. Emmorey (2001), for

instance, reports an instance of discourse in which a signer associates the year 1960 with a location on the left and the year 1980 with a location on the right. Subsequently, the signer uses the sequence timeline to refer to specific events over a period of time—such as marriage, divorce, re-marriage—by articulating signs at the relevant location along the timeline.

Other lines of research have shown that the left-to-right orientation of the sequential timeline in English, as observed in gestural and sign language research, does not derive from patterns in language (e.g. *Monday is to the left of Tuesday*) but, instead, from culturally specific spatial representations. As a result, the direction in which time flows along people's mental timeline has been shown to differ systematically across cultures (see Boroditsky et al. 2010 for Mandarin; Casasanto and Bottini 2014 for Dutch; Bergen and Chan Lau 2012 for Taiwanese; Fuhrman and Boroditsky 2010 for Hebrew; Tversky et al. 1991 for Arabic). For example, in one study, Tversky et al. (1991) instructed English participants (who read left-to-right) and Arabic participants (who read right-to-left) to graphically lay out a sequence of events, such as the meals of the day. The results showed that, whereas English participants organised the sequence from left-to-right, positioning breakfast to the left of lunch and dinner to the right, Arabic participants showed the opposite arrangement, consistent with the direction of orthography in both of these languages. Likewise, in sign language research, the orientation of the sequence timeline has been shown to differ across cultures, with earlier/later times extending from left-to-right in ASL and from right-to-left in Jordanian Sign Language (Emmorey 2001).

Similar patterns have also been found in reaction time tasks comparing English and Hebrew literates (Fuhrman and Boroditsky 2010), as well as Spanish and Hebrew literates (Ouellet et al. 2010). For example, Fuhrman and Boroditsky (2010) sought to examine whether culturally-specific spatial representations exist only with highly conventional temporal sequences (e.g. days of the weeks; months of the year), or whether these spatial representations could be extended to a range of temporal sequences that are not traditionally laid out on timelines, such as pictures depicting everyday actions and events. To test this, participants were instructed to make rapid temporal order judgments about pairs of images (e.g. a person at different stages in

life; filling a cup of coffee) that were presented one after the other by deciding whether the second image depicted a conceptually earlier or later time-point in relation to the first image. Their findings showed that English participants were consistently faster when making earlier judgments using the left response key and later judgments using the right response key. By contrast, Hebrew participants showed the reverse pattern. Moreover, instructing participants to use a space-time mapping that was inconsistent with the direction of orthography in their native language created interference, causing participants' response times to slow down. Taken together, Fuhrman and Boroditsky (2010) concluded that people automatically access culturally specific representations of space when making judgments about time.

The research reviewed demonstrates a widespread pattern in which languages appear to make use of the lateral axis for signalling sequential temporal reference. To examine the universality of this pattern, Boroditsky and Gaby (2010) investigated the representation of sequential time among the remote Australian Aboriginal community of Pormpuraaw, whose languages make use of absolute terms (e.g. cardinal points) for everyday spatial descriptions. For instance, to ask someone to move an object, a person might assert *Move your cup over to the north-northwest a little bit*. As such, in everyday parlance, it is necessary for speakers to conduct a background computation of orientation and direction, which is made possible by members of the Pormpuraaw community being adept at dead-reckoning (cf. Levinson 1996, 2003; Majid et al. 2004). To this end, as the Pormpuraawns make use of absolute space in everyday parlance, Boroditsky and Gaby (2010) sought to investigate whether these representations of space might also be used to arrange time. To test this, participants completed a series of temporal-ordering tasks, such as a card-arrangement activity, which required them to position sets of cards depicting temporal progression (e.g. a man at different ages) in the correct sequential order. Half-way through the task, participants were asked to reposition themselves at a different angle, typically 90° or 180° apart, before continuing with the task. The findings revealed that, as opposed to representing time spatially with respect to the body, the Pormpuraawns arranged sequential time from east to west, with time flowing from left to right when the person is facing south, from right to

left when the person is facing north, towards the body when the person is facing east and away from the body when the person is facing west. In discussing the implications of their findings, Boroditsky and Gaby (2010) hypothesised that the east-to-west orientation of time does not derive from patterns in temporal language—indeed, the Pormpuraawans possess a rich temporal vocabulary, yet do not use absolute direction terms to describe temporal relationships. Instead, they propose that the east-to-west orientation of time stems from the apparent motion of the sun.

In other lines of research, it has been shown that the Mianmin of Papua New Guinea similarly make use of absolute space in their representations of time (Fedden and Boroditsky 2012), suggesting that these representations are not restricted to a particular geographical location, physical environment or lifestyle. Moreover, Fedden and Boroditsky's (2012) findings indicate that when representations of space with respect to the landscape (as opposed to the body) become culturally salient, it also encourages people to create representations of time with respect to the landscape.

2.3.3. *Extrinsic t-FoRs*

Extrinsic t-FoRs serve as a means of fixing an event in time (the target event) with respect to a temporal matrix (the coordinate system) which, in turn, is anchored by the origo. According to Evans (2013), extrinsic t-FoRs exhibit a variety of systems for measuring periods of time, which can broadly categorised as *event-reckoning systems*, e.g. calendars and *time-reckoning systems*, e.g. clocks. In this respect, extrinsic temporal reference strategies arise, in part, as a cultural and intellectual achievement that is grounded in pre-existing spatial abilities and knowledge. Moreover, within both types of systems, further distinctions can be made between systems that are *repeatable*, *open-ended*, and *closed*, as shown in the following sub-sections:

2.3.3.1. *Event-reckoning systems*

An event-reckoning device is a *cultural artefact*[7] that provides a means of framing events in time. A key property of cultural artefacts is that they may be motivated by natural facts and the human phenomenological experience of these facts (Sinha et al. 2011). Evidence for the earliest event-reckoning devices dates back to the Upper Paleolithic Period (c. 40 000–10 000 BC). In particular, scholars have claimed that the notches carved onto a Taï bone plaque (c. 10 000 BC) correspond with the synodic month, i.e. the average time taken by the Moon to run through a complete cycle of phases (Marshack 1972).

As noted, event-reckoning systems can be sub-divided into different types of systems (Evans 2013). A *repeatable event-reckoning system* is a system that measures a naturally-recurring periodicity, such as the alteration of day and night, which marks the passage of a day (except at certain times of the year in the polar regions). An *open-ended event-reckoning* system measures periods of time from a specific point in time, such as the Anno Domini year-numbering system, which counts the years in relation to the traditional incarnation of Jesus Christ, AD 1. A *closed event-reckoning system* measures a finite period of time, such as an Advent Calendar, which counts down from the 1st December to the 25th December. In addition, event-reckoning systems often exhibit a recursive structure, which entails one system being embedded within another system. For instance, the Gregorian calendar, in conjunction with the Anno Domini year-numbering system have been adopted throughout most of the world for the pragmatic interests of international trade and communication; thereby, providing a universal civil standard.

2.3.3.2. *Time-reckoning systems*

Throughout the ages, humankind has devised many different methods of capturing and measuring intervals of time. A time-reckoning device is a cultural artefact which either embodies or symbolises the passage of time (Evans 2013). The earliest time-reckoning devices are likely to have been sundials and shadow clocks, for which there is evidence dating back from Egypt and China to the second

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[7] Cultural artefacts (or in other parlance, cultural technologies, cognitive artefacts or material artefacts), can be defined as "artefacts that support symbolic and conceptual processes in abstract conceptual domains" (da Silva Sinha et al. 2012: 32; cf. Evans 2013; Núñez and Cooperrider 2013; Tversky 2011; Williams 2004).

millennium BC. Subsequently, water clocks also came into fruition, an early example of which survives from Egypt and dates back to the fifteenth century BC. Other time-reckoning devices include the hourglass, the candle clock, the pendulum clock and most recently, the quartz crystal and the atomic clock (Richards 1999).

Similarly to event-reckoning systems, time-reckoning systems can also be sub-divided into different types of systems (Evans 2013). A *repeatable time-reckoning system* is a system that recurrently measures a specific period of time, such as the 24 hour clock which, once it reaches midnight, resets and starts again. Furthermore, a *closed time-reckoning system* measures a finite period of time, such as a countdown to the launch of a space rocket. Theoretically, an *open-ended time-reckoning* system that measures the elapse of time from a specific moment in time is also possible, such as a stopwatch that is left to run indefinitely.

2.3.3.3. *Non-linguistic evidence for extrinsic t-FoRs*

One claim that Evans (2013) makes about extrinsic temporal reference strategies is that they appear to make use of non-body-based two-dimensional representational space. For instance, the analogue clock-face depicts the minute and hour 'hands' rotating around a circular dial, which metonymically represents the elapse of time. Furthermore, a modern day calendar, such as the 12 month calendar, depicts horizontal rows of days that are sequenced in vertical rows of weeks, with earlier weeks sequenced above later weeks. Similarly to deictic and sequential temporal reference strategies, the extrinsic t-FoRs that people deploy vary considerably between language and culture. For instance, an English calendar depicts temporal linearity from left-to-right, whereas an Arabic calendar depicts temporal linearity from right-to-left, which is consistent with the direction of orthography in both of these languages (see Figure 3).

January 2013						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

يناير 2013						
س	ج	خ	ر	ث	ن	ح
٥	٤	٣	٢	١		
١٢	١١	١٠	٩	٨	٧	٦
١٩	١٨	١٧	١٦	١٥	١٤	١٣
٢٦	٢٥	٢٤	٢٣	٢٢	٢١	٢٠
		٣٠	٢٩	٢٨	٢٧	

Figure 3   *A comparison of temporal linearity on an English calendar (left) and an Arabic calendar (right)*

In addition to the sources of evidence highlighted by Evans (2013), arguably, extrinsic t-FoRs can also make use of *three*-dimensional representational space. For example, water clocks and hourglasses measure time via the regulated flow of a substance from an upper vessel into a lower vessel, whereby the depth of the substance is correlated with the passage of time (Richards 1999).

Furthermore, similarly to deictic and sequential reference, extrinsic temporal reference appears to lend itself to representation in gesture. Specifically, in addition to the deictic and sequence timeline, signers have been shown to also make use of a *calendar plane*, which is a two dimensional plane in front of the signer, parallel to the body (Engberg-Pedersen 1993). The calendar plane is modelled on the calendar, as the signs for the days of the week are associated with locations on the plane, akin to labelling the columns on a calendar. For example the sign EVERY-FRIDAY is made by drawing the FRIDAY F-handshape down a column of Fridays. In Danish Sign Language, the calendar plane is used primarily for describing events within the year, but in ASL, it is generally used for describing the general structure of weeks within the month (Emmorey 2001).

2.3.4. *Multiple t-FoRs*

The notion of Frame of Reference takes account of the fact that a number of possible perspectives are available for describing a scene. Similarly to spatial scenes, temporal scenes can be viewed from a number of possible perspectives. To illustrate, the *Next Wednesday's meeting* question does not include a commitment to a specific t-FoR, but the respondent must commit to a specific t-FoR in order to provide a response. Because the question does not entail a specific t-FoR, the respondent is free to choose from all compatible t-FoRs and individual respondents will make different choices. This offers an explanation as to why research has demonstrated that deictic, as well as non-deictic spatial schemas can be used to influence how people reason about events in time and their concomitant interpretation of a temporally ambiguous utterance (e.g. Boroditsky and Ramscar 2002; Kranjec 2006; Núñez et al. 2006). Specifically, by engaging in particular types of spatial-motion thinking, different construals of time can be primed by activating the relevant t-FoR. In the case of the *Next Wednesday's meeting* question, the event in question is both an event in the future and an event that forms part of a large-scale time interval; hence, deictic (Moving Time), as well as non-deictic 'linked' sequential spatial schemas, have been shown to prime *Monday* responses and deictic (Moving Ego), as well as non-deictic 'path' extrinsic spatial schemas, have been shown to prime *Friday* responses.

In addition to this, there are instances in which temporal overlapping occurs, in which two equally valid mental timelines may be activated at once. By way of illustration, consider the following sequence: *This here is today. Where would you put yesterday? Where would you put tomorrow?* (Fuhrman and Boroditsky 2010). This sequence can be conceptualised as an example of deictic reference, as the sequence is established in relation to the ego by virtue of being in the present, past or future. However, the sequence can also be conceptualised as an example of sequential reference, as the days within the sequence are also established in relation to one another by virtue of being earlier or later, i.e. yesterday, today, tomorrow. This offers one possible explanation as to why instances have been observed in which speakers spontaneously gesture on the lateral axis to signal deictic reference (as opposed to the sagittal axis, which is the customary axis deployed for deictic

reference): essentially, two timelines are being activated at once. For instance, in one experiment investigating how speakers gesture about time spontaneously, Casasanto and Jasmin observed a participant gesturing using the lateral axis when talking about "what it would have been like to live *back* then... and... even *farther back*" (2012: 14). Similarly to the previous example, the utterance could be conceptualised an example of deictic reference, in which the two past events are situated in relation to the ego, or as an example of sequential reference, whereby *back then* is situated sequentially in relation to *farther back*. As such, two temporal reference strategies appear to be simultaneously activated: deictic and sequential.

2.4. Summary

In sum, by drawing on and building upon recent lines of research, this chapter has evaluated the nature of temporal reference. In particular, this chapter has been focused on expanding the non-linguistic evidence for sequential, deictic and extrinsic t-FoRs; thereby, consolidating the existing evidence for three distinct t-FoRs. In the context of temporal cognition, a FoR provides a means of fixing an event in time with respect to a temporal reference point which, in turn, is anchored by a temporal coordinate system. As such, each t-FoR fulfils a different function: deictic t-FoRs serve to fix a temporal event in relation to the ego, giving rise to a past/future relation; successive t-FoRs serve to fix one event in time with respect to another event in time, facilitating an earlier/later relation; and extrinsic t-FoRs serve to fix an event in time with respect to the matrix system being used; thus, the temporal relations captured by this t-FoR are event iteration (in repeatable event-reckoning systems), dating (in open-ended event-reckoning systems) and durational elapse (in time-reckoning systems). Extending beyond the nature of temporal reference, in order to gain a greater understanding of the existence of time as an entity of and unto itself, the following chapter will explore the nature of time. In particular, the focus will be turned to the primary temporal experiences that underpin the human perceptual process, as well the ways in which the conceptualisation of time differs in inter-subjectively reliable ways.

3.   The nature of time

3.1. Introduction

How do we conceive of concepts that we cannot see or touch; concepts like time? While evidence from language, as well as other modalities, demonstrates that spatial concepts largely constitute our conceptions of temporality, such that space is often useful and, arguably, necessary to structure how people think about time (e.g. Lakoff 1993; Lakoff and Johnson 1999), this does not provide the whole picture. We do not possess apparatus specially designed for the processing of temporal experience in the same way that our sensory-perceptual apparatus enables the processing of spatial experience; yet, we can conceive of temporal experience in much the way that we can conceive of any other worldly experience—we are aware of its passage (Evans 2004). Indeed, a robust range of experimental research conducted by cognitive neuroscientists and psychologists gives support to the claim that, although subjective in nature, the experience of time is a phenomenologically real experience—the manifestation of which is often independent of our experience of motion in space (Kranjec and Chatterjee 2010; Kranjec et al. 2012). Not only do we perceive time in such a way that we can make systematic judgments about it but our sense of time is also a function of specific cognitive functions involving different processes and regions of the brain (Wittmann 2009). Thus, in attempting to achieve a more fully explanatory framework for theories of the temporal representation, this chapter will examine the existence of time as an entity of and unto itself—one that we can experience, as well as perceive.

3.2. The perception of time

What is the perception of time? This question has been addressed by researchers in the fields of neuroscience and psychology, who have, in turn, identified a number of temporal experiences that are fundamental to the human perceptual process. These can be broadly categorised in terms of three primary aspects of time: the *specious*

present, *succession* and *duration* (cf. Block 1990; Pöppel 1978) and are considered in more detail in the following sub-sections.

3.2.1. *The specious present*

Arguably, the most basic time experience of all is that of the specious present, the experience of 'nowness', or the duration of time for which we are "immediately and incessantly sensible" (James 1890: 631). The specious presence is underpinned by the smallest unit of temporal experience, the *perceptual moment*, which is embedded in time on two hierarchically related levels (Pöppel 1994). The first level operates within a time interval of 30 milliseconds and is a necessary condition for constructing the basic building blocks of conscious activity, *primordial events*. The second level, which sequentially links primordial events, is implemented in a temporal window of 2–3 seconds. Moreover, it is this operational level that provides the basis for conscious representation and thus, our experience of the phenomenal present (Pöppel 1994). Evidence in support of this claim comes from a variety of observations and experimental paradigms. For instance, in ambiguous visual stimuli, such as Rubin's vase, or the Necker cube, an automatic change in perspective will occur every 2–3 seconds. Similar patterns have also been observed with ambiguous auditory stimuli. For instance, when presented with sounds of similar syllables, such as *ku-ba-ku* (/kuba/ and /bacu/), the interpretation will alter every 3 seconds (Radilova et al. 1990). Furthermore, experiments investigating the temporal structure of the spoken line in poetry, as well as the intonation of spontaneous speech, indicate that spoken language is embedded in temporal windows of up to 3 seconds, which thus gives rise to its rhythmic structure (Vollrath et al. 1992; Turner and Pöppel 1983; see Pöppel 2009 for a review). Other lines of research have shown that when participants are instructed to synchronise finger taps to sequences of auditory stimuli with different inter-stimulus onset intervals, they are able to tap in anticipation of the subsequent stimulus if it occurs within 3 seconds; however, when stimuli are paced further apart, the sequence appears to be irregular and participants tend to react to the stimulus instead of anticipating it (Mates et al. 1994; Miyake et al. 2004). In addition, ethological research investigating the durations of overt behaviour shows similar temporal patterns across cultures, not only in conscious and intentional acts such as

handshakes or embraces and ritualised behaviour such as dances, but also in less conscious activities (Nagy 2011; Schleidt et al. 1987; Schleidt and Kien 1997). Indeed, Schleidt and colleagues observed that when people are engaged in a pattern of repeated simple movements, such as nodding or wiping, they either change their repetitive behaviours after about 3 seconds, or stop altogether. Similarly, when people are engaged in more complicated repeatable movements of behaviour, such as weaving a net or stirring a pot of soup, repetitions last for approximately 3 seconds. Taken together, these observations provide evidence of a temporal integration in the range of 2–3 seconds—one which provides a logistical basis for conscious representation, a working platform for our phenomenal present (Pöppel 2009).

3.2.2. *Succession*

Another basic time experience pertains to our ability to make judgments about the sequence of events, which is underpinned by two temporal thresholds. The *fusion threshold* is the minimum interval at which two events occurring in close succession, such as flashes of light or pulses of sound, can be perceived as temporally separate (Pöppel 1978). Psychophysical studies demonstrate that this threshold differs between sensory systems with, for instance, a lower threshold of detection being observable in the auditory system compared to the visual system (Pöppel 1978, 1988). The detection of non-simultaneity of two events is not, however, perceptually sufficient to reliably detect which event occurred first. A longer interval, the *temporal order threshold*, is necessary for determining the temporal order of events. Research shows that this threshold is comparable across sensory systems, suggesting a central time-organising system that is independent of purely sensory mechanisms (Hirsh and Sherrick 1961; Fink et al. 2006; Szymaszek et al. 2009). In addition, the association between an event, its time of occurrence and its relation to other events is retained in memory by virtue of a *time tag*—a process that does not require conscious intent (Pöppel 1978). Research investigating temporal memory judgments shows that people can make reasonably accurate temporal dating judgments about the serial position of an event, e.g. a word in a sequence of words, without being forewarned that they will be required to do so (Hintzman and Block 1971, 1973; Hintzman et al. 1973). However, other lines of

research on autobiographical memory show that while people may show relatively good accuracy in remembering, for instance, the time of day at which an event occurred, they may encounter difficulties in remembering other temporal aspects, such as the month or the year of the event (Friedman and Wilkins 1985), suggesting that the memory of an event is contextual in nature (Block 1990).

3.2.3. *Duration*

A period of time lasting for less than a few milliseconds is perceived as instantaneous, without duration. Beyond these few milliseconds, however, periods of time become framed in temporal units of perceived duration about which people can make subjective judgments. Psychologist Richard Block (1979) distinguishes between two fundamentally different experiences of duration: *experienced duration*, i.e. the duration of time in passing, which pertains to the present and *remembered duration*, i.e. the duration of time in retrospect, which relates to the past and relies primarily on the retrieval of information from memory. A body of research suggests that the experience of perceived duration is also variable in nature. In particular, social psychologist Michael Flaherty (1999) has identified three elementary forms of variation in the perceived passage of duration. The first of these, *protracted duration*, refers to the experience of time passing at a slower rate than usual, which arises in contexts when the density of conscious information processing is high. That is, when individuals are consciously attending to aspects of the self and their situation that would ordinarily be overlooked. Time is perceived to pass slowly in situations with abnormally high or abnormally low levels of stimulus complexity; thus, protracted duration may emerge within the context of uneventful, 'empty' intervals (e.g. solitary confinement) as well as eventful, 'full' intervals (e.g. a near-death encounter). In contrast, *temporal compression* refers to the experience of time passing at a quicker rate than usual, which arises in contexts when the density of conscious information processing is low. That is, time appears to speed up when an individual's attentional resources are not directed towards the self and their situation; hence, people can lose track of time when they are immersed in exciting situations. Other experiences in which the demands on the density of conscious information processing are low, and thus in which time appears to pass quickly, include those which involve 'routine complexity'. This relates to the notion that

activities that are performed habitually give rise to an abnormally low level of stimulus complexity brought on by the near absence of attention to self and situation (Flaherty 1999: 108). As such, familiarity through repetition can lead to the experience of time passing quickly. When time is not perceived to be passing slowly or quickly, it mostly goes unnoticed; thus, normal duration is marked by the absence of a person's attention to the passage of time. Flaherty (1999) terms this type of temporal experience *synchronicity*, as it is roughly synchronised with the intersubjective time of clocks and calendars.

3.3. The distortion of time

Studies investigating people's abilities to judge the passage of time have consistently shown that people find it difficult to accurately judge the duration of time intervals (e.g. Aschoff 1985; Campbell 1986; Lavie and Webb 1975; Loftus et al. 1987; Siffre 1964). For instance, in one experiment conducted by Campbell (1986), participants were confined to an isolation unit and instructed to estimate the time of day at various intervals throughout a 60 hour period. The results showed that, without access temporal cues, participants tended to underestimate the elapsed time, with the average subjective hour being judged at 1.12 hours in real time. The distortion of perceived duration has also been observed under more extreme conditions. For instance, when geologist Michel Siffre confined himself to live alone in an underground cave, he found that his judgments of short and long time periods were drastically distorted. Moreover, when he was returned to the surface after two months, he estimated that only 33 days had passed (Siffre 1964). Research has also shown that the perceived duration of shorter time intervals can be distorted. For example, in one experiment, memory researcher Elizabeth Loftus and colleagues (1987) showed participants a 30-second videotape of a bank robbery before later asking them to estimate the duration of the event. Their findings showed that, on average, participants overestimated the event as having lasted 150 seconds—five times longer than in reality. Personality research also suggests that the accuracy of time perception may differ between different personality types, with extroverts being more accurate time estimators than introverts (Veach and Touhey 1971).

In addition to this, other lines of research have shown that judgments of time may vary according to the internal temperature of the body. In the 1930s, psychologist Hudson Hoagland (1933) conducted a series of experiments investigating the effects of increased body temperature on time perception. Observing that the increasing temperature caused by his wife's fever appeared to be affecting her sense of time, he asked her to estimate the passage of a minute by counting what she believed to be 60 seconds at a rate of one per second. Simultaneously, the actual duration of a minute was monitored using a stopwatch. Hoagland observed that the higher his wife's temperature, the sooner she judged a minute to have passed. For instance, at 97°F, Hoagland's wife estimated that a minute had passed after 52 seconds; however, when her temperature increased to 103°F, she judged a minute as having passed after just 34 seconds. In other words, the higher her fever, the more likely she was to overestimate the duration of a minute—judging time as passing quicker than in reality. Building on Hoagland's findings, psychologist Alan Baddeley (1966) conducted a series of experiments to explore the effects of reduced body temperature on time estimation. In one experiment, divers were submerged in the sea off the west coast of Wales and were asked to estimate the length of a minute before and after their dives. The findings showed that, in comparison to before the dive, the divers were more likely to underestimate the duration of a minute after the dive, when they were colder—judging time as passing slower than in reality. A follow up study conducted in warm waters off the coast of Cyprus showed that the difference in estimates of a minute before and after the dive was negligible, thus supporting the initial finding that change in body temperature affected the perception of time among the divers (Baddeley 1966). Taken together, the findings indicate that, whereas increased body temperature tends to leads to an underestimation of time (Hoagland 1933; cf. Fraisse 1963, 1984), reduced body temperature can lead to an overestimation of time (Baddeley 1966).

3.4. The assessment of time

A variety of different methods have been employed for investigating the perception of time, the most common of which include tasks involving temporal estimation, production, reproduction and discrimination (Zakay 1990). In time estimation tasks, participants are presented with an interval of time, e.g. 10 seconds, and are required

to verbally estimate its perceived duration. In time production tasks, participants are required to produce the duration of a specified time interval by, for instance, tapping a pencil to signify the beginning and end of the interval. In time reproduction tasks, which combines both time estimation and time production, participants are presented with a time interval by a certain means, for example, by turning a light on and off. They are then required to replicate the duration of the interval, usually using the same means by which the sample duration was presented. In time discrimination tasks, participants are asked to determine the relative duration of two sequentially presented time intervals, such as a target duration of 400 ms versus a comparison duration of 600 ms.

Using these experimental paradigms, researchers have uncovered impairments in basic timing mechanisms in people with ADHD. For instance, in one study, Meaux and Chelonis (2003) investigated time perception skills in children with ADHD. Using a series of time intervals, children were instructed to watch a light, verbally estimate how long the light was illuminated and reproduce the time period by pressing a lever. The results showed that, for the time estimation component, there were no significant differences between children with ADHD and the control group; however, for the time reproduction component, children with ADHD were less accurate and made greater reproduction errors than the control group, particularly as time intervals increased. Meaux and Chelonis (2003) concluded that the similarities in time estimation scores but differences in time reproduction scores suggest that time perception deficiencies in children with ADHD is an impairment of behavioural performance, as opposed to being a deficit of knowledge or skill. In another study investigating the abilities of children with ADHD in skills of time perception, Smith et al. (2002) devised a time discrimination task for determining the idiosyncratic threshold at which two time intervals differing by several milliseconds could be distinguished. To do this, participants had to determine which of two coloured circles that were presented consecutively on a computer screen lasted the longest. The results showed that children with ADHD performed below the control group, exhibiting higher time discrimination thresholds; thus, indicating that children with ADHD exhibit a deficit in their ability to discriminate between brief intervals of time, which is only detectable in brief durations differing by several hundred milliseconds.

3.5. Summary

In sum, the reviewed research provides an important foundation for the understanding of the nature of time, demonstrating that while there are a number of commonalities that underpin the human experience of time, this multifaceted experience is also the consequence of a variety of factors, ranging from cognitive function and physiological mechanisms to momentary mood states (cf. Evans 2013). Taken together, these findings give rise to the question: what are the implications of these research findings for metaphorical representations of time? While much research in the cognitive sciences has been dedicated to the exploration of metaphors for time across languages and cultures, relatively little is known about the ways in which the conceptualisation of time and, in particular, how the interpretation of metaphorical language about time in prescribed contexts, differs in inter-subjectively reliable ways. This issue will be addressed empirically in Part II of the thesis.

Part II:

Investigation

4.   Individual differences

4.1. Introduction

As discussed previously, English exhibits three distinct reference strategies for framing events in time: deictic t-FoRs situate events in relation to the ego; sequential t-FoRs position events in relation to one another, as part of a sequence; and extrinsic t-FoRs fix events in relation to a temporal matrix. By adapting McGlone and Harding's (1998) *Next Wednesday's meeting* disambiguation paradigm, scholars in the cognitive sciences have provided evidence for the psychological reality of these three temporal frames of reference, with demonstrations that deictic spatial schemas (Boroditsky 2000; Boroditsky and Ramscar 2002), sequential spatial schemas (Núñez 2007; Núñez et al. 2006) and extrinsic spatial schemas (Kranjec 2006) can be used to influence how people reason about events in time. While spatial schemas may exert an important influence on the structure and representation of time, a person's conceptualisation of time is not merely dependent on their experiences of motion in space but rather, a complex of factors. Indeed, in addition to time, other abstract domains, such as emotion, can be understood in terms of motion in space, with certain emotions metaphorically eliciting particular types of movement, e.g. *jumping for joy*; *exploding in anger*; *scared stiff* (cf. Lakoff and Johnson 1980); thus, giving rise to the possibility that other abstract domains may be connected to time via shared spatial schemas. Although the majority of empirical research investigating space-time metaphors has hitherto been focused primarily on examining the effects of spatial priming on temporal reasoning, recent lines of research have extended beyond this, providing initial evidence that emotional differences, as well as personality differences, may also influence people's perspectives on the movement of events in time. For example, Hauser et al. (2009) investigated the link between the seemingly unrelated but similarly embodied abstract domains of anger and time. Emotion and cognition research suggests that anger, both as an emotion and as a personality trait, is spatially grounded in approach-related motivations, which drive

the active self to approach a goal or situation (Harmon-Jones 2003). Similarly, in the Moving Ego metaphor, the self is represented as an active agent who moves forward through time, approaching events in the future. Thus, drawing on aspects of Conceptual Metaphor Theory—namely, that abstract domains, such as anger or time, are conceptualised in terms of more concrete or perceptually rich domains, such as space, and that multiple abstract concepts can borrow from the same source domain—Hauser et al. (2009) hypothesised an embodied cognitive link between anger and the Moving Ego perspective, with the activation of one domain guiding the other through a shared approach-related spatial motivation. To test this hypothesis, in one experiment, participants completed a series of questionnaires for measuring trait anger (that is, anger as part of their personality) before responding to the *Next Wednesday's meeting* question. The results showed that participants who averaged higher trait anger (that is, anger as a part of their personality) were more likely to respond *Friday* (consistent with the Moving Ego perspective) than to respond *Monday* (consistent with the Moving Time perspective), thus providing initial evidence for a relationship between anger and metaphorical perspectives of time.

Probing this relationship further, Hauser et al. (2009) sought evidence of a potential bi-directional relationship between the two domains. That is, whether manipulating representations of time could affect feelings of anger, much in the way that feelings of anger affect representations of time. To test this, a scheduling task was devised in which participants were forced to adopt either a Moving Ego perspective or Moving Time perspective for rescheduling a series of events on a timeline. In the Moving Ego condition, participants 'moved forward' the rescheduled events *away* from themselves and in the Moving Time condition, participants 'moved forward' the rescheduled events *towards* themselves. After completing the task, participants were asked to rate how angry they were feeling at the current moment. The results showed that participants in the Moving Ego condition averaged significantly higher scores for self-reported anger than participants in the Moving Time condition, thus providing initial evidence for a bi-directional relationship between anger and metaphorical perspectives of time.

More recently, Richmond et al. (2012) investigated the relationship between level of perceived personal agency and metaphorical perspectives of time, reasoning that people who exhibit higher levels of perceived personal agency would be more likely to view themselves as approaching an event. To test this, participants responded to the *Next Wednesday's meeting* question before completing the Behaviour Identification Form (Vallacher and Wegner 1989) for measuring individual differences in level of perceived personal agency. Consistent with their predictions, the results showed that participants who adopted the Moving Ego perspective (responding *Friday*) averaged significantly higher agency scores compared to participants who adopted the Moving Time perspective (responding *Monday*). Probing this relationship further, in another study, Richmond et al. (2012, Study 3) sought to investigate whether this relationship might also extend to emotional experiences. On the assumption that feeling in control and proactively approaching a positive future is more likely to induce feelings of happiness, it was hypothesised that higher levels of self-reported happiness would encourage the adoption of the Moving Ego perspective (indicated by a *Friday* response). By contrast, waiting for time to exert control over the passive self is more likely to be depression-inducing; hence, higher levels of self-reported anxiety and depression would encourage the adoption of the Moving Time perspective (indicated by a *Monday* response). To test this, participants responded to the *Next Wednesday's meeting* question before completing a series of questionnaires for measuring anxiety, happiness and depression. The results showed that, in line with their predictions, participants who adopted the Moving Ego perspective reported significantly higher scores for happiness than participants who adopted the Moving Time perspective. Furthermore, participants who adopted the Moving Time perspective reported significantly higher scores for anxiety and depression than participants who adopted the Moving Ego perspective. Taken together, these findings extend the range of individual differences that may influence how people think about time, demonstrating that people's conceptualisation of time likely results from a culmination of factors, rather than a single factor.

Thus, while the majority of research on space-time metaphors has hitherto been focused primarily on investigating spatial influences on temporal reasoning, recent research findings have shed light on a number of additional influences on people's

perspectives on the movement of events in time and their resolution of temporal ambiguity. Taken together, these findings give rise to the question: which other individual differences might influence how people reason about events in time? To address this question, six studies were conducted, investigating whether previously unexplored personality differences (Studies 1 and 3), lifestyle differences (Study 2) and behavioural differences (Studies 4–6) may influence a person's conceptualisation of time and their concomitant interpretation of an ambiguous temporal question. Taken together, the results of the studies in this chapter provide converging evidence that individual differences in lifestyle and personality may combine with context to influence the ways in which people resolve linguistic ambiguities concerning the movement of events in time.

4.2. Personality differences: Extroversion-introversion

One personality dimension that has been highlighted as a fundamental dimension of personality and which is included in most personality inventories is that of extroversion-introversion (e.g. Briggs-Myers and Briggs 1985; Costa and McCrae 1985; Eysenck 1947; John 1990). Extroverts tend to be characterised as assertive, energetic and gregarious, exhibiting a more active approach towards the social and material world (John 1990; John and Srivastava 1999; John et al. 2008)—much in the way that in the Moving Ego metaphor, the self actively approaches events in the future. By contrast, introverts tend to be characterised as withdrawn, reserved and retiring, exhibiting a more passive perspective towards the social and material world—much in the way that in the Moving Time metaphor, the self passively observes the arrival of events. Building on insights from earlier lines of research, which demonstrate that individual factors which share an embodied cognitive link with the Moving Ego and Moving Time metaphors may likewise influence the resolution of temporally ambiguous language (Hauser et al. 2009; Richmond et al. 2012), it is hypothesised that there will be differences in temporal reasoning between extroverts and introverts, with extroverts being more likely to adopt an active approach to time, viewing themselves as approaching future events and introverts being more likely to adopt a passive approach to time, viewing future events as approaching themselves.

To this end, the aim of Study 1 is to examine further the role that spatially grounded individual differences play in influencing people's perspectives on the movement of events in time. Specifically, Study 1 investigates whether individual differences in extroversion (John 1990) might influence how people think about time and hence their resolution of the ambiguous *Next Wednesday's meeting* question. It is predicted that the more active, assertive personalities of extroverts should encourage the adoption of the Moving Ego perspective (indicated by a *Friday* response) and the more passive personalities of introverts should encourage the adoption of the Moving Time perspective (indicated by a *Monday* response).

4.2.1. *Study 1: Extroversion-introversion*

4.2.1.1. *Participants*

46 adults with an age range of 18 to 73 years and a mean age of 42 years participated in this study. 14 participants were male and 32 were female. The occupations of participants ranged from unemployed to professional (academics, lawyers) and the highest level of qualification ranged from no qualifications to PhD level. All participants were native speakers of English from the UK.

4.2.1.2. *Materials and procedure*

Participants were approached in libraries, coffee shops, sports centres and social clubs in Newcastle-upon-Tyne. Following informed consent, participants completed the study using a pen while sitting down at a table. To begin with, participants provided demographical information (age, gender, native language, nationality, occupation and highest level of education) before completing a three-part questionnaire. For Part 1 of the questionnaire, participants completed an acceptability judgment task which consisted of 9 pairs of temporal expressions, such as *We've passed the deadline* (Moving Ego) and *The deadline has passed* (Moving Time). Participants were presented with a 5-point Likert scale for each pair of expressions, with each expression anchoring one end of the scale, "more preferable" appearing underneath and "equally good" in the middle. The left/right ordering of the Moving Ego/Moving Time expressions was counterbalanced throughout. The purpose of including this task was to test whether, in unambiguous temporal expressions, the syntactic framings of the Moving Ego perspective and the

Moving Time perspective were equally acceptable to the participant population. For Part 2 of the questionnaire, extroversion was measured using the eight extroversion statements, e.g. *I see myself as someone who has an assertive personality*, from the Big Five Inventory (BFI; John 1990) and a five-point Likert scale with "Very true" anchoring the left-hand side of the scale, "Neutral" in the middle and "Very untrue" anchoring the right-hand side of the scale. For Part 3 of the questionnaire, participants then provided a response to the ambiguous temporal question: *Next Wednesday's meeting has been moved forward two days. What day has the meeting been rescheduled to?*

4.2.1.3. *Results and discussion*

The average extroversion score for each participant was calculated by using the BFI Scoring Key (John and Srivastava 1999). The scale ranged from 1–5, with 1 representing a low extroversion score and 5 representing a high extroversion score. Mean extroversion scores for each participant were calculated by adding the scores for each statement and dividing by the total number of statements, i.e. 8. The results showed that, consistent with the predictions, participants who adopted the Moving Ego perspective (answering *Friday*) reported significantly higher extroversion scores ($M = 3.739$; $SD = 0.554$) in comparison to participants who adopted the Moving Time perspective (answering *Monday*) ($M = 3.353$; $SD = 0.721$), $t(44) = 2.036$, $p = 0.048$, $d = 0.600$. To determine participant's preferences for the syntactic framing of the Moving Ego perspective and the Moving Time perspective in unambiguous temporal expressions, numerical values were assigned to the Likert scales, with -2 corresponding to the Moving Time end of the scale, 0 corresponding to the centre of the scale (i.e. both statements equally good), and 2 corresponding to the Moving Ego end of the scale. The results showed that there was no preference for either perspective in unambiguous temporal expressions ($M = -0.056$, $SD = 0.601$).

Building on earlier findings regarding the interplay between personality factors and temporal reasoning (Hauser et al. 2009; Richmond et al. 2012), Study 1 provides converging evidence that personality differences may influence people's perspectives on the movement of events in time. Specifically, as predicted, participants who adopted the Moving Ego perspective (answering *Friday*) averaged

higher extroversion scores than participants who adopted the Moving Time perspective (answering *Monday*). The results, however, require further probing. While recent research has provided evidence of additional influences on the resolution of temporal ambiguity, these studies have focused primarily on the role of individual differences in personality, raising the question of which other individual differences may influence how people reason about the movement of events in time. As discussed previously, people's conceptualisations of time are a consequence of a numerous factors, ranging from those more tightly bound to the individual, e.g. body temperature and emotional states of being, to those relating to the situations in which people find themselves, e.g. whether or not a task is familiar and how engaging a particular activity is deemed to be. Thus, in addition to examining personality differences among respondents, additional insights into factors that influence the ways in which people think about time might be gained by probing other variables. Noting that hitherto the majority of studies investigating the metaphoric representation of time have sampled student populations, but that the lifestyle of a student is not representative of the general population, one line of enquiry is whether lifestyle plays a role in influencing a person's conceptualisation of time and their concomitant interpretation of an ambiguous temporal expression. To test this, in Study 2, university students' responses to the *Next Wednesday's meeting* question were compared against those from a sector of the population operating under quite different time pressures: university administrators.

4.3.   Lifestyle differences: Students and administrators

A large body of empirical research from the cognitive sciences has provided evidence that our experience of time is grounded in our understanding of space, such that different ways of thinking about motion in space can influence the ways in which people reason about events in time (e.g. Boroditsky 2000; Boroditsky and Ramscar 2002; Kranjec 2006; Matlock et al. 2005, 2011; Núñez et al. 2006; Ramscar et al. 2010). While the priming-induced effects on temporal reasoning are indeed noteworthy, people's perspectives on the movement of events in time in a 'neutral' unprimed context has received little attention—the assumption being that in the absence of priming, the two responses to the *Next Wednesday's meeting* question are equally likely: "In a neutral context, people are equally likely to think

of themselves as moving through time as they are to think of time as coming toward them" (Boroditsky and Ramscar 2002: 185). However, a closer inspection of responses to the *Next Wednesday's meeting* question in the absence of spatial priming shows that only student participants have been sampled in a 'neutral' context and these respondents have demonstrated a preference for responding *Friday*: Boroditsky (2000), Núñez (2007) and Sullivan and Barth (2012) report these figures to be 54%, 61% and 77%,[8] respectively. To put these numbers in perspective, Boroditsky and Ramscar's (2002, Study 1) research reports that people primed to imagine moving through space towards a stationary object (in line with the Moving Ego perspective) responded *Friday* 57% of the time. Thus, as rates of *Friday* responses that differ little from the 'neutral' context baselines have been taken as evidence for the adoption of the Moving perspective, it gives rise to the possibility that there is something specific to the population sampled that favours a particular direction in the resolution of temporal ambiguity.

Thus, one issue that warrants further investigation is whether, as the lifestyle of a student is not representative of the general population, the results from earlier research may have arisen, in part, due to the particular lifestyle typical of the participant population. To demonstrate, in UK universities, the average academic year is 24 weeks and students receive an average of 13.4 contact hours per week (NUS-HSBC 2011; The Guardian 2011); thus, in general, students are relatively in control of the structuring of their time. By contrast, UK administrators, managers and professionals (who represent 66% of the UK labour market) and UK full-time employees work on average 41.4 hours per week and receive 28 days annual paid leave (BBC News 2008; Directgov 2012; Office for National Statistics 2010); thus, full-time employees have more external constraints and less control over the structuring of their time than students. In addition, whereas workers are paid for their time and have little choice over turning up for work, students pay to attend university; they are the consumers, which gives them the choice of whether or not to turn up to a lecture. The flexibility of time inherent in the student lifestyle thus stands in stark contrast to the rigid structure of time characterising the lifestyle of employees. In view of these differences and drawing on insights from Richmond et

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[8] Sullivan and Barth's (2012) sample consisted of a mostly (~98%) student population (Hilary Barth, personal communication, August 2013).

al. (2012), who found that people who report higher levels of perceived personal agency were more likely think of themselves as approaching an event (adopting the Moving Ego perspective), it is hypothesised that people who have control over their time and temporal flexibility in their daily lives, such as students, may perceive time quite differently to those who require high degrees of time management on a daily basis and are regimented by external demands, such as administrators. To test this hypothesis, students and university administrators (such as personal assistants, secretaries, university timetable coordinators), who deal with the daily management of events and activities, as well as the scheduling of meetings, were presented with the *Next Wednesday's meeting* question. It is predicted that students, with their flexible schedules and relative control over the structuring of their time, will be more likely to adopt the Moving Ego perspective, moving the meeting later in time, to *Friday*. In contrast, it is predicted that university administrators, who are more cognisant of external pressures and for whom time is relatively controlled by external demands, will be more likely to adopt the Moving Time perspective, moving the meeting earlier in time, to *Monday*.

4.3.1. *Study 2: Students and administrators*

4.3.1.1. *Participants*. 123 adults from Northumbria University participated in this study. 90 participants were administrators, with an age range of 23 to 62 years and a mean age of 40 years. 33 participants were full-time students (undergraduate and postgraduate), with an age range of 19 to 61 years and a mean age of 30 years. All participants were native speakers of English from the UK.

4.3.1.2. *Materials and procedure*

Participants were approached on the Northumbria University campus in offices, coffee shops and the university library. Following informed consent, all participants completed a questionnaire using pen and paper while sitting down at a table. For the questionnaire, participants provided demographical information (age, gender, native language and nationality) before providing a response to the ambiguous temporal question: *Next Wednesday's meeting has been moved forward two days. What day has the meeting been rescheduled to?*

4.3.1.3. *Results and discussion*

In line with the predictions, the results showed that, whereas administrators were more likely to adopt the Moving Time perspective (responding *Monday*), students were more likely to adopt the Moving Ego perspective (responding *Friday*). Specifically, 28.9% of administrators responded *Friday* in comparison to 60.6% of students. A chi-square test revealed a reliable difference in responses between administrators and students: $\chi^2_{1,123} = 10.375$; $p < 0.001$; Cramer's V = 0.290.[9] Indeed, the tendency among students for responding *Friday* response in an unprimed context is in line with the responses of control group participants in the studies conducted by Boroditsky (2000), Núñez (2007) and Sullivan and Barth (2012). In addition, the effect size is also comparable with that of Núñez (2007): Cramer's V = 0.239.[10] In contrast, the administrators showed a preference for disambiguating the question in line with a *Monday* response, consistent with the predictions based on lifestyle differences between the two groups of participants.

Taken together, the results demonstrate that lifestyle may play a role in influencing how people think about time and hence their resolution of a temporal ambiguity: as predicted, students, with their relative control over the structuring of their time and fewer external constraints, tended to think in a more egocentric way and hence tended to adopt Moving Ego perspective, moving the meeting later in time, to *Friday*. In contrast, university administrators, who are more cognisant of external pressures and for whom time is relatively controlled by external demands, were more likely to adopt the Moving Time perspective, moving the meeting earlier in time, to *Monday*. Study 2 thus provides initial evidence that individual differences in lifestyle may play a role in influencing how people reason about the movement of events in time and their concomitant interpretation of an ambiguous temporal question.

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[9] For completeness, an additional analysis for an age-matched sub-group of students and administrators was conducted ($N = 30$; $R = 23$ to 57 years; $M = 37$ years; $SD = 13.100$). In line with the overall findings, 26.7% of administrators responded *Friday* compared to 66.7% of students. A chi-square test revealed a reliable difference in responses between administrators and students: $\chi^2_{1,30} = 4.821$; $p = 0.028$; Cramer's V = 0.401.

[10] Due to insufficient information, it was not possible to calculate the effect size for Boroditsky (2000) and Sullivan and Barth (2012).

Drawing on these findings, there are additional reasons to believe that students and administrators may also differ along certain personality variables relating to time management. For instance, research shows that procrastination is widespread in the academic domain, with up to 95% of students procrastinating habitually with academic tasks such as writing assignments, studying for examinations and keeping up-to-date with weekly seminar reading (Ellis and Knaus 1977; Ferrari and Beck 1998; see also Solomon and Rothblum 1984; Steel et al. 2001). In addition, Rivera (2007) claims that procrastination is likely to be the single most common time management problem, with students ranking highly as a group most vulnerable to procrastination. Particularly relevant to the issue of how students organise their time, however, are the reasons for procrastination: (i) the amount of time a person spends studying is completely down to the individual—there is always more that could be done; (ii) for most students, contact hours are minimal and the majority of time is unstructured; thus, the onus is on the student to decide what to do and when to do it; and (iii) the university environment often offers a wide range of activities which could easily be prioritised over study time. Although relatively few studies have examined procrastination among the *nonstudent* population, procrastination has been found to chronically affect 15–20% of adults, with the lowest rates of procrastination reported by professional, business and educational employees, such as university administrators (Harriott and Ferrari 1996). In line with this tendency, the essential job criteria for Northumbria University administrators, like those in Study 2, state that applicants should possess "Excellent organisational skills" and the "Ability to prioritise workload and manage conflicting priorities" (Work4Northumbria 2012). Thus, if the preferences observed in Study 2 may be attributed, in part, by the tendency for students to procrastinate and for administrators not to procrastinate, it gives rise to the possibility that people who exhibit high degrees of procrastination may also disambiguate the *Next Wednesday's meeting* question in line with the Moving Ego perspective, showing a preference for interpretations in which the meeting has been moved later in time, to *Friday*. To test this, Study 3 directly investigates the relationship between procrastination and metaphorical perspectives of time.

4.4.   Personality differences: Procrastination and conscientiousness

In Study 2, it was shown that a population that is prone to procrastination tended to disambiguate the *Next Wednesday's meeting* question in line with the Moving Ego perspective (responding *Friday*). This tendency is reflected in the definition of the term *procrastination*:

> To defer action, delay; to postpone until another day; to defer; to put off; to be dilatory. *Often with the sense of deferring through indecision*, *when early action would have been preferable*. (OED 2007)

By contrast, a population that tends to prioritise, rather than procrastinate, were more likely to disambiguate the *Next Wednesday's meeting* question in line with the Moving Time perspective (responding *Monday*). Taken together, these observations give rise to the question of how a tendency to procrastinate, or resist procrastination, might influence how people reason about events in time.

Personality research suggests that procrastinators tend to avoid, delay or postpone action (Milgram et al. 1998; Milgram and Tenne 2000). In contrast, conscientious individuals tend to prioritise action (Back et al. 2006; John and Srivastava 1999). That is, whereas the deferment associated with procrastination entails the movement of tasks 'forward' into the future, in a direction concordant with the ego's movement through time (in line with the Moving Ego perspective), the prioritisation associated with conscientiousness entails the movement of tasks 'forward' towards the present, *ergo* towards the ego (in line with the Moving Time perspective). As such, if the habitual movement of tasks plays a role in influencing how people think about events in time, this should be reflected by responses to the *Next Wednesday's meeting* question, with procrastinators showing a preference for deferment, moving forward the meeting later in time, to *Friday* and conscientious individuals showing a preference for prioritisation, moving forward the meeting earlier in time, to *Monday*.

In addition to this, personality research proposes that our personalities are made up of both higher-order and more general personality factors—such as the Big Five:

conscientiousness, neuroticism, extroversion, agreeableness and openness—and lower-order and more specific traits, such as procrastination (e.g. Eysenck 1947; Allport 1963; Comrey 1988). Of particular interest to the current study is the negative correlation between procrastination and conscientiousness: researchers have shown than task avoidance procrastination and dilatory behaviour might be attributed to lack of conscientiousness (Milgram and Tenne 2000; Schouwenburg and Lay 1995). This negative correlation provides an additional means by which to strengthen the relation between procrastination and metaphorical perspectives of time: because procrastination tends to operate in parallel to (lack of) conscientiousness in predicting behaviour, the relation between procrastination and dilatory behaviour should be matched by an inverse relation between conscientiousness and dilatory behaviour (cf. Johnson and Bloom 1995; Lay 1997; Schouwenburg and Lay 1995), which would be reflected through temporal reasoning.

To this end, the aim of Study 3 is to examine further the role that individual differences play in influencing how people reason about events in time by investigating whether individual differences in conscientiousness (John 1990) and procrastination (Lay 1986) contribute to their conceptualisation of time and resulting resolution of the ambiguous *Next Wednesday's meeting* question. It is predicted that people who adopt the Moving Ego perspective (answering *Friday*) will report higher procrastination scores, as well as lower conscientiousness scores, whereas participants who adopt the Moving Time perspective (answering *Monday*) will report higher conscientiousness scores, as well as lower procrastination scores.

4.4.1. *Study 3: Procrastination and conscientiousness*

4.4.1.1. *Participants*
28 full-time undergraduate students from Northumbria University participated in this study, with an age range of 18 to 27 years and a mean age of 20 years. 8 participants were male and 20 were female. All participants were native speakers of English from the UK.

4.4.1.2. *Materials and procedure*

A two-part questionnaire was distributed to a first year English literature class. Following informed consent, participants completed the study using a pen while sitting down at a table. To begin with, participants provided demographical information (age, gender, native language and nationality) before undertaking the questionnaire. For Part 1 of the questionnaire, procrastination was measured using the Student Procrastination Scale (Lay 1986) and conscientiousness was measured using the Big Five Inventory (BFI; John 1990). Sample items included: *I generally delay before starting on work I have to do* (procrastination) and *I see myself as someone who does things efficiently* (conscientiousness). A five-point Likert scale was used with "Very true" anchoring the left-hand side of the scale, "Neutral" in the middle and "Very untrue" anchoring the right-hand side of the scale. For Part 2 of the questionnaire, participants then provided a response to the ambiguous temporal question: *Next Wednesday's meeting has been moved forward two days. What day has the meeting been rescheduled to?*

4.4.1.3. *Results and discussion*

The average procrastination score for each participant was calculated by using the Student Procrastination Scale Key (Lay 1986). The scale ranged from 1–5, with 1 representing a low procrastination score and 5 representing a high procrastination score. Mean procrastination scores for each participant were calculated by adding the scores for each statement and dividing by the total number of statements, i.e. 20. The results showed that, consistent with the predictions, participants who adopted the Moving Ego perspective (answering *Friday*) reported significantly higher procrastination scores ($M = 3.541$; $SD = 0.337$) in comparison to participants who adopted the Moving Time perspective (answering *Monday*) ($M = 2.978$; $SD = 0.499$), $t(26) = 3.446$, $p = 0.002$, $d = 1.322$. Next, the average conscientiousness score for each participant was calculated by using the BFI Scoring Key (John and Srivastava 1999). The scale ranged from 1–5, with 1 representing a low conscientiousness score and 5 representing a high conscientiousness score. Mean conscientiousness scores for each participant were calculated by adding the scores for each statement and dividing by the total number of statements, i.e. 9. In line with the predictions, the findings revealed that participants who adopted the Moving Time perspective (responding *Monday*) averaged higher conscientiousness scores

($M = 3.695$; $SD = 0.552$) compared to participants who adopted the Moving Ego perspective (responding *Friday*) ($M = 3.153$; $SD = 0.697$), $t(26) = 2.299$, $p = 0.030$, $d = 0.862$. Moreover, in line with earlier research, which indicates that procrastination operates in parallel to (lack of) conscientiousness in predicting behaviour (Johnson and Bloom 1995; Lay 1997; Schouwenburg and Lay 1995), there was a significant inverse correlation between self-reported conscientiousness and procrastination (Spearman's *rho* = 0.801, $p < 0.0001$).

In sum, Study 3 provides converging evidence that individual differences in personality play a role in influencing how people reason about the movement of events in time. Specifically, in line with the predictions, participants who adopted the Moving Ego perspective (answering *Friday*) averaged higher procrastination scores and lower conscientiousness scores in comparison to participants who adopted the Moving Time perspective (answering *Monday*). The findings, however, raise further questions. Although recent research has shown that individual differences in personality may influence the ways in which comprehenders resolve temporal ambiguities, all of these studies, to date, have relied on participants' self-reported assessments of personality variables (e.g. Hauser et al. 2009; Richmond et al. 2012). While most personality inventories encompass a range of items for tapping behaviours, feelings and thoughts and have been shown to provide a valid means of assessing personality (Roberts et al. 2007), one question that remains unanswered is whether these relationships have force in real life. To test this, three studies were conducted to examine whether, in addition to *self-reported* conscientiousness and procrastination, there is a relationship between conscientious and procrastinating *behaviours* and temporal perspective. Across three studies, the resolution of temporal ambiguity was compared against three measures of real life conscientious and procrastinating behaviours: the extent to which a worker was on schedule for work (Study 4); how close to the deadline a student submitted their assignment (Study 5); and the time at which a person arrived for a scheduled appointment (Study 6).

4.5. Behavioural differences: Procrastination and conscientiousness

While conscientiousness and procrastination may be related to various types of behaviour, one measure that has been demonstrably related to both of these personality variables throughout a number of studies is that of punctuality (e.g. Ashton 1998; Back et al. 2006; Díaz-Morales et al. 2006; Roberts et al. 2004; Solomon and Rothblum 1984). For instance, in one study investigating procrastination among students, lack of punctuality was shown to be the measure of behaviour that correlated most significantly with self-reported procrastination (Solomon and Rothblum 1984). Furthermore, in another study investigating the correlations between personality factors and self-reported workplace delinquency, self-reported lateness was found to be negatively correlated with conscientiousness (Ashton 1998). In other lines of research examining the influence of personality on punctuality in a real life setting, Back et al. (2006) found that participants who reported higher conscientiousness scores tended to arrive earlier for a scheduled appointment in comparison to participants who reported lower conscientiousness scores. As such, punctuality provides an observable real life measure of procrastination and conscientiousness.

In sum, these findings provide a way to address the question of whether the relationship between metaphorical perspectives of time and self-reported procrastination and conscientiousness have force in real life using a measure of real life behaviour: it is hypothesised that there would be differences in temporal reasoning between people who are efficient time-keepers and those who are not. To test this, Study 4 investigated whether the extent to which a person was on schedule for work would influence the temporal perspective they adopted in response to the *Next Wednesday's meeting* question. It is predicted that people who are running early would be more likely to adopt the Moving Time perspective, moving the meeting earlier in time, to *Monday*, whereas people who are running late would be more likely to adopt the Moving Ego perspective, moving the meeting later in time, to *Friday*.

4.5.1. *Study 4: Travelling to work*

4.5.1.1. *Participants*

104 adults with an age range of 18 to 59 years and a mean age of 33 years participated in this study in exchange for a small reward.[11] 40 participants were male and 65 were female. All participants were native speakers of English.

4.5.1.2. *Materials and procedure*

People waiting for a bus were approached individually by an experimenter at Newcastle Haymarket bus station and greeted before being asked if they were travelling to work. People who responded *Yes* were then asked if they would be willing to participate in a short survey. To begin with, participants provided demographical information (age, gender and native language). Participants then provided responses to two test questions and the Wednesday's meeting. For the first test question—*Are you on time for work?*—participants answered using one of the three options: *Yes*, *No*, or *Not applicable*.[12] For the second test question—*If yes or no which applies most to you?*—participants rated the extent to which they were on schedule for work using one of five options: *Very late*, *Late*, *On time*, *Early* or *Very early*. The order of the options was counterbalanced across participants. Participants then answered the ambiguous temporal question: *Next Wednesday's meeting has been moved forward two days. What day has the meeting been rescheduled to?* All questions were administered orally and all responses were written down by the experimenter throughout the exchange.

4.5.1.3. *Results and discussion*

Responses to the two test questions were compared against the response to the *Next Wednesday's meeting* question for each participant. For the first test question, which assessed whether each participant was on schedule for work, all participants responded either *Yes* or *No*. The results showed that, in line with the predictions, participants who were on schedule were more likely to disambiguate the meeting question in line with the Moving Time perspective (responding *Monday*), whereas

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[11] 12 participants were unwilling to disclose their age; thus, the range and mean is calculated on the basis of the remaining 92 participants.
[12] The *Not applicable* option was not selected by any of the participants.

participants who were not on schedule were more likely to disambiguate the meeting question in line with the Moving Ego perspective (responding *Friday*). Specifically, 62.7% of participants on schedule responded *Monday* in comparison to 17.2% of participants who were not. To determine whether the difference in the proportion of *Monday* and *Friday* responses was reliable, a chi-square test for independence was used, revealing a significant relationship: $\chi^2_{1,104} = 17.262$, p < 0.0001 Cramer's V = 0.407. For the second question, which assessed the participant's perception of the extent to which they were on schedule for work, responses were coded using a number from 1–5, in which 1 denoted *I am very late* and 5 denoted *I am very early*. The results showed that, consistent with the predictions, the Moving Time perspective (indicated by a *Monday* response) was more frequently adopted by people who were running earlier (*M* = 3.279; *SD* = 0.760), whereas the Moving Ego perspective (indicated by a *Friday* response) was more prominent among people who were running later (*M* = 2.635; *SD* = 0.908), $t(102) = 3.279$, $p < 0.001$, $d = 0.643$.

Building on the findings regarding the interplay between temporal disambiguation and self-reported measures of conscientiousness and procrastination observed in Study 3, Study 4 provides initial evidence that these relationships have force in real life contexts. That is, in addition to self-reported conscientiousness and procrastination, there is a relationship between conscientious and procrastinating behaviours and temporal perspective. The results, however, raise additional questions. One shortfall is that behaviour was measured using participants' self perceptions of the extent to which they were on schedule for work. However, additional value can also be gained by using other methods which do not rely on the individual, such as observer ratings or experimentally derived measures for directly assessing specific behaviours (Connelly and Hülsherger 2012; Vazire 2006). Thus, to examine whether the effects have observable, real world consequences, in Study 5, a more objective measure of procrastinating and conscientious behaviour was used: the timely submission of assignments.

4.5.2. *Study 5: The assignment submission*

As discussed, research shows that procrastination is especially common in the academic domain, with up to 95% of students procrastinating habitually with academic tasks, such as studying for examinations, keeping up-to-date with weekly seminar reading, as well as the submission of assignments (e.g. Ellis and Knaus 1977; Ferrari and Beck 1998; see also Solomon and Rothblum 1984; Steel et al. 2001). Many universities still use the traditional paper-based submission procedure, which requires students to submit their assignments to the school office by a designated time on deadline dates. There is a wide range of penalties for lateness across the university sector and although students are often aware that they might be penalised for the late submission of their work, this will often not deter them from submitting their assignments with little time to spare (Stoneham 2009). As such, research investing psychological explanations for procrastination among students has made use of the times taken by students to submit assignments as a method for assessing procrastinating behaviour (Beswick et al. 1988). Similarly, research investigating the relationship between professionalism and conscientiousness among medical students has assessed conscientious behaviour using the timely submission of assignments (Finn et al. 2009; McLachlan et al. 2009). As such, the timely submission of assignments provides an objectively observable means of assessing whether the relationship between temporal perspective and self-reported procrastination and conscientiousness is matched by the relationship between temporal perspective and procrastinating/conscientious behaviours. To this end, Study 5 sought to investigate whether there would be differences in temporal reasoning between students who submit their assignment further in advance of the deadline and students who submit their assignments closer to the deadline, as demonstrated by their response to the *Next Wednesday's meeting* question. It is predicted that students submitting their essay earlier would be more likely to adopt the Moving Time perspective, moving the meeting earlier in time, to *Monday*, whereas students submitting their essay later would be more likely to adopt the Moving Ego temporal perspective, moving the meeting later in time, to *Friday*.

4.5.2.1. *Participants*

60 undergraduate students from Northumbria University, with an age range from 19 to 30 and a mean age of 21 years, participated in this study. 21 participants were male and 39 were female. All participants were native speakers of English.

4.5.2.2. *Materials and procedure*

Participants were approached individually and greeted by an experimenter at the Student Advice and Support Centre on the Northumbria University campus, where students based in the Faculty of Arts and Social Sciences are required to submit their assignments for formal assessment. After agreeing to take part in a short survey, participants provided demographical information (age, gender and native language) before providing responses to the test question *How far in advance of the deadline did you submit your assignment?* and the ambiguous temporal question *Next Wednesday's meeting has been moved forward two days. What day has the meeting been rescheduled to?* All questions were administered orally and all responses were written down by the experimenter throughout the exchange.

4.5.2.3. *Results and discussion*

Responses to the test question were compared against the response to the *Next Wednesday's meeting* question for each participant.[13] Consistent with the predictions, the results showed that the Moving Time perspective (indicated by a *Monday* response) was more frequently adopted by participants who were submitting their assignment further away from the deadline ($M = 208$ minutes prior; $SD = 116$ minutes), whereas the Moving Ego perspective was more prominent among participants who were submitting their assignment closer to the deadline (indicated by a *Friday* response) ($M = 145$ minutes prior; $SD = 82$ minutes), $t(58) = 2.495$, $p = 0.015$, $d = 0.635$. Building on the findings from Study 4, these results provide consolidating evidence that, in addition to self-reported conscientiousness and procrastination, there is a relationship between conscientious and procrastinating *behaviours* and temporal perspective.

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[13] Similarly to the findings in Experiment 2, this student population showed a preference for answering *Friday* (58.3%) in comparison to *Monday* (41.7%) (cf. Boroditsky 2000; Núñez 2007; Sullivan and Barth 2012).

As demonstrated, despite the question consisting of a single measure, McGlone and Harding's (1998) ambiguous meeting question has been used extensively in research investigating metaphorical representations of time. However, two issues that arise from using a single experimental question are that, firstly, it is not possible to assess the internal consistency of single-item measures and secondly, measures comprising of a single item are potentially unreliable (e.g. Oshagbemi 1999; Pollard 1996; but see Wanous et al. 1997). Thus, if the *Next Wednesday's meeting* question is a robust and reliable measure of temporal perspective, a similar pattern of findings should be found using other ambiguous temporal questions that make use of different temporal units, e.g. hours within the day, *Tomorrow's noon meeting has been moved forward two hours* and months within the year, *The October meeting has been moved forward two months* (cf. Kranjec et al. 2010; Lai and Boroditsky 2013; Núñez et al. 2006).[14] Indeed, other lines of research have demonstrated that people tend to be consistent in their representations of time, such that people who imagine moving forward a meeting scheduled for Wednesday by two days to Monday (as opposed to Friday) are also more likely to imagine moving forward a meeting scheduled for noon by two hours to 10am (as opposed to 2pm) (Núñez et al. 2006; cf. Richmond et al. 2012). However, as with much related research, these measures have yet to be used in the assessment of real-life behaviours.

Thus, to address the issue of whether similar effects would be observable using different dependent variables for measuring temporal perspective or whether the original effects are attributable to the specific item being used, Study 6 investigated whether people arriving earlier for a scheduled appointment would think about time differently to people arriving later for a scheduled appointment, comparing the participant's time of arrival (cf. Back et al. 2006) against the resolution of two different temporal reasoning questions. Specifically, extending on from the *Next Wednesday's meeting* question, temporal perspective was measured using the *Noon meeting* question and the *October meeting* question. Building on insights from earlier findings, it is predicted that people arriving earlier for their appointment

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[14] Concordant with the *Next Wednesday's meeting* question, the *Noon meeting* question and the *October meeting* question are ambiguous, giving rise to two possible answers: *10am* or *2pm* (the *Noon meeting* question) and *August* or *December* (the *October meeting* question).

would be more likely to adopt the Moving Time perspective (indicated by *10am* and *August* responses), while people arriving later would be more likely to adopt the Moving Ego perspective (indicated by *2pm* and *December* responses).

4.5.3. *Study 6: The scheduled appointment*

4.5.3.1. *Participants*

45 adults with an age range of 19 to 65 years and a mean age of 38 years participated in this study in exchange for a gift voucher. 18 participants were male and 27 were female. All participants were native speakers of English.

4.5.3.2. *Materials and procedure*

To recruit participants, flyers were distributed in local shops and restaurants, as well as through an online advertising website. Participants were then instructed to contact the experimenter via email to take part in the study. Each participant was allocated with an appointment time and instructed that they should arrive at a specified meeting point—namely, the entrance of the Lipman coffee shop on the Northumbria University campus—at the time allocated. As participants arrived, the experimenter recorded their arrival time. Lateness was calculated by the number of minutes between the appointment time and the arrival time of the participants and earliness was calculated by the number of minutes between the appointment time and the arrival time of the participants multiplied by -1 (cf. Back et al. 2006); hence, positive scores indicate late arrival and negative scores indicate early arrival (e.g. 5 minutes late; 0 minutes on time; -5 minutes early). Following informed consent, participants completed the study using a pen while sitting down at a table. Participants provided demographical information (age, gender and native language) before completing a study consisting of six tasks that were unrelated to the current study. The two ambiguous meeting test questions appeared on separate pages and were interspersed between the different tasks (cf. Boroditsky 2000). The first test question appeared after task 3 (a vocabulary task) and the second test question appeared after task 5 (an author recognition task). Participants read each test question before providing their responses. The order in which the two test questions were presented was counterbalanced across participants.

4.5.3.3. *Results and discussion*

Participants arrived, on average, 2.89 minutes before their appointment time (*SD* = 9.14), with the time of arrival ranging from 22 minutes early to 25 minutes late. In particular, 30 participants were early, 0 were exactly on time, and 15 were late. Concordant with predictions, the Moving Time perspective (indicated by a *10am* and *August* response) was more frequently adopted by people who arrived early for their appointment, whereas the Moving Ego perspective (indicated by a *2pm* and *October* response) was more prominent among people who arrived late. Specifically, for the *Noon meeting* question, 63.3% of participants who arrived early responded *10am* in comparison to 36.7% of participants who arrived late. To determine whether the difference in the proportion of *10am* and *2pm* responses was reliable, a chi-square test for independence was used, revealing a significant relationship: $\chi^2_{1,45}$ = 4.132, p = 0.042 Cramer's V = 0.303. Similarly, for the *October meeting* question, 66.7% of participants who arrived early responded *August* in comparison to 33.3% of participants who arrived late. Again, a chi-square test showed a reliable difference in the proportion of *August* and *October* responses: $\chi^2_{1,45}$ = 4.500, p = 0.034 Cramer's V = 0.316. In line with earlier research findings (Núñez et al. 2006; cf. Richmond et al. 2012), participants were also highly consistent in their representations of time, such that those who imagined moving the noon meeting forward earlier to *10am* also moved the October meeting earlier to *August* (88.0%) and those who imagined moving the noon meeting later to *2pm* also moved the October meeting later to *December* (95.0%): $\chi^2_{1,45}$ = 30.633, p < 0.0001 Cramer's V = 0.825. In addition, for the *Noon meeting* question, participants who adopted the Moving Time perspective arrived earlier on average (*M* = -6.130; *SD* = 8.465) compared to participants who adopted the Moving Ego perspective (*M* = 0.750; *SD* = 8.744), *t*(45) = 2.585, *p* = 0. 013, *d* = 0.799. Also, for the *October meeting* question, participants who adopted the Moving Time perspective arrived earlier on average (*M* = -5.800; *SD* = 8.367) in comparison to participants who adopted the Moving Ego perspective (*M* = 0.750; *SD* = 8.944), *t*(45) = 2.531, *p* = 0. 015, *d* = 0.756.

Taken together, the results provide further evidence of a relationship between naturally-occurring conscientious and procrastinating behaviours and metaphorical perspectives of time. Furthermore, by using additional measures of adopted

temporal perspective, Study 6 extends earlier findings to temporal questions using different time scales, suggesting that the original effects were not merely attributable to the specific item being used, i.e. the *Next Wednesday's meeting* question.

4.6. General discussion

Hitherto, the vast majority of research investigating abstract thinking about time has been focused primarily on investigating spatial influences on temporal reasoning; however, recent lines of research have extended beyond this and have begun to consider extra-linguistic influences on people's perspectives of the movement of events in time and their resolution of temporal ambiguity (e.g. Hauser et al. 2009; Richmond et al. 2012). As people's conceptualisations of time are not merely dependent on their experiences of motion in space but, instead, are shaped by a complex of factors, six studies were conducted to examine further the range of individual differences that may influence how people think about time and their concomitant interpretation of an ambiguous temporal expression.

To begin with, Study 1 sought to examine further the role that personality differences play in influencing people's preferred temporal perspective, focusing specifically on the personality dimension of extroversion-introversion. It was shown that, in line with an active approach to time, participants who adopted the Moving Ego perspective (answering *Friday*) exhibited higher degrees of extroversion compared to participants who adopted the Moving Time perspective (responding *Monday*).

Noting that hitherto the majority of studies investigating the metaphoric representation of time have sampled student populations, but that the lifestyle of a student is not representative of the general population, Study 2 investigated whether lifestyle may play a role in influencing how people think about time, comparing students' responses to the *Next Wednesday's meeting* question against those of administrators. It was shown that students, with their relative control over the structuring of their time and fewer external constraints, were more likely to adopt the Moving Ego perspective (answering *Friday*), whereas administrators, who are

more cognisant of external pressures and for whom time is relatively controlled by external demands, were more likely to adopt the Moving Time perspective (answering *Monday*).

Reasoning that the habitual movement of tasks may be a contributor to the temporal perspective adopted in response to the *Next Wednesday's meeting* question, with procrastinators tending to postpone action (Milgram et al. 1998; Milgram and Tenne 2000), and conscientious individuals tending to prioritise action (Back et al. 2006; John and Srivastava 1999), Study 3 examined whether individual differences in conscientiousness (John 1990) and procrastination (Lay 1986) may influence how people think about the movement of events in time. The findings revealed that, in line with the predictions, participants who adopted the Moving Ego perspective (answering *Friday*) averaged higher procrastination scores and lower conscientiousness scores in comparison to participants who adopted the Moving Time perspective (answering *Monday*).

Next, observing that recent research investigating the effects of personality differences on temporal reasoning have relied on participants' self-reported assessments of personality variables, three studies were conducted to examine whether, in addition to *self-reported* conscientiousness and procrastination, there is a relationship between conscientious and procrastinating *behaviours* and metaphorical perspectives of time. To begin with, Study 4 probed whether the extent to which a person was on schedule for work would influence the temporal perspective they adopted in response to the *Next Wednesday's meeting* question. In line with the assumption that punctuality provides an observable real life measure of conscientiousness (Ashton 1998; Back et al. 2006) and that self-reported conscientiousness is demonstrably related to the Moving Time perspective (Study 3), it was shown that the Moving Time perspective (indicated by a *Monday* response) was more frequently adopted by people who were running earlier, whereas the Moving Ego perspective (indicated by a *Friday* response) was more prominent among people who were running later.

Extending on from participants' self-reported measures of timeliness, Study 5 and 6 examined whether the earlier effects have observable, real world consequences

using more objective measures of procrastinating and conscientious behaviours. To begin with, Study 5 tested whether there would be differences in temporal reasoning between students who submit their assignment further in advance of the deadline and students who submit their assignments closer to the deadline, as demonstrated by their response to the *Next Wednesday's meeting* question. Study 6 then investigated whether people arriving earlier for a scheduled appointment would think about time differently to people arriving later for a scheduled appointment, comparing the participant's time of arrival against the resolution of temporal ambiguity, using two new temporal reasoning questions: the *Noon meeting* question and the *October meeting* question. Concordant with earlier findings, participants who adopted the Moving Time perspective were more likely to exhibit conscientious behaviours, while those who adopted the Moving Ego perspective were more likely to procrastinate, suggesting that the earlier effects have observable, real world consequences.

In sum, building on recent research findings (e.g. Hauser et al. 2009; Richmond et al. 2012), the results from these studies provide further evidence of the range of individual differences that may influence how people reason about time, while also providing initial evidence that individual differences in time management as observed in real-life contexts may influence how people resolve temporal ambiguities. In addition, by using additional variables for measuring temporal perspective, these studies generalise earlier findings to temporal questions using different time scales, suggesting a consistency between temporal reasoning and the movement of events in time. While individual differences in personality and lifestyle may exert an influence on the interpretation of a temporally ambiguous utterance, these findings raise the question of whether different types of factors may also play a role in influencing the ways in which people think about time. Indeed, other lines of research on the *Next Wednesday's meeting* question have uncovered at least one aspect of what is encoded in the question that may influence temporal reasoning; namely, the ambiguous question refers to the rescheduling of a 'meeting', the nature of which is unspecified to the comprehender (Lee and Ji 2014; Margolies and Crawford 2008). Preliminary findings suggest that the valence of the event and specifically the comprehender's affective orientation towards the event may influence people's perspectives on the movement of events in time. To this

end, extending one step further, the following chapter will explore the ways in which temporal language interpretation may arise from an interaction between the valence of an event and aspects of the life experiences and personality of the comprehender.

5. Event valence

5.1. Introduction

Thus far, a range of factors that are directly tied to the individual have been shown to contribute to a person's conceptualisation of time and their concomitant resolution of temporal ambiguity. However, other lines of research investigating the relationship between spatial construals of time and affect indicate that the valence of an event (positive or negative) may also influence how people reason about the movement of events in time. Reasoning that, typically, positive affect is spatially represented by approach motivations and negative affect, by avoidance motivations (Cacioppo et al. 1993; Chen and Bargh 1999; Neumann et al. 2003),[15] Margolies and Crawford (2008) hypothesised that emotional states may provide a spatial context for thinking about time, with people symbolically moving towards positive events and passively observing the arrival of negative events. As such, they predicted that positively valenced events might encourage the use of the Moving Ego perspective and negatively valenced events might encourage use of the Moving Time perspective. To test this, in one experiment, participants were asked to imagine an event in the future, scheduled for next Wednesday, for which they might feel either enthusiasm (e.g. seeing a distant loved one) or dread (e.g. a stressful exam) before answering a number of task-related questions, such as: (i) *What day is the event now that it has been rescheduled?*; (ii) *How does this news change how you feel about the event? (a. Worse; b. Better)*; and (iii) *Which statement best expresses how you feel? (a. I am approaching this event; b. The event is approaching me.).* Consistent with their predications, the results showed that participants in the enthusiasm (positive) condition were more likely to describe themselves as approaching the event (in line with the Moving Ego perspective), whereas participants in the dread (negative) condition were more likely to describe the event as approaching themselves (in line with the Moving Time perspective). In addition, participants in the enthusiasm condition were more likely to feel better

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[15] An exception to this is the negative emotion and trait anger which, as discussed earlier, is characterised by approach-related motivations (Harmon-Jones 2003).

about the rescheduling of the event to *Monday* than participants in the dread condition. However, the valence of the event did not significantly affect whether the participants responded *Monday* or *Friday*. Margolies and Crawford (2008) offer two possible explanations for this apparent inconsistency, the first being that although people might have a tendency to imagine themselves approaching positive events (in line with the Moving Ego perspective), this effect is undermined by the tendency to want positive events to occur sooner (in line with the Moving Time perspective). The second possible explanation relates to the different nature of the two questions: whereas the 'approach question' relates to a spatial scene and may tap into a person's underlying representations of space, McGlone and Harding's (1998) 'days question' relates to a temporal scene and may tap into a person's underlying representations of time. Although related, the two representations may remain somewhat distinct (cf. Evans 2013).

Extending their findings, in a second experiment, Margolies and Crawford (2008) sought to examine whether the language of Moving Time and Moving Ego metaphors could be used to infer the valence of an event, reasoning that the metaphoric correspondences between motion and emotion should not only tacitly affect how interlocutors encode statements about time but also how they interpret encodings produced by others. To test this, participants were presented with a third-person narrative of a scenario in which an event had either been explicitly moved forward to *Monday* (the Moving Time condition) or *Friday* (the Moving Ego condition) before rating how they imagined the protagonist would feel about the rescheduling of the event. The results showed that participants in the Moving Ego condition rated the rescheduling of the event more positively than participants in the Moving Time condition, indicating that space-time metaphors also convey information about the valence of an event, with the language of Moving Ego being more associated with positivity than the language of Moving Time—at least in Western cultures.[16]

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[16] Noting that Monday and Friday differ in valence, with Friday generally being viewed more positively than Monday, Margolies and Crawford (2008) conducted a follow-up study to determine whether the observed effect was driven by valence difference or metaphor difference. In concordance with their earlier findings, they found that even when the event was rescheduled to a less positive day (Monday) using the language of Moving Ego, participants still viewed the event more positively than when it was rescheduled to a more positive day (Thursday) using the language of Moving Time.

Taken together, Margolies and Crawford's (2008) findings provide initial evidence of a bi-directional relationship between affect and spatial construals of time. Specifically, people are more likely to imagine themselves approaching a positive event (in line with the Moving Ego perspective), whereas they are more likely to imagine a negative event approaching themselves (in line with the Moving Time perspective). In addition to this, encoding temporal passages using the Moving Ego language, rather than Moving Time language, invites comprehenders to infer that the speaker is more positively disposed towards an event. In discussing the implications of their findings, Margolies and Crawford concluded that:

> Our embodied knowledge and perceptions are a result of an accumulation of sensorimotor experiences, including emotional reactions and spatial movements that influence each other in shaping thought. Abstract thought capitalises on more concrete domains and thus is subject to influences from both physical and affective experience. (2008: 1412)

Probing further the interrelations between affect and metaphorical perspectives of time, recent research by Lee and Ji (2014) suggests that temporal reasoning is not only influenced by the feelings evoked by an event but also whether the focal event is situated in the past or future. On the assumption that people typically approach what they like and avoid what they dislike in space (Cacioppo et al. 1993; Chen and Bargh 1999; Neumann et al. 2003), Lee and Ji (2014) hypothesised that similar tendencies might exist in time that enable people to dictate their psychological distance from different temporal events by minimising the distance from pleasant experiences and maximising the distance from unpleasant experiences. As such, they predicted that anticipating pleasant events in the future or recalling unpleasant events from the past, though differing in valence, should encourage the notion of actively moving away from the past and towards the future (in line with the Moving Ego perspective). Conversely, recalling pleasant events from the past or anticipating unpleasant events in the future should foster a preference for remaining closer to the past and further away from the future (in line with the Moving Time perspective). To test this, in one experiment, participants were instructed to write about a past experience in which they had felt either embraced or rejected by their friends before

responding to the *Next Wednesday's meeting* question. As predicted, participants' responses to the question were influenced by the valence of the recalled event with participants in the rejection condition more likely adopting the Moving Ego perspective than participants in the embraced condition. In another experiment, participants were instructed to write about an event in the future which would make them feel either happy or unhappy before completing a seemingly unrelated word puzzle, developed for assessing their preferred temporal perspective. Specifically, the task was to unscramble seven words (*deadline*, *we*, *the*, *is*, *are*, *approaching*, and *us*) that were presented randomly on a page into a grammatically correct five-word sentence by discarding two words, which resulted in two possibilities: *We are approaching the deadline* (reflecting the Moving Ego perspective) or *The deadline is approaching us* (reflecting the Moving Time perspective). The findings showed that, in line with their predictions, participants in the happy condition were more likely to solve the word puzzle using the Moving Ego perspective than participants in the unhappy condition. In concordance with Margolies and Crawford (2008), Lee and Ji's (2014) findings show that, whereas the anticipation of pleasant events prompted use of the Moving Ego perspective, the anticipation of unpleasant events encouraged participants to adopt the Moving Time perspective. However, extending one step further, Lee and Ji (2014) observed a reverse tendency for events in the past. Specifically, whereas the recollection of unpleasant emotions prompted use of the Moving Ego perspective, the recollection of pleasant emotions encouraged participants to adopt the Moving Time perspective. Taken together, Lee and Ji's (2014) findings provide further evidence of the ways in which life experiences, emotions and metaphorical perspectives of time are interrelated, demonstrating that how people reason about events in time is not only influenced by the feelings associated with an event but also whether the event is located in the past or the future.

The body of research reviewed thus extends the range of factors that may influence the ways in which people reason about events in time, providing new insights on metaphor and its ability to reflect people's thinking and feelings. Thus, to examine further the ways in which the valence of an event, aspects of the life experiences and personality of the comprehender and metaphorical perspectives of time are interrelated, two studies were conducted to investigate whether the interpretation of

a temporally ambiguous question may arise from an interaction between the valence of the event and aspects of the personality (Study 7) and lifestyle (Study 8) of the comprehender. In sum, the findings provide further evidence that temporal language interpretation may arise from an interaction between the valence of an event and the life experiences of the comprehender which may, in turn, also affect the comprehender's affective orientation towards the event.

5.2.   Event valence and personality

As discussed, recent research suggests that the valence of an event may influence how people reason about events in time, with the anticipation of positively valenced events encouraging use of the Moving Ego perspective (Lee and Ji 2014: Margolies and Crawford 2008). Moreover, as shown in Study 1, a similar preference for adopting the Moving Ego perspective has been observed among people who exhibit high degrees of extroversion. In addition to this, research from the field of personality demonstrates that extroverts tend to actively seek positive encounters with others and are more likely to enjoy and participate in social activities, such as parties and sororities, or in physical activities, such as team sports (Ashton et al. 1995; Furnham 1981; Emmons and Diener 1986). By contrast, introverts tend to withdraw from social situations and are more likely to engage in solitary activities, such as reading a novel or gardening (Argyle and Lu 1990). Tying these findings together, as positive affect and extroversion are represented by approach-related motivations and negative affective and introversion are represented by avoidance-related motivations (cf. Elliot and Thrash 2002; Hauser et al. 2009; Margolies and Crawford 2008), it raises the possibility that affect and extroversion-introversion may be connected to time via a shared spatial schema. Specifically, on the assumption that people are more likely to imagine themselves approaching a positive event (in line with the Moving Ego perspective) and to imagine a negative event approaching themselves (in line with the Moving Time perspective), it is hypothesised that extroverts would be more likely to imagine themselves approaching a social event (viewing it positively) (cf. Lucas et al. 2000), which would lead to a higher likelihood of adopting the Moving Ego perspective. By contrast, introverts would be more likely to imagine a social event approaching

themselves (viewing it negatively), which would lead to a higher likelihood of adopting the Moving Time perspective.

To this end, the aim of Study 7 is to probe the interaction between individual differences in extroversion-introversion and event valence on the interpretation of a temporally ambiguous question. Specifically, Study 7 investigates whether differences between the social-seeking behaviours of extroverts and the social-withdrawing behaviours of introverts would be reflected in the resolution of the ambiguous question: *Next Wednesday's **party** has been moved forward two days. What day has the event been rescheduled to?* In line with an active approach to positive encounters, it is predicted that people who adopt the Moving Ego perspective (answering *Friday*) will exhibit higher self-reported extroversion scores than participants who adopt the Moving Time perspective (answering *Monday*).

5.2.1. *Study 7: Next Wednesday's party*

5.2.1.1. *Participants*
40 full-time undergraduate students from Northumbria University participated in this study, with an age range of 19 to 55 years and a mean age of 23 years. 18 participants were male and 22 were female. All participants were native speakers of English from the UK.

5.2.1.2. *Materials and procedure*
A two-part questionnaire was distributed to a second year English literature class. Following informed consent, participants completed the study using a pen while sitting down at a table. To begin with, participants provided demographical information (age, gender, native language and nationality). For Part 1 of the questionnaire, extroversion was measured using the eight extroversion statements, e.g. *I see myself as someone who is outgoing*, *sociable*, from the BFI (John 1990) and a five-point Likert scale with "Very true" anchoring the left-hand side of the scale, "Neutral" in the middle and "Very untrue" anchoring the right-hand side of the scale. For Part 2 of the questionnaire, participants then provided a response to the ambiguous temporal question: *Next Wednesday's party has been moved forward two days. What day has the event been rescheduled to?*

5.2.1.3. *Results and discussion*

The average extroversion score for each participant was calculated by using the BFI Scoring Key (John and Srivastava 1999). The scale ranged from 1–5, with 1 representing a low extroversion score and 5 representing a high extroversion score. Mean extroversion scores for each participant were calculated by adding the scores for each statement and dividing by the total number of statements, i.e. 8. The results showed that, contrary to prediction, the difference in self-reported extroversion scores between participants adopting the Moving Ego perspective (responding *Friday*; $M = 3.833$; $SD = 1.033$) and those adopting the Moving Time perspective (responding *Monday*; $M = 3.412$; $SD = 0.876$) was marginal: $t(38) = 1.060$, $p = 0.296$, $d = 0.440$. One possible explanation for this null effect is that although extroverts might be more likely to imagine themselves approaching events (in line with the Moving Ego perspective), particularly social situations (Lucas et al. 2000), this effect is undermined by the tendency to want an enjoyable and sociable event, such as a party, to occur sooner (in line with the Moving Time perspective) (cf. Margolies and Crawford 2008).

While there was no significant effect between responses to the *Next Wednesday's party* question and self-reported extroversion, an interesting finding to emerge from Study 7 is that 85.0% of the student population adopted the Moving Time perspective, moving *Next Wednesday's party* forward to *Monday* in comparison to 39.4% of the student population sampled in Study 2, who moved *Next Wednesday's meeting* forward to *Monday*. A post-hoc analysis reveals a reliable difference in response across the two groups: $\chi^2_{1,73} = 16.401$; $p < 0.0001$; Cramer's V = 0.474; thus, further demonstrating that the type of event may influence people's perspectives on the movement of events in time, with a population of students prioritising a party, moving it earlier in time (in line with the Moving Time perspective) and deferring a meeting, moving it later in time (in line with the Moving Ego perspective). Moreover, this difference re-emphasises the role that lifestyle plays in influencing people's conceptualisations of time, suggesting that temporal language interpretation may arise from an interaction between the valence of an event and the life experiences of the comprehender. Probing this interaction further, Study 8 sought to investigate further the effects of event valence on

students' interpretation of an ambiguous temporal question using a focal event that features on all academic calendars: the assignment deadline.

5.3.   Event valence and lifestyle

In recent years, there has been a growth in interest concerning stress experienced by students studying in higher education. Stress can be viewed as "an imbalance between perceived demands and perceived resources" (Matheny et al. 2008: 50; cf. Lazarus and Folkman 1984). While research examining sources of stress among students has shown that stress may be attributed to a range of factors, such as financial difficulties, health problems and social strains, research shows that academic-related activities rank frequently as the most potent causes. More specifically, examinations and meeting deadlines for assignments have been reported as the two most common causes of academic stress (e.g. Abouserie 1994; Kohn and Frazer 1986). In addition to this, it has been reported that 75% to 80% of university students exhibit moderate levels of stress and 10% to 12% exhibit serious levels of stress (Abouserie 1994; Pierceall and Keim 2007).[17] A significant positive correlation has also been shown to emerge between stress and negative affect, as well as lack of perceived control (e.g. Abouserie 1994; Clark and Watson 1991; Watson 1988). Indeed, according to Abouserie, "students who believe in their abilities and in their control of their situations are less stressed than those who believe that things happen by luck or outside agents" (1994: 329). On the assumption that assignment deadlines are one of the most frequent causes of stress among students, it is hypothesised that students would feel negatively disposed towards the arrival of an assignment deadline, especially if it was rescheduled earlier in time. Furthermore, as stress is correlated with negative affect, as well as lack of perceived control—two factors that are demonstrably related to the Moving Time perspective (e.g. Margolies and Crawford 2008; Richmond et al. 2012)—it is also hypothesised that students would be more likely to imagine a stressful event, such as an assignment deadline, approaching themselves (in line with the Moving Time perspective) than to imagine themselves approaching it.

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[17] It should, however, be noted that in some situations stress can be beneficial. Indeed, distinctions have been made between eustress (positive stress) (Brown and Ralph 1999) and distress (Bush et al. 1985).

To this end, the aim of Study 8 is to examine further the ways in which the valence of an event, the life experiences of the comprehender and metaphorical perspectives of time are interrelated by focusing specifically on the participant's affective orientation towards the event. To do this, students were presented with the question *Next Wednesday's **assignment deadline** has been moved forward has been moved forward two days. What day has the event been rescheduled to?* before being asked whether they perceived themselves as approaching the event or whether they imagined the event approaching themselves and also whether the rescheduling of the event made them feel better or worse. In line with the findings that assignment deadlines are one of the most prominent causes of stress among students (Kohn and Frazer 1986) and that people tend to feel worse about the rescheduling of a negative event when it is moved earlier in time (Margolies and Crawford 2008), it is predicted that participants who report feeling worse about the rescheduling of the assignment deadline will be more likely to adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses) compared to participants who adopt the Moving Ego perspective (indicated by *Friday* and *I'm approaching the event* responses). Furthermore, building on insights from earlier findings which demonstrate that people are more likely to imagine a negative future event approaching themselves (Lee and Ji 2014; Margolies and Crawford 2008), it is predicted that the Moving Time perspective will be more prominent than the Moving Ego perspective among the student population.

5.3.1. *Study 8: Next Wednesday's assignment deadline*

5.3.1.1. *Participants*
39 full-time undergraduate students from Northumbria University participated in this study, with an age range of 18 to 24 years and a mean age of 21 years. 13 participants were male and 26 were female. All participants were native speakers of English from the UK.

5.3.1.2. *Materials and procedure*
A questionnaire was distributed to a third year English literature class. Following informed consent, participants completed the study using a pen while sitting down

at a table. To begin with, participants provided demographical information (age, gender, native language and nationality). Next, adopting the methodology used by Margolies and Crawford (2008), participants read the ambiguous temporal statement below before answering three related questions:

Next Wednesday's assessment deadline has been moved forward two days

1. *What day has the event been re-scheduled to?*
2. *Which statement best expresses how you feel?*
   a. I am approaching this event
   b. The event is approaching me
3. *How does this news change how you feel about the event?*
   a. Worse
   b. Better

5.3.1.3. *Results and discussion*

For the purpose of this discussion, question one is referred to as the Days question and question two is referred to as the Approach question. In line with the predictions, the results showed that participants who felt better about the rescheduling of the event were more likely to adopt the Moving Ego perspective (indicated by *Friday* and *I am approaching the event* responses), whereas participants who felt worse about the rescheduling of the event were more likely to adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses). Concretely, for the Days question, 85.2% of participants who felt worse about the rescheduling of the meeting responded *Monday* in comparison to 0% of participants who felt better about it. A chi-square test revealed a reliable difference in response: $\chi^2_{1,39} = 21.231$; $p < 0.0001$; Cramer's V = 0.768. Similarly, for the Approach question, 74.1% of participants who felt worse about the rescheduling of the meeting responded *The event is approaching me* in comparison to 11.1% of participants who felt better about it. Again, a chi-square test revealed a reliable difference in response: $\chi^2_{1,39} = 11.010$; $p < 0.001$; Cramer's V = 0.553. Participants were also highly consistent in their answers. Those who responded *Friday* also viewed themselves as approaching the event (84.7%), and those who responded *Monday* also viewed the event as approaching

themselves (82.7%): $\chi^2_{1,39} = 15.442$, p < 0.0001; Cramer's V = 0.655. Furthermore, in line with the predictions, the student population demonstrated a preference for adopting the Moving Time perspective for the Days and the Approach questions, with (63.9%) participants responding *Monday* and (58.3%) of participants responding *The event is approaching me*.

Taken together, the results from Study 8 provide further evidence that temporal language interpretation may arise from an interaction between the valence of an event and the life experiences of the comprehender, which may, in turn, also influence the comprehender's affective orientation towards the event. Specifically, as predicted, participants who felt better about the rescheduling of the event were more likely to adopt the Moving Ego perspective (indicated by *Friday* and *I am approaching the event* responses), whereas participants who felt worse about the rescheduling of the event were more likely to adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses). Furthermore, in line with earlier findings demonstrating that people are more likely to imagine a negative future event approaching themselves (Lee and Ji 2014; Margolies and Crawford 2008), the student population demonstrated a preference for disambiguating the *Next Wednesday's assignment deadline* question in line with the Moving Time perspective, as evidenced by *Monday* and *The event is approaching me* responses.

5.4. General discussion

Building on earlier observations that individual differences in personality and lifestyle may influence people's perspectives on the movement of events in time, two studies were conducted to investigate a number of additional factors that may also play a role in influencing the resolution of temporally ambiguous language. Drawing on preliminary lines of research, which suggest that the valence of an event and specifically the comprehender's affective orientation towards the event may also influence people's conceptualisations of time, the studies aimed to investigate whether the interpretation of a temporally ambiguous utterance may arise from an interaction between the valence of the event and aspects of the personality (Study 7) and lifestyle (Study 8) of the comprehender.

To begin with, Study 7 sought to examine further the interaction between individual differences in personality and event valence on the interpretation of a temporally ambiguous question, focusing specifically on the personality dimension of extroversion-introversion. Specifically, the aim was to investigate whether differences between the social-seeking behaviours of extroverts and the social-withdrawing behaviours of introverts would be reflected in their resolution of the ambiguous *Next Wednesday's party* question. It was shown that, contrary to the prediction that extroverts would be more likely to imagine themselves approaching a social event (viewing it positively) and introverts would be more likely to imagine a social event approaching themselves (viewing it negatively), the difference in self-reported extroversion scores between participants adopting the Moving Ego perspective (responding *Friday*) and those adopting the Moving Time perspective (responding *Monday*) was marginal; thus, suggesting that although extroverts might be more likely to imagine themselves approaching events (in line with the Moving Ego perspective), particularly social situations (Lucas et al. 2000), this effect is undermined by the tendency to want an enjoyable and sociable event, such as a party, to occur sooner (in line with the Moving Time perspective) (cf. Margolies and Crawford 2008).

Probing further the ways in which the valence of an event, the life experiences of the comprehender and metaphorical perspectives of time are interrelated, Study 8 examined the effects of event valence on students' interpretation of an ambiguous temporal question using a focal event that features on all academic calendars: the assignment deadline. To do this, students were presented with the *Next Wednesday's assignment deadline* question before being asked to rate whether the rescheduling of the event made them feel better or worse. In line with the findings that assignment deadlines are one of the most prominent causes of stress among students (Kohn and Frazer 1986) and that people tend to feel worse about the rescheduling of a negative event when it is moved earlier in time (Margolies and Crawford 2008), the results showed that participants who felt better about the rescheduling of the event were more likely to adopt the Moving Ego perspective (indicated by *Friday* and *I am approaching the event* responses), whereas participants who felt worse about the rescheduling of the event were more likely to

adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses). Furthermore, in line with earlier findings demonstrating that people are more likely to imagine a negative future event approaching themselves (Lee and Ji 2014; Margolies and Crawford 2008), the student population demonstrated a preference for disambiguating the *Next Wednesday's assignment deadline* question in line with the Moving Time perspective. In sum, the results from Study 8 provide additional evidence that the interpretation of an ambiguous temporal question may arise from an interaction between the valence of an event and the life experiences of the comprehender which may, in turn, also influence the comprehender's affective orientation towards the event.

Hitherto, a range of factors that are directly tied to the individual have been shown to play a role in resolution of temporally ambiguous language. Furthermore, recent lines of research have also uncovered at least one aspect of what is encoded that may influence temporal reasoning; namely, the valence of the event (Lee and Ji 2014; Margolies and Crawford 2008). However, while much research has made use of McGlone and Harding's (1998) ambiguous question (and more recently, various permeations of their question), very little research has been conducted to probe the linguistic contributors to the different interpretations of the question, thus leaving unanswered questions regarding the factors that may contribute to its ambiguity. To this end, in order to gain further insight into the nature of the ambiguity in the *Next Wednesday's meeting* question, in the following chapter, the focus of the investigation will be turned to the linguistic properties of individual elements in the question; probing factors that may contribute to the question's inherent ambiguity.

6.   Grammatical differences

6.1. Introduction

Spatial concepts largely constitute our conceptions of temporality, such that space is often useful and, arguably, necessary to structure how people think about time (Lakoff 1993; Lakoff and Johnson 1999). Indeed, the relationship between space and time is reflected in the language people habitually use when talking about events in time: durations can be expressed in terms of distance (a *long* meeting; a *short* vacation); events can be moved (the party was *brought forward*; the deadline was *pushed backward*); and instances in time can be conceived as points (the *middle* of the year; the *end* of the film). In addition, the spatial representation of time makes use of prescribed prepositions for conveying different types of temporal concepts: *at* is often used in conjunction with small temporal units (*at* midday); *on* usually co-occurs with intermediate temporal units (*on* Monday); and *in* tends to be used with larger temporal units (*in* May). Noting this pattern of usage, Wierzbicka (1993) has proposed that the choice between different prepositions across different types of temporal concepts is semantically motivated and not merely the result of idiosyncratic grammatical rules. Building on insights from this research, Kranjec et al. (2010) conducted an experiment to investigate whether the semantics of prescribed prepositions could be used to influence how people think about time. Specifically, by adapting McGlone and Harding's (1998) *Next Wednesday's meeting* question, participants responded to one of six possible ambiguous temporal questions: the Preposition condition comprised of three questions, using three distinct scales of temporal units (*hour*, *day*, and *month*) and their prescribed spatial preposition (*at*, *on* and *in*, respectively) and the No Preposition condition consisted of analogous questions, using the same three temporal scales but without the prescribed prepositions, resulting in the following six test questions:

Preposition condition

The meeting at noon has been moved forward two hours. At what hour is the meeting now that it has been rescheduled?

The meeting on Wednesday has been moved forward two days. On what day is the meeting now that it has been rescheduled?

The meeting in June has been moved forward two months. In what month is the meeting now that it has been rescheduled?

No Preposition condition

The noon meeting has been moved forward two hours. What hour is the meeting now that it has been rescheduled?

The Wednesday meeting has been moved forward two days. What day is the meeting now that it has been rescheduled?

The June meeting has been moved forward two months. What month is the meeting now that it has been rescheduled?

The results showed that in the No Preposition condition, the proportions of earlier and later responses were not reliably different from chance for all time scales; thus, suggesting that differences in time scale alone did not influence how participants disambiguated the questions. By contrast, in the Preposition condition, the proportions of earlier and later responses differed reliably from chance for all time scales, indicating that spatial prepositions do indeed influence temporal thinking. In addition, responses for the same time scale across the Preposition and No Preposition conditions differed, with particular prepositions (*at* and *in* but not *on*) encouraging participants to respond in an opposite manner to their no preposition counterpart questions.

In discussing the implications of their findings, Kranjec et al. (2010) suggest that the dimensional complexity of *at*, *on* and *in* may have influenced temporal thinking in particular ways: the 'zero-dimensional' preposition *at* biased thinking towards small points of time; the 'two-dimensional' *on*, towards intermediate lengths of time; and the 'three-dimensional' *in*, towards large volumes of time. To illustrate, consider the following: on a timeline, positions closer to the beginning convey smaller extensions of time and correspond with earlier times, whereas positions

towards the end represent larger extensions and correspond with later times. Thus, if spatial language influences participants to visualise a timeline extending from smaller (and earlier) times to larger (and later) times, then prepositions of different dimensional complexity might influence temporal thinking with respect to the corresponding segment of the mental representation. As such, questions using the zero-dimensional preposition *at* should result in a greater number of earlier responses; questions containing the two-dimensional preposition *on* should give rise to an intermediate pattern of results; and questions with the three-dimensional preposition *in* should produce a greater number of later responses—a pattern that is reflected in their results. Taken together, Kranjec et al. (2010) concluded that the dimensional characteristics of prescribed prepositions retain semantic content and modulate how people think about time.

Taken together, the research reviewed importantly extends the range of factors that may influence people's representations of time, demonstrating that the linguistic properties of individual elements of an ambiguous temporal question may also influence its interpretation. Thus, to examine further the linguistic contributors to the different interpretations of McGlone and Harding's (1998) ambiguous meeting question, a further two studies were conducted. Study 9 sought to investigate whether the locus of the ambiguity is centred on the adverb, centred on the verb or distributed across the utterance. The results indicate that the interpretation of the ambiguous temporal question results from an interplay of verb and adverb. In Study 10, the focus is turned to grammatical agency, comparing responses to the question in active or passive voice, and responses with an explicit first, second or third person agent. The findings indicate that the role of the grammatical person, but not grammatical voice, may also influence the interpretation of the ambiguous temporal question.

6.2. Disambiguating the ambiguity: Verb vs. adverb

The assumption has often been made by scholars that the ambiguity of the *Next Wednesday's meeting* question stems from the interpretation of the adverb *forward*, which can be interpreted either as indicating the direction of motion of the ego

through time or as indicating the direction of motion of time towards the ego:

> If the above statement is interpreted using the ego-moving schema, then *forward* is in the direction of motion of the observer, and the meeting should now fall on a *Friday*. In the time-moving interpretation, however, *forward* is in the direction of motion of time, and the meeting should now be on a *Monday*. (Boroditsky 2000: 8)

> The answer to the question about Wednesday's meeting is ambiguous because it depends on how the word *forward* is interpreted in the context of one's mental representation of the timeline. (Kranjec and McDonough 2011: 737)

More recently, however, it has been claimed that the ambiguity may in fact be rooted in the use of the directionally neutral verb *move*:

> ...simply substitute the word *push* for *move* and the sentence becomes disambiguated:
>
> Next Wednesday's meeting has been *pushed* forward by two days
>
> While *moved* can refer to movement in several different directions depending on one's perspective, *pushed* nearly always implies movement in a forward direction. When we push something, we use the muscles of our arms and trunk to propel the object away from us in a forward direction.[18] (Restak 2011: 44, italics added)

A further possibility is that the ambiguity may arise from a combination of both the verb (*move*) and the adverb (*forward*), indicating a distributed semantics of temporal expressions, analogous to the distributed semantics found in spatial expressions (Sinha and Kuteva 1995).

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[18] Notably, Restak presumes a lack of ambiguity stemming from the adverb *forward*.

While earlier research has probed the temporal ambiguity arising from constructions other than *moved forward*, a number of discrepancies make it difficult to draw firm conclusions from their findings. Specifically, in addition to the *Next Wednesday's meeting* disambiguation task, McGlone and Harding (1998) devised two additional test questions, using the constructions *advanced* and *pushed back*:

i. The reception originally scheduled for next Wednesday has been *advanced* two days

ii. The party originally scheduled for next Wednesday has been *pushed back* two days

To determine whether the target sentences were in fact ambiguous with respect to the direction of temporal movement, McGlone and Harding (1998) conducted a brief materials-check. Participants were instructed to read each sentence carefully before circling the day (*Monday* or *Friday*?) to which the fictitious event had been rescheduled. Problematically, as opposed to investigating the ambiguity of the test questions, their experiment setup created ambiguity at the time of response by providing two possible options: *Monday* or *Friday*? Thus, if the participant had not realised that the question was ambiguous, providing two possible responses overtly draws attention to this fact. Furthermore, instructing participants to "read each sentence carefully" increases the likelihood of participants over-thinking their response. The findings revealed that, unsurprisingly, all three test questions were considered ambiguous, giving rise to both *Monday* and *Friday* responses. As the design of McGlone and Harding's (1998) materials check may have masked differences in ambiguity across the variants of the question, it is difficult to determine, on the basis of their findings, whether the locus of the ambiguity is centred on the adverb, centred on the verb or distributed across the utterance. To address this, Study 9 sought to investigate the source of the ambiguity in the *Next Wednesday's meeting* question, examining whether the ambiguity of the question stems from the verb (*move*), the adverb (*forward*), or indeed a combination of both. To do this, responses to the ambiguous *Next Wednesday's meeting* question using nine verbs (*move*, *pull*, *bring*, *rush*, *draw*, *push*, *shift*, *take*, and *carry*) and two adverbs (*forward* and *backward*) were compared. The first aim of Study 9 is to investigate how people interpret the *Next Wednesday's meeting* question when

adverb is altered. It is predicted that if the adverb contributes to the ambiguity of the question (cf. Boroditsky 2000; Kranjec et al. 2010), then responses to *[verb] forward* constructions should differ from their *[verb] backward* counterparts. Next, the second aim of Study 9 is to investigate how people interpret the *Next Wednesday's meeting* question when the verb is altered. It is predicted that if the verb contributes to the ambiguity of the question (cf. Restak 2011), then altering the verb should influence participants' concomitant responses to the question. Finally, the third aim of Study 9 is to investigate whether the interpretation of the *Next Wednesday's meeting* question arises from the interplay of verb and adverb, indicating a distributed semantics of temporal expressions, analogous to the distributed semantics found in spatial expressions (Sinha and Kuteva 1995).

6.2.1. *Study 9: Verb vs. adverb*

6.2.1.1. *Participants*

320 administrators from two universities in Newcastle-upon-Tyne participated in this study, with an age range of 18 to 67 years and a mean age of 46 years. All participants were native speakers of English from the UK.

6.2.1.2. *Materials and procedure*

Participants were approached on the university campuses in offices, coffee shops and the university libraries. Following informed consent, all participants completed the questionnaire using a pen while sitting down at a table. For the questionnaire, participants provided demographical information (age, gender, native language and nationality) before providing a response to the *Next Wednesday's meeting* question. 18 variants of the question were created by combining one of nine verbs (*move, bring, pull, rush, draw, push, shift, carry* or *take*)[19] and one of two adverbs (*forward* or *backward*):

> *Next Wednesday's meeting has been [verb] **adverb** two days.*
> *What day has the meeting been re-scheduled to?*

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[19] Using the Global Web-Based English (GloWbE; Davies 2013) corpus, which demonstrated the co-occurrence of each of the nine verbs with the noun *meeting*, it was verified that these verbs are, in principle, compatible with the movement of events in time.

Each participant responded to only one variant of the question.

6.2.1.3. *Results*

In accordance with the predictions, the results showed that the adverb contributes to the interpretation and, hence, the ambiguity of the *Next Wednesday's meeting* question, with responses to *[verb]* **forward** constructions differing from their *[verb]* **backward** counterparts. Concretely, overall, 72.8% of participants answered *Monday* in response to the *[verb]* **forward** constructions, whereas 53.9% of participants answered *Monday* in response to the *[verb]* **backward** constructions (Figure 4). A logistic regression revealed a reliable effect of the adverb: χ^2 (df = 1) = 30.00, $p < .0001$.
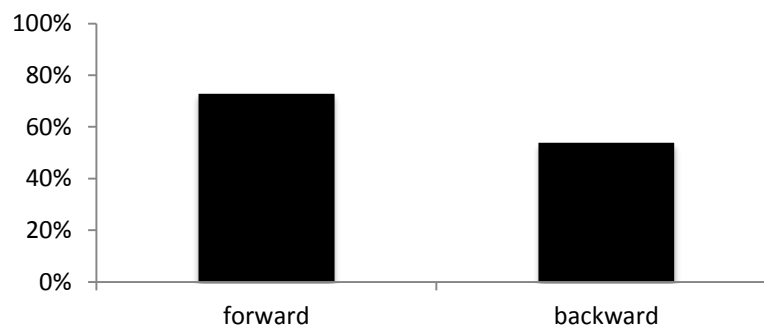
Figure 4   *Percentage of* Monday *responses for* [verb] forward *and* [verb] backward *questions*, *averaged across verbs*

Again, in line with the predictions, the results showed that the verb also plays a role in the interpretation of the *Next Wednesday's meeting* question, with responses to the question differing across the set of verbs (Figure 5). A logistic regression revealed a reliable effect of the verb: χ^2 (df = 8) = 56.50, $p < .0001$. Moreover, as shown in Figure 5, *rush* elicited the most *Monday* responses (87.5%) and *carry* elicited the fewest *Monday* responses (37.5%). In addition, the verb used in McGlone and Harding's (1998) *Next Wednesday's meeting* question, *move*, elicited a *Monday* response rate of 62.5%, demonstrating its perceived ambiguity; however, *take* and *shift* are depicted as the most ambiguous verbs, with the rate of *Monday* responses (50%) being matched by the rate of *Friday* responses (50%).
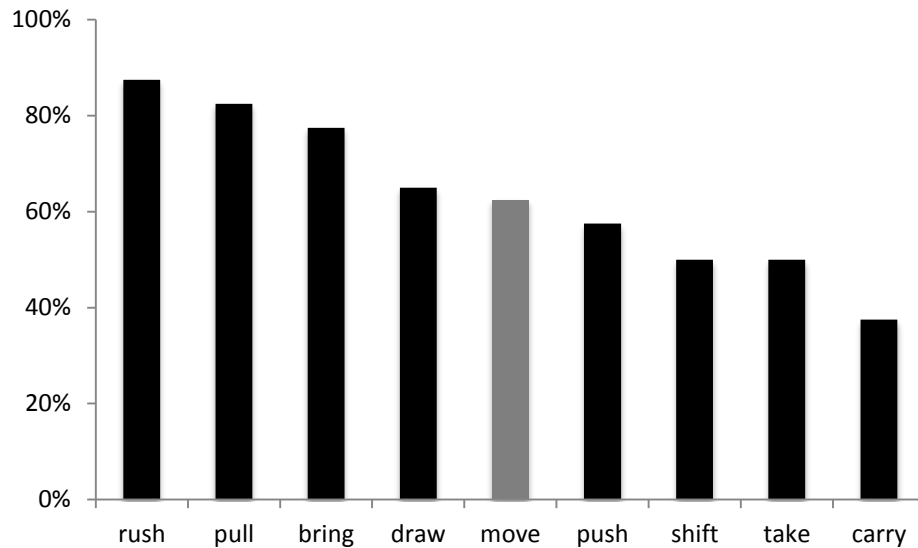
Figure 5 *Percentage of* Monday *responses to questions employing different verbs, averaged across adverbs (the results for* move *are shown in grey)*

Finally, the results showed an interaction between the verb and the adverb, whereby the difference in response to the *forward* and *backward* versions of the question varied depending on the choice of verb (Figure 5). This co-dependence of the verb and the adverb suggests a distributed semantics of temporal expressions, analogous to the distributed semantics found in spatial expressions (Sinha and Kuteva 1995). A logistic regression revealed a reliable interaction of the verb and the adverb: χ^2 (df = 8) = 37.86, p < .0001. Moreover, as seen in Figure 5, the most dramatic difference in response occurs with *bring* and *push*, which elicited a *Monday* response rate of 100% and 80%, respectively, for the *[verb]* **forward** constructions and 55% and 35%, respectively, for the *[verb]* **backward** constructions. By contrast, for *shift*, the rate of *Monday* responses (50%) in the *[verb]* **forward** construction is matched by the rate of *Monday* responses (50%) in the *[verb]* **backward** construction.
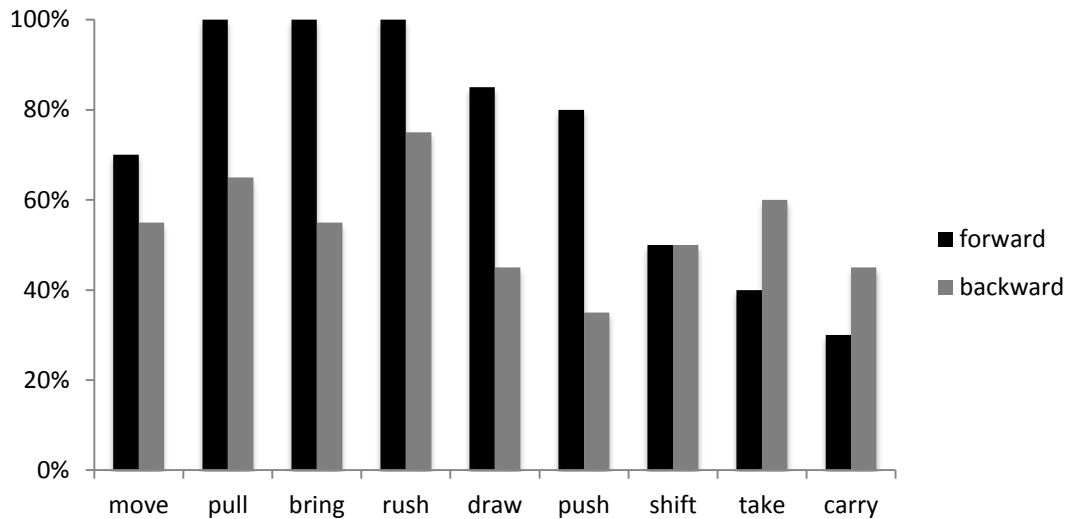
Figure 6   *Percentage of* Monday *responses to the 18* [verb] *adverb*
            constructions

6.2.1.4. *Discussion*

A number of scholars have made the assumption that the ambiguity of the *Next Wednesday's meeting* question stems from the interpretation of the adverb *forward* (Boroditsky 2000; Kranjec and McDonough 2011), while others have suggested that the ambiguity may in fact be rooted in the use of the verb *move* (Restak 2011). A third possibility is that the ambiguity may arise from a combination of both the verb (*move*) and the adverb (*forward*). To this end, Study 9 sought to investigate the source of the ambiguity in the *Next Wednesday's meeting* question, examining whether the ambiguity of the question arises from the verb (*move*), the adverb (*forward*), or indeed a combination of both. By comparing responses to the ambiguous *Next Wednesday's meeting* question using nine verbs (*move*, *pull*, *bring*, *rush*, *draw*, *push*, *shift*, *take*, and *carry*) and two adverbs (*forward* and *backward*), it was shown that the interpretation of the question likely results from the interplay of verb and adverb. Specifically, the results showed that responses to *[verb] **forward*** constructions differed significantly from their *[verb] **backward*** counterparts, thus demonstrating that the adverb contributes to the interpretation and, hence, the ambiguity of the *Next Wednesday's meeting* question. Furthermore, the results also show that the verb plays a role in the interpretation of the question, with responses to the question differing across the set of verbs. Finally, the results showed an

interaction between the verb and the adverb, whereby the difference in response to the *forward* and *backward* version of the question varied depending on the choice of verb. This co-dependence of the verb and the adverb suggests that individual lexical items do not influence the interpretations of the question in isolation. Instead, the locus of the ambiguity is distributed across the utterance, suggesting an interplay of the semantics of the verb and the semantics of the adverb. Taken together, this finding is consistent with the idea that, similarly to the domain of space, temporal expressions also demonstrate a distributed semantics. Probing further some additional linguistic features of the *Next Wednesday's meeting* question that may also play a role in its interpretation, in Study 10, the focus of the investigation is turned to that of the conceptual agent.

6.3. Disambiguating the ambiguity: Grammatical agency

While McGlone and Harding's (1998) original question simply stipulates *Next Wednesday's meeting has been moved forward two days*. *What day has the meeting been re-scheduled to?*, in recent research, restatements of the original question have been devised as investigators have sought to understand additional contributors to temporal reasoning. For example, in their study of the effects of emotional state on the temporal perspective adopted, Richmond et al. (2012) created scenarios based on, but expanding beyond, the original *Next Wednesday's meeting* question, such as:

> You have planned to meet with your ex-partner next Wednesday whom you split up with 3 weeks ago in order to get your things back that you had left at their house. [Your ex left you 3 weeks ago and you are still deeply in love with them, but you know that your ex wants nothing to do with you anymore, and you know that you are going to feel quite depressed after having met with them again]. Your ex has had to move meeting up with you forward two days. (Richmond et al. 2012: 818)

Specifically, the phrasing of the ambiguous meeting question in Richmond et al.'s (2012) study is divergent from McGlone and Harding's (1998) original question in a number of ways. First of all, whereas Richmond et al.'s (2012) question is written

in the active voice, the *Next Wednesday's meeting* question is written in the passive voice. Secondly, Richmond et al.'s (2012) question depicts an *explicit* third person—*your ex*—as the agent in control of moving the meeting. This contrasts with the original *Next Wednesday's meeting* question in which an unknown, *implicit* third person agent appears to be responsible for moving the meeting. Taken together, these differences give rise to the question of whether altering aspects of the question, such as the grammatical voice (active or passive) or the personal pronoun (first, second or third), might influence the ways in which people reason about events in time. Insights from converging lines of research suggest that they might. The Moving Ego and Moving Time metaphors both exhibit an implied agency: in the Moving Ego metaphor, the active self (the implied agent) moves forward through time towards the future, whereas in the Moving Time metaphor, time (the implied agent) moves forward through time towards the passive self. Building on this observation, Dennis and Markman (2005) sought to examine whether thinking about agency or passivity would influence how people think about time. To test this, participants were provided with a series of sentences for unscrambling which used either the first person subject pronoun, 'I' (e.g. *Mary I bridge under kissed the* "I kissed Mary under the bridge") or the first person object pronoun, 'me' (e.g. *Mary me kissed the bridge under* "Mary kissed me under the bridge") before responding to the *Next Wednesday's meeting* question (John Dennis, personal communication, July 2013). Dennis and Markman (2005) hypothesised that for participants who unscrambled the 'I' sentences, the structure of the sentence would prime representations of agency and hence would encourage the adoption of the Moving Ego perspective (answering *Friday*), whereas for participants who unscrambled the 'me' sentences, the structure of the sentence would prime representations of passivity and hence would encourage the adoption of the Moving Time perspective (answering *Monday*). The results showed that, in line with their predications, participants tended to answer in a prime-consistent manner to the *Next Wednesday's meeting* question, indicating that different ways of thinking about agency, and specifically grammatical agency, can influence how people reason about events in time.

In addition to grammatical voice (active; passive), another way of linguistically indicating agency is through person pronouns (first; second; third). Recent research

investigating the role that grammatical person plays in modulating a comprehender's perspective during narrative simulation (Brunyé et al. 2009; Sato and Bergen 2013) suggests that comprehenders mentally simulate events from an internal perspective (i.e. comprehender as agent) when presented with simple event sentences containing second person pronouns, such as 'you', and an external perspective (i.e. other as agent; comprehender as onlooker) when simple event sentences containing third person pronouns, such as 'he' are used (the evidence concerning sentences with first person pronouns, such as 'I' is mixed; cf. Brunyé et al. 2009); thus, suggesting that comprehenders may use personal pronouns as an indicator of their own agentive involvement in a given context.

Extending these initial findings, the aim of Study 10 is to examine grammatical cues to agency to determine which, if any, may play a role in influencing the temporal perspective participants adopt in response to the *Next Wednesday's meeting* question. Firstly, Study 10 will examine grammatical voice as a cue to agency, presenting the *Next Wednesday's meeting* question in both the active and passive voice. Secondly, the role of personal pronouns will be examined by presenting the question with a first person, a second person and a third person agent. Thus, in total, there will be six experimental conditions: first person active, first person passive, second person active, second person passive, third person active and third person passive. It is hypothesised that participants in the second person conditions, who are positioned as being in control of moving the meeting (e.g. *You have moved forward next Wednesday's meeting two days* (active voice) or *Next Wednesday's meeting has been moved forward two days by you* (passive voice)), will reason about time differently to participants in the third person conditions, who are positioned as not being in control of moving the meeting (e.g. *She has moved forward next Wednesday's meeting two days* (active voice) or *Next Wednesday's meeting has been moved forward two days by her* (passive voice)). In contrast to the second and third phrasings of the question, the first person phrasing is ambiguous in terms of whether the person in control of moving the meeting refers to the comprehender or to the person addressing the comprehender (e.g. *I have moved forward next Wednesday's meeting two days* (active voice) or *Next Wednesday's meeting has been moved forward two days by me* (passive voice)) (cf. Brunyé et al. 2009); hence, the pattern of responses among participants in the first person condition may

fall somewhere between responses among participants in the second person and third person conditions. In line with earlier findings, which suggest that different ways of thinking about agency may influence how people think about time (Dennis and Markman 2005; Richmond et al. 2012), it is predicted that higher degrees of perceived agency, as conveyed by either grammatical voice or personal pronoun, will encourage participants to adopt the Moving Ego perspective (answering *Friday*), whereas lower degrees of perceived agency will encourage participants to adopt the Moving Time perspective (answering *Monday*).

6.3.2. *Study 10: Grammatical agency*

6.3.2.1. *Participants*
108 full-time undergraduate students from Northumbria University participated in this study, with an age range of 19 to 26 years and a mean age of 21 years. 45 participants were male and 63 were female. All participants were native speakers of English from the UK.

6.3.2.2. *Materials and procedure*
A questionnaire was distributed to second year undergraduates during a lecture. Participants were randomly assigned to one of six conditions: first person active, first person passive, second person active, second person passive, third person active or third person passive. Following informed consent, participants completed the study using a pen while sitting down at a table. To begin with, participants provided demographical information (age, gender, native language and nationality) before undertaking the questionnaire. Participants were then instructed to imagine the following hypothetical scenario:

First person active condition:

> *I have just emailed a colleague informing her that I have moved forward next Wednesday's meeting two days. For confirmation, what day has the meeting been rescheduled to?*

First person passive condition:

I have just emailed a colleague informing her that next Wednesday's meeting has been moved forward two days by me. For confirmation, what day has the meeting been rescheduled to?

Second person active condition:

You have just emailed a colleague informing her that you have moved forward next Wednesday's meeting two days. For confirmation, what day has the meeting been rescheduled to?

Second person passive condition:

You have just emailed a colleague informing her that next Wednesday's meeting has been moved forward two days by you. For confirmation, what day has the meeting been rescheduled to?

Third person active condition:

You have just received an email from a colleague informing you that she has moved forward next Wednesday's meeting two days. For confirmation, what day has the meeting been rescheduled to?

Third person passive condition:

You have just received an email from a colleague informing you that next Wednesday's meeting has been moved forward two days by her. For confirmation, what day has the meeting been rescheduled to?

6.3.2.3. *Results*

The results showed that personal pronoun influenced the temporal perspective participants adopted in response to the test questions, with 25.0% of participants in the third person conditions adopting the Moving Ego perspective (answering *Friday*), in comparison to 55.6% of participants in the second person conditions and 44.4% of participants in the first person conditions. A logistic regression revealed a reliable effect of personal pronoun: χ^2 (df = 2) = 7.29, $p < .03$. However, the results showed no effect of grammatical voice, or an interaction between pronoun and

voice, suggesting that voice may not have been a reliable indicator of the participant's own agentive involvement in this particular context.
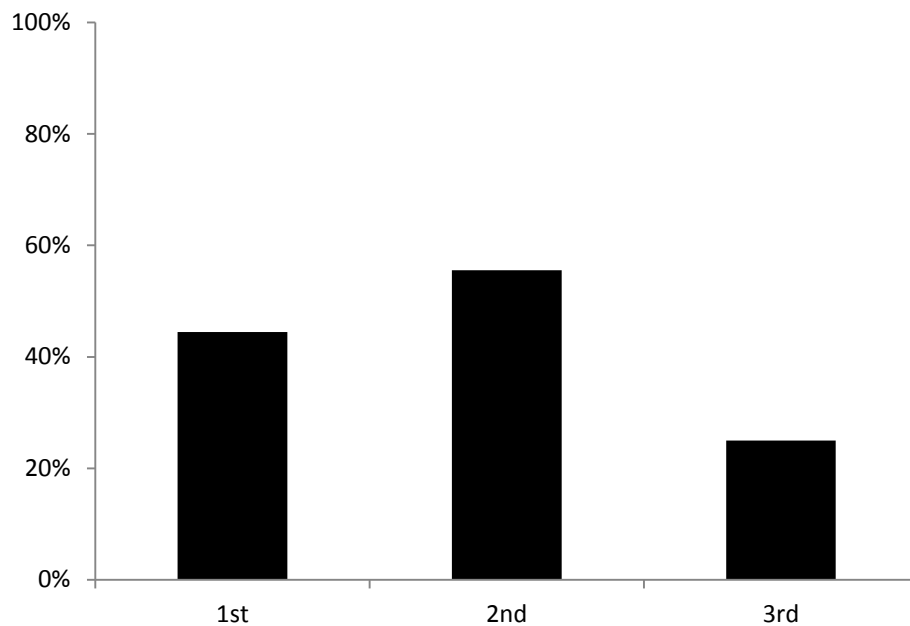
Figure 7   *Percentage of* Friday *responses across personal pronoun conditions*

6.3.2.4. *Discussion*

Building on insights from earlier lines of research, which suggest that level of agency may influence how people reason about time and their concomitant interpretation of an ambiguous temporal question (Dennis and Markman 2005; Richmond et al. 2012), Study 10 sought to investigate whether grammatical cues to agency may also influence the temporal perspective adopted in response to the *Next Wednesday's meeting* question, comparing responses to the question in active or passive voice, and responses with an explicit first, second or third person agent. While there was no effect of grammatical voice (active or passive) on the interpretation of the *Next Wednesday's meeting* question, the results showed that personal pronoun influenced the temporal perspective participants adopted in their responses. Specifically, when the wording of the question indicated that the participant had been responsible for rescheduling the meeting (second person condition), participants were more likely to adopt the Moving Ego perspective (responding *Friday*), whereas when the wording indicated that a colleague had

rescheduled the meeting (third person condition), participants were more likely to adopt the Moving Time perspective (responding *Monday*). These findings are consistent with those reported in recent research investigating perspectival mental simulation during language comprehension (Brunyé et al. 2009; Sato and Bergen 2013), which show that during narrative comprehension, second person pronouns such as 'you' promote mental simulation from an internal perspective (i.e. comprehender as agent) and third person pronouns such as 'he' encourage mental simulation from an external perspective (i.e. other as agent; comprehender as onlooker). In contrast to the second and third phrasings of the question, the first person phrasing is ambiguous in terms of whether the agent in control of moving the meeting (*I*) refers to the comprehender or to the person addressing the comprehender (cf. Brunyé et al. 2009). Consistent with these findings, the pattern of *Friday* responses among participants in the first person condition was mixed. In line with the assumption that the Moving Ego and Moving Time metaphors each exhibit an implied agency, the findings indicate that the conceptual agent, as encoded via personal pronoun, may also play a role in the resolution of the *Next Wednesday's meeting* question.

6.4. General discussion

While much research has made use of McGlone and Harding's (1998) ambiguous question (and more recently, various permeations of their question), very little research has been conducted to examine the linguistic contributors to the different interpretations of the question, thus leaving unanswered questions regarding the factors that may contribute to its ambiguity. To this end, in order to gain additional insight into the nature of the ambiguity in the *Next Wednesday's meeting* question, the focus of the investigation was turned to the linguistic properties of individual elements in the question; probing factors that may contribute to the question's inherent ambiguity.

Study 9 sought to investigate the source of the ambiguity in the *Next Wednesday's meeting* question, examining specifically whether the ambiguity of the question stems from the verb (*move*), the adverb (*forward*), or indeed a combination of both. The results showed an effect of the adverb, with responses to *[verb] **forward***

constructions differing significantly from their *[verb]* **backward** counterparts. Furthermore, there was an effect of the verb, with responses to the question differing across the set of verbs. Finally, there was an interaction between the verb and the adverb, whereby the difference in response to the *forward* and *backward* version of the question varied depending on the choice of verb; thus, suggesting that the locus of the question's ambiguity is distributed across the utterance. This finding is consistent with the idea that, similarly to the domain of space, temporal expressions also demonstrate a distributed semantics (Sinha and Kuteva 1995). In addition, a growing body of psycholinguistic research gives support to the idea of 'constraint satisfaction', which claims that the interpretation of an ambiguous input depends on the properties of individual pieces of information and combinations of pieces of information within an utterance (e.g. MacDonald and Seidenberg 2006; Trueswell and Tanenhaus 1994). The results from Study 9 thus substantiate this body of research.

Extending earlier findings, which demonstrate that level of agency may influence how people reason about time and their concomitant interpretation of an ambiguous temporal question (Dennis and Markman 2005; Richmond et al. 2012), Study 10 directly investigated whether different ways of thinking about conceptual agency may also influence how people reason about events in time by altering the grammatical voice (active or passive) and the personal pronoun (first, second or third) in the *Next Wednesday's meeting* question. The findings showed that when the wording of the question indicated that the participant had been responsible for rescheduling the meeting (second person condition), they were more likely to adopt the Moving Ego perspective (responding *Friday*), whereas when the wording indicated that a colleague had rescheduled the meeting (third person condition), participants were more likely to adopt the Moving Time perspective (responding *Monday*). Concordant with the assumption that the Moving Ego and Moving Time metaphors each exhibit an implied agency, the findings consolidate and extend earlier research on the influence of agency on temporal reasoning, demonstrating that comprehenders may use personal pronouns as an indicator of their own agentive involvement in a given context in order to resolve a temporally ambiguous utterance.

Across two studies, it was shown that altering individual elements of the *Next Wednesday's meeting* question also affected the ways in which participants resolved the ambiguity of the question. In addition to this, the findings of the studies raise additional questions concerning the nature of the ambiguity of the *Next Wednesday's meeting* question. One question is why the proportion of *Monday* responses was relatively high in comparison to the proportion of *Friday* responses in Study 9, to the extent that three *[verb]* **forward** constructions were considered unanimously to denote rescheduling the meeting to *Monday*. One possible explanation for this is that a frequently used lexical item already exists in English for conveying the deferral of an event: *postpone*. By contrast, there is no single lexical item in British English that unambiguously conveys the movement of an event to an earlier moment in time; instead, the closest antonym for *postpone* is the phrase *bring forward* (Widdowson 2003; cf. Cambridge Dictionaries Online 2013)—one of the *[verb]* **forward** *constructions* used in Study 9.[20] Thus, the prevalence of *Monday* responses may be partly attributed to the fact that the *[verb]* **forward** constructions tested were assumed to indicate movement to an earlier point in time because a more direct means of expressing movement to a later point—namely, *postpone*—would have otherwise been used (cf. Grice's Maxim of Manner, "be perspicuous... avoid obscurity of expression" [1989: 27]). A second possible explanation relates to participant demographical: all of the participants in Study 9 were university administrators who, as shown in Study 2, demonstrated a similar preference for responding *Monday*. As such, additional linguistic and lifestyle-based factors may have also contributed to the interpretation of the *Next Wednesday's meeting* question; thus, reiterating the notion that rather than being attributed to a single factor, a person's conceptualisation of time likely results from a culmination of factors.

Secondly, it was shown in Study 10 that, while level of perceived agency may also play a role in the resolution of the *Next Wednesday's meeting* question, this effect was tied to a particular means of encoding grammatical agency; namely, personal

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[20] However, this is not the case for all dialects of English. An Indian English neologism of very general currency that has been coined as an antonym of postpone is *prepone* (Oxford English Dictionary 2007). The coinage of this verb exploits the morphology of English in an entirely regular way, as exemplified by the formation of the related, contrasting words: *predate* and *postdate* (Widdowson 2003).

pronoun. As noted, another way linguistically to indicate agency is through grammatical voice (active; passive); however, there was no effect of grammatical voice on the temporal perspective adopted. One possible reason for this is that expressions invoking the Moving Ego perspective can be written in the active voice (e.g. *We're approaching Christmas*) or the passive voice (e.g. *Christmas is being approached by us*), much in the way that expressions invoking the Moving Time perspective can be written in the active voice (e.g. *Christmas is approaching [us]*) or the passive voice (e.g. *We're being approaching by Christmas*). Thus, the active voice is no more associated with the Moving Ego perspective than the Moving Time perspective and hence, may not be rooted in a comprehender's level of perceived agency. Conversely, the Moving Ego and Moving Time perspectives differ in terms of the assignment of the grammatical agent: in the Moving Ego metaphor, the ego (the active agent) moves forward through time towards the future, whereas in the Moving Time metaphor, time moves forward relative to the stationary self (the passive patient). As such, in terms of event simulation (Brunyé et al. 2009; Sato and Bergen 2013), the Moving Ego perspective aligns with the internal perspective, whereby the comprehender is positioned as the active agent. By contrast, the Moving Time perspective aligns with the external perspective, whereby the comprehender is positioned as the onlooker. Consistent with this, the findings from Study 10 showed that, in response to the *Next Wednesday's meeting* question, second person phrasing (e.g. *you have moved forward next Wednesday's meeting*) encouraged participants to adopt the Moving Ego perspective, whereas third person phrasing (e.g. *she has moved forward next Wednesday's meeting*) encouraged participants to adopt the Moving Time perspective. Taken together, the findings suggest that the role of agent as encoded via personal pronoun is an important indicator of a comprehender's level of perceived agency which, in turn, influences the adoption of a particular temporal perspective.

In sum, in an attempt to gain further insight into the nature of the ambiguity in the *Next Wednesday's meeting* question, in this chapter, the focus of the investigation was turned to the linguistic properties of individual elements in the question; probing factors that may contribute to the question's inherent ambiguity. By altering the adverb, the verb and grammatical indicators of agency, it was shown that changes in the language of the question resulted in changes in the temporal

perspective adopted; thus, providing support to the notion that language comprehension is grounded in constraint satisfaction (e.g. MacDonald and Seidenberg 2006; Trueswell and Tanenhaus 1994).

While McGlone and Harding's (1998) ambiguous meeting question has, thus far, provided a valuable paradigm for investigating a range of factors that may influence how people reason about time, the results, however, raise additional questions. As discussed, one issue that arises from using a single experimental question is that measures comprising of a single item are potentially unreliable (e.g. Oshagbemi 1999; Pollard 1996). In addition to this, Richmond et al. (2012) have drawn attention to the fact that, as the ambiguous meeting question refers specifically to the week (i.e. the calendar), as opposed to the ego, it raises the possibility that earlier findings may reflect properties of the English language, as opposed to being a function of temporal perspective *per se*. Thus, in an attempt to address these issues, Richmond et al. (2012) conducted an experiment to investigate the general reliability of McGlone and Harding's (1998) ambiguous meeting question. To do this, they examined the consistency between participants' responses to the *Next Wednesday's meeting* question and their responses to other ambiguous spatial, clock and calendar questions.[21] Their findings showed that, while the level of consistency varied between questions, with calendar questions demonstrating the highest level of consistency with responses to the *Next Wednesday's meeting* question, overall, responses to all four types of question were consistent in their representations.[22] As such, Richmond et al. (2012) concluded that, although the responses to the *Next Wednesday's meeting* question might be attributed, in part, to the way in which the calendar is used in English, responses to the spatial and clock questions produced relatively similar results, thereby demonstrating the robustness of the designation of the Moving Ego and Moving Time perspectives.

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[21] Examples included: *A book will be re-edited so that page 10 will move forward 5 pages* (spatial); *Normally an alarm clock is set for 9am but the alarm has been moved forward ten minutes* (clock); *The winter Olympics normally take place in December but the committee has moved it forward one month* (calendar). The responses to each question were coded as either ego-moving or time-moving in their representation.

[22] These findings are in line with other research, which, as mentioned previously, have similarly demonstrated that people tend to be consistent in their representations of time, such that people who imagine moving forward a meeting scheduled for Wednesday by two days to Monday (as opposed to Friday) are also more likely to imagine moving forward a meeting scheduled for noon by two hours to 10am (as opposed to 2pm) (Núñez et al. 2006).

Building on insights from these findings, one question is whether, as opposed to simply examining the consistency between responses to the *Next Wednesday's meeting* question and responses to other ambiguous questions, cultural artefacts, such as calendars and clocks, might be used as mediums for directly eliciting responses to ambiguous temporal questions. To this end, extending research on space-time mappings in a new direction, the following chapter will investigate the role of cultural artefacts, namely calendars and clocks, in the interpretation of language and specifically how they might be used to resolve ambiguous statements about time.

7.   Cultural artefacts

7.1. Introduction

How do we conceive of concepts that we cannot see or touch? As discussed
previously, one proposal is that the sensory and motor representations that derive
from interacting in the natural environment are recycled in order to support abstract
thought (e.g. Gibbs 1994; Kövecses 2000; Lakoff and Johnson 1980). In the domain
of time, for instance, these representations derive from the human experience of
navigating through, orienting within and observing motion in space. Research
examining the psychological reality of space-time metaphors has shown that spatial
schemas may exert an important influence on the representation of time, such that
engaging in certain types of spatial-motion thinking may influence how people
reason about events in time and their concomitant interpretation of a temporally
ambiguous statement (e.g. Boroditsky and Ramscar 2002; Kranjec 2006; Núñez et
al. 2006).

More recently, research has demonstrated that conceptual metaphors are as much
cultural as they are internally represented in the minds of individuals, with culture
playing an instrumental role in shaping embodiment and, hence, metaphorical
thought (cf. Gibbs 1999). Indeed, while the practice of using space to represent time
may be universal, vast differences have been observed in the ways in which time is
spatialised across languages and cultures. For instance, the future may be construed
as *in front* of us (English), *behind* us (Aymara), *below* us (Mandarin), *uphill*
(Yupno) or to *the west* (Kuuk Thaayorre) (Boroditsky et al. 2010; Boroditsky and
Gaby 2010; Núñez and Sweetser 2006; Núñez et al. 2012). Moreover, as discussed
in Chapter 2, a body of research lays testament to the ways in which culturally
specific spatial representations 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 the direction of orthography in their native
language, such that English literates will tend to arrange a sequence of events from

left-to-right and Arabic literates, from right-to-left (e.g. Bergen and Chan Lau 2012; Fuhrman and Boroditsky 2010; Tversky et al. 1991).

Taken together, these lines of research provide an important foundation for the understanding of space-time mappings, demonstrating that people's perspectives on the movement of events in time are not only grounded in their experiences of motion in space but also in their patterns of interactions with cultural artefacts. Combining these two separate lines of research on space-time mappings—namely, research investigating spatial influences on temporal reasoning and research investigating the culturally specific associations between space and time—the next step in extending the existing research is to examine whether people access culturally specific spatial representations of time in their interpretations of ambiguous metaphorical expressions about time. To do this, three studies were conducted investigating the use of cultural artefacts, namely calendars and clocks, as mediums for directly eliciting responses to ambiguous temporal questions. Study 11 directly investigates whether responses to the *Next Wednesday's meeting* question may be attributed to the way the calendar is used in English (cf. Richmond et al. 2012), comparing the responses to the original question and answer format with responses to the question elicited via a calendar. Building on insights from earlier research, which suggest that culturally specific spatial representations systematically shape how people think about time (e.g. Tversky et al. 1991), Study 12 examines further the culturally specific associations between space and time and the role of orthography direction in temporal reasoning. To do this, responses to the *Next Wednesday's meeting* question were elicited via a calendar and compared against responses elicited via a 'reverse' (right-to-left) calendar. Extending the findings from Studies 11 and 12, which investigate the role of the calendar in the resolution of McGlone and Harding's (1998) ambiguous *Next Wednesday's meeting* question, Study 13 investigates the role of the analogue clock in the resolution of Núñez et al.'s (2006) ambiguous *Noon meeting* question (*Tomorrow's noon meeting has been moved forward two hours. What time is the meeting now that it has been rescheduled?*), comparing responses elicited via a clock with responses elicited via a 'reverse' (anticlockwise) clock. Taken together, the results provide initial evidence that, in their interpretation of ambiguous metaphorical expressions about

time, people automatically access and use culturally specific spatial representations of extrinsic temporal reference, whereby moving forward in space corresponds with moving later in time. Moreover, asking participants to use a reverse space-time mapping causes interference, which is reflected through their temporal reasoning.

7.2. The Multi-tasking challenge

As shown, McGlone and Harding's (1998) ambiguous *Next Wednesday's meeting* question has been used extensively in research investigating spatial influences on temporal thinking. In particular, it has been observed that while the 'spatial schemas' guiding the responses to the question are assumed to operate below awareness, participants often become aware of the ambiguous nature of the question immediately upon providing their response (Kranjec and McDonough 2011). This might be explained, in part, by the fact that while a number of studies have attempted to disguise the purpose of the experiment by embedding the *Next Wednesday's meeting* question within booklets containing filler tasks (e.g. Boroditsky 2000; Matlock et al. 2011; Ramscar et al. 2010), the 'metalinguistic'[23] format of the question enables participants to reflect upon their response with a degree of awareness; thus, raising the question of whether it is possible to devise a context within which participants might respond to the *Next Wednesday's meeting* question with a reduced awareness of the task's objective than has previously been the case.[24] To address this, a new study was devised, in which participants were recruited to take part in a *Multi-tasking challenge*, whereby they were instructed to schedule a number of events into a calendar while simultaneously watching a video clip and answering questions relating to the video clip. Participants' responses to the *Next Wednesday's meeting* question were elicited via a calendar (test condition) and compared against responses to the original, metalinguistic version of the

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[23] Metalinguistic awareness involves the ability to think explicitly about aspects of language and solve linguistic problems, such as the detection of ambiguity and grammaticality (Galambos and Hakuta 1988; Galambos and Goldin-Meadow 1990). This requires an awareness of language as a system, as well as an ability to access and manipulate knowledge about the system (Bialystok and Ryan 1985).

[24] It should be noted that while earlier research investigating space-time mappings have made deliberate attempts to conceal the objective of the experiment (e.g. Gentner et al. 2002, Experiment 3), no such attempt has yet been made to conceal the objective of the *Next Wednesday's meeting* disambiguation task.

question (control condition). In light of earlier findings, which suggest that responses to the *Next Wednesday's meeting* question might be partly attributed to the way in which the calendar is used in English (Richmond et al. 2012, Study 1), it is predicted that the proportion of *Monday* and *Friday* responses will be parallel across the test and control conditions.

7.2.1. *Study 11: The Multi-tasking challenge*

7.2.1.1. *Participants*

65 full-time undergraduate students participated in this study, with an age range of 18 to 33 years and a mean age of 20 years. 17 participants were male and 48 were female. Participants were assigned to either the test or the control conditions. All participants were native speakers of English from the UK.

7.2.1.2. *Materials and procedure*

A questionnaire was distributed to a first year English language class. Following informed consent, participants completed the questionnaire using a pen while sitting down at a table. To begin with, participants provided demographical information (age, gender, native language and nationality) before undertaking the questionnaire.

Participants were then given a multi-tasking exercise that consisted of two tasks and were informed that they would complete the two tasks simultaneously while watching a video clip. They were also informed that they would be given until the end of the video clip (2 minutes, 25 seconds) to complete both tasks.

For Task 1, participants in the test condition were provided with a 12-month university events calendar which was printed on six pieces of paper back-to-back and were instructed to schedule three events into the calendar:

1. Thursday 19th January

   Kate Smith has cancelled the Solo Exhibition. Cross out the event in the calendar.

2. Wednesday 9th May

   The meeting has been moved forward two days. Enter the new date into the calendar.

3. Saturday 3rd March

   The Pauline Hughes Workshop has been rescheduled for the following Saturday. Enter the new date into the calendar.

In the test condition, responses to the *Next Wednesday's meeting* question were elicited by participants scheduling the rearranged date into the calendar provided. In the control condition, participants responded to the original, question and answer format of the *Next Wednesday's meeting* question.

For Task 2, which was a distracter task, all participants answered three multiple-choice questions relating to the video clip, *Matthew's Day Off*,[25] which was projected onto a screen at the front of the classroom. The purpose of the distracter task was twofold. The first aim was to minimise participants' engagement of metalinguistic awareness; thereby, allowing them to process the questions and provide answers to them more automatically. The second aim was to ensure that participants had attended to the video clip, which was assessed by whether or not they had answered at least two out of the three multiple-choice questions correctly.

7.2.1.3. *Results and discussion*
Four participants were excluded from subsequent analyses for failure to answer at least two of the multiple-choice questions correctly. Of the remaining participants (N = 61), participants in the Calendar (test) condition were more likely to respond

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[25] *Matthew's Day Off* is Honda's 2012 game-day Superbowl commercial for the Honda CRV, in which the actor Matthew Broderick parodies his role in the popular film, *Ferris Bueller's Day Off*. Available at: http://www.youtube.com/watch?v=mP5l1_s4urU [accessed September 2012].

Friday (83.9%) than participants in the Metalinguistic (control) condition (60.0%). Contrary to the prediction that the proportion of *Monday* and *Friday* responses would be parallel across the test and control conditions, a chi-square test revealed a reliable difference in the responses between the two conditions: $\chi^2_{1,61} = 4.322$; $p = 0.038$; Cramer's V = 0.266. Thus, while both groups of participants demonstrated a preference for answering *Friday*, this finding raises the question of why participants in the Calendar condition were more likely to reschedule the meeting to *Friday* than participants in the Metalinguistic condition. One possible explanation relates to the notion that the left-to-right orientation of time in English does not stem from patterns in language (e.g. **Monday is to the left of Tuesday*), but rather, from the left-to-right direction of orthography in Western culture. Indeed, Casasanto and Jasmin note that "because graphic conventions in English-speaking cultures have an implicit rightward directionality, English speakers have a polarised left-right spatial continuum which can be co-opted for time" (2012: 659). To illustrate, the calendar instantiates extrinsic temporal reference, whereby days are conventionally conceptualised as locations along a calendar's timeline in ascending order from left-to-right (e.g. from the 1st to the 7th) and moving rightward in space correlates with moving later in time (Casasanto and Bottini 2014; Kranjec 2006). Thus, in contrast to participants in the control condition, who 'mentally visualised' moving forward the meeting, participants in the calendar condition were predisposed to a left-to-right space-time mapping by means of the calendar, whereby the directionality of forward motion is towards later times and hence moving the meeting later to *Friday*.[26]

The findings from Study 11 thus suggest that as the calendar served to highlight the left-to-right orientation of time in English, responses to the *Next Wednesday's meeting* question might be attributed to the lateral organisation of time on calendars, as opposed to temporal perspective *per se*; therefore, offering an explanation as to why *Friday* responses were more prevalent among participants in the Calendar

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[26] Indeed, findings from behavioural studies have shown that the left-to-right representation of the mental line in Western cultures generalizes to the mental representation of ordinal sequences more broadly, such as the arrangement of numbers, letters, days and months. When people are thinking about ordinal sequences, they move along the mental line, suggesting a strong coupling between external physical space and internal mental space (e.g. Dehaene et al. 1993; Gevers et al. 2003).

condition, in comparison to the Metalinguistic condition. Taken together, Study 11 corroborates and extends the range of research demonstrating that people automatically access culturally specific spatial representations that are consistent with the direction of orthography in their native language when reasoning about time (e.g. Boroditsky et al. 2010; Bergen and Chan Lau 2012; Fuhrman and Boroditsky 2010; Ouellet et al. 2010; Santiago et al. 2007; Tversky et al. 1991). Building on these findings, Study 12 sought to investigate further the culturally specific associations between space and time and the role that the direction of orthography plays in shaping people's conceptualisations of time.

7.3. The Calendar task

Recent research investigating whether orthography can influence the direction and orientation of people's mental timelines has demonstrated that, through exposure to a new orthography, it is possible to alter their space-time associations. Specifically, in one experiment conducted by Casasanto and Bottini (2014), Dutch speakers undertook a series of space-time congruity tasks, in which the instructions and stimuli were presented in either standard or mirror-reversed orthography. Their findings showed that when participants judged temporal phrases, such as 'a year before' (*een jaar daarvoor*) or 'a decade after' (*een decennium daarna*), in standard Dutch orthography, they were faster to judge past-oriented phrases by pressing the left button and future-oriented phrases by pressing the right button. However, after brief exposure to mirror-reversed orthography, their mental timelines reversed, with participants judging past-oriented phrases faster using the right button and future-oriented faster using the left button. In discussing the implications of their findings, Casasanto and Bottini (2014) concluded that exposure to a new orthography for a period of time is sufficient to transiently weaken people's culturally preferred space-time mapping, hence reversing the flow of time in their minds.

Building on insights from Casasanto and Bottini's (2014) findings, Study 12 repeated the calendar rescheduling task used in Study 11, replacing the familiar calendar format with a reverse, right-to-left calendar that is incongruent with the direction of orthography in English. Specifically, English literates were provided with an Arabic calendar, which depicts temporal linearity from right-to-left and

instructed to enter the date of the rescheduled Wednesday's meeting into the calendar. On the assumption that asking people to use a space-time mapping that is inconsistent with the direction of orthography in their native language causes interference (Fuhrman and Boroditsky 2010), it is predicted that that there will be a mixed response to the *Next Wednesday's meeting* question among participants in the Reverse Calendar condition. Specifically, it is predicted that some participants will be guided by the direction of the reverse temporal number line (right-to-left), leading to a *Friday* response, whereas other participants will be guided by the direction of orthography in English (left-to-right), leading to a *Monday* response. To provide a comparison group for the results from the Reverse Calendar condition, a second group of participants responded to the *Next Wednesday's meeting* question using a 'normal' left-to-right calendar. Concordant with the findings from Study 11, it is predicted that participants in the Normal Calendar condition will demonstrate a similar preference for responding *Friday*.

ماي

MAY

السَّبْتُ Saturday	الجُمْعَةُ Friday	الخميسُ Thursday	الأربعاءُ Wednesday	الثُلاثاءُ Tuesday	الإثنينِ Monday	الأحدُ Sunday
5	4	3	2	1		
12	11	10	9 *Meeting*	8	7	6
19	18	17	16	15	14	13
26	25	24	23	22	21	20
		31	30	29	28	27

Figure 8   *The reverse calendar used in Study 12*

7.3.1. *Study 12: The Calendar task*

7.3.1.1. *Participants*
58 full-time undergraduate students participated in this study, with an age range of 18 to 21 years and a mean age of 19 years. 34 participants were male and 24 were

female. Participants were assigned to either the Normal Calendar or the Reverse Calendar conditions. All participants were native speakers of English from the UK.

7.3.1.2. *Materials and procedure*

A two-part questionnaire was distributed to a first year history class. Following informed consent, all participants completed the questionnaire using a pen while sitting down at a table. Part 1 of the questionnaire gathered demographical information: age, gender, native language and nationality. For Part 2 of the questionnaire, participants were provided with a one-month calendar, which was printed on a single side of paper. In the Normal Calendar condition, the days of the week were positioned at the top of the calendar and arranged in ascending order from left-to-right. In the Reverse Calendar condition, the days of the week in Arabic, with an English translation underneath, were positioned at the top of the calendar and arranged in ascending order from right-to-left. The only event featured on both calendars was the meeting scheduled for Wednesday 9th May. The following instructions appeared underneath the calendar:

Wednesday 9th May

The meeting has been moved forward by two days.

Enter the new date into the calendar.

7.3.1.3. *Results and discussion*

As predicted, in contrast to the participants in the Normal Calendar condition, who again showed a preference for answering *Friday* (82.8%),[27] responses among participants in the Reverse Calendar condition were mixed, with 51.7% of participants responding *Friday* in comparison to 48.3% of participants responding *Monday*. To determine whether the difference in responses between participants in the Normal Calendar condition and Reverse Calendar condition was significant, a chi-square test for independence was used. The chi-square test revealed a reliable difference in the proportion of *Monday* and *Friday* responses across the two conditions: $\chi^2_{1,58} = 6.340$; $p = 0.012$; Cramer's V = 0.331. Taken together, the findings suggest that the prevalence of *Friday* responses among participants in the

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[27] Notably, the proportion of *Monday* and *Friday* responses without the distracter task is in line with the responses reported in Study 11, which included a distracter task.

Normal Calendar condition may be attributed to participants using a space-time mapping that is consistent with the direction of orthography in English—as found in Study 11. By contrast, asking participants to use a (right-to-left) space-time mapping that is inconsistent with the (left-to-right) direction of orthography in English caused interference (cf. Fuhrman and Boroditsky 2010); hence, responses among participants in the Reverse Calendar condition were mixed. In sum, Studies 11 and 12 provide the first studies of their kind into the ways in which people may use cultural artefacts, such as calendars, to resolve ambiguous metaphorical expressions about time. Developing this area of research, Study 13 sought to investigate further the role of cultural artefacts in the resolution of temporally ambiguous expressions by means of the clock.

7.4. The Clock task

As discussed in Chapter 2, there is a broad distinction that can be made in terms of extrinsic temporal reference between event-reckoning systems (e.g. calendars), which provide a means of framing events in time and time-reckoning systems (e.g. clocks), which either model or represent the passage of time (Evans 2013). Within both types of systems, further distinctions can be made between systems that are repeatable, open-ended, and closed. For instance, whereas open-ended systems relate to *linear* representations of time, repeatable systems are concerned with *cyclical* representations of time (Evans 2013). While people conceptualise time using both types of representations, recent empirical research suggests that people are generally biased towards linear thinking—a tendency that has been observed among industrialised as well as non-industrialised communities (e.g. Brang et al. 2010; Kessell 2008; Sinha et al. 2011). For instance, recent experimental research on the Amazonian language Amondawa suggests that cyclicity is not relevant to the time interval system used in Amondawa culture (Sinha et al. 2011). In one experiment, participants took part in an elicitation game, which required them to construct schematic representations of different time intervals, e.g. the succession of seasons and the 24-hour diurnal cycle, by placing a series of paper plates, each representing an interval of time, on the ground. The results showed that all of the participants constructed curvilinear representations of the seasonal and diurnal cycles on a horizontal axis, in either a left-to-right or right-to-left direction.

Moreover, none of the participants produced cyclical representations of the time intervals. In discussing their findings, Sinha et al. (2011) posit that in Amondawa, the seasonal and diurnal time intervals are conceptualised in terms of 'happenings' against which other activities and events are indexed, or with which other happenings in the natural and social world may coincide. As such, the schematisation of time intervals appears to be simply in terms of succession, which can be spatially represented as a line (although not necessarily a straight one).

In another series of experiments conducted by Kessell (2008; cf. Kessell and Tversky submitted, as cited in Jamalian and Tversky 2012) investigating the production and comprehension of cyclical and linear processes, participants were instructed to produce diagrams depicting cyclical processes, such as the seasons, and linear processes, such as making scrambled eggs. The findings showed that, as anticipated, participants tended to depict the linear processes in lines but, surprisingly, they also tended to depict the cyclical processes in lines without any return to the beginning. In discussing the implications of the findings, namely that people tend to produce linear representations of cyclical processes, Kessell (2008) reasons that it is easier to conceptualise events progressing forward through time with a beginning, a middle and end than it is to imagine events travelling in a circle, returning to where they started and initiating the process again. Indeed, time moves forward and cannot go back on itself and while each day consists of a morning, noon and night, each day is also unique, rather than a replication of the day previous. Conceptualising time as a cycle is difficult because it requires thinking about a series of events in terms of a general process rather than an individual instance (cf. Jamalian and Tversky 2012).[28]

As research investigating space-time mappings has hitherto been focused primarily on linear representations of time (e.g. Casasanto and Bottini 2014; Fuhrman and Boroditsky 2010; Tversky et al. 1991), new research investigating cyclical representations of time importantly paves the way for further empirical study in this

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[28] Notably, other lines of research investigating the ways in which people spatially represent the months of the year show that time-space synesthetes are more likely to depict calendars using cyclical representations, whereas, consistent with Kessell's findings (2008), non-synesthetes are more likely to use linear rows or rectangular arrangements (Brang et al. 2010).

area.[29] As such, whereas Studies 11 and 12 focused on linear representations of time, in Study 13, the attention will be turned to circular representations of time. Notably, calendars are typically represented in terms of horizontal rows of days that are sequenced in vertical rows of weeks, with earlier weeks sequenced above later weeks; thus, representing linear time. By contrast, an analogue clock measures time in cycles of seconds, minutes and hours using hands that trace a cyclic path around the dial; thus, it lends itself to capturing cyclical time (Evans 2013). As such, whereas McGlone and Harding's (1998) *Next Wednesday's meeting* question provides a useful tool for investigating linear representations of time, Núñez et al.'s (2006) *Noon meeting* question would be more apt for examining cyclical representations of time.

To this end, whereas Studies 11 and 12 investigated the role of the calendar in the resolution of the ambiguous *Next Wednesday's meeting* question, Study 13 sought to investigate the role of the analogue clock in the resolution of the ambiguous *Noon meeting* question. To do this, participants were provided with a clockwise clock (condition 1) or an anticlockwise clock (condition 2) and instructed to indicate the time of the rescheduled noon meeting by drawing the minute and the hour hands onto the face of the clock—thus, providing a new method for eliciting participants' responses to the question. Similarly to Study 12, which aimed to determine how participants would fare with a temporal rescheduling task using a reverse calendar, the purpose of the anticlockwise clock is for investigating how participants would resolve temporal ambiguity using a clock that is incongruent with the customary direction of motion around the clock. In this situation, it is predicted that there will be a mixed response to the *Noon meeting* question: some participants will be guided by the direction of the reverse temporal number line (anticlockwise), leading to a *2pm*, whereas other participants will be guided by the customary direction of motion (clockwise), leading to a *10am* response.

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[29] The dearth of research on cyclical representations of time might be attributed to the fact that cyclical representations of time are comparatively less diverse than linear representations of time. To illustrate, consider the way in which the hands on an analogue clock rotate around the dial in a clockwise direction. The explanation for this is quite simple: the first mechanical clocks were built to imitate the path of a sundial shadow where, in the northern hemisphere, the shadow on the sundial rotates from west to north to east, i.e. clockwise (Sorensen 2011); henceforth, the clockwise rotation became quasi-standardised across the globe.
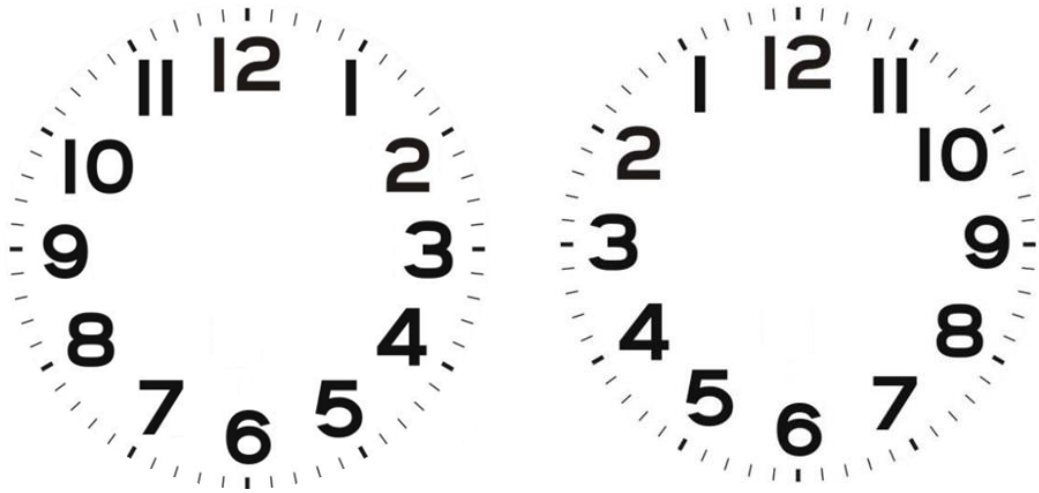
Figure 9   *The clockwise clock (left) and anticlockwise clock (right) used in Study 13*

7.4.1. *Study 13: The Clock task*

7.4.1.1. *Participants*

60 full-time students participated in this study, with an age range of 18 to 27 years and a mean age of 20 years. 29 participants were male and 31 were female. Participants were assigned to either the Clockwise or the Anticlockwise conditions. All participants were native speakers of English from the UK.

7.4.1.2. *Materials and procedure*

Participants were approached on the Northumbria University campus in the university library. Following informed consent, all participants completed a two-part questionnaire using a pen while sitting down at a table. Part 1 of the questionnaire gathered demographical information: age, gender, native language, and nationality. For Part 2 of the questionnaire, participants were provided with a diagram of an analogue clock, without the minute or the hour hands, printed on a single side of paper. The following instructions appeared underneath the diagram of the clock:

Tomorrow's noon meeting has been moved forward by two hours. Draw the minute and the hour hands onto the face of the clock to indicate the new time of the meeting.

7.4.1.3. *Results and discussion*

As predicted, in contrast to the participants in the Clockwise condition, who showed a preference for depicting *2pm* on the face of the clock (73.3%), responses among participants in the Anticlockwise condition were mixed, with 46.3% of participants depicting *2pm* in comparison to 53.3% of participants depicting *10am*. To determine whether the difference in depictions between participants in the Clockwise condition and Anticlockwise condition was significant, a chi-square test for independence was used. The chi-square test revealed a reliable difference in the proportion of *10am* and *2pm* depictions across the two conditions: $\chi^2_{1,60} = 4.444$; $p = 0.035$; Cramer's V = 0.272. The findings thus suggest that the prevalence of *2pm* responses among participants in the Clockwise condition may be attributed to participants using a space-time mapping that is consistent with the customary direction of motion around the clock, whereby moving forward (i.e. clockwise) in space corresponds with moving later in time. By contrast, asking participants to use an (anticlockwise) space-time mapping that is inconsistent with the customary (clockwise) direction of motion around the clock may have caused interference; hence, responses among participants in the Anticlockwise condition were mixed.

7.5. General discussion

Across languages and cultures, speakers systematically employ space to represent events in time. This strong space-time association is reflected in the language people use when talking about time, the actions people use to depict events in time and the artefacts cultures use to represent time. Earlier research has shown that spatial schemas may exert an important influence on the representation of time, such that engaging in certain types of spatial-motion thinking may influence how people reason about events in time and their concomitant interpretation of a temporally ambiguous expression (e.g. Boroditsky and Ramscar 2002; Kranjec 2006; Matlock et al. 2005, 2011; Núñez et al. 2006). Combining two separate lines of research on space-time mappings—namely, research investigating spatial

influences on temporal reasoning and research investigating the culturally specific associations between space and time—the aim of this chapter was to extend research on space-time mappings in a new direction. Specifically, three studies investigated the role of cultural artefacts, namely calendars and clocks, in the interpretation of metaphorical language in context.

Study 11 directly investigated whether responses to the *Next Wednesday's meeting* question might be attributable, in part, to the way the calendar is used in English (cf. Richmond et al. 2012), comparing the responses to the question elicited via a calendar with responses elicited metalinguistically. The findings showed a significant difference in the proportion of *Monday* and *Friday* responses across the two conditions, with participants in the Calendar condition more likely rescheduling the meeting to *Friday* than participants in the Metalinguistic condition. On the assumption that people automatically access culturally specific spatial representations that are consistent with the direction of orthography in their native language when reasoning about time (e.g. Boroditsky et al. 2010; Bergen and Chan Lau 2012; Fuhrman and Boroditsky 2010; Tversky et al. 1991), the results suggest that the prevalence of *Friday* responses among participants in the Calendar condition may be attributed to the left-to-right orientation of time in English, whereby the directionality of forward motion is towards later times, as opposed to temporal perspective *per se*.

Building on these findings, Study 12 investigated further the culturally specific associations between space and time and the role of orthography direction in temporal reasoning, comparing responses to the *Next Wednesday's meeting* question elicited via an English calendar with responses elicited via a 'reverse' (Arabic) calendar. The results showed that participants in the Normal Calendar condition were more likely to respond *Friday* than participants in the Reverse Calendar condition, for whom the difference in the proportion of *Monday* and *Friday* responses was marginal. Thus, while the prevalence of *Friday* responses among participants in the Normal Calendar condition may be attributed to participants using a space-time mapping that is consistent with the direction of orthography in English, asking participants to use a (right-to-left) space-time mapping that is inconsistent with the direction of orthography in English caused interference (cf.

Fuhrman and Boroditsky 2010), resulting in mixed responses among participants in the Reverse Calendar condition.

Noting that research investigating space-time mappings has hitherto been focused primarily on linear representations of time (e.g. Casasanto and Bottini 2014; Fuhrman and Boroditsky 2010; Tversky et al. 1991), Study 13 focused on circular representations of time, investigating the role of the analogue clock in the resolution of the *Noon meeting* question, by comparing responses elicited via a clockwise clock with responses elicited via an anticlockwise clock. It was found that, participants in the Clockwise condition were more likely to depict *2pm* on the face of the clock than participants in the Anticlockwise condition, for whom the difference in the proportion of *10am* and *2pm* depictions was marginal. Thus, while the prevalence of *2pm* responses among participants in the Clockwise condition might be due to participants using a space-time mapping that is consistent with the customary direction of motion around the clock, using an (anticlockwise) space-time mapping that is incongruent with the customary direction of motion around the clock may have caused interference; hence, responses among participants in the Anticlockwise condition were mixed.

In sum, the findings from this chapter provide further validation that people's perspectives on the movement of events in time are not only grounded in their experiences of motion in space but also in their patterns of interactions with cultural artefacts. The results also extend prior research by showing that, in their interpretation of ambiguous metaphorical expressions about time, people automatically access and use familiar spatial representations of extrinsic temporal reference, whereby moving forward in space corresponds with moving later in time. Furthermore, asking participants to use a reverse space-time mapping causes interference, which is reflected through their temporal reasoning.

In addition, the results from this study give rise to the question of why cultural artefacts have such an effect on temporal reasoning. Cultural artefacts, such as calendars and clocks, externalise thought (cf. Tversky 2011); thus, they provide a means of not only mapping temporal paths in space, but also indicating specific moments or events along a (linear or circular) temporal path. As such, cultural

artefacts simultaneously abstract and depict a model of time, thereby providing a more concrete form of temporal representations than purely symbolic speech. Cultural artefacts, thus, play a role in the extended cognitive process (e.g. Clark and Chalmers 1998), acting as a means of not only aiding embodied cognition, but also influencing it.

Furthermore, the findings give support to the Mediated Mapping Hypothesis (Sinha et al. 2011), which suggests that time-reckoning is dependent on the cultural construction of counting practices based upon large number systems (Pica et al. 2004), as well as the cultural-cognitive schema of a linear number line (Dehaene et al. 2008). As such, direct space-time mappings arise as a result of the combination of numeric symbolic cognitive processes with language which, in turn, are supported by historically developed cultural artefacts, such as calendars and clocks.

Thus far, the chapters from Part II of the thesis have explored the role that a number of factors—namely, individual differences, event valence, grammatical differences and cultural artefacts—play in influencing people's perspectives on the movement of events in time and their concomitant interpretation of temporally ambiguous utterances. While the findings from each chapter serve to provide greater and richer insights into metaphoric representations of time, all of these studies have relied on the interpretation of ambiguous temporal language in devised contexts. Thus, the aim of the following chapter is to build upon and expand beyond the existing research by investigating the occurrence of metaphorical expressions about time in natural language.

8.   Spatial metaphors for time in natural language

8.1. Introduction

As shown thus far, the nature of the relationship between space and time has been scrutinised extensively by researchers in the cognitive sciences. To reiterate Casasanto:

> *Time* has become for the metaphor theorist what the fruit fly is for the geneticist: the model system of choice for linguistic and psychological tests of relationships between metaphorical source and target domains. (2009: 128)

Indeed, while the domain of time arguably provides the ideal arena in which to probe the claims made by metaphor theorists (e.g. Kövecses 2000; Lakoff and Johnson 1980, 1999), one area that has received comparatively less attention, but has not been overlooked entirely, is the frequency and contexts of use of space-time metaphors in natural language. Similarly to Margolies and Crawford (2009), McGlone and Pfiester (2009) hypothesised a link between time, motion, and emotion; however, as opposed to relying on the interpretation of an ambiguous temporal question, McGlone and Pfiester (2009) sought to investigate whether the metaphoric correspondences between time, motion and emotion may influence the ways in which people encode their temporal experiences, as well as how they interpret encodings produced by others. Specifically, does the manner in which people encode their temporal experiences indicate their affective orientation towards events in life, such that communicators assign temporal agency to themselves when describing positive events but to events when describing negative events? To test this, in one experiment, McGlone and Pfiester (2009) employed a corpus-based approach to examine the relationship between event valence and agency in temporal communication by exploring the occurrence of Moving Ego and Moving Time temporal expressions in natural language and judging whether the

valence of the encoded event was positive, negative, or neutral. Consistent with their predictions, the results showed that the temporal passage of a positive event was more frequently encoded by the Moving Ego perspective, e.g. *There is much optimism that **we might be coming** to*. By contrast, the temporal passage of a negative event tended to be encoded by the Moving Time perspective, e.g. *when **the time comes** she can't do things and she has to be cared for*.[30] To investigate further the relationship between event valence and temporal agency, in a second experiment, McGlone and Pfiester (2009) asked participants to write narratives about pleasant or unpleasant events that they had experienced recently and rate the event's pleasantness on a scale. The results showed that, while participants made use of both types of temporal expressions in their narratives, the Moving Ego perspective tended to be more frequent in narratives describing pleasant events, e.g. *it was great hanging out in the blind and **passing the time** drinking beer*. By contrast, the Moving Time perspective was more typically used in narratives describing unpleasant events, e.g. *practically **an entire hour passed** while I just sat there*. Taken together, the results suggest that the valence of an event influences the language people use to encode its temporal passage, with the passage of positive events more frequently being encoded by the Moving Ego perspective and the passage of negative events more often being encoded by the Moving Time perspective.[31] In a final experiment, McGlone and Pfiester (2009) then investigated whether the temporal metaphors used to describe an event would influence people's affective inferences about it. To test this, participants were asked to read a fictitious first-person account of a narrative describing the activities of a student over the course of a week. Different versions of the narrative were devised in which the target event—a conference—was encoded via the Moving Ego perspective (*We are fast approaching the day of the peer counselling conference*) or the Moving Time perspective (*The day of the peer counselling conference is fast approaching*). Participants then rated the extent to which the narrator appeared to be excited and

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[30] 22 space-time metaphors that can be used in Moving Time and Moving Ego expressions were selected for analysis, including 15 verbs, e.g. *approach*; *come* and 7 prepositions, e.g. *ahead*; *from*. McGlone and Pfiester's (2009) corpus search yielded 2069 temporal tokens containing one or more of these key terms.

[31] In line with the assumption that conceptual metaphors operate outside of conscious awareness (Lakoff and Johnson 1999), debriefing interviews also showed that participants were unaware that different perspectives on the movement of events in time were the focus of the study, expressing "puzzlement and confusion" about the distinction between the Moving Ego and Moving Time perspectives once it had been described (McGlone and Pfiester 2009: 18).

worried about the arrival of the conference. The findings showed that excitement ratings tended to be higher among readers in the Moving Ego condition, whereas worried ratings tended to be higher among readers in the Moving Time condition. In discussing the implications of their findings, McGlone and Pfiester (2009) concluded that communicators tend to assign temporal agency to themselves when describing positive events but to events when describing negative events, such that people may draw inferences about a communicator's feelings about an event based on the language they use to describe its temporal passage.

Taken together, McGlone and Pfiester's (2009) research provides valuable preliminary insights into the ways in which space-time metaphors are used in natural language, demonstrating that the valence of an event influences the language people use to encode its temporal passage, with the passage of positive events more frequently being encoded by the Moving Ego perspective and the passage of negative events more frequently being encoded by the Moving Time perspective. In addition to this, their results showed that when communicators encode the passage of events using the Moving Ego language, rather than Moving Time language, it invites comprehenders to infer that the speaker is more positively disposed towards it (cf. Margolies and Crawford 2008). Despite this, as McGlone and Pfiester's (2009) line of inquiry was concerned solely with the metaphoric correspondences between time, motion and emotion, the conclusions that can be made are largely limited. To this end, the aim of Chapter 8 is to examine further the relative frequency and contexts of use of Moving Ego and Moving Time metaphors in naturally-occurring temporal expressions by using the linguistic expression of motion events in the sub-domain of TEMPORAL MOTION as a testbed for further investigation.

8.2. The linguistic expression of motion events

Motion events can be described as situations "containing movement or the maintenance of a stationary location" (Talmy 1985: 85). According to Talmy (1985, 2000), a motion event consists of six basic conceptual elements: FIGURE (the entity that is moving), GROUND (the locative reference object against which the Figure moves), MOTION (the movement itself), PATH (the direction or trajectory of motion),

MANNER (the way in which the Figure moves) and CAUSE (the situation that brought about the motion event). Theoretical work on the linguistic encoding of motion events has demonstrated that languages differ in the ways in which they represent motion events. Indeed, by studying the ways in which different languages lexicalise semantic components, Talmy (1985, 2000) has identified two main typological groups of languages: *satellite-framed* languages (or 'S-languages', e.g. Germanic languages) and *verb-framed* languages (or 'V-languages', e.g. Romance languages). These two groups of languages have been shown to differ in the ways they linguistically encode the components of a motion event. Specifically, when describing a motion event, S-languages and V-languages differ considerably in the attention that they pay to MANNER and PATH (Slobin 2003; Talmy 1985, 2000): S-languages, such as English, tend to use verbs which conflate MANNER and MOTION, while PATH is expressed by an element other than a verb, called the satellite, e.g. "The man *ran* (MANNER OF MOTION) *across* (PATH OF MOTION) the street". By contrast, V-languages, such as Italian, tend to encode PATH in the main verb, while MANNER may optionally be expressed as a participial adjunct, e.g. "L'uomo *attraversò* (PATH OF MOTION) la strada *correndo* (MANNER OF MOTION)" (The man *crossed* [PATH OF MOTION] the street *running* [MANNER OF MOTION]) (Cardini 2008). Notably, in V-languages, manner tends only to be expressed when it is necessary for the characterisation of the motion event (McNeill 2000; Özcalışkan and Slobin 2003; Slobin 1997).

In recent years, much research has been dedicated to examining the different lexicalisation patterns of motion events across languages. As lexicalisation patterns are reflected in the online use of language, speakers of S-languages and V-languages have been shown to adopt different rhetorical styles of narratives for describing the same motion event (Slobin 2000, 2004). In particular, extensive cross-linguistic research has made use of a wordless picture storybook, *Frog, Where Are You?* (Mayer 1969) to elicit oral narratives from speakers aged from three through to adulthood in over 70 worldwide languages (e.g. Strömqvist and Verhoeven 2004 for a full bibliography of frog stories). The book consists of 24 pictures depicting a story of a boy who, accompanied by his dog, goes in search for his pet frog. Their search involves a variety of different types of motion events, which invite a rich array of motion descriptions: the dog falls from a window; the

boy climbs and falls from a tree; the dog runs away from a swarm of bees; the boy climbs a rock and gets entangled in the antlers of a deer; the deer throws the boy and his dog over a cliff into a pond; and the boy and his dog climb out of the water and over a log to find the missing frog. According to Slobin (2005), the strength of the frog story lies in the wordless presentation of a readily understood plot, with enough complexity to allow for the in depth analysis of temporal, causal and spatial dimensions of events. It also provides a common content and plotline across age and language for comparative linguistic and narrative analysis. Research findings have consistently shown that, in comparison to V-languages, speakers of S-languages use manner verbs more frequently and with greater lexical diversity when describing events in the frog story (Slobin 2003).

Languages not only differ in the way they lexicalise the components of motion events, but also in the way speakers 'filter' their experience through language for purposes of speaking (Berman and Slobin 1994; Slobin 2000, 2003; cf. Ibarretxe-Antuñano 2009). These different patterns have important effects on the relative 'codability'[32] of the semantic domains that constitute the components of a motion event. For instance, as manner of motion is expressed in S-languages in the main verb of the clause, it is more economically expressed and thus more codable than in V-languages, where manner of motion is generally expressed as an adjunct. As a result, speakers of S-languages tend to experience lower cognitive costs when accessing manner information in comparison to speakers of V-languages—a tendency that has been experimentally observed across numerous separate measures of codability (Feist 2013). Thus, as S-languages make habitual use of manner verbs for encoding motion events, they typically exhibit larger lexicons with a complex of saturated and fine-grained distinctions of manner, contrary to the smaller and less-differentiated manner lexicons in V-framed languages (Slobin 2003). For instance, the French verb *bondir* does not discriminate between the manners of motion encoded by the English verbs *jump*, *leap*, *bound*, *spring*, *skip* and *gambol*. Similarly, the Spanish verb *escabullirse* can be translated into English as *creep*, *glide*, *slide*, *skip* and *slither* (Slobin 2003: 163). Moreover, Slobin (2004: 251)

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[32] Codability denotes the ease of expression of a concept. For instance, concepts expressed by a single word (e.g. run) are more codable than those expressed by phrases or clauses (e.g. while running) (Slobin 2003).

reports that Romance languages, Turkish and Hebrew (V-languages) have no more than approximately 75 intransitive manner verbs in regular use, whereas the Germanic and Slavic languages, Hungarian and Mandarin (S-languages) each contain over 150.

While converging evidence from cross-linguistic research investigating the size, diversity of motion verb lexicon and frequency of motion verb usage suggests that speakers of V-languages may be less sensitive to manner of motion on the whole, diverging patterns have been observed among different sub-domains of motion. For instance, recent research has demonstrated that the S-framed Slavic languages, Russian and Polish, exhibit significantly fewer manner of motion verbs in the sub-domain of AQUAMOTION than the V-framed Romance languages, Portuguese, Spanish and French (Koptjevskaja-Tamm et al. 2010). Other lines of research have also demonstrated intra-typological differences between cognates and non-cognates of manner of motion verbs in the sub-domain of ROTATION in Polish (which focuses on speed of rotation) and Russian (which differentiates between controlled and uncontrolled motion) (Rakhilina 2010).

Thus, considering the amount of attention that the linguistic expression of motion events in space has received and in view of the fact that time is lexicalised in terms of motion in space—an area that has also been explored extensively—the study of the linguistic expression of motion events in the sub-domain of TEMPORAL MOTION appears to have been, thus far, overlooked. To address this, a brief corpus study was conducted. The aim of the study is twofold. The first aim is to investigate whether the path/manner asymmetries observed in the domain of MOTION are also evident in temporal metaphorical uses by specifically examining the relative frequency of naturally-occuring path and manner verbs in English in the sub-domain of TEMPORAL MOTION. The second aim of the study is to examine the relative frequency of Moving Ego and Moving Time metaphors in naturally-occurring expressions denoting temporal motion. The findings of the study, although still preliminary, demonstrate a reverse pattern in the sub-domain of TEMPORAL MOTION compared to the domain of MOTION, with English exhibiting a higher proportion of path verbs than manner verbs for describing motion events in time. The findings

also demonstrate a slightly higher propoprtion of Moving Time metaphors, in comparison to Moving Ego metaphors, in natural language use.

8.2.1. *Study 14: Temporal motion events*

8.2.1.1. *Materials and procedure*

Data analysis proceeded in four phases. In the first phase, Cifuentes-Férez's (2008) taxonomy of English motion verbs was used to devise a three column table: the first column listed the 360 English motion verbs in alphabetical order, the second column specified the semantic component of each verb (e.g. 'manner', 'path') and the third column depicted whether the verb expressed translational motion or self-contained motion (see Appendix 1).[33] In the second phase, I used the Brigham Young University-British National Corpus (BYU-BNC; Davies 2004–)[34] for calculating the overall frequency of each English motion verb in natural production, using the lemma of each verb, e.g. [fall].[v][35] (see Appendix 1). 60 verbs, including the general motion verb, *move*, were then excluded for encoding a semantic component other than 'manner' or 'path', or additional semantic components, e.g. 'emigrate' (path + ground). 84 verbs involving self-contained motion were then excluded due to the fact that in self-contained motion, an object keeps its same or 'average' location, e.g. 'The butterfly hovered over the flower'. By contrast, in translational motion, an object's basic location shifts from one point to another in space, e.g. 'John entered the room' (Talmy 2000: 35); thus, translational motion aligns more closely to the Moving Ego and Moving Time metaphors, whereby an entity (ego or event) shifts from one point to another in time. As such, the remaining motion verb set comprised of 176 manner verbs and 40 path verbs. The 15 most frequent manner verbs and the 15 most frequent paths verbs were then selected for analysis. In the third phase, I assessed the temporal frequency of each motion verb in natural production by extracting 200-token samples for each motion verb from the BYU-BNC (Davies 2004–) and identifying tokens in which the

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[33] Cifuentes-Férez's (2008) original codings were maintained; however, for the purpose of this study, motion verbs with multiple senses were conflated, an example of which includes the motion verb *moonwalk* (sense one: *to walk on the surface of the moon*; sense two: *to dance the moonwalk*).

[34] The BYU-BNC (Davies 2004–) is an online interface to the 100-million-word British National Corpus.

[35] Specifying the verb in the search input is necessary for ensuring that the search output consists solely of verbal forms of the word, e.g. [fall] yields instances in which fall is a noun, as well as a verb.

motion verb was used in its temporal sense (e.g. *A full minute **passed** before he could move again*), as opposed to its spatial sense (e.g. *As soon as she **passed** the gate she could hear the sirens*) or a different sense (e.g. *It is not pleasant for a human being to **pass** judgment on another*). I then recorded the token frequency of temporal tokens for each path and manner of motion verb (see Tables 2 and 3). In the fourth phase, I examined the temporal perspective implied by each temporal token and coded it as either a Moving Ego or a Moving Time expression (see Appendix 2). Lastly, I then recorded the token frequency of Moving Ego and Moving Time expressions for each motion verb that yielded one or more temporal tokens (see Table 4).

8.2.1.2. *Results and discussion*

The corpus search yielded a total of 55 temporal expressions involving 12 motion verbs. To address the first aim of whether the path/manner asymmetries observed in physical motion are also evident in the sub-domain of TEMPORAL MOTION, the relative frequency of path and manner verbs were compared. A comparison revealed that path verbs were encoded by 91% of the temporal tokens, whereas manner verbs were encoded by 9%; thus, demonstrating a reverse pattern in the sub-domain of TEMPORAL MOTION, with speakers of English more frequently using path verbs than manner verbs for describing motion events in time. In line with the asymmetry by tokens, the extracted temporal expressions also displayed a greater type frequency of path verbs, with eight path verbs (*go*, *come*, *follow*, *reach*, *pass*, *enter*, *arrive* and *approach*) compared to four manner verbs (*travel*, *race*, *tear* and *wander*).

Table 2   *English path of motion verbs in the sub-domain of* TEMPORAL
                MOTION

	English motion verb	**Overall frequency**	**Temporal frequency***
1	go	236313	1
2	come	143322	7
3	leave	60578	0
4	follow	40602	7
5	fall	25843	0
6	reach	22088	3
7	return	21364	0
8	pass	19336	14
9	enter	13681	1
10	arrive	13422	2
11	drop	10021	0
12	cross	6706	0
13	approach	6647	15
14	escape	5135	0
15	pursue	4512	0

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* Based on the frequency of temporal instances per 200 hits.

	English motion verb	Overall frequency	Temporal frequency*
1	run	38304	0
2	walk	19882	0
3	drive	14493	0
4	throw	10776	0
5	travel	8410	2
6	shoot	7203	0
7	ride	5022	0
8	slip	4667	0
9	race	3496	1
10	rush	3025	0
11	sweep	2949	0
12	slide	2798	0
13	tear	2663	1
14	sail	2646	0
15	wander	2306	1

Table 3 *English manner of motion verbs in the sub-domain of TEMPORAL MOTION*

The second aim of the study was to examine the relative frequency of Moving Ego and Moving Time metaphors. An examination of the extracted instances revealed a slightly higher percentage of Moving Time expressions (54%) than Moving Ego expressions (46%) across the set of motion verbs. These numbers are in line with McGlone and Pfiester (2009), who similarly reported a slightly higher percentage of Moving Time expressions (53%) than Moving Ego expressions (47%) in their corpus study.

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* Based on the frequency of temporal instances per 200 hits.

Table 4   *Frequency of Moving Time and Moving Ego metaphors*

	English motion verb	Semantic component	Temporal frequency	Moving Time frequency (%)	Moving Ego frequency (%)
1	go	path	1	100	0
2	come	path	7	100	0
3	follow[**]	path	7	N/A	N/A
4	reach	path	3	0	100
5	pass	path	14	100	0
6	enter	path	1	0	100
7	arrive	path	2	100	0
8	approach	path	15	53	47
9	travel	manner	2	0	100
10	race	manner	1	100	0
11	wander	manner	1	0	100
12	tear	manner	1	100	0

8.3. General discussion

Extending on from McGlone and Pfiester's (2009) research investigating the frequency and contexts of use of space-time metaphors in natural language, this chapter sought to examine further the relative frequency of Moving Ego and Moving Time metaphors in naturally-occurring temporal expressions by focusing specifically on motion events in the sub-domain of TEMPORAL MOTION.

Taken together, the preliminary findings suggest that, although space-time metaphors are attested in natural language, they are not pervasive—at least not among expressions denoting the passage of of temporal motion events. In addition, the path/manner asymmetries observed in the domain of MOTION were not reflected in the sub-domain of TEMPORAL MOTION. Specifically, the results showed an

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[**] Temporal expressions containing the motion verb *follow* were all non-deictic, e.g. *In the hours that **follow***. Thus, for the purpose of this analysis, they are not applicable, as they cannot be classified as either Moving Time or Moving Ego in their representation.

opposite pattern to the domain of MOTION, with path verbs being used more frequently than manner verbs for the description of temporal motion events in English. Secondly, the results demonstrated a slightly higher percentage of Moving Time expressions in comparison to Moving Ego expressions across the set of motion verbs. In addition to this, the results also show that, while some verbs were found only in Moving Time expressions (*go*, *come*, *pass*, *arrive*, *race* and *tear*; e.g. *for months to come*; a *few minutes passed*), other verbs were found only in Moving Ego expressions (*reach*, *enter*, *travel* and *wander*; e.g. *before reaching pension age*; *as you enter your forties*); thus, raising additional questions concerning the frequency and contexts of use of space-time metaphors in natural language.

Firstly, one question that arises is why Moving Time expressions and Moving Ego expressions tended to select for different verbs. One possible explanation for this stems from the idea that *lexical concepts*[36] are associated with a lexical profile, which constrains the range of elements that can 'fill' the lexical concept of the kinds sanctioned by different space-time metaphors. Specifically, these elements, captured in the form of *selectional tendencies*, relate to the vehicle types that can encode the lexical concept (the *formal selectional tendencies*) and the semantic arguments that make up the argument-structure of the lexical concept (the *semantic selectional tendencies*). For instance, deictic lexical concepts, each of which exhibit a unique lexical profile, can be categorised into clusters, such as [FUTURE], [PRESENT], [PAST], [DEGREE OF REMOVE] (Evans 2013). As illustrated by the expressions in Appendix 2, [FUTURE] cluster expressions, such as *Christmas is coming* and *As the skiing season approaches us* capture an 'imminence' relation: the target events (Christmas; the skiing season) are fixed in the 'imminent' future with respect to the location of the ego (RP), which is coincident with the experience of now (origo). In addition, the temporal scene is depicted from the perspective of the target event, which, by virtue, receives focal prominence and, hence, appears in the subject position. In terms of selectional tendencies for the [IMMINENCE] lexical concept, the VP, which is filled by a motion event, typically selects for a manner-neutral motion verb that is directional towards an implicit deictic centre. Motion that is not deictic, or motion away from the ego tends to produce somewhat

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[36] Lexical concepts constitute the semantic units conventionally associated with linguistic forms (Evans 2007: 120).

unnatural expressions, e.g. #*Christmas is leaving*. In addition, Evans (2013) notes that this lexical concept tends to select for an intransitive argument structure, with a subject NP (filled by the target event) and a VP, but no object argument, e.g. *As the skiing season approaches [us]*. Moreover, when the motion described does not intrinsically encode directional motion, an oblique, headed by a preposition, tends to be selected for serving this function, e.g. *Christmas is coming towards us*. As also demonstrated by the expressions in Appendix 2, [PAST] cluster expressions, such as *The afternoon was racing by* and *Time was tearing along*, capture an 'immediacy of occurrence' relation: the target events (the afternoon; time) are 'occurring' and are fixed as being past-oriented with respect to the ego (RP), which is concordant with the egocentric experience of the presence (origo). In addition, the temporal scene is viewed from the perspective of the target event, which receives focal prominence and is integrated with the subject NP slot. In terms of selectional tendencies for the [IMMEDIACY OF OCCURRENCE] lexical concept, the VP involves the ongoing motion of the target event by and away from the ego—that is, the transitioning between the presence and past. As such, it selects for the imperfective aspect (Evans 2013). Taken together, the findings from this study, although preliminary, provide additional evidence from language in natural contexts to substantiate Evans' (2013) claims that there indeed appears to be selectional tendencies in the grammatical constructions of metaphorical expressions about time.

A second question concerns the frequency of Moving Time and Moving Ego metaphors. Specifically, as noted, McGlone and Pfiester's (2009) corpus search yielded 2069 temporal expressions, in comparison to the 55 temporal expressions found in this study. One possible explanation for this disparity relates to the difference in method employed. McGlone and Pfiester's (2009) key terms comprised of 22 space-time metaphors that they considered to be both common and applicable for both Moving Time and Moving Ego expressions. By contrast, the key terms employed in this study consisted of 15 of the most frequent path verbs and 15 of the most frequent manner verbs in the BNC, as verifed by a corpus search. Of the 52 key terms used across both studies, there were eight overlaps: seven path verbs (*approach*; *arrive*; *come*; *enter*; *go*; *pass*; *reach*) and one manner verb (*run*). In addition to the differences in key terms, different corpora were also used. Whereas McGlone and Pfiester used five smaller-scale American English corpora consisting

of no more than 15 million words, the corpus used in this study was a larger-scale British English corpus consisting of 100 million words. As such, the frequency of Moving Time and Moving Ego metaphors may be influenced by a number or combination of factors, such as key terms, corpora and dialect.

In sum, this chapter serves to bridge a gap in the existing literature between two areas of research that have received much attention in cognitive linguistics and related disciplines; namely, the lexicalisation of space-time metaphors and the linguistic expression of motion events in space. Specifically, by investigating the linguistic expression of motion events in the sub-domain of TEMPORAL MOTION, this chapter demonstrates that greater and richer insights into the metaphoric representation of time can be achieved by drawing on separate (but converging) lines of research on space-time mappings. It also highlights the value that can be gained by studying the frequency and contexts of use of space-time metaphors in natural language.

Part III:

Evaluation

9.   Discussion

9.1. Introduction

What factors influence the ways in which people conceptualise time? In English, three distinct reference strategies are used for framing events in time: deictic t-FoRs situate events in relation to the ego; sequential t-FoRs position events in relation to one another, as part of a sequence; and extrinsic t-FoRs fix events in relation to a temporal matrix. As discussed, the notion of Temporal Frame of Reference takes account of the fact that temporal scenes can be viewed from a number of possible perspectives. To illustrate, the *Next Wednesday's meeting* question does not include a commitment to a specific t-FoR, but the respondent must commit to a specific t-FoR in order to provide a response. As the question does not entail a specific t-FoR, the respondent has the option of choosing from all compatible t-FoRs which, in turn, leads to individual respondents making different choices. This offers an explanation as to why research has demonstrated that deictic, as well as non-deictic spatial schemas can be used to influence the resolution of temporally ambiguous utterances (e.g. Boroditsky and Ramscar 2002; Kranjec 2006; Núñez et al. 2006). Specifically, by engaging in particular types of spatial-motion thinking, different construals of time can be primed by activating the relevant t-FoR. In the case of the *Next Wednesday's meeting* question, the event in question is both an event in the future and an event that forms part of a large-scale time interval; hence, deictic (Moving Time), as well as non-deictic 'linked' sequential spatial schemas, have been shown to prime *Monday* responses and deictic (Moving Ego), as well as non-deictic 'path' extrinsic spatial schemas, have been shown to prime *Friday* responses.

While research investigating abstract thinking about time has thus far been focused primarily on examining the effects of spatial priming on temporal reasoning, recent lines of research have extended beyond this, providing preliminary evidence that personality differences, emotional experiences and the valence of an event may also

influence people's perspectives on the movement of events in time and their resolution of a temporally ambiguous utterance (e.g. Hauser et al. 2009; Margolies and Crawford 2008; Richmond et al. 2012). Building on insights from these findings, this thesis extends prior work on the metaphoric representation of time, providing new insights into the mechanisms at work during the interpretation of language in context. To begin with, a series of studies were conducted to examine further the range of factors that may influence how people reason about events in time, focusing specifically on previously unexplored personality differences, lifestyle differences and behavioural differences (Studies 1 to 8). Next, the focus of the investigation was turned to the interpretation of metaphorical expressions about time in prescribed contexts (Studies 9 to 14). In this chapter, the thesis is drawn to a conclusion and the findings of these studies are reported and discussed in terms of the theoretical, methodological and practical issues they raise for the language sciences. In addition, with an aim of continuing the ongoing process of mutual feeding between theoretical and experimental research in the field of cognitive linguistics (Núñez 2007), new areas of research are suggested for further empirical testing.

9.2. Overview: Part II

9.2.1. *Chapter 4: Individual differences*

Hitherto, research investigating abstract thinking about time has been focused primarily on investigating spatial influences on temporal reasoning. However, while spatial schemas may exert an important influence on the structure and representation of time, people's construals of time are not solely dependent on their experiences of motion in space but rather, a complex of factors. Indeed, in addition to time, other abstract domains, such as emotion and personality, can be understood in terms of motion in space (Lakoff and Johnson 1980); thus, raising the possibility that other abstract domains may be connected to time via shared spatial schemas. Building on insights from recent lines of research, which have highlighted a number of additional influences on ambiguity resolution in the interpretation of metaphorical expressions about time (Hauser et al. 2009; Richmond et al. 2012), in Chapter 4, six studies were conducted to examine further the range of factors that

may influence how people think about time and their concomitant interpretation of an ambiguous temporal expression.

STUDY 1: EXTROVERSION-INTROVERSION

To begin with, Study 1 examined the role that personality differences play in influencing people's perspectives on the movement of events in time, focusing specifically on the personality dimension of extroversion-introversion. The findings revealed that, in line with an active approach to time, participants who adopted the Moving Ego perspective (answering *Friday*) in response to the *Next Wednesday's meeting* question exhibited higher degrees of extroversion in comparison to participants who adopted the Moving Time perspective (responding *Monday*).

STUDY 2: STUDENTS AND ADMINISTRATORS

Next, reasoning that earlier research investigating the metaphoric representation of time have sampled student populations, but that the lifestyle of a student is not representative of the general population, Study 2 investigated whether lifestyle may play a role in influencing people's conceptualisations of time. To test this, in Study 2, university students' responses to the *Next Wednesday's meeting* question were compared against those from a sector of the population operating under quite different time pressures: university administrators. The findings showed that students, with their relative control over the structuring of their time and fewer external constraints, were more likely to disambiguate the question using the Moving Ego perspective (answering *Friday*), whereas administrators, who are more cognisant of external pressures and for whom time is relatively controlled by external demands, were more likely to use the Moving Time perspective (answering *Monday*).

STUDY 3: PROCRASTINATION AND CONSCIENTIOUSNESS

On the assumption that the habitual movement of tasks may be a contributor to the temporal perspective adopted in response to the *Next Wednesday's meeting*

question, Study 3 tested whether individual differences in conscientiousness (John 1990) and procrastination (Lay 1986) may contribute to a person's view of time and, hence, to their interpretation of the question. Concordant with earlier findings, which show that procrastinators tend to postpone action (Milgram et al. 1998; Milgram and Tenne 2000) and conscientious individuals tend to prioritise action (Back et al. 2006; John and Srivastava 1999), the results showed that participants who adopted the Moving Ego perspective (answering *Friday*) averaged higher procrastination scores and lower conscientiousness scores in comparison to participants who adopted the Moving Time perspective (answering *Monday*).

STUDY 4: TRAVELLING TO WORK

Noting that recent research investigating the effects of personality differences on the resolution on temporal ambiguity have relied on participants' self-reported assessments of personality variables, three studies examined whether these relationships have force in real life by testing whether, in addition to *self-reported* conscientiousness and procrastination, there is a relationship between conscientious and procrastinating *behaviours* and temporal perspective. To begin with, Study 4 compared participant's responses to the *Next Wednesday's meeting* question against the extent to which they were on schedule for work (i.e. if they were early, on time, or late). In line with earlier findings, which indicate that high degrees of self-reported conscientiousness are demonstrably related to the Moving Time perspective (Study 3) and that conscientious behaviour is associated with punctuality (Ashton 1998; Back et al. 2006), the findings showed that people who adopted the Moving Time perspective (responding *Monday*), were more likely to be running early in comparison to people who adopted the Moving Ego perspective (responding *Friday*).

STUDIES 5 AND 6: THE ASSIGNMENT SUBMISSION AND THE SCHEDULED APPOINTMENT

Moving beyond self-assessment of timeliness, to examine whether the observed effects have real world consequences, Studies 5 and 6 sought evidence of a

relationship between more objectively observable on-time behaviours and metaphorical perspectives of time. Specifically, Study 5 investigated whether students submitting their assignment closer to the deadline would think about time differently in comparison to students submitting their assignment further in advance of the deadline, as demonstrated by their response to the *Next Wednesday's meeting* question. Next, Study 6 investigated the relationship between temporal perspective and timeliness for a scheduled appointment, comparing participant's time of arrival against their resolution of temporal ambiguity, using two new temporal reasoning questions: the *Noon meeting* question and the *October meeting* question. Concordant with earlier findings, the results from Studies 5 and 6 showed that participants who adopted the Moving Time perspective were tending to their obligations earlier on average compared to participants who adopted the Moving Ego perspective, suggesting that the earlier effects have observable consequences, as evidenced by more objectively measureable real-life behaviours.

In sum, building on recent research findings (e.g. Hauser et al. 2009; Richmond et al. 2012), the results from Chapter 4 provide further evidence of the range of individual differences that may influence how people reason about time, while also providing initial evidence that individual differences in time management as observed in real-life contexts may influence how people resolve temporal ambiguities. In addition, by drawing on additional measures of adopted temporal perspective, these studies generalise previous findings to temporal reasoning at different time scales, suggesting a consistency between temporal reasoning and the ways in which people conceptualise the movement of events in time.

9.2.2. *Chapter 5: Event valence*

Moving beyond factors that are directly tied to the individual, in other lines of research investigating the metaphoric representation of time, it has been shown that the valence of the event, and specifically the comprehender's affective orientation towards the event, may also influence the resolution of a temporally ambiguous utterance, thus providing new insights on metaphor and its ability to reflect people's thinking and feelings (Margolies and Crawford 2008; Lee and Ji 2013; Ruscher 2011). To examine further the ways in which the valence of an event, the life

experiences and personality of the comprehender and metaphorical perspectives of time are interrelated, in Chapter 5, two studies were conducted to investigate whether the interpretation of a temporally ambiguous question may arise from an interaction between the valence of the event and aspects of the personality and lifestyle of the comprehender.

STUDY 7: NEXT WEDNESDAY᾽S PARTY

Firstly, Study 7 sought to examine further the interaction between individual differences in personality and event valence on temporal reasoning, focusing specifically on the personality dimension of extroversion-introversion. Specifically, the aim was to investigate whether differences between the social-seeking behaviours of extroverts and the social-withdrawing behaviours of introverts would be reflected in their resolution of the ambiguous *Next Wednesday's party* question. Contrary to the prediction that extroverts would be more likely to imagine themselves approaching a social event (viewing it positively) and introverts would be more likely to imagine a social event approaching themselves (viewing it negatively), the finding showed that the difference in self-reported extroversion scores between participants adopting the Moving Ego perspective (responding *Friday*) and those adopting the Moving Time perspective (responding *Monday*) was marginal. Thus, although extroverts might be more likely to imagine themselves approaching events (in line with the Moving Ego perspective), particularly social situations (Lucas et al. 2000), this effect may be undermined by the tendency to want an enjoyable and sociable event, such as a party, to occur sooner (in line with the Moving Time perspective) (cf. Margolies and Crawford 2008).

STUDY 8: NEXT WEDNESDAY᾽S ASSIGNMENT DEADLINE

Next, probing further the ways in which the valence of an event, the life experiences of the comprehender and metaphorical perspectives of time are interrelated, Study 8 investigated the effects of event valence on students᾽ resolution of temporal ambiguity using a focal event that features on all academic calendars: the assignment deadline. In line with the assumption that assignment deadlines are one

of the most prominent causes of stress among students (Kohn and Frazer 1986) and that people tend to feel worse about the rescheduling of a negative event when it is moved earlier in time (Margolies and Crawford 2008), the results showed that, in response to the *Next Wednesday's assignment deadline* question, participants who felt better about the rescheduling of the event were more likely to adopt the Moving Ego perspective (indicated by *Friday* and *I am approaching the event* responses). By contrast, participants who felt worse about the rescheduling of the event were more likely to adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses). Moreover, consistent with other lines of research, which suggest that people are more likely to imagine a negative future event approaching themselves (Lee and Ji 2013; Margolies and Crawford 2008), the student population displayed a tendency for disambiguating the *Next Wednesday's assignment deadline* question in line with the Moving Time perspective. In sum, the results from Study 8 provide additional evidence that the interpretation of an ambiguous temporal question may arise from an interaction between the comprehender's affective orientation towards the event and aspects of their lifestyle.

9.2.3. *Chapter 6: Grammatical differences*

While much research has made use of McGlone and Harding's (1998) ambiguous question (and more recently, various permeations of their question), very little research has been conducted to probe the linguistic contributors to the different interpretations of the question, leaving unanswered questions regarding the factors that may contribute to its ambiguity. To this end, in Chapter 6, the focus of the investigation was turned to the linguistic properties of individual elements in the question; probing factors that may contribute to the question's inherent ambiguity.

STUDY 9: NEXT WEDNESDAY'S MEETING – VERB VS. ADVERB

To begin with, Study 9 sought to investigate the source of the ambiguity in the *Next Wednesday's meeting* question, examining whether the locus of the ambiguity is centred on the adverb *forward* (cf. Boroditsky 2000; Kranjec and McDonough

2011), centred on the verb *move* (cf. Restak 2011), or a combination of both. By comparing responses to the ambiguous question using nine verbs (*move*, *pull*, *bring*, *rush*, *draw*, *push*, *shift*, *take* and *carry*) and two adverbs (*forward* and *backward*), it was shown that the interpretation of the question likely results from the interplay of verb and adverb, with responses to *[verb]* **forward** constructions differing from their *[verb]* **backward** counterparts and responses to the question differing across the set of verbs. In addition, the results showed an interaction between the verb and the adverb, with the difference in response to the *forward* and *backward* version of the question varying depending on the choice of verb. This co-dependence of the verb and the adverb suggests that individual lexical items do not influence the interpretations of the question in isolation. Instead, the locus of the ambiguity is distributed across the utterance, suggesting an interplay of the semantics of the verb and the semantics of the adverb, analogous to the distributed semantics observed in the domain of space (Sinha and Kuteva 1995).

STUDY 10: NEXT WEDNESDAY'S MEETING – GRAMMATICAL AGENCY

Building on insights from earlier lines of research, which demonstrate that level of agency may influence how people reason about time and their concomitant interpretation of an ambiguous temporal question (Dennis and Markman 2005; Richmond et al. 2012), Study 10 directly investigated whether different ways of thinking about conceptual agency may also influence temporal reasoning by altering the grammatical voice (active or passive) and the personal pronoun (first, second or third) in the *Next Wednesday's meeting* question. The results showed that, while there was no effect of grammatical voice (active or passive) on the interpretation of the question, personal pronoun influenced the temporal perspective participants adopted in their responses. Specifically, when the wording of the question implied that the participant had been responsible for rescheduling the meeting (second person condition), participants were more likely to adopt the Moving Ego perspective (responding *Friday*). By contrast, when the wording indicated that a colleague had rescheduled the meeting (third person condition), participants were more likely to adopt the Moving Time perspective (responding *Monday*). In line with the assumption that the Moving Ego and Moving Time metaphors each exhibit

an implied agency, the findings consolidate and extend earlier research on the influence of agency on temporal reasoning, demonstrating that comprehenders may use personal pronouns as an indicator of their own agentive involvement in a given context in order to resolve an ambiguous temporal question.

In sum, in order to gain further insight into the nature of the ambiguity in the *Next Wednesday's meeting* question, the focus of the investigation in Chapter 6 was turned to the linguistic properties of individual elements in the question. By altering the adverb, the verb and grammatical indicators of agency, it was shown that changes in the language of the question resulted in changes in the temporal perspective adopted in response to the question; thus, providing support to the notion that the interpretation of an ambiguous input depends on the properties of individual pieces of information and combinations of pieces of information within an utterance (e.g. MacDonald and Seidenberg 2006; Trueswell and Tanenhaus 1994).

9.2.4. *Chapter 7: Cultural artefacts*

Spatial representations of time are pervasive across the world. This strong space-time association is reflected in the language people use when talking about time, the actions people use to depict events in time and the artefacts cultures use to represent time. While the practice of using space to represent time is shared by many languages and cultures, vast differences have been observed in the ways in which time is laid out in space. Specifically, a body of research lays testament to the ways in which culturally specific spatial representations systematically shape how people think about time (e.g. Boroditsky et al. 2010; Casasanto and Bottini 2014; Bergen and Chan 2012; Fuhrman and Boroditsky 2010; Tversky et al. 1991). In other lines of research, it has also been shown that spatial schemas may exert an important influence on the representation of time, such that engaging in certain types of spatial-motion thinking may influence how people reason about events in time and their concomitant interpretation of a temporally ambiguous expression (e.g. Boroditsky and Ramscar 2002; Kranjec 2006; Matlock et al. 2005, 2011; Núñez et al. 2006). Combining these two separate lines of research on space-time mappings—namely, research investigating spatial influences on temporal reasoning

and research investigating the culturally specific associations between space and time—the aim of Chapter 7 was to extend research on space-time mappings in a new direction. To do this, three studies were conducted to investigate the role of cultural artefacts, namely calendars and clocks, in the interpretation of metaphorical language in context and specifically how they might be used to resolve ambiguous statements about time.

STUDY 11: THE MULTI-TASKING CHALLENGE

Firstly, Study 11 directly tested whether responses to the *Next Wednesday's meeting* question might be attributable, in part, to the way the calendar is used in English (cf. Richmond et al. 2012). To do this, responses to the question elicited via a calendar were compared against responses elicited metalinguistically. The results revealed a significant difference in the proportion of *Monday* and *Friday* responses across the two conditions, with participants in the Calendar condition more likely rescheduling the meeting to *Friday* than participants in the Metalinguistic condition. On the assumption that people automatically access culturally specific spatial representations that are consistent with the direction of orthography in their native language when reasoning about time (e.g. Boroditsky et al. 2010; Bergen and Chan Lau 2012; Fuhrman and Boroditsky 2010; Tversky et al. 1991), the results indicate that the prevalence of *Friday* responses among participants in the Calendar condition may be attributed to the left-to-right orientation of time in English, whereby the directionality of forward motion is towards later times, as opposed to temporal perspective *per se*.

STUDY 12: THE CALENDAR TASK

Extending these findings, Study 12 sought to investigate further the culturally specific associations between space and time and the role of orthography direction in temporal reasoning. To do this, responses to the *Next Wednesday's meeting* question elicited via an English calendar were compared against responses elicited via a 'reverse' (right-to-left) calendar. The findings revealed that participants in the Normal Calendar condition were more likely to respond *Friday* than participants in

the Reverse Calendar condition, for whom the difference in the proportion of *Monday* and *Friday* responses was marginal. Taken together, the findings suggest that, while the prevalence of *Friday* responses among participants in the Normal Calendar condition may be attributed to participants using a space-time mapping that is congruent with the direction of orthography in English, asking participants to use a (right-to-left) space-time mapping that is incongruent with the direction of orthography in English causes interference (cf. Fuhrman and Boroditsky 2010); hence, responses among participants in the Reverse Calendar condition were mixed.

STUDY 13: THE CLOCK TASK

Extending the findings from Studies 11 and 12, which investigated the role of the calendar in the resolution of McGlone and Harding's (1998) ambiguous *Next Wednesday's meeting* question, Study 13 investigated the role of the analogue clock in the resolution of Núñez et al.'s (2006) ambiguous *Noon meeting* question, comparing responses elicited via a clockwise clock with responses elicited via a 'reverse' (anticlockwise) clock. The results showed that participants in the Clockwise condition were more likely to depict *2pm* on the face of the clock than participants in the Anticlockwise condition, for whom the difference in the proportion of *10am* and *2pm* depictions was marginal. Thus, while the prevalence of *2pm* responses among participants in the Clockwise condition might be due to them using a space-time mapping that is consistent with the customary direction of motion around the clock, asking participants to use an (anticlockwise) space-time mapping that is inconsistent with the customary direction of motion around the clock may have caused interference; thus, resulting in a mixed response among participants in the Anticlockwise condition.

Taken together, the findings from Chapter 7 provide additional evidence that people's perspectives on the movement of events in time are not only grounded in their experiences of motion in space, but also in their patterns of interactions with cultural artefacts. Furthermore, the results extend prior research by demonstrating that, in their interpretation of ambiguous metaphorical expressions about time, people automatically access and use familiar spatial representations of extrinsic

temporal reference, whereby moving forward in space corresponds with moving later in time. Moreover, asking participants to use a reverse space-time mapping creates interference, which is reflected through their temporal reasoning.

9.2.5. *Chapter 8: Space-time metaphors in natural language*

While the nature of the relationship between space and time has been scrutinised extensively by researchers in the cognitive sciences, one area that has received comparatively less attention is the frequency and contexts of use of space-time metaphors in natural language. Extending McGlone and Pfiester's (2009) research, which provides valuable initial insights into the ways in which space-time metaphors are used in the passage of positively and negatively valenced events in natural language, in Chapter 8, a brief corpus study was conducted to examine further the relative frequency and contexts of use of Moving Ego and Moving Time metaphors in the description of temporal motion events.

STUDY 14: TEMPORAL MOTION EVENTS

The aim of Study 14 was twofold. The first aim was to investigate whether the path/manner asymmetries observed in the domain of MOTION are also evident in temporal metaphorical uses by examining the relative frequency of naturally-occuring path and manner verbs in English in the sub-domain of TEMPORAL MOTION. The second aim was to examine the relative frequency of Moving Ego and Moving Time metaphors in naturally-occurring temporal expressions. The findings of the study, although still preliminary, suggest that, although space-time metaphors are attested in natural language, they are not pervasive—at least not among expressions denoting the passage of of temporal motion events. In addition, the path/manner asymmetries observed in the domain of MOTION were not reflected in the sub-domain of TEMPORAL MOTION. Specifically, the results showed an opposite tendency to the domain of MOTION, with path verbs being used more frequently than manner verbs for the description of temporal motion events in English. Secondly, the results demonstrated a slightly higher percentage of Moving Time expressions in comparison to Moving Ego expressions across the set of motion verbs.

9.2.6. *General remarks*

In sum, by adapting McGlone and Harding's (1998) *Next Wednesday's meeting* disambiguation paradigm, scholars in the cognitive sciences have provided evidence for the psychological reality of three distinct spatial construals of time, with demonstrations that deictic spatial schemas (Boroditsky 2000; Boroditsky and Ramscar 2002), sequential spatial schemas (Núñez 2007; Núñez et al. 2006) and extrinsic spatial schemas (Kranjec 2006) can be used to influence how people think about time and their concomitant interpretation of an ambiguous temporal question. More recently, research has extended beyond investigating the effects of spatial influences on temporal reasoning, providing preliminary evidence that personality differences, emotional experiences and the valence of an event may also influence people's perspectives on the movement of events in time (e.g. Hauser et al. 2009; Margolies and Crawford 2008; Richmond et al. 2012). By building on and extending the findings of prior research, this thesis serves to shed light on the mechanisms at work during the interpretation of language in context, providing a more fully explanatory framework for the metaphoric representation of time. Specifically, taken together, the results demonstrate that the interpretation of metaphorical language about time in context is modified by the strength and relevance of multiple sources, ranging from linguistic cues and contextual features to individual differences, which interact in order to create meaning. These findings are concordant with other lines of cognitive linguistic research concerning individual differences in language knowledge, which demonstrate that comprehenders' performances are influenced by a number of factors, such as frequency and lexical specificity (e.g. Street and Dąbrowska 2010, 2014). In addition, these findings provide additional support for psycholinguistic research on constraint-based processing (e.g. MacDonald and Seidenberg 2006; Trueswell and Tanenhaus 1994), which stipulates that a myriad of information sources play an immediate role in the comprehension of words and sentences. Indeed,

to reiterate Farmer et al.:

> …comprehenders use all salient and reliable sources of information, as soon as possible, to guide their interpretation of an incoming linguistic signal. Indeed, many factors... may influence how an incoming string of words is processed. (2012: 354)

In this regard, the processing of metaphorical expressions about time, and, in particular, the resolution of temporal ambiguity, is no exception. Nevertheless, it is important to acknowledge that this research is not without its limitations. Indeed, the studies undertaken in this thesis give rise to a number of additional research questions which require future investigation.

9.3. Future research

9.3.1. *Implications for cross-linguistic research*

Hitherto, the vast majority of research examining the interpretation of ambiguous metaphorical expressions about time has been conducted in English; thus, greater and richer insights into metaphoric representations of time might be achieved, firstly, by extending the number of languages under investigation. Indeed, while cross-linguistic research in this area is comparatively scarce (see Bender et al. 2005, 2010 for German, Mandarin and Tongan; Elvevåg et al. 2011 for Dutch; Lai and Boroditsky 2013 for Mandarin), preliminary cross-linguistic research findings suggest that the language itself may play a role in the interpretive possibilities available to a comprehender. For instance, Elvevåg et al. (2011) examined interpretations of the *Next Wednesday's meeting* question among Dutch speakers, the results of which showed that, similarly to English, the question elicited both *Monday* and *Friday* responses. As such, although preliminary research suggests that when translated into some languages, the question remains ambiguous, other lines of research have shown that this is not universally the case: when the question is translated into German, using the term *vorverlegen* for 'moved forward', the vast majority of participants responded *Monday* (Bender et al. 2005), indicating that the

German translation of the question is not truly ambiguous. A similar preference for responding *Monday* has also been observed among speakers of Mandarin (Bender et al. 2010; Lai and Boroditsky 2013). In addition, anecdotal evidence which, pending further empirical analysis, should be taken with some caution, suggests that in other languages, such as Czech (Mirjam Fried, personal communication, August 2011), Finnish (Tuomas Huumo, personal communication, August 2011), Italian (Claudia Baldoli, personal communication,   July 2011) and Ukrainian (Olga Pykhtina, personal communication, August 2011), *Friday* is the only possible response. As such, whether or not multiple competing interpretations are available in the language being examined is a factor that should be taken into consideration in further cross-linguistic research in this area. Moreover, given that language itself may play a role in the interpretive possibilities available to a comprehender, these findings also highlight, as a method of best practice, the necessity of surveying participants' native languages, as the interpretation of the question in a participant's L1 may influence their interpretation of the question in L2. For instance, a native speaker of German might be more likely to infer an L1 interpretation and respond *Monday* to the question in English.[37]

Tying in with the findings from Chapter 7, which make use of cultural artefacts as mediums for directly eliciting responses to ambiguous temporal questions, follow-up research might build upon these preliminary findings by examining whether the patterns observed vary systematically across languages and cultures. For instance, because graphic conventions in Arabic-speaking cultures have an implicit leftward directionality, Arabic literates have a polarized right-left spatial continuum which can be co-opted for time (e.g. Tversky et al. 1991). Thus, one question that arises is when would Arabic participants move forward Wednesday's meeting to if they were provided with an Arabic calendar which highlights the *right-to-left* orientation of time in Eastern culture? Similarly, speakers of Mandarin frequently make use of vertical metaphors for talking about events in time (e.g. Scott 1989; Yu 1998); thus, how would Mandarin participants resolve the *Next Wednesday's meeting* question if

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[37] All experiments in this thesis explicitly surveyed the participants' native language. As all participants were native speakers of English, cross-linguistic influences can be ruled-out as a potential contributor.

they were provided with a vertical calendar that highlights the *up-to-down* orientation of time reflected linguistically in Mandarin?

Also, building on the findings of Chapter 8, which demonstrate a higher proportion of path verbs than manner verbs in English for describing motion events in time, as well as selectional tendencies in the grammatical constructions of temporal motion expressions, the next step in extending this research would be to examine these patterns of usage in other languages. Of particular interest is whether V-languages, such as Spanish, would display a similar tendency to English for the path/manner asymmetries in the domain of MOTION to be divergent from those observed in the sub-domain of TEMPORAL MOTION.

In sum, by extending the number of languages under investigation and the methods of assessment, it may be possible to achieve a more fully explanatory framework for the metaphoric representation of time.

9.3.2. *Implications for theories of metaphor*

Recently, at the 12th International Cognitive Linguistics Conference, cognitive linguists were encouraged to: (i) 'look back', taking stock of the past 25 years of research in cognitive linguistics; (ii) 'look forward', considering the next generation of cognitive linguistics research; and (iii) 'look outward', extending research to understudied populations and applications, particularly in regard to endangered languages and signed languages (ICLC-12, June 2013). While recent metaphor research, especially in the domains of space and time, has taken heed of the notion 'looking outward', by investigating spatial representations of time among an increasing range of indigenous communities,[38] the question remains of how it is possible to 'look forward' and pave the way for the next generation of metaphor

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[38] Examples include: Amondawa (Sinha et al. 2011); Aymara (Núñez and Sweetser 2006); Mian (Fedden and Boroditsky 2012); Pormpuraaw (Boroditsky and Gaby, 2010); Tzeltal (Brown 2012); Yélî Dnye (Levinson and Majid 2013); Yucatec Mayas (Le Guen and Balam 2012); and Yupno (Núñez et al. 2012).

research. With the advent of new interactive technologies, one possible solution is to turn our focus to the role that emerging cultural artefacts play in creating wider cognitive and computational webs (cf. Gibbs 1999). In particular, for future research, the iGeneration (born after 1999, Pendergast 2009; Rosen 2010) may provide a rich testbed for investigating whether people's interactions with digital cultural artefacts shape embodiment and, hence, metaphorical thought.

There has, for instance, been a recent surge of videos on YouTube depicting 'technotoddlers' interacting with a range of digital technologies, the most prominent of which is the iPad (Wohlwend 2013). One video entitled, *A Magazine is an iPad That Does Not Work*,[39] shows a toddler using her fingers to press, tap, swipe and pinch on the screen of an iPad. Subsequently, she attempts to use the same finger movements on the pages of a magazine but appears perplexed and loses interest when the magazine is unresponsive to her actions. While such casual observations should be interpreted with some caution, recent research from the field of neuroscience suggests that digital cultural artefacts are indeed radically altering the ways in which young minds are developing and functioning (e.g. Small et al. 2009; Small and Vorgan 2008). Taken together, these findings raise the question of how new cultural artefacts may, consequently, be influencing metaphoric thought. To illustrate, consider the ways in which people interact with touch screen calendars on smart devices. The iPad (iOS 7), for example, enables users to alternate between different 'views' of time, each of which is understood through different space-time metaphors: in the 'day' view and the 'month' view, users advance through the hours of the day and the months of the year by vertically swiping the screen upwards (UP IS EARLIER; DOWN IS LATER), whereas in the 'week' view, users move later through the days of the week by horizontally swiping the screen leftwards (LEFT IS EARLIER; RIGHT IS LATER). Thus, by automatically alternating between different space-time metaphors—namely, UP IS EARLIER and LEFT IS EARLIER—digital cultural artefacts dictate a necessity for users to be flexible in their representations of time, as they

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[39] Available at: http://www.youtube.com/watch?v=uqF2gryy4Gs (CBSNewsOnline 2011) [accessed November 2013].

switch to thinking about different time spans on different timescales (cf. Casasanto and Jasmin 2012).[40]

In addition, while recent lines of metaphor research have begun exploring the cognitive and neural basis of metaphor, the focus has largely been centred on the processing of metaphor as a function of language-related factors, such as novelty, interpretability and valence (e.g. Cardillo et al. 2010; Schmidt and Seger 2009; Subramaniama et al. 2012). Drawing on the assumption that conceptual metaphors are as much internally represented in the minds of individuals as they are spread out into the social and cultural world (Gibbs 1999), new insights into the 'metaphorical brain' (cf. Lai and Coulson in preparation) might similarly be gained by extending the neuroscientific investigation of metaphor out into the digital world; thereby, exploring metaphor processing as a function of interactions with digital cultural artefacts. Furthermore, future research in cognitive linguistics would benefit from exploring the roles that cultural artefacts—both existing and emerging—play in shaping metaphoric thought.

9.4. Conclusion

By building upon and extending earlier lines of research on space-time mappings, the overall aim of this thesis was to shed light on the mechanisms at work during the interpretation of language in context, providing a more fully explanatory framework for the metaphoric representation of time. This aim was achieved through a series of studies that were conducted to examine further the range of factors that may influence how people reason about events in time and by investigating further the interpretation of metaphorical expressions about time in prescribed contexts. Taken together, the results reported in this thesis have yielded

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[40] It should be noted that recent research has sought to distinguish between two fundamentally different representations of deictic time: one with an 'internal' perspective, where the deictic centre (the ego) correlates with the present and metaphorically signifies the experience of *now* and a second with an 'external' perspective, where the deictic centre is displaced to an external vantage point, which is perpendicular to the axis on which time is represented (Casasanto and Jasmin 2012; Núñez and Cooperrider 2013). Moreover, recent research on temporal gestures proposes that, in their conceptualisation of external deictic time, people adopt a 'Moving Attention' perspective (as opposed to a Moving Ego or Moving Time perspective), which is grounded in patterns of interaction with cultural artefacts (as opposed to patterns of interaction with the natural environment) (Casasanto and Jasmin 2012).

some original and valuable data, which should be of interest to practitioners and academics in the language sciences. They also provide the opportunity for a number of future research studies in this area.

Arguably, research on space-time mappings—both empirical and theoretical—is growing at a faster pace than any other area of research in the field cognitive linguistics. Thus, although the results reported in this thesis have yielded some innovative insights, a conservative approach should be adopted in their interpretation. Specifically, as progress continues to be made in this area of research, a reappraisal of the current findings might be necessitated in the future. Indeed, theoretical developments generate new hypotheses for empirical testing, dictate what experimental distinctions to make and allow for new theoretical interpretations of existing empirical results which are, in turn, fed back into the process. To reiterate Núñez (2007), knowledge attainment in cognitive linguistics involves developments not only in linguistics and psychology, but also in neuroscience, anthropology and other related disciplines. It is through this continuing process of mutual feeding that further insight into and greater understanding of the metaphoric representation of time is also perpetuated.

Appendices

Appendix 1

<u>Frequency of English motion verbs</u>

English motion verb	Frequency	Motion	Semantic components
abandon	4253	Transl	Path
accelerate	1046	Transl	Manner
accompany	4663	Transl	Figure + Co-motion
advance	2925	Transl	Path
alight	338	Transl	Path
amble	165	Transl	Manner
approach	6647	Transl	Path
arise	9450	Self-c / Transl	Manner
arrive	13422	Transl	Path
ascend	323	Transl	Path
back	4150	Transl	Path
backpack	60	Transl	Manner
balloon	62	Transl	Manner
bend	3259	Self-c	Manner
bicycle	42	Transl	Manner
bike	68	Transl	Manner
blow	4730	Transl	Cause
boat	64	Transl	Manner
bob	371	Self-c	Manner
bobsled (US)	0	Transl	Manner
bobsleigh (UK)	0	Transl	Manner
bolt	430	Transl	Manner
boogie	48	Self-c	Manner

English motion verb	Frequency	Motion	Semantic components
bop	35	Self-c	Manner
bounce	1167	Self-c	Manner
bound	487	Transl	Manner
bow	1288	Self-c	Manner
bowl	727	Transl	Manner
bus	83	Transl	Manner
cab	1	Transl	Manner
cancan	0	Self-c	Manner
canoe	14	Transl	Manner
canter	103	Transl	Manner
caper	11	Transl	Manner
capriole	0	Self-c	Manner
capsize	95	Self-c	Manner
caravan	0	Transl	Manner
careen	10	Self-c / Transl	Manner
career	201	Transl	Manner
cavort	68	Transl	Manner
charge	6368	Transl	Path + Manner
chariot	0	Transl	Manner
chase	2013	Transl	Path + Manner
circle	631	Transl	Manner
circuit	13	Transl	(Motion) + Ground
circulate	1390	Transl	(Motion) + Ground
clamber	397	Transl	Manner
climb	5328	Transl	Path + Manner
clip	643	Transl	Manner
clump	44	Transl	Manner
coach	910	Transl	Manner
coggle	0	Self-c	Manner
coil	211	Self-c	Manner
come	143322	Transl	Path

English motion verb	Frequency	Motion	Semantic components
conduct	5027	Transl	Figure + Co-motion
conga	0	Self-c	Manner
convoy	5	Transl	Figure + Co-motion
crash	2109	Transl	Concurrent Result
crawl	1050	Transl	Manner
creep	1452	Transl	Manner
cross	6706	Transl	Path
crouch	801	Self-c	Manner
cruise	601	Transl	Manner
curvet	0	Self-c	Manner
cycle	546	Transl	Manner
dance	3211	Self-c	Manner
dart	538	Transl	Manner
dash	876	Transl	Manner
dawdle	73	Transl	Manner
decelerate	42	Transl	Manner
depart	1338	Transl	Path
descend	1654	Transl	Path
desert	999	Transl	Path
disembark	122	Transl	Path + Ground (ship)
dive	1015	Transl	Path + Manner
divert	1156	Transl	Path
dodder	12	Self-c / Transl	Manner
dodge	410	Self-c / Transl	Manner / Path
dogsled	0	Transl	Manner
dribble	187	Transl	Manner
drift	1828	Transl	Cause
drive	14493	Transl	Manner
drop	10021	Transl	Path
edge	743	Transl	Manner
embark	1319	Transl	Path + Ground (ship)

English motion verb	Frequency	Motion	Semantic components
emigrate	429	Transl	Path + Ground (country)
enter	13681	Transl	Path
escape	5135	Transl	Path
escort	747	Transl	Figure + Co-motion
exit	385	Transl	Path
fall	25843	Transl	Path
ferry	332	Transl	Manner
file	1415	Transl	Manner
flap	485	Self-c	Manner
flee	1998	Transl	Cause + Path + Manner
flick	996	Self-c	Manner
flip	420	Self-c	Manner
flit	221	Transl	Manner
float	1708	Self-c / Transl	Manner
flounder	157	Self-c	Manner
flutter	451	Self-c	Manner
fly	8571	Transl	Ground (air)
follow	40602	Transl	Path
ford	34	Transl	Path + Ground (river) + Manner
foxtrot	3	Self-c	Manner
frisk	36	Transl	Manner
frolic	8	Transl	Manner
gallop	369	Transl	Manner
gambol	20	Transl	Manner
gimp	4	Transl	Manner
glide	433	Transl	Manner
go	236313	Transl	Path
gondole	0	Transl	Manner
goosestep	0	Transl	Manner
grovel	58	Transl	Manner
guide	2055	Transl	Figure + Co-motion

English motion verb	Frequency	Motion	Semantic components
hare	32	Transl	Manner
hasten	474	Transl	Manner
helicopter	9	Transl	Manner
hike	82	Transl	Manner
hobble	172	Transl	Manner
hop	501	Self-c / Transl	Manner
hound	134	Transl	Path
hover	878	Self-c	Ground (on air)
hurl	665	Transl	Manner
hurry	2291	Transl	Manner
hurtle	248	Transl	Manner
immigrate	5	Transl	Path + Ground (country)
inch	308	Transl	Manner
jeep	0	Transl	Manner
jet	75	Transl	Manner
jig	28	Self-c	Manner
jitterbug	2	Self-c	Manner
jive	26	Self-c	Manner
jog	455	Transl	Manner
journey	221	Transl	Manner
jump	4810	Self-c / Transl	Manner
kayak	5	Transl	Manner
keel	103	Self-c	Manner
kick	3417	Self-c	Figure (body part: feet, legs)
kneel	963	Self-c	Manner
land	3628	Transl	Path + Ground (land)
lead	32102	Transl	Figure + Co-motion
lean	4444	Self-c	Manner
leap	1961	Self-c / Transl	Manner
leap-frog	0	Transl	Manner
leave	60578	Transl	Path

English motion verb	Frequency	Motion	Semantic components
limp	369	Transl	Manner
lope	68	Transl	Manner
lumber	0	Transl	Manner
lunge	193	Transl	Path + Manner
lurch	392	Self-c	Manner
march	1718	Transl	Manner
meander	173	Transl	Manner
mince	88	Transl	Manner
moonwalk	0	Self-c / Transl	Manner / Manner + Ground
moped	15	Transl	Manner
mosey	9	Transl	Manner
motor	176	Transl	Manner
motorbike	0	Transl	Manner
motorcycle	22	Transl	Manner
mount	3037	Transl	Path
move	37290	Self-c + Transl	(Motion)
nip	402	Transl	Manner
nod	5408	Self-c	Figure (body part: head)
oar	3	Transl	Manner
outrun	61	Transl	Manner + Co-motion / Action correlation
overturn	636	Self-c	Manner
pace	602	Transl	Manner
pad	228	Transl	Manner
paddle	362	Transl	Manner / Manner + Ground (water)
parachute	76	Transl	Manner
parade	372	Transl	Manner
pass	19336	Transl	Path
pedal	183	Transl	Manner
penetrate	1162	Transl	Path
perambulate	12	Transl	Manner

English motion verb	Frequency	Motion	Semantic components
pirouette	0	Self-c	Manner
plod	210	Transl	Manner
plummet	274	Transl	Path + Manner
plunge	1333	Transl	Path + Manner
polka	0	Self-c	Manner
pop	1956	Transl	Manner
pounce	311	Transl	Path + Manner
prance	77	Transl	Manner
promenade	12	Transl	Manner
pronk	0	Self-c / Transl	Manner
prowl	177	Transl	Manner
punt	34	Transl	Manner
pursue	4512	Transl	Path
quake	35	Self-c	Manner
quickstep	3	Self-c	Manner
quiver	342	Self-c	Manner
race	3496	Transl	Manner
raft	6	Transl	Manner
ramble	119	Transl	Manner
reach	22088	Transl	Path
recede	445	Transl	Path
recline	92	Self-c	Manner
recoil	200	Transl	Path
reel	402	Self-c / Transl	Manner
retire	3480	Transl	Path
retreat	889	Transl	Path
return	21364	Transl	Path
revolve	485	Self-c	Manner
rickshaw	2	Transl	Manner
ride	5022	Transl	Manner
rise	14608	Self-c / Transl	Manner / Path

English motion verb	Frequency	Motion	Semantic components
roam	535	Transl	Manner
roar	937	Transl	Manner
rock	948	Self-c	Manner
rocket	116	Transl	Manner / Path + Manner
roll	4438	Self-c / Transl	Manner
rollerblade	1	Transl	Manner
romp	130	Transl	Manner
rotate	684	Self-c	Manner
rove	63	Transl	Manner
row	567	Transl	Manner
rumba	0	Self-c	Manner
run	38304	Transl	Manner
rush	3025	Transl	Manner
sail	2646	Transl	Manner
samba	0	Self-c	Manner
sashay	13	Transl	Manner
saunter	183	Transl	Manner
scale	567	Transl	Path
scamper	167	Transl	Manner
scatter	1516	Transl	Path
scoot	38	Transl	Manner
scram	5	Transl	Path + Manner
scramble	966	Transl	Manner
scud	33	Transl	Manner
scurry	297	Transl	Manner
scuttle	254	Transl	Manner
seesaw	2	Self-c	Manner
shadow	291	Transl	Path
shake	8494	Self-c	Manner
shamble	75	Transl	Manner
ship	1562	Transl	Manner

English motion verb	Frequency	Motion	Semantic components
shiver	1093	Self-c	Manner
shoot	7203	Transl	Manner
shudder	660	Self-c	Manner
shuffle	517	Transl	Manner
shuttle	32	Transl	Manner
sidle	113	Transl	Manner
sink	2919	Transl	Path
skate	275	Transl	Manner
skateboard	23	Transl	Manner
skedaddle	2	Transl	Path + Manner
ski	378	Transl	Manner
skid	209	Transl	Manner
skim	342	Transl	Manner
skip	660	Transl	Manner
skitter	57	Transl	Manner
skulk	59	Transl	Manner
skydive	6	Transl	Ground (on air) + Path + Manner
sled (US)	8	Transl	Manner
sledge (UK)	7	Transl	Manner
sleepwak	0	Transl	Manner
slide	2798	Transl	Manner
slink	53	Transl	Path + Manner
slip	4667	Transl	Manner
slither	234	Transl	Manner
slog	69	Transl	Manner
slouch	96	Self-c / Transl	Manner
sneak	447	Transl	Manner
soar	934	Transl	Path + Manner
somersault	63	Self-c	Manner
somnambulate	0	Transl	Manner
speed	1711	Transl	Manner

English motion verb	Frequency	Motion	Semantic components
spin	1710	Self-c	Manner
spring	1722	Transl	Manner
sprint	247	Transl	Manner
squaredance	0	Self-c	Manner
squat	487	Self-c	Manner
stagger	718	Self-c / Transl	Manner
stalk	415	Transl	Manner / Path + Manner
stamp	1158	Self-c / Transl	Figure (body part: foot) + Manner
stampede	32	Transl	Path + Manner
step	5520	Transl	Figure (body part: foot) + Manner
stomp	102	Self-c / Transl	Manner
stoop	419	Self-c	Manner
storm	659	Transl	Manner
stray	484	Transl	Path
streak	231	Transl	Manner
stretch	4472	Self-c	Manner
stride	1040	Transl	Manner
stroll	772	Transl	Manner
strut	141	Transl	Manner
stumble	997	Transl	Manner
stump	150	Transl	Manner
swagger	19	Transl	Manner
sway	758	Self-c	Manner
sweep	2949	Transl	Manner
swerve	212	Transl	Path
swim	2302	Transl	Manner + Ground (water)
swing	3177	Self-c	Manner
swirl	395	Self-c	Manner
swoop	393	Transl	Path + Manner + Ground
tack	384	Transl	Path
tail	172	Transl	Path + Manner

English motion verb	Frequency	Motion	Semantic components
tango	6	Self-c	Manner
tapdance	0	Self-c	Manner
taxi	15	Transl	Manner
tear	2663	Transl	Manner
teeter	116	Self-c / Transl	Manner
throw	10776	Transl	Manner
thrust	1325	Transl	Path + Manner
thunder	290	Transl	Manner
tiptoe	163	Transl	Manner
tittup	2	Transl	Manner
toboggan	11	Transl	Manner
toddle	44	Transl	Manner
topple	393	Transl	Cause + Path
totter	153	Self-c / Transl	Manner
tour	761	Transl	Manner
track	899	Transl	Path + Manner
trail	1070	Transl	Path + Manner
traipse	48	Transl	Manner
tram	4	Transl	Manner
tramp	196	Transl	Manner
trample	276	Transl	Figure (body part: feet) + Manner
travel	8410	Transl	Manner
traverse	291	Transl	Path
tread	886	Transl	Figure (body part: feet) + Manner
trek	162	Transl	Manner
tremble	1383	Self-c	Manner
trip	779	Transl	Manner
trolley	1	Transl	Manner
troop	105	Transl	Manner
trot	436	Transl	Manner
truck	24	Transl	Vehicle / Instrument

English motion verb	Frequency	Motion	Semantic components
trudge	252	Transl	Manner
trundle	171	Transl	Manner
tumble	824	Transl	Path + Manner
turn	43441	Self-c / Transl	Manner / Path
twine	57	Self-c	Manner
twirl	134	Self-c	Manner
twist	1757	Self-c	Manner
vault	150	Transl	Manner
vibrate	282	Self-c	Manner
waddle	96	Transl	Manner
wade	295	Transl	Ground (water) + Manner
waft	199	Transl	Ground (air) + Manner
wag	215	Self-c	Manner
walk	19882	Transl	Manner
waltz	25	Self-c	Manner
wander	2306	Transl	Manner
wave	2471	Self-c	Manner
wheel	663	Transl	Manner
whirl	380	Self-c	Manner
whisk	380	Transl	Manner
whiz(z)	149	Transl	Manner
wiggle	88	Self-c	Manner
wind	2211	Self-c	Manner
wobble	219	Self-c	Manner
wriggle	443	Self-c	Manner
yacht	0	Transl	Manner
zigzag	63	Self-c	Manner
zoom	237	Transl	Manner

Appendix 2

English motion verbs in the sub-domain of TEMPORAL MOTION

Contexts: Path of motion verbs

Go

1	if there's any thing on, before we go to bed (SP:PS03T) I'm going to see this eighty thirty five, As Time *Goes* By	MT

Come

1	worry, as usual, that I shall be mopping you up for months to *come*." Maybe,' said Jay.' I'm too far in	MT
2	The fighting, which had died down during the night, flared again as dawn *came*, and US Cobra gunships began to fly over	MT
3	the greater part (but not all) of them know that the time has *come*: they are off and have begun once more that great southward flight	MT
4	I am sure he will retain the leadership for many years to *come* and he is in the process of emerging from the Government's	MT
5	What are the names of your children?'), or night *comes* so abruptly it is as though someone has pulled down a blind.	MT
6	will doubtless provide the basic starting-point for scholars of twentieth century Conservatism for years to *come*, but to date it	MT
7	And he's taking me shopping in New York tomorrow. Christmas is *coming* and he thinks I ought to know about	MT

Follow

1	Return to Bracknell station *following* my engagement, to catch the 9.49pm train back to Waterloo.	Seq.
2	In Britain such was the period *following* the defeat of Clodius Albinus in the civil war of AD 196.	Seq.
3	In the half-century that *followed* the restoration of the Stuart monarchy in 1660	Seq.

4	it may have been a manifestation of the insecurity of Aldfrith in the years immediately *following* his accession.	Seq.
5	to renew and confirm the charters, which was done in october *following*. To these charters were now added	Seq.
6	In the hours that *follow*, these glycoproteins dendritic spines, and the synaptic contact areas	Seq.
7	Although air-raid sirens were often heard in Baghdad during the months that *followed*, both sides' air forces tended	Seq.

Reach

1	to ACFA by transfer from the Cystic Fibrosis Research Trust's mailing list when they *reach* the age of 18, or by direct referral.	ME
2	3-4 years, and 84 per cent of those with 1-2 years to go before *reaching* pension age. Second, we found that ill health was	ME
3	line (pause) it's the analogy of someone pedalling on a bicycle, if you *reach* thirty five and you're going up on a bicycle	ME

Pass

1	As time *passes* this new life will change and itself be superseded, requiring a re-ordering of the	MT
2	that from the time I was sixteen I found myself hardly letting a week *pass* without writing one or two descriptions	MT
3	But it slowed her up considerably, and as time *passed* she found herself casting furtive glances over her shoulder.	MT
4	Sir Fulke.' The knight blew out his cheeks.' The day is *passing*, friar,' he observed tartly, glaring out of the window.'	MT
5	A few minutes *passed* as they congratulated Cara on what they realised was something of a very large achievement	MT
6	you haven't got no idea of the (SP:PS0G0) No. (SP:PS0FS) time sort of *pass* (SP:PS0G0) But I did hear this one	MT
7	he whispered achingly. A tiny echo sighed back at him. A full minute *passed* before he could move again.	MT

8	on Bishopstow almost before Alexandra realized it, so swiftly and busily did her days *pass*. Her parents travelled home	MT
9	(Lights snap on. Nothing displaced. Much time has *passed*. The three people look the same. Abberley talking cheerfully to Max.	MT
10	to the bubble fountain, when the lights were switched on. The time had *passed* so quickly that she hadn't realised how late it was	MT
11	As the months and years *passed*, Dorian Gray grew more and more afraid of the picture.	MT
12	sleepless, she waited for the night to *pass*. She had known they weren't going to make love the moment the sound	MT
13	and has been singularly unsuccessful in doing so over the three decades that have *passed* since Suez.	MT
14	Five centuries have *passed* since the discovery of America, a focal point in the history of discoveries.	MT

Enter

1	skin absorbs too readily here and may become puffy. # FORTIES # As you *enter* your forties your skin is likely to be even drier	ME

Arrive

1	Christmas Eve had now *arrived* along with her two grown-up children, Stephen and Carol	MT
2	all winter, though she has ventured on a carriage trip or two since spring *arrived*, is excited by the promise Cavour has made	MT

Approach

1	Furthermore, as Congress *approached* its October adjournment, several other pieces of legislation threatened to	ME
2	He was now *approaching* thirty years old and, as the year turned, he wanted desperately to get	ME
3	that a fierce spark of that madness might be living on within her as she *approached* the middle of her life.	ME

4	Remove the uncertainty of succession, all three directors are *approaching* their mid-forties, and therefore	ME
5	And as the skiing season *approaches*, you can rely on them to supply first-class winter warmers.	MT
6	The family portrait reveals more: father of three children and *approaching* his ruby wedding with his wife Sheila	ME
7	I longed for company and felt unreasonably deserted. When the appointed hour *approached* and we could see the visitors	MT
8	With winter *approaching* and the slump growing the situation looks like getting worse.	MT
9	and as the days lengthened and winter *approached* there was understandable bad feeling between landladies and	MT
10	The shop had suddenly become very busy as Christmas *approached*, and although the cycling was finished Anne and Sarah	MT
11	a show of force as the number of corruption charges increased him and the date *approached* for the release of the Rettig report	MT
12	As noon *approached* John adopted a behaviour pattern that I knew well: stretching, scratching, complacently	MT
13	It was dusk by the time she checked out of the Shelbourne; night was *approaching* rapidly. The sun left a red stain	MT
14	Thus skidding violently from one side to the other, his youth *approached* the moment at which he would	ME
15	Scottish Natural Heritage.' We are fast *approaching* the point when the risk of attempting a rescue	ME

Contexts: Manner of motion verbs

Travel

| 1 | the Department of Public Services. # CARDIFF CASTLE # *TRAVEL* BACK THROUGH 1900 YEARS OF HISTORY # | ME |
| 2 | Oxford's Lord Mayor, Queenie Warley will *travel* through time to meet Queen Elizabeth the First | ME |

Race

| 1 | The afternoon was slipping away, the afternoon was *racing* by. Sheltered from the wind, Jessica could feel her face begin to roast | MT |

Wander

| 1 | Lizzie was *wandering* backwards in time. The past, reflected Sara, when the peacock silk curtains were newly hung | ME |

Tear

| 1 | She began to feel exasperated. Time was *tearing* along and there were the coals to fetch. | MT |

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Publications

Duffy, S. and M. Feist. 2014. Individual differences in the interpretation of ambiguous statements about time. *Cognitive Linguistics* 25(1), 29-54.

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Sarah E. Duffy* and Michele I. Feist

Individual differences in the interpretation of ambiguous statements about time

Abstract: What factors influence the ways in which people resolve ambiguity? In English, two contrasting perspectives are implicit in deictic temporal expressions: the Moving Time metaphor conceptualizes time as moving forward towards the ego and the Moving Ego metaphor conceptualizes the ego as moving forward towards the future (Clark 1973). We examine the ambiguity arising from these two conceptualizations, claimed to be equally likely in a "neutral" context (Boroditsky and Ramscar 2002). Whereas previous studies have demonstrated that exposure to a spatial situation related to one interpretation may influence the resolution of the ambiguity (e.g. Boroditsky 2000; Núñez 2007), we focus on the lifestyle and personality factors of the participants as potential additional influences on ambiguity resolution in the interpretation of temporal metaphors. Experiment 1 asks whether lifestyle might influence an individual's approach to time and resulting resolution of temporal ambiguity, comparing preferred responses from two groups of participants with very different demands on the structuring of time: university students and administrators. We observed a difference between the two groups, with administrators more frequently adopting the Moving Time perspective and students, the Moving Ego perspective. Experiment 2 examines personality-related differences, focusing specifically on individual differences in procrastination (Lay 1986) and conscientiousness (John 1990). We observed a significant effect with participants who adopted the Moving Ego perspective reporting higher procrastination scores and lower conscientiousness scores than participants who adopted the Moving Time perspective. Experiment 3 investigates further personality-related differences, focusing specifically on individual differences in extroversion (John 1990). We observed a relationship between extroversion and disambiguation responses, with participants who adopted the Moving Ego perspective evidencing higher levels of extroversion. Taken together, the results from these three studies suggest that individual differences in lifestyle and personality may influence people's perspectives on the movement of events in time and their concomitant interpretation of temporally ambiguous utterances, precluding a universal "neutral" context within which language is interpreted.

Keywords: Moving Time, Moving Ego, metaphor, temporal perspective, ambiguity, individual differences, lifestyle, personality.

*Corresponding author: Sarah Duffy: Northumbria University, Faculty of Arts and Social Sciences, Department of Humanities, Newcastle-upon-Tyne, UK. E-mail: sarah.duffy@unn.ac.uk
Michele Feist: University of Louisiana at Lafayette, Department of English, Lafayette, LA, USA. E-mail: feist@louisiana.edu

1 Introduction

It has long been observed that speakers systematically employ language from concrete and perceptually rich domains to talk about abstract concepts. One of the most paradigm examples of this is illustrated by the ways in which the abstract domain TIME is metaphorically conceptualized in terms of the concrete domain SPACE in a wide range of languages throughout the world (e.g. Evans 2004; Haspelmath 1997; Núñez and Sweetser 2006; Yu 1998). In English, there are various types of spatial metaphors for time, including those structured around the relative placement of ego and events in time (Moving Ego and Moving Time, Clark 1973; Lakoff and Johnson 1999), those structured around the conceptualization of events as elements in a sequence (Moore 2006; Núñez et al. 2006), and those structured around the conceptualization of events placed in relation to the forward-moving flow of time, without additional reference points (Kranjec 2006). Of these, the space-time metaphors that have received the most attention in the empirical literature are those structured around the relative placement of ego and events in time (e.g. Boroditsky and Ramscar 2002; Matlock et al. 2005; McGlone and Harding 1998; Ramscar et al. 2010). In the Moving Ego metaphor, time is depicted as a stationary landscape that the active ego moves across, as evidenced by expressions such as *We're approaching Christmas* and *We're coming up to the deadline*. In the Moving Time metaphor, time is conceived as a conveyor belt that events move along, from the future to the past, relative to a stationary ego, as evidenced by expressions such as *Christmas is approaching* and *The deadline is coming up*. These two metaphors are argued to be equally common in English speakers' conceptualizations of time: "In a neutral context, people are equally likely to think of themselves as moving through time as they are to think of time as coming toward them" (Boroditsky and Ramscar 2002: 185).[1]

The systematicity and coherence of the Moving Ego and Moving Time metaphors in language have given rise to research investigating the psychological reality of these two metaphors. In a seminal study conducted by McGlone and Harding (1998), participants were asked to interpret a series of context sen-

tences which were phrased in either the terms of 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*). At the end of the block of priming statements, participants read an ambiguous target statement, such as *The meeting originally scheduled for next Wednesday has been moved forward two days* and were then asked to indicate the day of the week on which the event would occur. The results showed that participants tended to disambiguate the target consistently with the primes, such that participants who were primed with Moving Ego metaphors more frequently interpreted "moved forward" in line with the Moving Ego perspective (responding *Friday*), and participants who were primed with Moving Time metaphors more frequently interpreted "moved forward" in line with the Moving Time perspective (responding *Monday*). In addition to providing evidence for two psychologically distinct global systems underlying two different ways of mapping events in time, these results suggest that the perspective adopted in the interpretations of unambiguous temporal statements may exert an influence on the interpretation of subsequent ambiguous temporal statements.

Building on McGlone and Harding's (1998) findings, Boroditsky (2000) and Boroditsky and Ramscar (2002) devised a series of experiments to investigate whether engaging in certain types of spatial thinking might influence how people think about time. In one experiment, participants were asked to imagine moving towards a stationary object or to imagine an object moving towards them before

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1 Although spatial metaphors for time are attested in English, one area that has received comparatively less attention is how common natural usages of these metaphors are and how they are used. One reviewer raises the question of whether space-time metaphors are in fact quite infrequent and used only in circumscribed contexts. To illustrate, two of the most cited VPs used in examples of Moving Ego and Moving Time metaphors are *approaching* and *coming up* (Clark 1973; Bender et al. 2010; Boroditsky 2000; Evans and Green 2006; Lakoff and Johnson 1999; McGlone and Harding 1998; Moore 2006; Núñez 2007; Núñez and Sweetser 2006; Radden 2004). In order to assess the frequency of temporal uses of these VPs in natural production, we extracted 200-token samples for each VP from the *Brigham Young University-British National Corpus* (BYU-BNC; Davies 2004–). Of these, we identified 20 temporal instances of *approaching* and 17 temporal instances of *coming up* (see Appendix); thus, demonstrating that although space-time metaphors may be infrequent, they are attested in corpora. Examination of the extracted instances revealed that 60% of the instances of *approaching* and 53% of the instances of *coming up* represented the Moving Time perspective. While an extensive analysis of the nature and frequencies of naturally occurring temporal expressions is beyond the remit of this paper, it is nevertheless worth highlighting their rate of occurrence in natural language use.

answering the ambiguous *Next Wednesday's meeting* question. Based on the assumption that our experience of time is grounded in our understanding of space (Lakoff 1993; Lakoff and Johnson 1980, 1999), it was hypothesized that imagining moving through space towards a stationary object is analogous to the Moving Ego perspective and imagining a moving object travelling through space towards the self is analogous to the Moving Time perspective. Thus, if space and time do share some relational structure, participants primed in the ego-moving spatial condition should "reuse" this perspective for time and answer *Friday*, whereas participants primed in the object-moving spatial condition should adopt the Moving Time perspective and answer *Monday*. As predicted, participants tended to respond in a prime-consistent manner to the *Next Wednesday's meeting* question, suggesting that different ways of thinking about motion in space can yield different construals of time. Further experiments conducted in a range of settings have confirmed these initial findings (Boroditsky and Ramscar 2002). For instance, participants who were at the beginning or end of a train journey and thus more likely to be engaged with the notion of travelling were more likely to respond *Friday* than participants who were in the middle of their journey. This pattern of results suggests that the temporal perspective adopted, and hence the interpretations of ambiguous temporal statements, can be primed not only by temporal, but also by spatial stimuli; thus, indicating that spatial and temporal representations are conceptually related.

These preliminary results have been extended, with demonstrations that non-deictic spatial schemas (Kranjec 2006; Núñez et al. 2006), abstract spatial motion schemas (Matlock et al. 2011) and deictically-oriented fictive motion schemas (Matlock et al. 2005; Ramscar et al. 2010) can also influence interpretations of ambiguous temporal statements. For example, Matlock et al. (2005) and Ramscar et al. (2010) conducted a number of experiments to investigate whether thinking about fictive motion (FM), similarly to thinking about actual motion, would influence the ways in which people think about time. In these studies, participants were primed with one of two FM sentences, *The road goes all the way to New York* or *The road comes all the way from New York* (whereby the participants' location at Stanford was the implied starting point or end point) before answering the *Next Wednesday's meeting* question. The results showed that when participants were primed with FM going away from them, from Stanford to New York, they were more likely to provide a *Friday* response, whereas when participants were primed with FM coming towards them, from New York to Stanford, they were more likely to provide a *Monday* response. As was the case with actual motion, Ramscar et al. (2010) concluded that just thinking about fictive motion is sufficient to influence how people think about time. Furthermore, these findings further substantiate the claim that when people engage in certain kinds of

spatial-motion thinking, they may also unwittingly and dramatically change how they think about time.

While spatial schemas may exert an important influence on the structure and representation of time, a closer look at responses in the absence of priming reveals an additional potential contributor: only student participants have been sampled in a "neutral" context, and these respondents have shown a preference for answering *Friday*: Boroditsky (2000), Núñez (2007) and Sullivan and Barth (2012) report these figures to be 54%, 61% and 77%,[2] respectively. To further put these numbers in perspective, Boroditsky and Ramscar (2002, Study 1) report that people primed to imagine themselves moving through space (and predicted to adopt the Moving Ego perspective) responded *Friday* 57% of the time. Similarly, people waiting to fly (and thus likely thinking about motion and predicted to adopt the Moving Ego perspective) responded *Friday* 62% of the time (Boroditsky and Ramscar 2002, Study 3). Thus, rates of *Friday* responses which differ little from the "neutral" context baselines have been taken as evidence for the adoption of the Moving Ego perspective, suggesting that there might be something about the population sampled that favours one direction in the resolution of temporal ambiguity.

As researchers in the cognitive sciences have been concerned primarily with testing the effects of priming on the interpretation of ambiguous temporal statements, preferred temporal perspective in a "neutral" unprimed context has received scant attention. However, recent research investigating the ways in which people perceive and understand time has extended beyond demonstrating the psychological reality of space-time metaphors and has begun to consider language-external characteristics of the participants on the perception of time and the resolution of temporally ambiguous utterances. In an innovative study, Hauser et al. (2009) investigated the link between the seemingly unrelated but similarly embodied abstract domains of anger and time. Anger, both as an event-induced emotion and as a personality trait, is spatially represented by approach-related motivations, which cause the active self to approach a goal or situation (Harmon-Jones 2007), much as the self moves into the future in the Moving Ego metaphor. Building on aspects of Conceptual Metaphor Theory; namely, that people understand abstract concepts, such as anger or time, in terms of more concrete domains, such as space, and that multiple abstract concepts can borrow from the same source domain, Hauser et al. (2009) hypothesized that anger and

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2 Sullivan and Barth's (2012) sample consisted of a mostly (~98%) student population (Hilary Barth, personal communication, August 2013).

the Moving Ego representation of time may tap into a similar approach-related spatial motivation that would serve as an embodied cognitive link between the two domains. To test this hypothesis, Hauser et al. (2009) asked participants to complete questionnaires designed to measure trait anger (that is, anger as part of their personality) before responding to the *Next Wednesday's meeting* question. Their findings showed that participants with higher trait anger, as measured by the questionnaires, were more likely to adopt the Moving Ego perspective (responding *Friday*) than to adopt the Moving Time perspective (responding *Monday*). In discussing the implications of their results, Hauser et al. (2009: 1178) observe that as time representation is influenced by trait anger, it raises the possibility that additional personality-related differences may play important roles in influencing how people reason about time.

More recently, Richmond et al. (2012), reasoning that those with a strong sense of personal agency (Vallacher and Wegner 1989) would be more likely to conceive of themselves as moving through time, investigated the relationship between level of perceived personal agency and temporal perspective. In one experiment, participants responded to the *Next Wednesday's meeting* question before completing a questionnaire for measuring individual differences in the level of perceived personal agency (Richmond et al. 2012, Study 2). The findings showed that, in line with their predictions, participants who adopted the Moving Ego perspective reported significantly higher agency scores in comparison to participants who adopted the Moving Time perspective; thus providing initial evidence for the relationship between perceived agency and temporal perspective. Probing this relationship further, Richmond et al. (2012, Study 3) examined whether perceived agency and temporal perspective might be associated with emotional experiences. Reasoning that people who feel in control and proactively approach a positive future are more likely to experience feelings of happiness, while people who wait for time to exert control over them are more likely to experience depression, Richmond et al. (2012) hypothesized that higher levels of self-reported happiness would encourage the adoption of the Moving Ego perspective (indicated by a *Friday* response), while higher levels of self-reported anxiety and depression would encourage the adoption of the Moving Time perspective (indicated by a *Monday* response). To test this, they compared participants' responses to the *Next Wednesday's meeting* question with their scores on a series of questionnaires for measuring anxiety, happiness and depression. In line with their predictions, the results showed that participants who adopted the Moving Ego perspective evidenced higher scores for happiness than participants who adopted the Moving Time perspective. Conversely, participants who adopted the Moving Time perspective evidenced higher scores for anxiety and depression than participants who adopted the Moving Ego perspective. Taken together, these

findings extend the range of individual differences that may influence people's representations of time.

While the majority of research investigating abstract thinking about time has thus far been primarily focused on investigating spatial influences on temporal reasoning, arguably, there are factors beyond the control of the experimenters that play a role in how speakers interpret an ambiguous temporal utterance – suggesting an important gap in our understanding of the contributors to language understanding. In particular, recent lines of research have provided initial evidence that personality differences and emotional experiences may also influence people's perspectives on the movement of events in time and their concomitant interpretations of temporally ambiguous utterances, precluding a universal "neutral" context within which language is interpreted (Hauser et al. 2009; Richmond et al. 2012; see also Margolies and Crawford 2008; Ruscher 2011). Furthermore, while motion in space is demonstrably related to temporal perspective (e.g. Boroditsky 2000; Boroditsky and Ramscar 2002), it cannot be the sole determiner: Margolies and Crawford (2008) found different effects of emotional valence on responses to the *Next Wednesday's meeting* question when compared to responses to a question asking whether participants considered themselves to be approaching an event or considered the event to be approaching them. Thus, rather than being attributed to a single factor, a person's conceptualization of time likely results from a culmination of factors. To reiterate Richmond et al. (2012), although time is objectively measured, it is subjectively understood. Taken together, these findings give rise to the question: which other individual differences might influence how people think about time? To address this question, three experiments were conducted, investigating whether previously unexplored lifestyle and personality differences may influence a person's conceptualization of time and their concomitant interpretation of an ambiguous temporal expression. First, because the majority of studies have sampled student populations, but the lifestyle of a student is not representative of the general population, we investigated whether lifestyle might influence an individual's approach to time, comparing the preferred responses of university students to the *Next Wednesday's meeting* question with those from a sector of the population operating under quite different time pressures: university administrators (Experiment 1). Turning to factors more tightly bound to the individual, we investigated whether individual differences in procrastination, conscientiousness (Experiment 2) and extroversion (Experiment 3) might influence the temporal perspective adopted in response to the *Next Wednesday's meeting* question. The results of the experiments provide further evidence that individual differences in lifestyle and personality may combine with context to influence the ways in which comprehenders resolve linguistic ambiguities regarding the placement of events in time.

2 The present studies

2.1 Lifestyle differences: Students and administrators

As discussed, earlier lines of research investigating the psychological reality of space-time metaphors have focused on testing the effects of priming on the interpretation of ambiguous temporal statements primarily among students (Boroditsky 2000; Núñez 2007; see also Alloway et al. 2006; Matlock et al. 2005; Matlock et al. 2011; Núñez et al. 2006; Ramscar et al. 2010). More to the point, only students have been surveyed outside of a priming context. However, as observed by Hauser et al. (2009: 1178):

> … time representation is not simply affected by situations (e.g. one's current move-
> ment through space), but is a variable that is influenced by perceptually related individual
> differences.

Thus, one issue that warrants further investigation is that the lifestyle of a student is not representative of the general population, which gives rise to the possibility that earlier results may have occurred, in part, due to the particular lifestyle typi-cal of the participant population. To illustrate, in UK universities, the average academic year is 24 weeks and students receive an average of 13.4 contact hours per week (NUS-HSBC 2011; Guardian 2011); thus, students are able to structure the bulk of their time for themselves. By contrast, UK administrators, managers and professionals (representing 65.2% of the UK labour market) and UK full-time employees work on average 41.4 hours per week and receive 28 days annual paid leave (BBC News 2008; Directgov 2012; Office for National Statistics 2010). For these full-time employees, time is primarily structured by external demands rather than by the employees themselves. Furthermore, whereas workers are paid for their time, students are the ones who pay to attend university; they are the consumers. Therefore, generally speaking, whereas students have the option of turning up to a lecture, workers do not have the option of turning up for work, providing students with a greater degree of temporal flexibility in their daily lives than that enjoyed by workers in full-time positions. As such, students differ from full-time employees in two separate but related ways: first, students are relatively in control of the structuring of their time, whereas employees are relatively con-trolled by time; second, students enjoy a relatively high degree of temporal flexi-bility. In view of these differences, and in view of insights from Richmond et al. (2012), who found that people who report higher levels of perceived personal agency were more likely to adopt the Moving Ego perspective, we hypothesized that these differences may influence people's attitudes about time, with the result

that people who have control over time and temporal flexibility in their daily lives, such as students, may think of time quite differently to those who require high degrees of time management on a daily basis and are regimented by the clock, such as administrators.

To this end, in Experiment 1, we ask whether the nature of a person's lifestyle contributes to their view of time and, hence, to their interpretation of ambiguous statements about time in an unprimed context. To test this, we presented university students and administrators (such as personal assistants, secretaries, university timetable coordinators), who deal with the daily management of a multitude of events and activities, with the ambiguous *Next Wednesday's meeting* question. With their relative control over the structuring of their own time and high degree of temporal flexibility, we predict that students will be more likely to adopt the Moving Ego perspective, showing a preference for interpretations in which the meeting has been moved later in time, to *Friday*, as observed in previous studies. In contrast, professionals are subject to more external constraints and hence are more aware of external influences and pressures. As such, we predict that administrators, who require high degrees of time management in their daily lives and for whom time is relatively controlled by external demands, will be more likely to adopt the Moving Time perspective, showing a preference for interpretations in which the meeting has been moved earlier in time, to *Monday*.

2.2 Experiment 1

2.2.1 Participants

123 adults from Northumbria University participated in this experiment. 90 participants were administrators, with an age range of 23 to 62 years and a mean age of 40 years. 33 participants were full-time students (undergraduate and postgraduate), with an age range of 19 to 61 years and a mean age of 30 years. All participants were native speakers of English from the UK.

2.2.2 Materials and procedure

Participants were approached on the Northumbria University campus in offices, coffee shops and the university library. Following informed consent, all participants completed a questionnaire using a pen while sitting down. The questionnaire consisted of one experimental question: the *Next Wednesday's meeting* disambiguation paradigm, in addition to demographic questions requesting the

participant's age, gender, native language, nationality and occupation. Participants were informed that the experimenter was investigating attitudes towards time management in universities.

The following instructions appeared at the top of the page:

> Please read the following question and provide your answer below. Do not spend too much time thinking about it and do not change your answer: I am interested in your initial reaction.
>
> *Next Wednesday's meeting has been moved forward two days.*
> *What day has the meeting been re-scheduled to?*

2.2.3 Results and discussion

As predicted, we found that administrators were more likely to respond *Monday*, while students were more likely to respond *Friday*. Concretely, only 28.9% of administrators responded *Friday* in comparison to 60.6% of students. To determine whether the difference in responses between administrators and students was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1,123} = 10.375$; $p < 0.001$; Cramer's V = 0.290.[3] Indeed, the student response is in line with the responses of control group participants in the studies conducted by Boroditsky (2000), Núñez (2007) and Sullivan and Barth (2012), who report a similar preference among students for answering *Friday* in an unprimed context. Moreover, the effect size is also comparable with that of Núñez (2007): Cramer's V = 0.239.[4] In contrast, the administrators demonstrated a tendency to choose *Monday*, in line with predictions based on lifestyle differences between the two groups.

These results indicate an influence of lifestyle on people's preferred temporal perspective and consequent responses to a temporally ambiguous question: as predicted, students, with their high degree of temporal flexibility and relative

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3 For completeness, we also examined results for an age-matched sub-group of students and administrators ($N = 30$; $R = 23$ to 57 years; $M = 37$ years; $SD = 13.100$). In line with the overall findings, 26.7% of administrators responded *Friday* in comparison to 66.7% of students. To determine whether the difference in responses between administrators and students was significant, a chi-square test for independence was used. The chi-square test revealed a significant relationship: $\chi^2_{1,30} = 4.821$; $p = 0.028$; Cramer's V = 0.401.
4 Due to insufficient information, we were unable to calculate the effect size for Boroditsky (2000) and Sullivan and Barth (2012).

control over the structuring of their own time, were more likely to think in a more egocentric way, and thus, were more likely to adopt the Moving Ego perspective (responding *Friday*). In contrast, professionals, who are subject to more external constraints and are more aware of external influences and pressures, were more likely to adopt the Moving Time perspective (responding *Monday*). Experiment 1 thus provides initial evidence that lifestyle differences may influence people's perspectives on the movement of events in time and their concomitant interpretations of temporally ambiguous utterances.

Hand-in-hand with lifestyle differences, there is a tendency for students and administrators to differ along certain personality parameters. For example, research shows that procrastination is especially common in the academic domain, with up to 95% of students procrastinating habitually with academic tasks such as writing assignments, studying for examinations and keeping up-to-date with weekly seminar reading (Ellis and Knaus 1977; Ferrari and Beck 1998; see also Solomon and Rothblum 1984). Furthermore, Rivera (2007) claims that procrastination is likely to be the single most common time management problem and that students rank highly as a group most vulnerable to procrastination. In contrast to the student population, procrastination has been found to chronically affect 15–20% of nonstudent adults, with the lowest rates of procrastination reported by professional, business and educational employees, such as university administrators (Harriott and Ferrari 1996). Consistent with this assumption, the essential job criteria for Northumbria University administrators, like those in our study, stipulate that applicants should possess "Excellent organisational skills" and the "Ability to prioritise workload and manage conflicting priorities" (Work4Northumbria 2012). If the preferences observed in Experiment 1 were driven, in part, by a tendency for students to procrastinate and for administrators to resist procrastination, we might expect that people who report high degrees of procrastination would be more likely to adopt the Moving Ego perspective than people who report low degrees of procrastination. To test this, Experiment 2 directly examines the relationship between temporal perspective and procrastination.

2.3 Personality differences: Procrastination

In Experiment 1, we found that a population which tends to be associated with high rates of procrastination tended to adopt the Moving Ego perspective in their responses to the *Next Wednesday's meeting* question, while a population which tends to be associated with low rates of procrastination tended to adopt the Moving Time perspective. How might the tendency to procrastinate relate to the

interpretation of a temporally ambiguous utterance? As defined by the Oxford English Dictionary (OED 2007), to *procrastinate* is:

> To defer action, delay; to postpone until another day; to defer; to put off; to be dilatory.

Consistent with this, evidence from personality research suggests that procrastinators are characterized by a tendency to defer or postpone action (Milgram et al. 1998; Milgram and Tenne 2000), whereas conscientious individuals tend to prioritize action (Back et al. 2006; John and Srivastava 1999). Looked at another way, the deferment associated with procrastination can be understood as the movement of tasks 'forward' into the future, in a direction defined by the ego's movement through time (in line with the Moving Ego perspective), while the prioritization associated with conscientiousness can be viewed as the movement of tasks 'forward' towards the present, *ergo* towards the ego (in line with the Moving Time perspective). Thus, if this habitual movement of tasks helps to define the temporal perspective adopted in response to the *Next Wednesday's meeting* question, we should see that procrastinators favour the Moving Ego perspective, and conscientious individuals, the Moving Time perspective.

Along with the opposed directionality of task movement, personality research also indicates that lack of conscientiousness may account for task avoidance procrastination and dilatory behaviour (Milgram and Tenne 2000; Schouwenburg and Lay 1995). This negative correlation suggests a means by which to strengthen our test of the relation between procrastination and time perspective: because procrastination operates in parallel to (lack of) conscientiousness in predicting behaviour, the relation found between procrastination and dilatory behaviour should be matched by an inverse relation between conscientiousness and dilatory behaviour (cf. Johnson and Bloom 1995; Lay 1997; Schouwenburg and Lay 1995).

In Experiment 2 we draw upon this connection to further examine the role that individual differences play in influencing people's preferred temporal perspective. Specifically, Experiment 2 investigates whether individual differences in conscientiousness (John 1990) and procrastination (Lay 1986) contribute to a person's view of time and, hence, to their interpretation of the ambiguous *Next Wednesday's meeting* question in an unprimed context. Consistent with the correlations between procrastination and lifestyle and with the results of Experiment 1, we predict that people who adopt the Moving Ego perspective (responding *Friday*) will exhibit a higher degree of procrastination, as well as a lower degree of conscientiousness, whereas people who adopt the Moving Time perspective (responding *Monday*) will exhibit a lower degree of procrastination, as well as a higher degree of conscientiousness.

2.4 Experiment 2

2.4.1 Participants

28 full-time undergraduate students from Northumbria University participated in this experiment, with an age range of 18 to 27 years and a mean age of 20 years. 8 participants were male and 20 were female. All participants were native speakers of English from the UK.

2.4.2 Materials and procedure

A three-part questionnaire was distributed to a first year introductory English literature class. Following informed consent, all participants completed the questionnaire using a pen while sitting down.

Part 1 of the questionnaire gathered demographic information: age, gender, native language and nationality.

For Part 2 of the questionnaire, procrastination was measured using the Student Procrastination Scale (Lay 1986) and conscientiousness was measured using the Big Five Inventory (BFI; John 1990). Sample items included: *I generally delay before starting on work I have to do* (procrastination) and *I see myself as someone who does things efficiently* (conscientiousness). A five-point Likert scale was used with "Very true" anchoring the left-hand side of the scale, "Neutral" in the middle and "Very untrue" anchoring the right-hand side of the scale.

The final part of the questionnaire consisted of one question: the *Next Wednesday's meeting* disambiguation paradigm. Participants read the following instructions:

> Please read the following question and provide your answer below. Do not spend too much time thinking about it and do not change your answer: I am interested in your initial reaction.
>
> *Next Wednesday's meeting has been moved forward two days.*
> *What day has the meeting been re-scheduled to?*

2.4.3 Results and discussion

The Student Procrastination Scale Key (Lay 1986) was used to calculate the average procrastination score for each participant. The scale ranged from 1–5, with 1 denoting a low procrastination score and 5 denoting a high procrastination score. Mean scores for each individual were calculated by adding the scores for each statement and dividing by the total number of statements, i.e. 20. As

predicted, participants who adopted the Moving Ego perspective (responding *Friday*) averaged significantly higher procrastination scores (M = 3.541; SD = 0.337) than participants who adopted the Moving Time perspective (responding *Monday*) (M = 2.978; SD = 0.499), $t(26)$ = 3.446, p = 0.002, d = 1.322.

The BFI Scoring Key (John and Srivastava 1999) was then used to calculate the average conscientiousness score for each participant. The scale ranged from 1–5, with 1 denoting a low conscientiousness score and 5 denoting a high con-scientiousness score. Mean scores for each individual were calculated by adding the scores for each statement and dividing by the total number of statements, i.e. 9. Again, as predicted, participants who adopted the Moving Time perspective (responding *Monday*) averaged significantly higher conscientiousness scores (M = 3.695; SD = 0.552) than participants who adopted the Moving Ego perspec-tive (responding *Friday*) (M = 3.153; SD = 0.697), $t(26)$ = 2.299, p = 0.030, d = 0.862.

Furthermore, in concordance with earlier studies which demonstrate that procrastination operates in parallel to (lack of) conscientiousness in predicting behaviour (Johnson and Bloom 1995; Lay 1997; Schouwenburg and Lay 1995), we found that there was a significant negative correlation between conscientious-ness and procrastination (Spearman's *rho* = 0.801, p < 0.0001).

Building on earlier findings regarding the interplay between personality factors and temporal disambiguation (Hauser et al. 2009; Richmond et al. 2012), Experiment 2 provides converging evidence that personality differences play a role in influencing how people think about time and interpret temporally ambigu-ous language. Specifically, as predicted, participants who interpreted the tempo-rally ambiguous *Next Wednesday's meeting* question in line with the Moving Ego perspective (answering *Friday*) averaged higher degrees of procrastination and lower degrees of conscientiousness as compared to participants who adopted the Moving Time perspective (answering *Monday*). Whereas Experiment 2 examined a personality factor connected to the lifestyle difference examined in Experiment 1, the earlier studies suggest that additional individual factors which share a conceptual relation with the Moving Ego and Moving Time metaphors may like-wise influence the resolution of temporally ambiguous language (cf. Hauser et al. 2009; Richmond et al. 2012). Thus, to further investigate the role that personality differences play in influencing how people think about time, Experiment 3 exam-ines the relationship between temporal perspective and another Big Five person-ality factor: extroversion.

2.5 Personality differences: Extroversion

One of the most reliably identified personality differences is the distinction be-tween extroverts and introverts (Eysenck 1952; Giambra et al. 1988; Revelle et al.

1980). Extroverts are typically characterized as assertive, dominant, and energetic, implying a more active approach towards the social and material world, whereas introverts are better characterized as withdrawn, reserved, and compliant, implying a more passive approach (John 1990; John and Srivastava 1999; John et al. 2008). Furthermore, extroversion is represented by behavioural approach motivations (e.g. Elliot and Thrash 2002), much like anger, which Hauser et al. (2009) found to be associated with *Friday* responses to the *Next Wednesday's meeting* question. Approach and avoidance motivations are inherently spatial (cf. Hauser et al. 2009; Margolies and Crawford 2008); thus, building on earlier lines of research which demonstrate that engaging in particular types of spatial thinking can yield different construals of time, we hypothesized that there would be differences in temporal reasoning between extroverts and introverts that parallel the spatially-based differences between approach and avoidance. Because approach motivation involves the activation of outward, goal-directed and engaging behaviours (Higgins 1997), extroversion aligns well with the Moving Ego perspective, with its connections to active control over the structuring of one's own time. By contrast, avoidance motivation involves passive or inhibited behaviours (Higgins 1997); thus, introversion aligns well with the Moving Time perspective, with its suggestion that it is time that exerts control over the passive individual.

To this end, the aim of Experiment 3 is to further examine the role that spatially grounded individual differences play in influencing people's preferred temporal perspective. Specifically, Experiment 3 investigates whether individual differences in extroversion (John 1990) contribute to a person's view of time and, hence, to their interpretation of the ambiguous *Next Wednesday's meeting* question in an unprimed context. We predict that the more active, assertive personalities of extroverts would lead to a higher likelihood of adopting the Moving Ego perspective (responding *Friday*) and the more passive personalities of introverts would lead to a higher likelihood of adopting the Moving Time perspective (responding *Monday*).

2.6 Experiment 3

2.6.1 Participants

46 adults with an age range of 18 to 73 years and a mean age of 42 years participated in this experiment. 14 participants were male and 32 were female. In order to more clearly focus on the distinction between extroverts and introverts, we chose to sample a broad cross-section of society: occupations ranged from

unemployed to professional (academics, lawyers) and highest level of qualification ranged from no qualifications to PhD level. All participants were native speakers of English from the UK.

2.6.2 Materials and procedure

Participants were approached in libraries, coffee shops, sports centres and social clubs in Newcastle-upon-Tyne. Following informed consent, all participants completed a four-part questionnaire using a pen while sitting down.

Part 1 of the questionnaire gathered demographic information: age, gender, native language, nationality and highest level of education.

For Part 2 of the questionnaire, participants completed an acceptability judgment task which consisted of 9 pairs of temporal expressions, such as *We're approaching Christmas* (Moving Ego) and *Christmas is approaching* (Moving Time). Participants were presented with a 5-point Likert scale for each pair of expressions, with each expression anchoring one end of the scale and "equally good" anchoring the centre. The purpose of including this task was to ensure that in unambiguous temporal expressions, both the syntactic framing associated with the Moving Ego perspective and that associated with the Moving Time perspective were acceptable to our participant population.

For Part 3 of the questionnaire, extroversion was measured using the eight extroversion statements, such as *I see myself as someone who is reserved*, from the BFI (John 1990) and a five-point Likert scale with "Very true" anchoring the left-hand side of the scale, "Neutral" in the middle and "Very untrue" anchoring the right-hand side of the scale.

The final part of the questionnaire consisted of one question: the *Next Wednesday's meeting* disambiguation paradigm. Participants read the following instructions:

> Please read the following question and provide your answer below. Do not spend too much time thinking about it and do not change your answer: I am interested in your initial reaction.
>
> *Next Wednesday's meeting has been moved forward two days.*
> *What day has the meeting been re-scheduled to?*

2.6.3 Results and discussion

The BFI Scoring Key (John and Srivastava 1999) was used to calculate the average extroversion score for each participant. The scale ranged from 1–5, with 1 denot-

ing a low extroversion score and 5 denoting a high extroversion score. Mean extroversion scores for each individual were calculated by adding the scores for each statement and dividing by the total number of statements, i.e. 8. As predicted, participants who adopted the Moving Ego perspective (responding *Friday*) averaged significantly higher extroversion scores ($M = 3.739$; $SD = 0.554$) than participants who adopted the Moving Time perspective (responding *Monday*) ($M = 3.353$; $SD = 0.721$), $t(44) = 2.036$, $p = 0.048$, $d = 0.600$.

We then examined participants' preferences for either the syntactic framing associated with the Moving Ego perspective or that associated with the Moving Time perspective in the absence of ambiguity. We assigned numerical values to the Likert scales used in the acceptability judgment task, with –2 corresponding to the Moving Time end of the scale, 0 corresponding to the centre of the scale (i.e. both statements equally good), and 2 corresponding to the Moving Ego end of the scale. Our results showed no preference for either perspective in unambiguous statements ($M = -0.056$, $SD = 0.601$).

Experiment 3 thus provides converging evidence that individual differences in personality play a role in influencing how people think about time. Specifically, as predicted, participants who interpreted the temporally ambiguous *Next Wednesday's meeting* question in line with the Moving Ego perspective (answering *Friday*) averaged higher degrees of extroversion than participants who disambiguated the question in line with the Moving Time perspective (answering *Monday*).

3 General discussion

Hitherto, the vast majority of research investigating abstract thinking about time has been primarily focused on investigating spatial influences on temporal reasoning; however, recent lines of research have extended beyond this, providing initial evidence that emotional experiences and, to a lesser extent, personality differences, may also influence people's perspectives on the movement of events in time and their concomitant interpretations of temporally ambiguous utterances, suggesting that there may not be a universal "neutral" context within which language is interpreted (Hauser et al. 2009; Richmond et al. 2012; see also Margolies and Crawford 2008; Ruscher 2011). As people's conceptualizations of time cannot be attributed to a single factor, but instead, to a complex of factors, we sought to further investigate which other individual differences might influence the ways in which people reason about events in time. Our results demonstrate that both lifestyle and personality factors influence people's temporal perspective, precluding a universal "neutral" context for language interpretation and ambiguity resolution.

In Experiment 1, we addressed the representativeness of the undergraduate populations directly, asking whether lifestyle differences play a role in influencing people's preferred temporal perspective. To do this, we compared responses of students to the *Next Wednesday's meeting* question with those of administrators. We found that students, with relative control over the structuring of their own time and a high degree of temporal flexibility, were more likely to adopt the Moving Ego perspective (responding *Friday*). In contrast, administrators, who deal with the daily management of events and for whom time is regulated by external demands, were more likely to adopt a Moving Time perspective (responding *Monday*). Thus, lifestyle factors may carry through to language interpretation, leading to differences in the interpretation of an ambiguous temporal utterance in the absence of further disambiguation cues.

Building on earlier findings, which demonstrate that personality differences play a role in influencing how people think about time (Hauser et al. 2009; Richmond et al. 2012), Experiment 2 investigated whether individual differences in conscientiousness (John 1990) and procrastination (Lay 1986) contribute to a person's view of time and, hence, to their interpretation of the ambiguous *Next Wednesday's meeting* question in an unprimed context. In line with the prediction that the habitual movement of tasks may be a contributor to the temporal perspective adopted in response to McGlone and Harding's (1998) ambiguous meeting question, with procrastinators tending to postpone action to a later date (Milgram et al. 1998; Milgram and Tenne 2000), and conscientious individuals tending to prioritize early action (Back et al. 2006; John and Srivastava 1999), we found that participants who adopted the Moving Ego perspective (answering *Friday*) averaged higher degrees of procrastination, as well as lower degrees of conscientiousness, whereas participants who adopted the Moving Time perspective (answering *Monday*) averaged higher degrees of conscientiousness, as well as lower degrees of procrastination.

Experiment 3 provided converging evidence that individual differences in personality play a role in influencing how people think about time. Our findings in this experiment focused on one personality factor – extroversion – a factor that is characterized by an active approach-related motivation (John and Srivastava 1999). In line with this active approach to events, we observed that participants who adopted the Moving Ego perspective (responding *Friday*) reported a higher degree of extroversion than participants who adopted the Moving Time perspective (responding *Monday*). Taken together, the findings from Experiments 2 and 3 re-emphasize the differences noted in Experiment 1, while suggesting a potential convergence between the roles of lifestyle and personality in the resolution of temporal ambiguity. This convergence of factors is incompatible with the assumption of a "neutral" context, suggesting that language interpretation may

arise from an interaction between that which is encoded in the utterance and aspects of the experiences and personality of the interpreter.

Our finding that the lifestyle and personality of the comprehender influences the interpretation of an ambiguous temporal utterance raises the question of whether other kinds of factors may exert significant influences on interpretation. Previous research on the *Next Wednesday's meeting* question points to two aspects of what is encoded in the question that may interact with the lifestyle and personality factors examined here.

First, the ambiguous question asks about the rescheduling of a "meeting", the nature of which is unspecified to the comprehender.[5] Recent research has demonstrated that the valence of an event (positive or negative) may influence how people reason about time (Margolies and Crawford 2008). Reasoning that positive affect is typically associated with approach motivations and negative affect, with avoidance motivations (Cacioppo et al. 1993; Chen and Bargh 1999; Neumann et al. 2003), Margolies and Crawford (2008) predicted that positively valenced events might encourage use of the Moving Ego perspective and negatively valenced events might encourage use of the Moving Time perspective. Across three experiments, they observed an association between positive affect and the Moving Ego perspective (and, conversely, between negative affect and the Moving Time perspective), suggesting that the valence of an event can influence how people reason about time.[6]

Second, the language itself may play a role in the interpretive possibilities available to a comprehender. Although the ambiguity observed in English is evident in some other languages, such as Dutch (Elvevåg et al. 2011), cross-linguistic investigations of the *Next Wednesday's meeting* question have shown that this is not universally the case: when the question is translated into German, using the

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5 We thank an anonymous reviewer for bringing this to our attention.

6 It should be noted that while participants in the positive (enthusiasm) condition were more likely to describe themselves as approaching the event (in line with the Moving Ego perspective) and participants in the negative (dread) condition were more likely to describe the event as approaching themselves (in line with the Moving Time perspective), the valence of the event did not significantly affect whether the participants responded *Monday* or *Friday*. Margolies and Crawford (2008) offer two possible explanations for this apparent inconsistency, the first being that although people might have a tendency to imagine themselves approaching positive events (in line with the Moving Ego perspective), this effect is undermined by the tendency to want positive events to occur sooner (in line with the Moving Time perspective). The second possible explanation relates to the different nature of the two questions: whereas the 'approach question' relates to a spatial scene and may tap into a person's underlying representations of space, McGlone and Harding's (1998) 'days question' relates to a temporal scene and may tap into a person's underlying representations of time. Although related, the two representations may remain somewhat distinct.

term *vorverlegen* for "moved forward", the overwhelming majority of participants responded *Monday* (Bender et al. 2005), suggesting that the German question is not truly ambiguous. A similar preference for responding *Monday* has also been observed among speakers of Mandarin Chinese (Bender et al. 2010). Following up on these observations, preliminary cross-linguistic research investigating the *Next Wednesday's meeting* question indicates that when translated into some languages, the question remains ambiguous, while in others, it does not (Duffy in preparation): Anecdotally, the question is ambiguous in Afrikaans (p.c. Hannelie Grobler 2011), Danish (p.c. Marie Jensen 2011) and Hungarian (p.c. Zoltán Kövecses 2011), much as it is in English. By contrast, the ambiguity is not apparent in languages such as Czech (p.c. Mirjam Fried 2011), Finnish (p.c. Tuomas Huumo 2011), Italian (p.c. Claudia Baldoli 2011) and Ukrainian (p.c. Olga Pykhtina 2011), for which *Friday* appears to be the only possible response. While these preliminary findings, pending further empirical analysis, should be taken with some caution, these cross-linguistic differences further counter the notion of the "neutral" context. They also highlight, as a method of best practice, the necessity of surveying participants' native languages, as the interpretation of the question in a participant's L1 may influence their interpretation of the question in L2. For instance, a native speaker of German might be more likely to infer an L1 interpretation and respond *Monday* to the question in English.[7]

4 Conclusion

Research examining interpretations of the temporally ambiguous *Next Wednesday's meeting* question have largely been built on the assumption that participants may respond in a "neutral" context (Boroditsky and Ramscar 2002). While these studies have convincingly demonstrated a role for spatial thinking in the resolution of the temporal ambiguity, they have left unexamined a host of potential contributors to language interpretation and ambiguity resolution. By challenging the assumption of a "neutral" context, our study aims to round out the picture of contributors to language interpretation. Taken together, our findings suggest that individual differences in personality and lifestyle may influence people's perspectives on the movement of events in time, suggesting a role for such individual factors in the interpretation of ambiguous language and the conceptualization of time. To reiterate Levine (2006: XVI):

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7 To the best of our knowledge, our studies are the first to explicitly survey participants' native language. As all our participants were native speakers of English from the UK, we can rule out cross-linguistic influences as a potential contributor.

> . . . how people construe the time of their lives comprises a world of diversity. There are drastic differences on every level: from culture to culture, city to city, and from neighbor to neighbor.

In sum, our evidence combines with past findings to suggest that a complete understanding of responses to temporally ambiguous language might only be achieved through the joint consideration of individual factors as well as contextual priming.

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Appendix

Table 1: Temporal instances of *approaching* in the BYU-BNC

Token sample: 200		
Token frequency: 20 (10%)		
Moving Time (MT) frequency: 12 (60%)		
Moving Ego (ME) frequency: 8 (40%)		

1	Then he washed his hands. Christmas was *approaching* and the shop windows began to fill with seasonal tableaux.	MT
2	They made love as though tomorrow was fast *approaching*, and with it imminent departure.	MT
3	Our mission? To film arctic foxes facing up to the rigours of *approaching* winter. We were not, however destined to be alone	MT
4	It was several weeks later. There was a smell of *approaching* summer in the air. The Sunday school had closed	MT
5	Another Friday 13th was *approaching* so I was certain we could expect another move, maybe the big one.	MT
6	of the play. The scene with Lesley-Jane started. Everyone knew the climax was *approaching*.	MT
7	With Christmas *approaching* police believe the thieves may try to sell off the birds to dealers	MT
8	It is *approaching* midnight in Munster when the recovery crew return to conclude another busy day for the	ME
9	The time might be *approaching* when the viability of employing these vase armies of professionals needs to be reappraised.	MT
10	the time was fast *approaching* when the reverse became true and the king would defend the church from the plans	MT
11	You are a destroyer, MacQuillan, but the time is *approaching* when you will be destroyed. No over-use of capitals, no underlining.	MT
12	This time with the Parliamentary Recess fast *approaching*, the Government urged the Commons not to insist on its disagreement with the Lords	MT
13	The indenture suggests that he was then *approaching* the end of his career. A citizen's will of July 1449 implies that	ME
14	he stares into his Guinness with the glum patience of a headmaster *approaching* retirement.	ME
15	Imperial Adventures by Dea Birkett Macmillan, 25 IN January 1892 Mary Kingsley, *approaching* 30, was her mother's nurse in Cambridge.	ME
16	It took Preston back fifteen years. Like the problem. It was a problem of youth, not of *approaching* middle age.	MT
17	his courage and sense of public duty there is no need to enlarge. Though *approaching* early middle age, on the outbreak of the last world war he at once	ME
18	Young people *approaching* the age when they would no longer be the formal responsibility of the local authorities	ME
19	The fact that she was *approaching* thirty can not have made the decision any easier. Neither can the marriage of her younger sister	ME
20	These fortunate people are the first generation *approaching* retirement who have not suffered a significant interruption in their career because of the war	ME

Table 2: Temporal instances of *coming up* in the BYU-BNC

Token sample: 200
Token frequency: 17 (8.5%)
Moving Time (MT) frequency: 9 (53%)
Moving Ego (ME) frequency: 8 (47%)

1	The time is just *coming up* to twenty-one minutes past seven o'clock. Tonight we are certainly – hopping – from one subject to another.	ME
2	We exhibited there. But there's an International Business Fair *coming up* at the end of this month.	MT
3	Symphony No 29 was written in the later part of 1773. Mozart was then *coming up* to his eighteenth birthday, but already a mature master	ME
4	they will tell you everybody they know who's going to have er a wedding *coming up* and then you can write to them.	MT
5	their fortunes in the opinion polls did they decide that, with the general *coming up*, and the prospect of their being routed, they should do something.	MT
6	What we're gonna do now, it's just *coming up* to twenty past three, so we'll take a tea break and then	ME
7	It's *coming up* for midnight,' said Shirley, with some relief, pointing at the quartz carriage clock on the mantelpiece	ME
8	again haven't asked Spike about finding out erm (pause) when and where by-elections are *coming up*. (SP:PS1R8) I don't think there are any coming up.	MT
9	eye on a little set of drawers, yew-wood veneer. Lucy's birthday's *coming up*, November the seventh . . ."	MT
10	And with several parties *coming up* this autumn-winter the prospects for the coming months are looking good.	MT
11	If you've got a birthday or something *coming up* and if somebody wants to know what to buy you (pause) that's what	MT
12	No I haven't got me outfit yet (SP:PS01V) No, when is your wedding *coming up*? (SP:PS01T) April the fourth (SP:PS01V) Ooh is it, ooh (SP:PS01T)	MT
13	so Dave's forty one? (SP:PS09U) Forty, forty last June, he's *coming up* to forty one this year (SP:PS09T) forty one in May? (SP:PS09U) Yeah (pause)	ME
14	Runaway wins against Newport and Bridgend has boosted confidence but the crunch is *coming up* . . . time for Gloucester to fight their way out of trouble	MT
15	seven (SP:PS01V) Oh that's fantastic (SP:PS01T) Aye (SP:PS01T) you know he's twenty seven *coming up* you know	ME
16	I will certainly er stay in order but (pause) the British electorate *coming up* to June the ninth and the European er elections will not know even if	ME
17	they do not face the same regeneration problem; only now are their oldest consultants *coming up* to retirement.	ME

Moving Through Time: The Role of Personality in Three Real-Life Contexts

Sarah E. Duffy,[a] Michele I. Feist,[b] Steven McCarthy[a]

[a]*Department of Humanities, Northumbria University*
[b]*Department of English, University of Louisiana at Lafayette*

Abstract

In English, two deictic space-time metaphors are in common usage: the Moving Ego metaphor conceptualizes the ego as moving forward through time and the Moving Time metaphor conceptualizes time as moving forward toward the ego (Clark, 1973). Although earlier research investigating the psychological reality of these metaphors has typically examined spatial influences on temporal reasoning (e.g., Boroditsky & Ramscar, 2002), recent lines of research have extended beyond this, providing initial evidence that personality differences and emotional experiences may also influence how people reason about events in time (Duffy & Feist, 2014; Hauser, Carter, & Meier, 2009; Richmond, Wilson, & Zinken, 2012). In this article, we investigate whether these relationships have force in real life. Building on the effects of individual differences in self-reported conscientiousness and procrastination found by Duffy and Feist (2014), we examined whether, in addition to *self-reported* conscientiousness and procrastination, there is a relationship between conscientious and procrastinating *behaviors* and temporal perspective. We found that participants who adopted the Moving Time perspective were more likely to exhibit conscientious behaviors, while those who adopted the Moving Ego perspective were more likely to procrastinate, suggesting that the earlier effects reach beyond the laboratory.

Keywords: Moving Ego; Moving Time; Time; Metaphor; Procrastination; Conscientiousness; Personality; Self-report; Behavior

1. Introduction

It has often been observed that in English, language from the relatively concrete domain of space is recruited to talk about the relatively abstract domain of time (e.g.,

Correspondence should be sent to Sarah E. Duffy, Faculty of Arts and Social Sciences, Department of Humanities, Northumbria University, Lipman Building, Newcastle-upon-Tyne NE1 8ST, UK. E-mail: sarah.duffy@unn.ac.uk

Clark, 1973; Evans, 2004; Lakoff & Johnson, 1999; Traugott, 1978). Indeed, many metaphor theorists have claimed that the sensory and motor representations that derive from constant successful functioning in the cultural and physical environment are recycled to support abstract thought (Gibbs, 1994; Kövecses, 2000; Lakoff & Johnson, 1980, 1999). In the domain of time, for instance, these representations derive from the human experience of navigating through, orienting within, and observing motion in space. While there are various types of spatial metaphors for time in English, particular attention has been paid to two deictic space-time metaphors: the Moving Ego metaphor conceptualizes time as a stationary landscape that the active ego moves across, for example, *We're approaching Christmas* and the Moving Time metaphor conceives of time as a conveyor belt that events move along, relative to a stationary ego, for example, *Christmas is approaching* (Clark, 1973; Lakoff & Johnson, 1999). In seminal research investigating the psychological reality of these two metaphors, Boroditsky (2000; Boroditsky & Ramscar, 2002) devised a series of experiments to examine whether engaging in thought about spatial motion under various circumstances might prime different construals of time. In one experiment, participants were asked to imagine moving toward a stationary object or to imagine an object moving toward them before answering the ambiguous question: *Next Wednesday's meeting has been moved forward 2 days. Which day is the meeting now that it's been moved?* (cf. McGlone & Harding, 1998). Based on the assumption that people's understanding of time is grounded in their experiences in space (Lakoff, 1993; Lakoff & Johnson, 1999), it was hypothesized that imagining moving through space toward a stationary object would encourage participants to adopt the Moving Ego perspective (responding *Friday*) and imagining a moving object traveling through space toward the self would encourage participants to adopt the Moving Time perspective (responding *Monday*). As predicted, participants tended to respond in a prime-consistent manner to the Wednesday's meeting question, suggesting that different ways of thinking about motion in space may influence a person's conceptualization of time and their concomitant interpretation of a temporally ambiguous question. These preliminary results have been extended, with demonstrations that non-deictic spatial schemas (Kranjec, 2006; Núñez, Motz, & Teuscher, 2006), fictive motion schemas (Matlock, Ramscar, & Boroditsky, 2005; Ramscar, Matlock, & Dye, 2010) and abstract motion schemas (Matlock, Holmes, Srinivasan, & Ramscar, 2011) can also influence how people reason about events in time.

In addition to time, a variety of abstract domains draw upon the concrete domain of space, including emotions, health, social status, personality traits, etc. (Lakoff & Johnson, 1980), raising the possibility that these domains may be connected to time via shared spatial schemas. Although the majority of research investigating abstract thinking about time has hitherto been primarily focused on investigating spatial influences on temporal reasoning, recent lines of research have provided initial evidence that personality differences and emotional experiences may also influence an individual's approach to time and resulting resolution of temporal ambiguity (Duffy & Feist, 2014; Hauser, Carter, & Meier, 2009; Richmond, Wilson, & Zinken, 2012; see also Lee & Ji, 2014; Margolies & Crawford, 2008; Ruscher, 2011). For example, Hauser et al. (2009)

investigated the link between the seemingly unrelated but similarly embodied abstract domains of anger and time, reasoning that anger is spatially grounded in approach-related motivations, which cause the active self to approach a goal (Harmon-Jones, 2003), much in the way that the self approaches the future in the Moving Ego meta-phor. As such, Hauser et al. (2009) hypothesized that this approach-related spatial moti-vation could serve as an embodied cognitive link between the two domains. To test this hypothesis, they had participants complete a series of questionnaires for measuring trait anger (that is, anger as part of their personality) before responding to the Wednes-day's meeting question (Hauser et al., 2009). The results showed that participants who reported higher trait anger scores were more likely to adopt the Moving Ego perspec-tive (responding *Friday*) than to adopt the Moving Time perspective (responding *Mon-day*), thus providing initial evidence for a relationship between anger and representations of time.

In another study, Richmond et al. (2012), reasoning that people with a strong sense of personal agency (Vallacher & Wegner, 1989) would be more likely to conceive of them-selves as moving through time, investigated the relationship between level of perceived personal agency and temporal perspective. In one experiment, participants responded to the Wednesday's meeting question before completing a questionnaire for assessing indi-vidual differences in the level of perceived personal agency (Richmond et al., 2012; Study 2). They found that participants who adopted the Moving Ego perspective reported significantly higher agency scores than participants who adopted the Moving Time per-spective. These findings thus extend the range of spatially grounded individual differences that may influence people's representations of time, demonstrating that people's conceptu-alization of time likely results from a culmination of factors, rather than a single factor (Richmond et al., 2012).

More recently, Duffy and Feist (2014) investigated whether individual differences in conscientiousness (John, 1990) and procrastination (Lay, 1986) would contribute to a person's view of time and, hence, to their interpretation of the ambiguous Wednesday's meeting question. Personality research shows that in contrast to procrastinators, who tend to defer or postpone action (Milgram, Mey-Tal, & Levison, 1998; Milgram & Tenne, 2000), conscientious individuals tend to prioritize action (Back, Schmukle, & Egloff, 2006; John & Srivastava, 1999). In other words, procrastination involves the movement of tasks "forward" into the future, in a direction defined by the ego's move-ment through time (in line with the Moving Ego perspective) while conscientiousness involves the movement of tasks "forward" toward the present, ergo toward the ego (in line with the Moving Time perspective).[1] Thus, Duffy and Feist (2014) hypothesized that the habitual movement of tasks may be a contributor to the temporal perspective adopted in response to the Wednesday's meeting question, with procrastinators favoring the Moving Ego perspective, and conscientious individuals favoring the Moving Time perspective. To test these predictions, they had participants complete a questionnaire for measuring trait conscientiousness (John, 1990) and trait procrastination (Lay, 1986). Sample items included *I do not do assignments until just before they are to be handed in* (procrastination) and *I see myself as someone who does things efficiently* (conscien-

tiousness). Participants then responded to the Wednesday's meeting question. Consistent with the predictions, participants who adopted the Moving Ego perspective (answering *Friday*) averaged higher procrastination scores, as well as lower conscientiousness scores than participants who adopted the Moving Time perspective (answering *Monday*).

While recent research has provided initial evidence that individual personality differences that may be conceptualized spatially may also influence an individual's approach to time and resulting resolution of temporal ambiguity, all of these studies have relied on participants' self-reports regarding personality traits, leaving open the question of whether these relationships have force in real life. To address this question, three experiments examined the resolution of temporal ambiguity, using as our impetus Duffy and Feist's (2014) investigation of conscientiousness and procrastination in relation to temporal perspective. Thus, the current study compares the resolution of temporal ambiguity to the timeliness of workers traveling to work, that is, if they were early, on time, or late (Experiment 1), to the timeliness of students submitting an essay (Experiment 2), and to the time of arrival for a scheduled appointment (Experiment 3). The results from these three experiments provide further validation of the initial findings while also providing evidence that individual differences in time management as observed in real-life contexts may influence how people think about time and how they resolve temporal ambiguities.

2. The present studies

2.1. Experiment 1

While many kinds of behavior may be associated with conscientiousness and procrastination, one measure that has been demonstrably related to both of these personality variables across a number of studies is that of punctuality (e.g., Ashton, 1998; Back et al., 2006; Díaz-Morales, Ferrari, Díaz, & Argumedo, 2006; Roberts, Bogg, Walton, Chernyshenko, & Stark, 2004; Solomon & Rothblum, 1984). For instance, in one study investigating reasons for procrastinating among students, Solomon and Rothblum (1984) found lack of punctuality to be the measure of behavior that correlated most significantly with self-reported procrastination. In another study investigating the influence of personality on punctuality in a real-life setting, Back et al. (2006) found that participants who reported higher conscientiousness scores tended to arrive earlier for their scheduled appointment. Thus, punctuality provides an objectively observable real-world reflex of procrastination and conscientiousness.

Taken together, these findings suggest a way to extend Duffy and Feist's (2014) results using a measure of real-life behavior: we hypothesized that there would be differences in temporal reasoning between people who are on time for work and those who are not. To test this, in Experiment 1, we interviewed people at a bus station who were en route to work. We predict that, in response to the Wednesday's meeting question, people who are

running early would be more likely to adopt the Moving Time perspective (responding *Monday*), whereas people who are running late would be more likely to adopt the Moving Ego perspective (responding *Friday*).

2.1.1. Participants

One hundred and four adults with an age range of 18–59 years and a mean age of 33 years participated in this experiment in exchange for a small reward.[2] Forty participants were male and 65 were female. All participants were native speakers of English.

2.1.2. Materials and procedure

The experiment took place on a Wednesday morning between 7.30 am and 9.30 am at Newcastle Haymarket bus station. People waiting for a bus were approached individually by an experimenter. The experimenter greeted each person and asked if they were traveling to work. People who responded *Yes* were then asked if they would be willing to take part in a brief survey. Following informed consent, participants provided demographical information (age, gender, and native language) before answering two test questions and the Wednesday's meeting question. For the first test question—*Are you on time for work*—participants answered using one of the three options provided: *Yes*, *No*, or *Not applicable*.[3] For the second test question—*If yes or no which applies most to you?*—participants rated the extent to which they were on schedule for work using one of five options: *Very late*, *Late*, *On time*, *Early*, or *Very early*. The order in which these options were presented was counterbalanced across participants. Participants then provided a response to the ambiguous temporal question: *Next Wednesday's meeting has been moved forward 2 days. What day has the meeting been rescheduled to?* All questions were administered orally and all responses were written down by the experimenter throughout the exchange.

2.1.3. Results and discussion

The answers to the two test questions were compared against the answer to the Wednesday's meeting question for each participant. As predicted, participants who were on schedule or early were more likely to adopt the Moving Time perspective (responding *Monday*), whereas participants who were running late were more likely to adopt the Moving Ego perspective (responding *Friday*). Concretely, 62.7% of participants on schedule responded *Monday* in comparison to 17.2% of participants who were not. A chi-square test revealed a reliable difference in the proportion of *Monday* and *Friday* responses between the two groups: $\chi^2_{1,104} = 17.262$, $p < .0001$ Cramer's V $= 0.407$. For the second test question, which measured the extent to which each participant was on schedule for work, responses were coded with a number from 1 to 5, with 1 denoting *I am very late* and 5 denoting *I am very early*. As predicted, participants who adopted the Moving Time perspective (responding *Monday*) were more likely to be running early ($M = 3.279$; $SD = 0.760$) than participants who adopted the Moving Ego perspective (responding *Friday*) ($M = 2.635$; $SD = 0.908$), $t(102) = 3.279$, $p < .001$, $d = 0.643$.

Building on the effects of self-reported conscientiousness and procrastination on temporal reasoning found by Duffy and Feist (2014) Experiment 1 provides converging

evidence that, in addition to self-reported conscientiousness and procrastination, there is a relationship between conscientious and procrastinating behaviors and temporal perspective, as observed in a real-life setting. The results, however, raise further questions. One shortfall is that the measure of behavior relied on participants' self perceptions of the extent to which they were on schedule for work; thus, giving rise to the question of whether the effects have observable, real-world consequences using more objective measures. To address this, in Experiment 2 we sought a more objective measure of behavior, surveying students as they arrived to submit an assignment.

2.2. Experiment 2

Procrastination is argued to be especially common in the academic domain, with up to 95% of students procrastinating consistently with academic tasks such as studying for examinations, keeping up-to-date with weekly seminar reading and writing essays (e.g., Ellis & Knaus, 1977; Ferrari & Beck, 1998; see also Solomon & Rothblum, 1984; Steel, Brothen, & Wambach, 2001). Researchers investigating psychological explanations for procrastination among students have assessed procrastinating behavior via the times taken by students to submit assignments (Beswick, Rothblum, & Mann, 1988). Similarly, research investigating conscientiousness and its relation to professionalism among medical students has made use of on-time submission of assignments as an objective measure of conscientiousness (Finn, Sawdon, Clipsham, & McLachlan, 2009; McLachlan, Finn, & Macnaughton, 2009). Because the punctuality of the submission of an assignment provides an objectively observable index of conscientiousness/procrastination, Experiment 2 investigated whether students submitting their assignment further in advance of the deadline would reason about time differently from students submitting their assignment closer to the deadline, as evidenced by the temporal perspective they adopted in response to the Wednesday's meeting question. We predict that students who submit their essay earlier would be more likely to adopt the Moving Time perspective (responding *Monday*), whereas students who submit their essay later would be more likely to adopt the Moving Ego perspective (responding *Friday*).

2.2.1. Participants

Sixty undergraduate students from Northumbria University, with an age range from 19 to 30 and a mean age of 21 years, participated in this experiment. Twenty-one participants were male and 39 were female. All participants were native speakers of English.

2.2.2. Materials and procedure

The experiment took place on a Wednesday. Participants were approached individually by an experimenter at the Student Advice and Support Centre on the Northumbria University campus, where students based in the Faculty of Arts and Social Sciences are required to submit their assignments for formal assessment. The experimenter greeted each participant and asked if they would be willing to take part in a brief survey. Following

informed consent, participants provided demographic information (age, gender, and native language) before answering the test question *How far in advance of the deadline did you submit your assignment?* and then providing a response to the ambiguous temporal question *Next Wednesday's meeting has been moved forward 2 days. What day has the meeting been rescheduled to?* All questions were administered orally and all responses were written down by the experimenter throughout the exchange.

2.2.3. Results and discussion

The answer to the test question was compared against the response to the Wednesday's meeting question for each participant.[4] As predicted, participants who adopted the Moving Ego perspective (responding *Friday*) were submitting their assignment closer to the deadline ($M = 145$ min prior; $SD = 82$ min) than participants who adopted the Moving Time perspective (responding *Monday*) ($M = 208$ min prior; $SD = 116$ min), $t(58) = 2.495$, $p = .015$, $d = 0.635$. The results thus extend upon the findings in Experiment 1, providing further evidence that the relationship between temporal perspective and self-reported procrastination and conscientiousness is matched by the relationship between temporal perspective and procrastinating/conscientious *behaviors*.

Across two experiments, we have observed connections between time-management behaviors and temporal perspective sampled outside the laboratory. However, as in much related research, the findings rely on the interpretation of a single ambiguous question; thus, giving rise to the question of whether we would observe similar effects using different dependent variables for measuring temporal perspective. If the Wednesday's meeting question is a robust and reliable measure of temporal perspective, we would expect to observe a similar pattern of results using other ambiguous temporal questions that make use of different temporal units, for example, hours within the day, *Tomorrow's noon meeting has been moved forward 2 hours* and months within the year, *The October meeting has been moved forward 2 months* (cf. Kranjec, Cardillo, Schmidt, & Chatterjee, 2010; Lai & Boroditsky, 2013; Núñez et al., 2006).[5] Indeed, research shows that people tend to be consistent in their representations of time, such that people who imagine moving forward a meeting scheduled for Wednesday by 2 days to Monday (as opposed to Friday) are also more likely to imagine moving forward a meeting scheduled for noon by 2 hours to 10 am (as opposed to 2 pm) (Núñez et al., 2006; cf. Richmond et al., 2012). However, these measures have yet to be used in conjunction with the sampling of real-world behaviors.

To address this issue, Experiment 3 investigated whether people arriving earlier for a scheduled appointment would reason about time differently to people arriving later for a scheduled appointment (cf. Back et al., 2006). Extending on from the Wednesday's meeting question, participants responded to two different questions intended to measure temporal perspective: the noon meeting question and the October meeting question. Building on earlier findings, we predict that people who arrive early would be more likely to adopt the Moving Time perspective (indicated by *10 am* and *August* responses), whereas people who arrive late would be more likely to adopt the Moving Ego perspective (indicated by *2 pm* and *December* responses).

2.3. Experiment 3

2.3.1. Participants

Forty-five adults with an age range of 19–65 years and a mean age of 38 years participated in this experiment in exchange for a gift voucher. Eighteen participants were male and 27 were female. All participants were native speakers of English.

2.3.2. Materials and procedure

The experiment took place between January and March. Participants were recruited through flyers that were distributed in local shops and restaurants, as well as through an online advertising website. To take part in the study, participants were instructed to contact the experimenter via email. They were then allocated an appointment time and instructed that they should arrive at a specified meeting point—namely, the entrance of the Lipman coffee shop on the Northumbria University campus—at the time allocated. The experimenter recorded the arrival time of each participant. Lateness was calculated by the number of minutes between the appointment time and the time of the participant's arrival and earliness was calculated by the number of minutes between the appointment time and the time of the 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., 5 min late; 0 min on time; −5 min early). Following informed consent, all participants completed the study using a pen while sitting down at a table. To begin with, participants provided demographical information (age, gender, native language, occupation, and highest level of education) before undertaking a study comprised of six tasks that were unrelated to the current experiment. The two ambiguous meeting test questions appeared on separate pages and were interspersed between the different tasks (cf. Boroditsky, 2000). Specifically, the first test question appeared after task 3 (a vocabulary task) and the second test question appeared after task 5 (an author recognition task). Participants read each test question before indicating when the meeting had been rescheduled to. The order of the two test questions was counterbalanced across participants.

2.3.3. Results and discussion

The time of arrival ranged from 22 min early to 25 min late. On average, participants arrived 2.89 min before their appointment time (*SD* = 9.14). Thirty participants were early, 0 were exactly on time, and 15 were late. As predicted, participants who arrived early for their appointment were more likely to adopt the Moving Time perspective (indicated by *10 am* and *August* responses), whereas participants who arrived late were more likely to adopt the Moving Ego perspective (indicated by *2 pm* and *December* responses). Concretely, for the noon meeting question, 63.3% of participants who arrived early responded *10 am* in comparison to 36.7% of participants who arrived late. A chi-square test revealed a reliable difference in response: $\chi^2_{1,45} = 4.132$, $p = .042$ Cramer's V = 0.303. Similarly, for the October meeting question, 66.7% of participants who arrived early responded *August* in comparison to 33.3% of participants who arrived late. Again, a chi-square test showed a reliable difference in response: $\chi^2_{1,45} = 4.500$,

p = .034 Cramer's V = 0.316. Participants were also highly consistent in their answers. Those who responded *10 am* also answered *August* (88.0%), and those who responded *2 pm* also answered *December* (95.0%): $\chi^2_{1,45}$ = 30.633, p < .0001 Cramer's V = 0.825.

Looked at another way, for the noon meeting question, participants who adopted the Moving Time perspective arrived earlier on average (M = −6.130; SD = 8.465) than participants who adopted the Moving Ego perspective (M = 0.750; SD = 8.744), $t(45)$ = 2.585, p = .013, d = 0.799. Similarly, for the October meeting question, participants who adopted the Moving Time perspective arrived earlier on average (M = −5.800; SD = 8.367) than participants who adopted the Moving Ego perspective (M = 0.750; SD = 8.944), $t(45)$ = 2.531, p = .015, d = 0.756.

These results provide corroborating evidence that time-management behaviors, as sampled in real-world situations, correlate with the perspective adopted in the resolution of temporal ambiguity. Furthermore, Experiment 3 extends the findings to two additional temporal reasoning questions, strengthening our confidence in the relationships uncovered and suggesting that the original effects observed were not due to the specific item being used, that is, the Wednesday's meeting question.

3. General discussion

Hitherto, research investigating abstract thinking about time has typically been concerned with investigating spatial influences on temporal reasoning. However, the influence of space as a source domain for metaphor extends beyond time, encompassing other abstract domains such as emotion, social status, and personality traits. Our understanding of the workings of metaphor is incomplete without an investigation of potential connections among similarly grounded abstract domains.

Recent lines of research have extended beyond demonstrating the psychological reality of space-time metaphors, providing initial evidence that personality differences and emotional experiences, particularly those grounded in spatial schemas, may also influence an individual's approach to time and resulting resolution of temporal ambiguity (Duffy & Feist, 2014; Hauser et al., 2009; Richmond et al., 2012; see also Lee & Ji, 2014; Margolies & Crawford, 2008; Ruscher, 2011). However, these studies have all relied on participants' self-reports regarding personality traits, introducing a measure of uncertainty into the conclusions regarding the connections uncovered. Building on insights from Duffy and Feist (2014) who found that individual differences in self-reported conscientiousness and procrastination may contribute to a person's view of time and, hence, to their interpretation of the ambiguous Wednesday's meeting question, we sought to investigate whether these relationships have force beyond the laboratory. Across three experiments, we examined whether, in addition to self-reported conscientiousness and procrastination, there is a relationship between conscientious and procrastinating behaviors and temporal perspective.

In Experiment 1, we investigated whether the extent to which a traveler was on time for work would influence the temporal perspective they adopted in response to the

Wednesday's meeting question. Consistent with earlier findings which showed that high degrees of self-reported conscientiousness are demonstrably related to the Moving Time perspective (Duffy & Feist, 2014) and that conscientious behavior is associated with punctuality (Ashton, 1998; Back et al., 2006), we found that people who adopted the Moving Time perspective (responding *Monday*), were more likely to be running early than were people who adopted the Moving Ego perspective (responding *Friday*).

In Experiments 2 and 3, we moved beyond self-assessment of timeliness, investigating the relationship between objectively observable on-time behavior and temporal perspective. Experiment 2 examined whether students submitting their assignment further in advance of the deadline would reason about time differently from students submitting their assignment closer to the deadline, while Experiment 3 examined the relationship between temporal perspective and timeliness for a scheduled appointment, while also extending the sampling measure to two new temporal reasoning questions. In line with earlier findings, we found in both cases that participants who adopted the Moving Ego perspective were meeting their obligations later on average than participants who adopted the Moving Time perspective, thus extending earlier findings to encompass more objectively measureable behaviors.

Taken together, the results from these experiments provide further validation of earlier findings that individual differences in conscientiousness and procrastination may influence how people think about time and how they resolve temporal ambiguities (Duffy & Feist, 2014), suggesting psychologically real connections between similarly grounded abstract domains. In addition, the results extend prior work in two ways. First, these results provide evidence of a relationship between naturally occurring conscientious and procrastinating behaviors and temporal perspective, thus taking the findings beyond the laboratory to strengthen our confidence in the relationships uncovered. Secondly, by drawing on additional measures of adopted temporal perspective, these studies generalize previous findings to temporal reasoning at different time scales, suggesting a consistency between temporal reasoning and the ways in which we move through time.

Acknowledgments

Notes

1. In line with the opposed directionality of task movement, personality research suggests that procrastination tends to operate in parallel to (lack of) conscientiousness

in predicting behavior (e.g., Lay, 1997; Johnson & Bloom, 1995; Schouwenburg & Lay, 1995).

2. Twelve participants were unwilling to disclose their age; thus, the range and mean is calculated on the basis of the remaining 92 participants.

3. No participant chose the *Not applicable* option.

4. In line with earlier findings, this student population demonstrated a preference for answering *Friday* (58.3%) in comparison to *Monday* (41.7%) (cf. Boroditsky, 2000; Duffy & Feist, 2014; Núñez, 2007; Sullivan & Barth, 2012).

5. Similarly to the Wednesday meeting question, the noon meeting and the October meeting questions are ambiguous, giving rise to two possible responses: 10 am or 2 pm (the noon meeting question) and August or December (the October meeting question).

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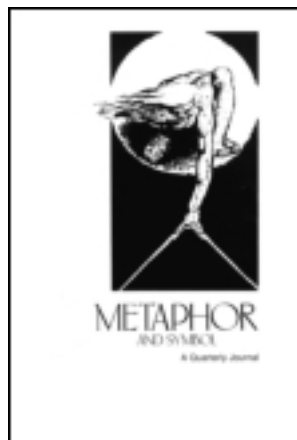
The Role of Cultural Artifacts in the Interpretation of Metaphorical Expressions About Time

Sarah E. Duffy[a]

[a] Northumbria University
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The Role of Cultural Artifacts in the Interpretation of Metaphorical Expressions About Time

Sarah E. Duffy

Northumbria University

Across cultures, people employ space to construct representations of time. English exhibits two deictic space–time metaphors: the *"moving ego"* metaphor conceptualizes the ego as moving forward through time and the *"moving time"* metaphor conceptualizes time as moving forward towards the ego. Earlier research investigating the psychological reality of these metaphors has shown that engaging in certain types of spatial-motion thinking may influence how people reason about events in time. More recently, research has shown that people's interactions with cultural artifacts may also influence their representations of time. Extending research on space–time mappings in new directions, three experiments investigated the role of cultural artifacts, namely calendars and clocks, in the interpretation of metaphorical expressions about time. Taken together, the results provide initial evidence that, in their interpretation of ambiguous metaphorical expressions about time, people automatically access and use spatial representations of absolute time, whereby moving forward in space corresponds with moving later in time. Moreover, asking participants to use a reverse space–time mapping causes interference, which is reflected through their temporal reasoning.

One of the most fundamental and yet enigmatic aspects of human experience is that of time. We do not possess apparatus for the processing of temporal experience in the same way that our sensory-perceptual apparatus enables the processing of spatial experience; yet, we can conceive of its passage in much the way we can conceive of any other worldly experience (Evans, 2004). The reason for this, it has been proposed, is that the sensory and motor representations that derive from interacting in the natural environment are recycled in order to support abstract thought (e.g., Gibbs, 1994; Kövecses, 2000; Lakoff & Johnson, 1980). In the domain of time, for instance, these representations derive from the human experience of navigating through, orienting within and observing motion in space. As such, spatial concepts largely constitute our conceptions of temporality, such that space is often useful and, arguably, necessary to structure how people think about time (Lakoff, 1993; Lakoff & Johnson, 1999).

More recently, research has demonstrated that conceptual metaphors are as much cultural as they are internally represented in the minds of individuals, with culture playing an instrumental role in shaping embodiment and, hence, metaphorical thought (cf. Gibbs, 1999). Indeed, while the practice of using space to represent time may be universal, vast differences have been observed in the ways in which time is spatialized across languages and cultures. For instance, the

Address correspondence to Sarah E. Duffy, Northumbria University, Department of Humanities, Newcastle-upon-Tyne, NE1 8ST, UK. E-mail: sarah.duffy@unn.ac.uk

future may be construed as *in front* of us (English), *behind* us (Aymara), *below* us (Mandarin), *uphill* (Yupno), or to *the west* (Kuuk Thaayorre) (Boroditsky, Fuhrman, & McCormick, 2010; Boroditsky & Gaby, 2010; Núñez, Cooperrider, Doan, & Wassmann, 2012; Núñez & Sweetser, 2006). Furthermore, a body of research has provided evidence that people's experiences with *cultural artifacts*[1]—such as calendars, graphs, and written text—may also influence their representations of time. For example, in one study, Tversky, Kugelmass, and Winter (1991) instructed English participants (who read left-to-right) and Arabic participants (who read right-to-left) to graphically lay out a sequence of events, such as the meals of the day. The results showed that, whereas English participants organized the sequence from left-to-right, positioning breakfast to the left of lunch and dinner to the right, Arabic participants showed the opposite arrangement, consistent with the direction of orthography in both of these languages. Similar patterns have also been found in reaction time tasks comparing English and Hebrew literates (Fuhrman & Boroditsky, 2010; cf. Ouellet, Santiago, Israeli, & Gabay, 2010). For example, Fuhrman and Boroditsky (2010, Studies 2 and 3) found that when instructing participants to make rapid temporal order judgments about pairs of images (e.g., a person at different stages in life; filling a cup of coffee), English participants were consistently faster when making earlier judgments using the left response key and later judgments using the right response key. By contrast, Hebrew participants showed the reverse pattern. Moreover, instructing participants to use a space–time mapping that was inconsistent with the direction of orthography in their native language created interference, causing participants' response times to slow down. Taken together, Fuhrman and Boroditsky (2010) concluded that people automatically access culturally specific representations of space when making judgments about time.

The relationship between space and time is also reflected in the language people habitually use when talking about events in time: instances in time can be conceived as points (*at* noon; *on* Monday); durations can be expressed in terms of distance (a *long* meeting; a *short* vacation); events can be moved (the party was *brought forward*; the deadline was *pushed backward*). Indeed, while English exhibits various spatial metaphors for time, particular attention has been paid to two deictic space–time metaphors: in the *"moving ego"* metaphor, time is construed as a static landscape that the active ego moves across (e.g., *"We're approaching Christmas"; "We've passed the deadline"*) and in the *"moving time"* metaphor, time is conceptualized as a conveyor belt on which events move, relative to a stationary ego (e.g., *"Christmas is approaching"; "The deadline has passed"*; H. H. Clark, 1973; Lakoff & Johnson, 1999). In addition to linguistic evidence, research conducted by Boroditsky and colleagues (Boroditsky, 2000; Boroditsky & Ramscar, 2002) has provided evidence for the psychological reality of these two metaphors, demonstrating that thinking about spatial motion under various circumstances can prime different construals of time. For instance, by using an ambiguous temporal task, namely *Next Wednesday's meeting has been moved forward two days. What day is the meeting now that it has been rescheduled?* (cf. McGlone & Harding, 1998), Boroditsky and Ramscar (2002) found that when participants were primed with a self-motion scenario (e.g., moving through space towards a stationary object; in line with the *"moving ego"* perspective), they were more likely to re-use this perspective for time and respond *Friday*. By contrast, when participants imagined motion towards the self

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[1]Cultural artifacts (or in other parlance, cultural technologies, cognitive artifacts, or material artifacts), can be defined as "artifacts that support symbolic and conceptual processes in abstract conceptual domains" (da Silva Sinha, Sinha, Sampaio, & Zinken, 2012, p. 32; cf. Evans, 2013; Núñez & Cooperrider, 2013; Tversky, 2011; Williams, 2004).

(e.g., imagining a moving object traveling through space towards them; in line with the *"moving time"* perspective), they were more likely to respond *Monday*. Taken together, the results provide evidence of a conceptual relationship between spatial and temporal representations, such that different ways of thinking about motion in space can yield different construals of time.

Probing this relationship further, Matlock, Holmes, Srinivasan, and Ramscar (2011) conducted a series of experiments to investigate whether, similarly to thinking about actual motion, thinking about subtler forms of motion, such as abstract motion,[2] may influence how people reason about events in time and their concomitant interpretation of a temporally ambiguous expression. Through a series of experiments, participants completed tasks which required them to think about sequences of numbers or letters that proceeded in either ascending order (*5* to *17* or *G* to *P*) or descending order (*17* to *5* or *P* to *G*) before answering the ambiguous Wednesday's meeting question. The results showed that when participants were primed with forward abstract motion (ascending order), they were more likely to adopt the *"moving ego"* perspective and respond *Friday*, whereas when participants were primed with backward abstract motion (descending order), there was no reliable difference between the proportion of *Friday* and *Monday* responses. In discussing the implications of their findings, Matlock et al. (2011) reasoned that forward motion is deeply entrenched in everyday experience (e.g., through walking, cycling and driving), which may encourage participants to adopt the *"moving ego"* perspective and respond *Friday*. By contrast, as people are far less accustomed to engaging in backward motion, it is probably less clear which perspective to adopt; hence, responses to the ambiguous meeting question were mixed.

Moving beyond spatial-motion thinking, Jamalian and Tversky (2012) reasoned that if people use actions in space to express their construals of time and gestures are abstracted actions in space that frequently accompany language, then observing gesture may likewise affect how people reason about events in time. In one study investigating whether speech-accompanying gestures could be used to disambiguate the Wednesday's meeting question, Jamalian and Tversky (2012) found that participants who viewed a gesture moving away from them accompanying the utterance *was moved forward*, were more likely to adopt the *"moving ego"* perspective (responding *Friday*), whereas participants who viewed a gesture moving towards them were more likely to adopt the *"moving time"* perspective (responding *Monday*). Concordant with earlier findings, Jamalian and Tversky (2012) concluded that observing representational actions, namely gestures, also dramatically influence how people think about time. Moreover, information that is conveyed in gestures, but not in speech, can also alter people's conceptions of time and their concomitant interpretation of a temporally ambiguous expression.

As demonstrated, McGlone and Harding's (1998) ambiguous meeting question has been used extensively in research investigating metaphorical representations of time, despite the question consisting of a single measure. However, one issue that arises from using a single experimental question is that measures comprised of a single item are potentially unreliable (e.g., Oshagbemi, 1999; Pollard, 1996). Furthermore, as noted by Richmond, Wilson, and Zinken (2012), as the ambiguous meeting question refers specifically to the week (i.e., the calendar), as opposed to

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[2]Abstract motion occurs in processes that involve mentally moving from symbol to symbol in an ordinal sequence (see Langacker, 1986, 1987).

the ego, it raises the possibility that earlier findings may reflect properties of the English language, as opposed to being a function of temporal perspective per se. To address these issues, Richmond et al. (2012) sought to investigate the general reliability of McGlone and Harding's (1998) ambiguous meeting question by examining the consistency between participants responses to the Wednesday's meeting question and their responses to other ambiguous spatial, clock and calendar questions.[3] While the level of consistency varied between questions, with calendar questions demonstrating the highest level of consistency with responses to the Wednesday's meeting question, the results showed an overall pattern, whereby responses to all four types of question were consistent in their representations.[4] Richmond et al. (2012) concluded that although the responses to the Wednesday's meeting question might be attributed, in part, to the way in which the calendar is used in English, responses to the spatial and clock questions produced relatively similar results, thereby demonstrating the robustness of the designation of the *"moving ego"* and *"moving time"* temporal perspectives.

Taken together, the reviewed research provides an important foundation for the understanding of space–time mappings, demonstrating that people's perspectives on the movement of events in time are not only grounded in their experiences of motion in space but also in their patterns of interactions with cultural artifacts; thus, reiterating the notion that conceptual metaphors are as much cultural as they are internally represented in the minds of individuals (Gibbs, 1999). Combining these two separate lines of research on space–time mappings—namely, research investigating spatial influences on temporal reasoning and research investigating the culturally specific associations between space and time—the next step in extending the existing research is to examine whether people access culturally specific spatial representations of time in their interpretations of ambiguous metaphorical expressions about time. To do this, three experiments were conducted investigating the use of cultural artifacts, namely calendars and clocks, as mediums for directly eliciting responses to ambiguous temporal questions. Experiment 1 directly investigates whether responses to the Wednesday's meeting question may be attributed to the way the calendar is used in English (cf. Richmond et al., 2012), comparing the responses to the original question and answer format with responses to the question elicited via a calendar. Building on insights from earlier research, which suggest that culturally specific spatial representations systematically shape how people think about time (e.g., Tversky et al., 1991), Experiment 2 sought to investigate further the culturally specific associations between space and time and the role of orthography direction in temporal reasoning. To do this, responses to the Wednesday's meeting question were elicited via a calendar and compared against responses elicited via a "reverse" (right-to-left) calendar. Extending the findings from Experiments 1 and 2, which investigate the role of the calendar in the resolution of McGlone and Harding's (1998) ambiguous Wednesday's meeting question, Experiment 3 investigated the role of the analogue clock in the resolution of

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[3]Examples included: *A book will be re-edited so that page 10 will move forward 5 pages* (spatial); *Normally an alarm clock is set for 9 a.m. but the alarm has been moved forward 10 minutes* (clock); *The winter Olympics normally take place in December but the committee has moved it forward one month* (calendar). The responses to each question were coded as either ego-moving or time-moving in their representation.

[4]Concordantly, other lines of research have similarly demonstrated that people tend to be consistent in their representations of time, such that people who imagine moving forward a meeting scheduled for Wednesday by two days to Monday (as opposed to Friday) are also more likely to imagine moving forward a meeting scheduled for noon by two hours to 10 a.m. (as opposed to 2 p.m.; Núñez, Motz, & Teuscher, 2006; cf. Duffy, Feist, & McCarthy, in press).

Núñez and colleagues' (2006) ambiguous Noon meeting question (*"Tomorrow's noon meeting has been moved forward two hours. What time is the meeting now that it has been rescheduled?"*), comparing responses elicited via a clock against responses elicited via a "reverse" (anticlockwise) clock. Taken together, the results provide initial evidence that, in their interpretation of ambiguous metaphorical expressions about time, people automatically access and use culturally specific spatial representations that are consistent with the direction of orthography in their native language. Moreover, asking participants to use a reverse space–time mapping causes interference, which is reflected through their temporal reasoning.

EXPERIMENT 1

As shown, McGlone and Harding's (1998) ambiguous Wednesday's meeting question has been used extensively in research investigating spatial influences on temporal thinking. In particular, it has been observed that while the "spatial schemas"[5] guiding the responses to the Wednesday's meeting question are assumed to operate below awareness, participants often become aware of the ambiguous nature of the question immediately upon providing their response (Kranjec & McDonough, 2011). This might be explained, in part, by the fact that while a number of studies have attempted to disguise the purpose of the experiment by embedding the Wednesday's meeting question within booklets containing filler tasks (e.g., Boroditsky, 2000; Matlock et al., 2011; Ramscar, Matlock, & Dye, 2010), the "metalinguistic"[6] format of the question enables participants to reflect upon their response with a degree of awareness; thus, raising the question of whether it is possible to devise a context within which participants might respond to the Wednesday's meeting question with a reduced awareness of the task's objective than has previously been the case. To address this, a new experiment was devised, in which participants were recruited to take part in a *Multi-tasking Challenge*, whereby they were instructed to schedule a number of events into a calendar while simultaneously watching a video clip and answering questions relating to the video clip. Participants' responses to the Wednesday's meeting question were elicited via a calendar (test condition) and compared against responses to the original, metalinguistic version of the question (control condition). In light of earlier findings, which suggest that responses to the Wednesday's meeting question might be partly attributed to the way in which the calendar is used in English (Richmond et al., 2012, Study 1), it is predicted that the proportion of *Monday* and *Friday* responses will be parallel across the test and control conditions.

Method

Participants.   Participants in Experiment 1 were 65 full-time undergraduate students, with an age range of 18 to 33 years and a mean age of 20 years. Of participants, 17 were male and 48 were

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[5]A spatial schema can be considered as a "condensed redescription of perceptual experience for the purpose of mapping spatial structure onto conceptual structure" (Oakley, 2010, p. 215; cf. Johnson, 1987).

[6]Metalinguistic awareness involves the ability to think explicitly about aspects of language and solve linguistic problems, such as the detection of ambiguity and grammaticality (Galambos & Goldin-Meadow, 1990; Galambos & Hakuta, 1988). This requires an awareness of language as a system, as well as an ability to access and manipulate knowledge about the system (Bialystok & Ryan, 1985).

female. Participants were assigned to either the test or the control conditions. All participants were native speakers of English from the UK.

Materials and procedure. Participants were given a multi-tasking exercise that consisted of two tasks and were informed that they would complete the two tasks simultaneously while watching a video clip. They were also informed that they would be given until the end of the video clip (2 minutes, 25 seconds) to complete both tasks.

For Task 1, participants in the test condition were provided with a 12-month university events calendar which was printed on six pieces of paper back-to-back and were instructed to schedule three events into the calendar:

1. Thursday 19th January

   Kate Smith has cancelled the Solo Exhibition. Cross out the event in the calendar.

2. Wednesday 9th May

   The meeting has been moved forward two days. Enter the new date into the calendar.

3. Saturday 3rd March

   The Pauline Hughes Workshop has been rescheduled for the following Saturday. Enter the new date into the calendar.

In the test condition, responses to the Wednesday's meeting question were elicited by participants scheduling the rearranged date into the calendar provided. In the control condition, participants responded to the original, question and answer format of the Wednesday's meeting question.

For Task 2, which was a distracter task, all participants answered three multiple-choice questions relating to the video clip, *Matthew's Day Off*,[7] which was projected onto a screen at the front of the classroom. The purpose of the distracter task was twofold. The first aim was to minimize participants' engagement of metalinguistic awareness; thereby, allowing them to process the questions and provide answers to them more automatically. The second aim was to ensure that participants had attended to the video clip, which was assessed by whether or not they had answered at least two out of the three multiple-choice questions correctly.

Results and Discussion

Four participants were excluded from subsequent analyses for failure to answer at least two of the multiple-choice questions correctly. Of the remaining participants ($N = 61$), participants in the Calendar (test) condition were more likely to respond *Friday* (83.9%) than participants in the Metalinguistic (control) condition (60.0%). Contrary to the prediction that the proportion of *Monday* and *Friday* responses would be parallel across the test and control conditions, a chi-square test revealed a reliable difference in the responses between the two conditions:

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[7]*Matthew's Day Off* is Honda's 2012 game-day Super Bowl commercial for the Honda CRV, in which actor Matthew Broderick parodies his role in the popular film *Ferris Bueller's Day Off* (http://www.youtube.com/watch?v=mP5l1_s4urU).

$\chi^2_{1,61} = 4.322$; $p = 0.038$; Cramer's V = 0.266. Thus, while both groups of participants demonstrated a preference for answering *Friday*, this finding raises the question of why participants in the Calendar condition were more likely to reschedule the meeting to *Friday* than participants in the Metalinguistic condition. One possible explanation relates to the notion that the left-to-right orientation of time in English does not stem from patterns in language (e.g., *Monday is to the left of Tuesday*), but rather, from the left-to-right direction of orthography in Western culture. Indeed, Casasanto and Jasmin note that "because graphic conventions in English-speaking cultures have an implicit rightward directionality, English speakers have a polarized left-right spatial continuum which can be co-opted for time" (2012: 659). To illustrate, the calendar instantiates absolute time, whereby days are conventionally conceptualized as locations along a calendar's timeline in ascending order from left-to-right (e.g., from the 1st to the 7th) and moving rightward in space correlates with moving later in time (Casasanto & Bottini, 2013; Kranjec, 2006). Thus, in contrast to participants in the control condition, who "mentally visualized" moving forward the meeting, participants in the calendar condition were predisposed to a left-to-right space–time mapping by means of the calendar, whereby the directionality of forward motion is towards later times and hence moving the meeting later to *Friday*.[8]

The findings from Experiment 1 thus suggest that as the calendar served to highlight the left-to-right orientation of time in English, responses to the Wednesday's meeting question might be attributed to the lateral organization of time on calendars, as opposed to temporal perspective per se; therefore, offering an explanation as to why *Friday* responses were more prevalent among participants in the Calendar condition, in comparison to the Metalinguistic condition. Taken together, Experiment 1 corroborates and extends the range of research demonstrating that people automatically access culturally specific spatial representations that are consistent with the direction of orthography in their native language when reasoning about time (e.g., Bergen & Chan Lau, 2012; Boroditsky et al., 2010; Fuhrman & Boroditsky, 2010; Ouellet et al., 2010; Tversky et al., 1991). Building on these findings, Experiment 2 sought to investigate further the culturally specific associations between space and time and the role that the direction of orthography plays in shaping people's conceptualizations of time.

EXPERIMENT 2

Recent research investigating whether orthography can influence the direction in which time flows along people's mental timelines has demonstrated that, through exposure to a new orthography, it is possible to alter their space–time associations. Specifically, in one experiment conducted by Casasanto and Bottini (2013), Dutch literates were presented with a series of phrases such as "a year before" (*een jaar daarvoor*) or "a decade after" (*een decennium daarna*) and were instructed to press a button on the left or right of a keyboard to indicate whether the phrases referred to a time in the past or the future. In one condition, the phrases were presented in standard Dutch

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[8]Indeed, findings from behavioral studies have shown that the left-to-right representation of the mental line in Western cultures generalizes to the mental representation of ordinal sequences more broadly, such as the arrangement of numbers, letters, days, and months. When people are thinking about ordinal sequences, they move along the mental line, suggesting a strong coupling between external physical space and internal mental space (e.g., Dehaene, Bossini, & Giraux, 1993; Gevers, Reynvoet, & Fias, 2003).

orthography and in the other condition, the phrases were presented in mirror-reversed Dutch. Casasanto and Bottini's (2013) findings showed that participants in the Standard Dutch condition were faster to assess past-oriented phrases by pressing the left button and future-oriented phrases by pressing the right button. However, by the second series of testing, participants in the Mirror-reversed Dutch condition displayed the reverse pattern of reaction times. In discussing the implications of their findings, Casasanto and Bottini (2013) concluded that exposure to a new orthography for a period of time is sufficient to transiently weaken people's culturally preferred space–time mapping, hence reversing the flow of time in their minds.

Building on insights from Casasanto and Bottini's (2013) findings, Experiment 2 repeated the calendar rescheduling task used in Experiment 1, replacing the familiar calendar format with a reverse, right-to-left calendar that is incongruent with the direction of orthography in English (Figure 1). Specifically, English literates were provided with an Arabic calendar, which depicts temporal linearity from right-to-left and instructed to enter the date of the rescheduled Wednesday's meeting into the calendar. On the assumption that asking people to use a space–time mapping that is inconsistent with the direction of orthography in their native language causes interference (Fuhrman & Boroditsky, 2010), it is predicted that that there will be a mixed response to the Wednesday's meeting question among participants in the Reverse Calendar condition. Specifically, it is predicted that some participants will be guided by the direction of the reverse temporal number line (right-to-left), leading to a *Friday* response, whereas other participants will be guided by the direction of orthography in English (left-to-right), leading to a *Monday* response. To provide a comparison group for the results from the Reverse Calendar condition, a second group of participants responded to the Wednesday's meeting question using a "normal" left-to-right calendar. Concordant with the findings from Experiment 1, it is predicted that participants in the Normal Calendar condition will demonstrate a similar preference for responding *Friday*.

FIGURE 1 The reverse calendar used in Experiment 2.

Method

Participants.   Participants for Experiment 2 were 58 full-time undergraduate students, with an age range of 18 to 21 years and a mean age of 19 years. Of participants, 34 were male and 24 were female. Participants were assigned to either the Normal Calendar or the Reverse Calendar conditions. All participants were native speakers of English from the UK.

Materials and procedure.   Participants were provided with a one month calendar, which was printed on a single side of paper. In the Normal Calendar condition, the days of the week were positioned at the top of the calendar and arranged in ascending order from left-to-right. In the Reverse Calendar condition, the days of the week in Arabic, with an English translation underneath, were positioned at the top of the calendar and arranged in ascending order from right-to-left. The only event featured on both calendars was the meeting scheduled for Wednesday 9th May. The following instructions appeared underneath the calendar:

> Wednesday 9th May
> The meeting has been moved forward by two days.
> Enter the new date into the calendar.

Results and Discussion

As predicted, in contrast to the participants in the Normal Calendar condition, who again showed a preference for answering *Friday* (82.8%),[9] responses among participants in the Reverse Calendar condition were mixed, with 51.7% of participants responding *Friday* in comparison to 48.3% of participants responding *Monday*. To determine whether the difference in responses between participants in the Normal Calendar condition and Reverse Calendar condition was significant, a chi-square test for independence was used. The chi-square test revealed a reliable difference in the proportion of *Monday* and *Friday* responses across the two conditions: $\chi^2_{1,58} = 6.340$; $p = 0.012$; Cramer's V = 0.331. Taken together, the findings suggest that the prevalence of *Friday* responses among participants in the Normal Calendar condition may be attributed to participants using a space–time mapping that is consistent with the direction of orthography in English—as found in Experiment 1. By contrast, asking participants to use a (right-to-left) space–time mapping that is inconsistent with the (left-to-right) direction of orthography in English caused interference (cf. Fuhrman & Boroditsky, 2010); hence, responses among participants in the Reverse Calendar condition were mixed. In sum, Experiments 1 and 2 provide the first studies of their kind into the ways in which people may use cultural artifacts, such as calendars, to resolve ambiguous metaphorical expressions about time. Developing this area of research, Experiment 3 sought to investigate further the role of cultural artifacts in the resolution of temporally ambiguous expressions by means of the clock.

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[9]Notably, the proportion of *Monday* and *Friday* responses without the distracter task is in line with the responses reported in Experiment 1, which included a distracter task.

EXPERIMENT 3

According to Evans (2013), there is a broad distinction that can be made in terms of absolute temporal reference between event-reckoning systems (e.g., calendars), which provide a means of framing events in time and time-reckoning systems (e.g., clocks), which either model or represent the passage of time. Within both types of systems, further distinctions can be made between systems that are repeatable, open-ended, and closed. For instance, whereas open-ended systems relate to *linear* representations of time, repeatable systems are concerned with *cyclical* representations of time (Evans, 2013). While people conceptualize time using both types of representations, recent empirical research suggests that people are generally biased towards linear thinking—a tendency that has been observed among industrialized as well as non-industrialized communities (e.g., Brang, Teuscher, Ramachandarn, & Coulson, 2010; Kessell 2008; Sinha, da Silva Sinha, Zinken, & Sampaio, 2011). For instance, recent experimental research on the Amazonian language Amondawa suggests that cyclicity is not relevant to the time interval system used in Amondawa culture (Sinha et al., 2011). In one experiment, participants took part in an elicitation game, which required them to construct schematic representations of different time intervals (e.g., the succession of seasons and the 24-hour diurnal cycle), by placing a series of paper plates, each representing an interval of time, on the ground. Sinha et al. (2011) found that all of the participants constructed curvilinear representations of the seasonal and diurnal cycles on a horizontal axis, in either a left-to-right or right-to-left direction. Moreover, none of the participants produced cyclical representations of the time intervals. In discussing their findings, Sinha et al. (2011) posit that in Amondawa, the seasonal and diurnal time intervals are conceptualized in terms of "happenings" against which other activities and events are indexed, or with which other happenings in the natural and social world may coincide. As such, the schematization of time intervals appears to be simply in terms of succession, which can be spatially represented as a line (although not necessarily a straight one).

In another series of experiments conducted by Kessell (2008; cf. Kessell & Tversky, submitted, as cited in Jamalian & Tversky, 2012) investigating the production and comprehension of cyclical and linear processes, participants were instructed to produce diagrams depicting cyclical processes, such as the seasons, and linear processes, such as making scrambled eggs. The findings showed that, as anticipated, participants tended to depict the linear processes in lines but, surprisingly, they also tended to depict the cyclical processes in lines without any return to the beginning. In discussing the implications of the findings, namely that people tend to produce linear representations of cyclical processes, Kessell (2008) reasons that it is easier to conceptualize events progressing forward through time with a beginning, a middle and end than it is to imagine events travelling in a circle, returning to where they started and initiating the process again. Indeed, time moves forward and cannot go back on itself and while each day consists of a morning, noon and night, each day is also unique, rather than a replication of the day previous. Conceptualizing time as a cycle is difficult because it requires thinking about a series of events in terms of a general process rather than an individual instance (cf. Jamalian & Tversky, 2012).[10]

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[10]Notably, other lines of research investigating the ways in which people spatially represent the months of the year show that time–space synesthetes are more likely to depict calendars using cyclical representations, whereas, consistent with Kessell's (2008) findings, non-synesthetes are more likely to use linear rows or rectangular arrangements (Brang et al., 2010).

As research investigating space–time mappings has hitherto been primarily focused on linear representations of time (e.g., Casasanto & Bottini, 2013; Fuhrman & Boroditsky, 2010; Tversky et al., 1991), new research investigating cyclical representations of time importantly paves the way for further empirical study in this area.[11] As such, whereas Experiments 1 and 2 focused on linear representations of time, in Experiment 3, the attention will be turned to circular representations of time. Notably, calendars are typically represented in terms of horizontal rows of days that are sequenced in vertical rows of weeks, with earlier weeks sequenced above later weeks; thus, representing linear time. By contrast, an analogue clock measures time in cycles of seconds, minutes and hours using hands that trace a cyclic path around the dial; thus, it lends itself to capturing cyclical time (Evans, 2013). As such, whereas McGlone and Harding's (1998) Wednesday's meeting question provides a useful tool for investigating linear representations of time, Núñez et al.'s (2006) Noon meeting question would be more apt for examining cyclical representations of time.

To this end, whereas Experiments 1 and 2 investigated the role of the calendar in the resolution of the ambiguous Wednesday's meeting question, Experiment 3 sought to investigate the role of the analogue clock in the resolution of the ambiguous Noon meeting question. To do this, participants were provided with a clockwise clock (condition 1) or an anticlockwise clock (condition 2) and instructed to indicate the time of the rescheduled noon meeting by drawing the minute and the hour hands onto the face of the clock—thus, providing a new method for eliciting participants' responses to the question (Figure 2). Similarly to Experiment 2, which aimed to determine how participants would fare with a temporal rescheduling task using a reverse calendar, the purpose of the anticlockwise clock is for investigating how participants would resolve temporal ambiguity using a clock that is incongruent with the customary direction of motion around
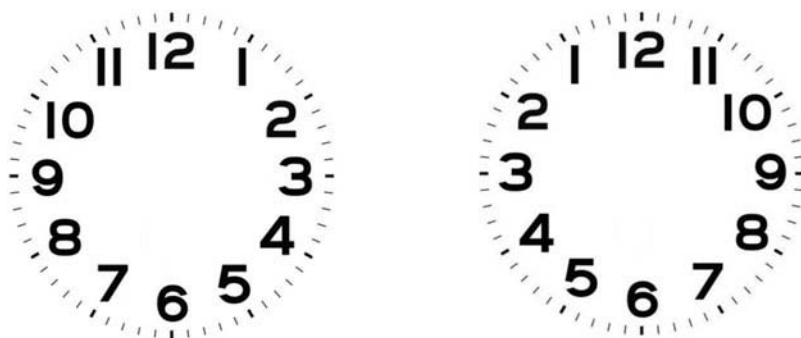

FIGURE 2   The clockwise clock (left) and anticlockwise clock (right) used in Experiment 3.

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[11]The dearth of research on cyclical representations of time might be attributed to the fact that cyclical representations of time are comparatively less diverse than linear representations of time. To illustrate, consider the way in which the hands on an analogue clock rotate around the dial in a clockwise direction. The explanation for this is quite simple: the first mechanical clocks were built to imitate the path of a sundial shadow where, in the northern hemisphere, the shadow on the sundial rotates from west to north to east, i.e., clockwise (Sorensen, 2011); henceforth, the clockwise rotation became quasi-standardized across the globe.

the clock. In this situation, it is predicted that there will be a mixed response to the Noon meeting question: some participants will be guided by the direction of the reverse temporal number line (anticlockwise), leading to a *2 p.m.*, whereas other participants will be guided by the customary direction of motion (clockwise), leading to a *10 a.m.* response.

Method

Participants.   Participants for Experiment 3 were 60 full-time students, with an age range of 18 to 27 years and a mean age of 20 years. Of this group, 29 participants were male and 31 were female. Participants were assigned to either the Clockwise or the Anticlockwise condition. All participants were native speakers of English from the UK.

Materials and procedure.   Participants were provided with a diagram of an analogue clock, without the minute or the hour hands, printed on a single side of paper. The following instructions appeared underneath the diagram of the clock:

> Tomorrow's noon meeting has been moved forward by two hours. Draw the minute and the hour hands onto the face of the clock to indicate the new time of the meeting.

Results and Discussion

As predicted, in contrast to the participants in the Clockwise condition, who showed a preference for depicting *2pm* on the face of the clock (73.3%), responses among participants in the Anticlockwise condition were mixed, with 46.3% of participants depicting *2pm* in comparison to 53.3% of participants depicting *10 a.m.* To determine whether the difference in depictions between participants in the Clockwise condition and Anticlockwise condition was significant, a chi-square test for independence was used. The chi-square test revealed a reliable difference in the proportion of *10 a.m.* and *2 p.m.* depictions across the two conditions: $\chi^2_{1,60} = 4.444$; $p = 0.035$; Cramer's V = 0.272. The findings thus suggest that the prevalence of *2 p.m.* responses among participants in the Clockwise condition may be attributed to participants using a space–time mapping that is consistent with the customary direction of motion around the clock, whereby moving forward (i.e., clockwise) in space corresponds with moving later in time. By contrast, asking participants to use an (anticlockwise) space–time mapping that is inconsistent with the customary (clockwise) direction of motion around the clock may have caused interference; hence, responses among participants in the Anticlockwise condition were mixed.

GENERAL DISCUSSION

Across languages and cultures, speakers systematically employ space to represent events in time. This strong space–time association is reflected in the language people use when talking about time, the actions people use to depict events in time and the artifacts cultures use to represent time. Earlier research has shown that spatial schemas may exert an important influence on the

representation of time, such that engaging in certain types of spatial-motion thinking may influence how people reason about events in time and their concomitant interpretation of a temporally ambiguous expression. Combining two separate lines of research on space–time mappings—namely, research investigating spatial influences on temporal reasoning and research investigating the culturally specific associations between space and time—the aim of this paper was to extend research on space–time mappings in a new direction. Specifically, three experiments investigated the role of cultural artifacts, namely calendars and clocks, in the interpretation of metaphorical language in context.

Experiment 1 directly investigated whether responses to the Wednesday's meeting question might be attributable, in part, to the way the calendar is used in English (cf. Richmond et al., 2012), comparing the responses to the question elicited via a calendar with responses elicited metalinguistically. The findings showed a significant difference in the proportion of *Monday* and *Friday* responses across the two conditions, with participants in the Calendar condition more likely rescheduling the meeting to *Friday* than participants in the Metalinguistic condition. On the assumption that people automatically access culturally specific spatial representations that are consistent with direction of orthography in their native language when reasoning about time (e.g., Boroditsky et al., 2010; Bergen & Chan Lau, 2012; Fuhrman & Boroditsky, 2010; Ouellet et al., 2010; Tversky et al., 1991), the results suggest that the prevalence of *Friday* responses among participants in the Calendar condition may be attributed to the left-to-right orientation of time in English, whereby the directionality of forward motion is towards later times, as opposed to temporal perspective per se.

Building on these findings, Experiment 2 investigated further the culturally specific associations between space and time and the role of orthography direction in temporal reasoning, comparing responses to the Wednesday's meeting question elicited via an English calendar with responses elicited via a "reverse" (Arabic) calendar. The results showed that, in contrast to the participants in the Normal Calendar condition, who showed a preference for answering *Friday*, the difference in the proportion of *Monday* and *Friday* responses among participants in the Reverse Calendar condition was marginal. Thus, while the prevalence of *Friday* responses among participants in the Normal Calendar condition may be attributed to participants using a space–time mapping that is consistent with the direction of orthography in English, asking participants to use a (right-to-left) space–time mapping that is inconsistent with the direction of orthography in English caused interference (cf. Fuhrman & Boroditsky, 2010), resulting in mixed responses among participants in the Reverse Calendar condition.

Noting that research investigating space–time mappings has hitherto been primarily focused on linear representations of time (e.g., Casasanto & Bottini, 2013; Fuhrman & Boroditsky, 2010; Tversky et al., 1991), Experiment 3 focused on circular representations of time, investigating the role of the analogue clock in the resolution of the Noon meeting question, by comparing responses elicited via a clockwise clock with responses elicited via an anticlockwise clock. It was found that, in contrast to the participants in the Clockwise condition, who showed a preference for depicting *2 p.m.* on the face of the clock, the difference in the proportion of *10 a.m.* and *2 p.m.* depictions among participants in the Anticlockwise condition was marginal. Thus, while the prevalence of *2 p.m.* responses among participants in the Clockwise condition might be due to participants using a space–time mapping that is consistent with the customary direction of motion around the clock, using an (anticlockwise) space–time mapping that is inconsistent with the customary direction of

motion around the clock may have caused interference; hence, responses among participants in the Anticlockwise condition were mixed.

Implications for Future Research

Taken together, the results provide further evidence that people automatically access and use culturally specific spatial representations when reasoning about time. However, as cross-linguistic research investigating the interpretation of ambiguous metaphorical expressions about time is comparatively scarce (but see Bender, Beller, & Bennardo, 2010 for German, Mandarin, and Tongan; Elvevåg, Helsen, De Hert, Sweers, & Storms, 2011 for Dutch; Lai & Boroditsky, 2013 for Mandarin), follow-up research might build upon these preliminary findings by examining whether the patterns observed in this study vary systematically across languages and cultures. For instance, because graphic conventions in Arabic-speaking cultures have an implicit leftward directionality, Arabic literates have a polarized right-left spatial continuum which can be co-opted for time (e.g., Tversky et al., 1991). Thus, one question that arises is when would Arabic participants move forward Wednesday's meeting to if they were provided with an Arabic calendar which highlights the *right-to-left* orientation of time in Eastern culture? Similarly, speakers of Mandarin frequently make use of vertical metaphors for talking about events in time (e.g., Chun, 1997; Scott, 1989; Yu, 1998); thus, how would Mandarin participants resolve the Wednesday's meeting question if they were provided with a vertical calendar that highlights the *up-to-down* orientation of time reflected linguistically in Mandarin?[12]

Implications for Theories of Metaphor

Recently, at the 12th International Cognitive Linguistics Conference, cognitive linguists were encouraged to: (a) "look back," taking stock of the past 25 years of research in cognitive linguistics; (b) "look forward," considering the next generation of cognitive linguistics research; and (c) "look outward," extending research to understudied populations and applications, particularly in regard to endangered languages and signed languages (ICLC-12, June 2013). While recent metaphor research, especially in the domains of space and time, has taken heed of the notion "looking outward," by investigating spatial representations of time among an increasing range of indigenous communities,[13] the question remains of how it is possible to "look forward" and pave the way for the next generation of metaphor research. With the advent of new interactive technologies, one possible solution is to turn our focus to the role that emerging cultural artifacts play in creating wider cognitive and computational webs (cf. Gibbs, 1999). In particular, for

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[12]It should be noted that preliminary cross-linguistic research investigating the Wednesday's meeting question indicates that when translated into some languages (e.g., Dutch, Danish), the question remains ambiguous, while in other languages (e.g., German, Mandarin), the ambiguity is not apparent (Bender et al., 2010; Elvevåg et al., 2011; Lai & Boroditsky, 2013; see also Duffy & Feist, 2014); thus, whether or not multiple competing interpretations are available in the language being examined is a factor that should be taken into consideration in further cross-linguistic research in this area.

[13]Examples include Amondawa (Sinha et al., 2011), Aymara (Núñez & Sweetser, 2006), Mian (Fedden & Boroditsky, 2012), Pormpuraaw (Boroditsky & Gaby, 2010), Tzeltal (Brown, 2012), Yélî Dnye (Levinson & Majid, 2013), Yucatec Mayas (Le Guen & Balam, 2012), and Yupno (Núñez et al., 2012).

future research, the iGeneration (born after 1999; Pendergast, 2009; Rosen, 2010) may provide a rich testbed for investigating whether people's interactions with digital cultural artifacts shape embodiment and, hence, metaphorical thought. For instance, there has been a recent surge of videos on YouTube depicting "technotoddlers" interacting with a range of digital technologies, the most prominent of which is the iPad (Wohlwend, 2013). One video entitled *A Magazine is an iPad That Does Not Work* (CBS News Online, 2011) shows a toddler using her fingers to press, tap, swipe, and pinch on the screen of an iPad. Subsequently, she attempts to use the same finger movements on the pages of a magazine but appears perplexed and loses interest when the magazine is unresponsive to her actions. While such casual observations should be interpreted with some caution, recent research from the field of neuroscience suggests that digital cultural artifacts are indeed radically altering the ways in which young minds are developing and functioning (e.g., Small, Moody, Siddarthm, & Bookheimer, 2009; Small & Vorgan, 2008). Taken together, these findings raise the question of how new cultural artifacts may, consequently, be influencing metaphoric thought. To illustrate, consider the ways in which people interact with touch screen calendars on smart devices.[14] The iPad (iOS 7), for example, enables users to alternate between different "views" of time, each of which is understood through different space–time metaphors: in the "day" view and the "month" view, users advance through the hours of the day and the months of the year by vertically swiping the screen upwards *("UP IS EARLIER"*; *"DOWN IS LATER"*), whereas in the "week" view, users move later through the days of the week by horizontally swiping the screen leftwards (*"LEFT IS EARLIER"*; *"RIGHT IS LATER"*). Thus, by automatically alternating between different space–time metaphors—namely, *"UP IS EARLIER"* and *"LEFT IS EARLIER"*—digital cultural artifacts dictate a necessity for users to be flexible in their representations of time, as they switch to thinking about different time spans on different timescales (cf. Casasanto & Jasmin, 2012).[15]

In addition, while recent lines of metaphor research have begun exploring the cognitive and neural basis of metaphor, the focus has largely been centered on the processing of metaphor as a function of language-related factors, such as novelty, interpretability and valence (e.g., Cardillo, Schmidt, Kranjec, & Chatterjee, 2010; Schmidt & Seger, 2009; Subramaniam, Faust, Beeman, & Mashal, 2012). Drawing on the assumption that conceptual metaphors are as much internally represented in the minds of individuals as they are spread out into the social and cultural world (Gibbs, 1999), new insights into the "metaphorical brain" (cf. Lai & Coulson, in press) might similarly be gained by extending the neuroscientific investigation of metaphor out into the digital world, thereby exploring metaphor processing as a function of interactions with digital cultural artifacts. Moreover, future research in cognitive linguistics would benefit from exploring the roles that cultural artifacts—both existing and emerging—play in shaping metaphoric thought.

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[14]I thank Michele Feist for raising this point.

[15]It should be noted that recent research has sought to distinguish between two fundamentally different representations of deictic time: one with an "internal" perspective, where the deictic center (the ego) correlates with the present and metaphorically signifies the experience of *now* and a second with an "external" perspective, where the deictic center is displaced to an external vantage point, which is perpendicular to the axis on which time is represented (Casasanto & Jasmin, 2012; Núñez & Cooperrider, 2013). Moreover, recent research on temporal gestures indicates that, in their conceptualisation of external deictic time, people adopt a *"moving attention"* perspective (as opposed to a *"moving ego"* or *"moving time"* perspective), which is grounded in patterns of interaction with cultural artifacts (as opposed to patterns of interaction with the natural environment; Casasanto & Jasmin, 2012).

CONCLUSION

In sum, the findings from this paper provide further validation that people's perspectives on the movement of events in time are not only grounded in their experiences of motion in space but also in their patterns of interactions with cultural artifacts. In addition, the results extend prior research by showing that, in their interpretation of ambiguous metaphorical expressions about time, people automatically access and use spatial representations of absolute time, whereby moving forward in space corresponds with moving later in time. Furthermore, asking participants to use a reverse space–time mapping causes interference, which is reflected through their temporal reasoning.

In addition, the results from this study give rise to the question of why cultural artifacts have such an effect on temporal reasoning. Cultural artifacts, such as calendars and clocks, externalize thought (cf. Tversky, 2011); thus, they provide a means of not only mapping temporal paths in space, but also indicating specific moments or events along a (linear or circular) temporal path. As such, cultural artifacts simultaneously abstract and depict a model of time, thereby providing a more concrete form of temporal representations than purely symbolic speech. Cultural artifacts, thus, play a role in the extended cognitive process (e.g., A. Clark & Chalmers, 1998), acting as a means of not only aiding embodied cognition, but also influencing it.

Furthermore, the findings give support to the Mediated Mapping Hypothesis (Sinha et al., 2011), which suggests that time-reckoning is dependent on the cultural construction of counting practices based upon large number systems (Pica, Lemer, Izard, & Dehaene, 2004), as well as the cultural-cognitive schema of a linear number line (Dehaene, Izard, Spelke, & Pica, 2008). As such, direct space–time mappings arise as a result of the combination of numeric symbolic cognitive processes with language which, in turn, are supported by historically developed cultural artifacts, such as calendars and clocks. In sum, by highlighting new avenues for empirical research investigating the role of cultural artifacts in temporal reasoning and understanding, this paper demonstrates that, by drawing on separate (but converging) lines of research on space–time mappings, it is possible to gain greater and richer insights into metaphoric representations of time.

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