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24. Time

1. Introduction

Research on time, in cognitive linguistics, is concerned with how time manifests itself in language and thought. Cognitive linguists study time as a cognitive phenomenon, which can be investigated, in part, from its linguistic reflexes. Being interdisciplinary in nature, cognitive linguistics has approached the study of time from various perspectives. In addition to linguistics, research on temporal cognition has been informed by findings from experimental psychology, philosophy, neuroscience, and (cognitive) anthropology. This chapter addresses the key questions that cognitive linguistics has raised and attempted to answer, with respect to time.

2. What is the nature and status of time?

Does time arise from an internal subjectively-real experience type? Or is it abstracted from external sensory-motor experiences arising in veridical reality − our experience of the world "out there"? Questions of this sort have been addressed, either directly or indirectly, by cognitive linguists working with sometimes different theoretical, analytic and descriptive goals.

Conceptual Metaphor Theory (see Gibbs this volume), for instance, has provided much of the impetus for exploring these specific questions. Lakoff and Johnson (1980, 1999) have argued that time is abstracted from veridical experiences, such as motion events: time is an abstract conceptual domain, while space is concrete. They put it as follows: "Very little of our understanding of time is purely temporal. Most of our understanding of time is a metaphorical version of our understanding of motion in space" (1999: 139). On this account time does not exist as a "thing-in-itself … [w]hat we call the domain of time appears to be a conceptual domain that we use for asking certain questions about events through their comparison to other events." (Lakoff and Johnson 1999: 138). In short, time arises from the abstraction of relations between events that we perceive and experience in the world "out there". Once these relations have been abstracted, they are structured in terms of spatial correlates, allowing us to conceptualise time. And once time has been conceptualised we can then experience it. In short, "our concept of time is cognitively constructed … events and motion are more basic than time." (Lakoff and Johnson 1999: 167).

Other conceptual metaphor theorists have taken a more nuanced view. Grady (1997) holds that time and space evince a qualitative distinction that, and contrary to Lakoff and Johnson, is not best captured in terms of relative abstractness versus concreteness. Grady proposes that time derives from phenomenologically real, albeit subjective experience types, while spatial concepts are grounded in sensory-motor experiences. Moore (e.g., 2006), in his work on space-to-time conceptual metaphors concurs. He argues that time is as basic as space. Hence, time antecedes the conceptual metaphors that serve to structure it. The utility of metaphor, Moore contends, is to make time more accessible for conceptualisation, rather than creating it.

Evans (2004; see also 2013b), focusing on lexical concepts for time − rather than conceptual metaphors − argues that time is in some ways more fundamental than space, at least at the neurological level: it facilitates and underpins our ability to perceive and interact in the world, to anticipate, and to predict. Based on neurological evidence, Evans argues that the distributed nature of temporal processing is critical to our ability to perceive events. Event-perception is therefore facilitated by temporal processing, an issue we return to later.

In large part, the view taken on the nature and status of time depends on whether we are addressing temporal representations (concepts), or neurological representations (experiences). Indeed, the issue resolves itself into the following bifurcation: time is a subjectively real experience − as Grady, Moore and Evans hold − yet it is also a mental achievement, not something in and of itself, but rather abstracted from our perception of events in the world − the position argued for by Lakoff and Johnson.

One way out of this conundrum is to conclude that time is in fact both: temporal concepts are grounded in experiences that are independent of space (and sensory-motor experience more generally), but, time is also reified as an ontological entity, abstracted from the experiences which ground it, giving rise to an abstract category which can be deployed for intersubjective reflection. And in terms of the latter, this abstract category can be structured, in part via conceptual metaphors, derives from sensory-motor experience.

There is now a very large body of evidence which supports the former view: not only is time directly experienced, its manifestation is often independent of our experience of motion events in space. Moreover, the human experience of time is, in principle, distinct from sensory-motor experience. For instance, Flaherty (1999) has found that our perception of duration is a function of how familiar subjects happen to be with particular tasks: training can influence our experience of task duration. Ornstein ([1969] 1997) has demonstrated that the complexity of a given perceptual array influences perception of duration. And Zakay and Block (1997) found that temporal perception is influenced by how interesting a particular activity is judged to be, or whether we are paying attention to a particular activity.

Other research reveals that our ability to judge duration is a consequence of physiological mechanisms, which vary in inter-subjectively predictable ways. For instance, if vital functioning is accelerated by the consumption of stimulants such as amphetamines, or due to increased body temperature, this results in an overestimation of time amongst subjects (Hoagland 1933; Fraisse 1963, 1984). In contrast, reduced body temperature leads to an underestimation of time (Baddeley 1966). In general, an increase or decrease in vital function consistently leads to perceiving duration as elapsing more quickly or slowly respectively (see Wearden and Penton-Voak 1995 for review).

Flaherty (1999) has found that the nature of experience types can influence our experience of time. For instance, the phenomenon of *protracted duration* − the phenomenologically real and vivid experience that time is proceeding more slowly than usual appears to be a consequence of events including boredom and near death experiences. In contrast, routine tasks with which we are familiar can give rise to the opposite effect: *temporal compression* − the phenomenologically real experience that time is proceeding more quickly than usual.

While findings such as these suggest that time is directly perceived, and phenomenologically real, there are types of temporal representation that appears not to be directly grounded in phenomenologically real experiences of this kind. One example of this is the *matrix* conceptualisation of time (Evans 2004, 2013b), also referred to as *time-as-such* (Sinha et al. 2011). This relates to our understanding of time as a manifold which, metaphorically, is draped across, and constitutes the whole of history; from this perspective, time is *the* event within which all other events take place. This view of time is exemplified by the linguistic example in (1):

(1) Time flows on (forever)

From this perspective, it makes sense to talk of time as having a beginning, as if it were an entity that lies outside us, in some sense providing reality with structure. It is this Matrix conceptualisation that is implicit in the conception of time in the classical mechanics of Newton, and to some extent, in post-Einsteinian physics. And by virtue of time as a Matrix being conceived as an ontological category independent of events, we can discuss and study it, and describe its "history", as evidenced by Steven Hawking's book title: *A Brief History of Time*.

In sum, temporal representations include those grounded in directly perceived temporal experiences. But representations for time can also be abstracted away from these experiences and reified as an ontological category independent of such experiences. This gives rise to mental achievements that are then available for intersubjective reflection without regard to directly experienced time. Representations of this type presume the existence of an objectively-real substrate that can be physically measured or observed, in some sense. And this conceptualisation presumably facilitates our ability to construct and interpret time-measurement systems such as calendars and clocks (Evans 2013b).

3. What is the relationship between time and space?

The relationship between temporal and spatial representation is, in a profound sense, paradoxical. On the one hand, space and time are, for many cognitive linguists, equally basic conceptual domains (Langacker 1987). They are basic in the sense that, although involving distinct types of representations, relating to matter and action, all other domains would seem to assume both space and time. In terms of the experiential level, we must have evolved mechanisms for processing the properties associated with space and time.

Some cognitive linguists have assumed that the fundamental nature of space and time results from a common structural homology (e.g., Talmy 2000). Linguistic evidence for this comes from what Talmy refers to as *conceptual conversion operations*. Talmy (2000) points out, on the basis of linguistic evidence, that acts and activities (from the domain of time) can be converted into objects and mass (from the domain of space). When a temporal concept is *reified*, this is conveyed by expressions exemplified by *a wash* and *some help* in (2) and (3) respectively:

(2)	*An act*	*reified as an object*	*(discrete)*
	John washed her.	John gave her a wash.	
(3)	*Activity*	*reified as a mass*	*(continuous)*
	John helped her.	John gave her some help.	

In example (2), the expression *washed* encodes an act, while *a wash* conceives of the same act as if it were an object. It is precisely because lexical concepts relating to time and space can be quantified, Talmy argues, that they can exhibit the conceptual alternativity evident in (2).

In example (3), the expression *helped* encodes an activity, while *some help* encodes a mass lexical concept. When an act is reified as an object, it can be described in terms consistent with the properties of objects. For example, physical objects can be transferred: *to call (on the phone)* becomes: *he gave me a call*. Physical objects can also be quantified: *to slap* becomes: *She gave him two slaps*. As Talmy observes, however, there are constraints upon this process of reification. For example, a reified act or activity cannot be expressed in the same way that prototypical physical objects can. Example (4) illustrates that the reified act, *a call* is incompatible with verbal lexical concepts that are prototypically physical.

(4) *John pushed/threw/thrust/slid Lily a call

The converse operation, which converts matter to action, is referred to as *actionalisation* (Talmy 2000). When units of matter are actionalised, they are expressed by lexical concepts encoded by verb phrase vehicles. This operation is illustrated by the following examples adapted from Talmy (2000: 45).

(5)	*An object*	*actionalised as an act*	*(discrete)*
	Jane removed the pit from the olive.	Jane pitted the olive.	
(6)	*A mass*	*actionalised as an activity*	*(continuous)*
	Jane has a nosebleed.	Jane is bleeding from the nose.	

In contrast, there are good reasons to think that, at the representational level, time and space are asymmetrically structured: time is supported by, and arguably parasitic on spatial representation: the position of Lakoff and Johnson (1980, 1999). Lakoff and Johnson argue that mappings recruit from the domain of space to provide structure for the domain of time, but not vice versa. Following seminal work by Clark (1973), Lakoff and Johnson have posited a "passage" conceptual metaphor, in which time recruits structure from (motion through) space. There are two versions of this conceptual metaphor, both based on linguistic evidence.

The first of these is the Moving Time Metaphor. In this conceptualisation there is a stationary Observer whose location corresponds to the present. The Observer faces the future, with the space behind corresponding to the past (Figure 24.1).

In Figure 24.1, events are represented by small circles. Motion is represented by the arrows. Events move from the future towards the Observer, and then behind into the past. The reason for thinking that speakers of English store this in their minds again comes from language:

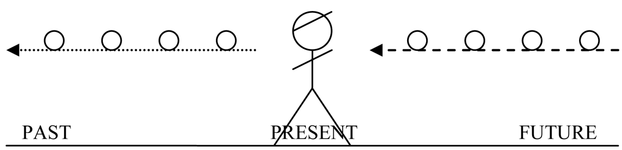

Fig. 24.1: The Moving Time Metaphor

Tab. 24.1: Mappings for the Moving Time Metaphor

Source domain: MOTION OF OBJECTS	Mappings	Target domain: TIME
OBJECTS	→	TIMES
THE MOTION OF OBJECTS PAST THE OBSERVER	→	THE "PASSAGE" OF TIME
PROXIMITY OF OBJECT TO THE OBSERVER	→	TEMPORAL "PROXIMITY" OF THE EVENT
THE LOCATION OF THE OBSERVER	→	THE PRESENT
THE SPACE IN FRONT OF THE OBSERVER	→	THE FUTURE
THE SPACE BEHIND THE OBSERVER	→	THE PAST

(7) a. Christmas is *approaching*.
b. The time for action *has arrived.*
c. The end-of-summer sales *have passed*.

As these examples show, we employ the language of motion to refer to the passage of time. The regions of space in front of, co-located with, and behind the Observer correspond to future, present and past. In addition, we understand motion to relate to time's *passage*, as is clear by the use of *approaching*, in the first sentence. The series of mappings that allow us to understand these different aspects of the motion of objects in terms of TIME are captured in Table 24.2.

The second passage conceptual metaphor, which we can think of as being a reversal of the Moving Time Metaphor, is referred to as the Moving Ego, or Moving Observer metaphor. Here, time is conceived as a static "timescape" with events conceptualised as specific and static locations towards which the Observer moves and then passes (Figure 24.2).

As previously, events are represented by small circles in Figure 24.2, which are specific locations in the temporal landscape. Motion is represented by the arrows. In this case, it is the Observer, rather than the events, which is in motion. Here, we understand the passage of time *in terms of* the Observer's motion: the Observer moves across the temporal landscape towards and then past specific events, expressed as fixed locations in space. Lakoff and Johnson again point to evidence from language for this conceptualisation:

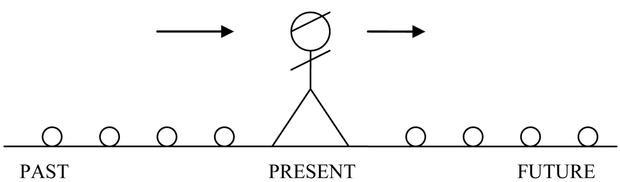

Fig. 24.2: The Moving Observer Metaphor

Tab. 24.2: Mappings for The Moving Observer metaphor

Source domain: MOTION OF OBSERVER	Mappings	Target domain: TIME
LOCATIONS ON OBSERVER'S PATH	→	TIMES
THE MOTION OF THE OBSERVER	→	THE "PASSAGE" OF TIME
THE LOCATION OF THE OBSERVER	→	THE PRESENT
THE SPACE IN FRONT OF THE OBSERVER	→	THE FUTURE
THE SPACE BEHIND THE OBSERVER	→	THE PAST
DISTANCE OF OBSERVER FROM LOCATION	→	TEMPORAL "DISTANCE" OF EVENT
RAPIDITY OF MOTION OF OBSERVER	→	IMMINENCE OF EVENT'S OCCURRENCE

(8) a. They're *approaching* crisis-point.
b. The relationship *extended over* many years.
c. He left *at* 10 o'clock.

Examples like these have been taken to reveal that, metaphorically, the Observer's motion is ascribed to time's passage. Time is being likened to a static landscape as we can see from expressions such as *extended over*. And the use of *at*, as in *He left at 10 o'clock* demonstrates that specific locations in the static landscape correspond to temporal events. See Table 24.2 for mappings that have been proposed for this metaphor.

In behavioural experiments, Boroditsky (2000; Boroditsky and Ramscar 2002) provided the first psycholinguistic support for Lakoff and Johnson's claim for asymmetric organisation between time and space. Boroditsky developed both spatial and temporal primes which she applied to temporal and spatial reasoning tasks. She reasoned that if spatial and temporal representations are structured symmetrically, which is to say, if temporal representation is just as useful for reasoning about space, as spatial representation is for time, then spatial cues should prime for temporal reasoning, while temporal cues should prime for spatial reasoning tasks. Boroditsky found evidence consistent with an asymmetric perspective: spatial cues appear to be useful for reasoning about time, but temporal primes appear not to be used when reasoning about space. More recently, Casasanto and Boroditsky (2008) have provided additional support for the asymmetric organisation of time in terms of space, making use of non-linguistic behavioural tasks.

One specific manifestation of the asymmetric organisation of space and time relates to *frames of reference* (FoRs). A FoR, in the domain of time, comprises three coordinates to locate or fix a temporal entity with respect to another (Zinken 2010). Early research focused on examining FoRs from the domain of space, investigating how they are recruited to structure temporal reference: the assumption being that FoRs from the domain of space are naturally mapped onto time. Two such taxonomies have been proposed (Bendner et al. 2010; Tenbrink 2011; see also Moore 2011). However, there is, as yet, little consensus on the nature of these taxonomies, or indeed whether spatial FoRs really do subserve temporal reference (see Bender et al. 2012 for critical evaluation). For instance, Evans (2013a, 2013b) has proposed that FoRs in the domain of time are qualitatively distinct from those in the domain of space. He has developed a time-based taxonomy of temporal FoRs deriving from the notion of *transience* (discussed below). Temporal FoRs is now one of the fastest developing areas of research in the study of temporal cognition.

At the neurological level, two proposals have been put forward to account for the relationship between time and space. Bonato et al. (2012) have proposed what they term the *Mental Time Line* (MTL) hypothesis. This hypothesis is consistent with the asymmetric organisation posited by Lakoff and Johnson's Conceptual Metaphor Theory. They posit that, at the neurological level, temporal experience is structured *in terms* of spatial characteristics.

A second possibility, one that would account for the data provided by Talmy, posits a single magnitude system. Such a system would provide a common metric allowing the different parameters associated with the domains of time and space to be quantified, and integrated. Such an approach has been proposed by Walsh (2003; Bueti and Walsh 2009) in *A Theory of Magnitude* (ATOM). Walsh proposes that there is a single generalised, neurologically-instantiated magnitude system, present at birth. This allows space and time to be quantified, in principle, in symmetrical ways.

Whichever of the two approaches, ATOM, or MTL, turns out to be correct − and there are arguments in favour of both − the only candidate brain region that might facilitate the interaction between spatial and temporal experience appears to be the inferior parietal cortex − this region of the brain is host to a series of closely-related sub-areas specialised for processing time, space and number (Bonato et al. 2012; Bueti and Walsh 2009; Walsh 2003).

4. What is the distinction between time and space?

If time does recruit structure from the domain of space, are the two domains distinct? In important work, Galton (2011) has proposed a number of parameters that allow representations for time and space to be compared and contrasted. This research demonstrates that time and space are qualitatively distinct conceptual domains. The relevant parameters enabling comparison of the two domains are: *magnitude*,[1] *dimensionality*,[2] and *directedness* (Galton 2011). I consider and nuance each of these parameters in turn.

The parameter of magnitude relates to the quantifiability of a given *substrate* − the stuff that makes up the domain. The substrate the makes up space is *matter*, of which two broad types can be distinguished: discrete entities (e.g., objects) and mass entities (e.g., fluids). This distinction, in types of matter, is reflected in the grammatical organisation of many languages, whereby a distinction between count versus mass nouns is encoded.

In addition, the substrate that makes up a domain exhibits a particular property allowing the substrate to be quantified: the way in which the substrate can be "cut up" into "amounts". The amounts, in the domain of space, relate to the property *extension*. Extension manifests itself in three distinct types − which is a function of the three-dimensional-

1 Galton (2011) uses the term "extension".
2 Galton (2011) uses the term "linearity".

Tab. 24.3: Comparing the parameter magnitude for space and time

Domain	*Space*	*Time*
Substrate	Matter	Action
Property	Extension	Duration
Distinction	Discrete vs. mass	Bounded vs. Unbounded

ity of space, discussed further below. Space's extension involves length (one dimension), area (two dimensions), and volume (three dimensions).

The substrate that makes up time is that of *action* (Talmy 2000). As with space, action can also be broadly subdivided, as reflected in language. This relates to whether action is *bounded* versus *unbounded*, analogous to the distinction between discrete versus mass for the substrate matter. This is illustrated by the grammatical distinction between perfective versus imperfective aspect in many languages.

In the domain of time, the property exhibited by action, and hence, the means of "cutting up" action into amounts is *duration*, rather than extension. While duration can, self-evidently, be quantified by using *measurement systems* involving material artefacts such as clocks, duration (of relatively shorts periods) can be estimated without the need for measurement systems such as these. The distinctions between space and time in terms of the parameter of magnitude are summarised in Table 24.3.

Dimensionality, in physical terms, relates to the *constituent structure* of matter. The constituent structure of matter involves three distinct planes with respect to which points can be located. These are the transversal (left/right), sagittal (front/back) and vertical (up/down) planes. Hence, our everyday representation of space can be said to be three-dimensional.

In contrast, in the domain of time the constituent structure of action involves *succession*: the sequential relationship that holds between distinct units and sub-units of action (cf. Moore 2006; Núñez et al. 2006). In other words, our representation for time involves a relationship between units of action in a sequence. This involves just one dimension.

Physical theories that incorporate time, such as in the Theory of General Relativity (Einstein 1916), treat time as the fourth dimension of space, forming a space-time continuum, or Minkowski space, after the celebrated 19th century mathematician who first proposed incorporating time into space. On this view, points can be "located" in time, where units of action are strung out, all at once, across time. Yet this view is at odds with the human phenomenological experience of time (see Evans 2004: Chapter 19). Insofar as time, from a phenomenological perspective, can be said to exhibit dimensionality, this relates to the sequential relationship between events, providing one-dimensional constituent structure.

The final parameter, directedness, relates to whether the substrate in a given domain is *symmetric* (i.e., isotropic) or *asymmetric* (i.e., anisotropic). Space is isotropic: it has no inherent asymmetry. Indeed, it is possible to proceed in any direction: forward or back, or from side to side. In contrast, time is anisotropic: it manifests asymmetric organisation. From a phenomenological perspective, time is experienced as anisotropic. This concerns the anticipation of a future event, the actual experience of the event, and finally, the recollection of the event as past.

In his work, Galton (2011) discusses an additional feature which he argues is exhibited by time, but not by space. This he refers to as *transience*: the fleeting quality associated with temporal experience. For Galton, transience is the hallmark of time, and hence part of its inalienable character.

5. Is time homogenous or multifaceted?

Linguistic evidence demonstrates that the conceptual domain of time is multifaceted (Evans 2004, 2013b; Grady 1997; Moore 2006). For instance, the English word *time* covers a range of quite different lexical concepts (Evans 2004). Consider the following examples:

(9) The time for action has arrived

(10) a. Time flies when you're having fun
b. Time drags when you have nothing to do

(11) a. The young woman's time [= labour/childbirth] approached
b. His time [= death] had come
c. Arsenal saved face with an Ian Wright leveller five minutes from time [BNC]

(12) [T]ime, of itself, and from its own nature, flows equably without relation to anything external [Sir Isaac Newton]

In these examples, all involving the vehicle *time*, a different reading is obtained. In (9), a discrete temporal point or moment is designated, without reference to its duration. The examples in (10) provide a reading relating to what might be described as "magnitude of duration". (10a) relates to the phenomenologically real experience whereby time proceeds "more quickly" than usual − this constitutes the phenomenon of temporal compression (Flaherty 1999) discussed briefly above. The example in (10b) relates to the experience of time proceeding 'more slowly" than usual − the phenomenon of protracted duration, also discussed briefly above. In (11), the readings relating to *time* concern an event. In (11a) the event relates to the onset of childbirth, in (14b) the event designated relates to death, while in (11c) it concerns the referee blowing the whistle signalling the end of a game of soccer. In the sentences in (12) *time* prompts for an entity which is infinite, and hence unbounded in nature.

While English has one word for a range of (arguably) quite distinct experience types, other languages don't inevitably have a single word that covers the same semantic territory. For instance, recent research on the Amazonian language Amondawa reveals that there is no equivalent of the English word *time* in that language (Sinha et al. 2011). To give another example of a typologically and areally distinct language, it is also the case that Inuit languages don't have a single lexeme for *time*. Moreover, even genetically related languages utilise distinct lexical items to describe the semantic territory covered by the single lexical form, *time*, in English.

In sum, the English examples demonstrate that the form *time* relates to quite different types of representations − having a single word-form provides the illusion of semantic unity (Evans 2009), and gives rise to the myth that time relates to a homogenous set of experiences. The fact that other languages don't have a single word for the same set of experiences further underscores the cultural variability of cutting up the domain of time.

6. Are representations for time universal?

Some cognitive linguists have argued, or at least implied, that the motion-through-space conceptual metaphors for time are universal. For instance, Fauconnier and Turner put things as follows: "Time as [motion through] space is a deep metaphor for *all human beings*. It is common across cultures, psychologically real, productive and profoundly entrenched in thought and language" (2008: 54) [my emphasis]. But there are languages that appear not to have this conceptual metaphor. One example is the indigenous South American language Aymara; Aymara doesn't make use of motion on the sagittal plane to conceptualise time's passage (Núñez and Sweetser 2006).[3]

More strikingly, Sinha et al. (2011), based on their fieldwork of Amondawa, argue that motion-through-space metaphors for time are not transcultural universals. Amondawa is spoken by a small tribe of a little of 100 individuals located in remote western Amazonia. Official contact was not made until 1986. Based on their fieldwork, Sinha and colleagues make two claims. First, and in contrast to Indo-European languages, Amondawa does not make use of ascriptions from spatial language, and language relating to motion, to talk about time. Second, Amondawa does not make reference to time as an ontological category independent of events themselves: what Sinha et al. refer to as *time-as-such*. They maintain that there is no evidence from the Amondawa language or culture that the Amondawa have time available, per se, as an object of conscious (intersubjective) reflection.

If correct, what do these claims say about time? First off, they don't imply that all aspects of time are not universal. As we have seen, time is a complex and multifaceted domain. Moreover, it is, at least in part, grounded in specialised, albeit distributed, neurobiological processes and structures that are purely temporal (Kranjec and Chatterjee 2010). Our experience of time is variegated, directly perceived via interoception, and subjectively real. The basal ganglia and cerebellum are implicated in fundamental timekeeping operations upon which the coordination of motor control is dependent (Harrington et al. 1998). Other neuroscientists have argued that temporal processing is widely distributed across brain structures, being intrinsic to neural function (e.g., Mauk and Buonomana 2004), and is fundamental to cognitive function (Varela 1999). Distinct brain structures are implicated in the experience of duration, succession, our experience of the present, our recollection of the past and pre-experience of the future (see Evans 2013b for a review). Indeed, the emerging view from neuroscientific research is that the exquisitely sophisticated timing structures in the brain are key to a raft of fundamental cognitive functions such as motor control, and perception and may provide the cognitive "glue" that facilitates learning and memory, behaviour planning, awareness, imagination and creativity (Pouthas and Perbal 2004; Pöppel 2009; Rubia et al. 2009).

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3 However, Aymara does make use of motion on the transverse plane to conceptualise the succession of events.

Based on proposals in Evans (2013b), a taxonomy suggests itself for directly grounded temporal representations.[4] The most basic temporal concept is termed a *temporal element*. These are representations grounded in phenomenologically simple experience types that contribute to − or in some cases arise from − our experience of transience. Examples include felt experience types such as now, past, future, earlier and later, and are associated with the corresponding lexical forms (e.g., *now*, *past*, *future*, *earlier*, *later*, etc.).

The next type of temporal concept is grounded in the experience of transience, discussed earlier. Evans (2013b) suggests that there are three types of transience: *duration, succession*, and *anisotropicity*. Duration concerns the felt experience of the passage constituting an elapse − something greater than the *perceptual moment* − the smallest neurologically-instantiated unit of perceptual processing which is consciously accessible, and which is likely to constitute the basis for the human experience of now (Pöppel 1994, 2009). The perceptual moment has an outer limit of around 3 seconds (see Evans 2004, 2013b). Succession concerns the felt experience of the passage involving earlier and later experience types, which are sequenced with respect to each other. And anisotropicity concerns the felt experience that the passage exhibits inherent asymmetry − a felt distinction between future, present and past. Concepts associated with these transience types are encoded in language by lexical forms such as *duration*, *succession*, *passage*, and indeed *transience*. Table 24.4 summarises these transience types.

Transience logically supports more complex experience types: *temporal qualities*. Temporal qualities involve a comparison across events, with respect to transience. Examples include frequency, change and synchronicity. Change, for instance, involves a comparison, or awareness of a difference between two states at different temporal intervals, and hence, is processed with respect to transience. Frequency involves the identification of a number of iterations of experiences, or experience types at different temporal intervals. And synchronicity involves an awareness of two experiences or experience types occurring at the same temporal moment (see Table 24.5). Temporal qualities are more complex than either temporal elements or transience types as temporal qualities are presupposed by them.

While temporal elements, transience types and temporal qualities are all likely to be universal, there are representations for time that are not directly grounded in temporal experience. These can be thought of as mental achievements, in part supported (or constructed) by conceptual metaphors. A notable example concerns time conceptualised as

Tab. 24.4: Transience types

TRANSIENCE TYPE	DESCRIPTION
Duration	the felt experience of the passage constituting an elapse
Succession	the felt experience of the passage involving earlier and later experience types
Anisotropicity	the felt experience that the passage exhibits inherent asymmetry − a felt distinction between future, present and past

4 Cf. Pöppel (1978) who argues for what he terms “elementary time experiences”.

Tab. 24.5: Temporal qualities

TEMPORAL QUALITY	DESCRIPTION
Change	a comparison, or awareness of a difference between two states at different temporal intervals
Frequency	the identification of a number of iterations of experiences, or experience types at different temporal intervals
Synchronicity	an awareness of two experiences or experience types occurring at the same temporal moment

a valuable resource which can be bought and sold, just like physical merchandise (Lakoff and Johnson 1999). Many languages − especially those associated with pre-industrialised cultures − do not conceptualise time in terms of a commodity or a resource (Evans 2004). This suggests that some temporal representations are cultural constructs. In short, Sinha and colleagues appear to be correct that some temporal representations are culture-specific.

The second claim made by Sinha and colleagues, recall, is that Amondawa lacks the concept of time-as-such (aka the Matrix conception). This conceptualisation is a pre-requisite for time-measurement systems, which the Amondawa also lack. The Matrix conception entails a reification of duration as an entity distinct from and external to our subjective, and phenomenologically real, experience of duration. This particular concept also appears to be a mental achievement; after all, conceiving of time as *the* event in which all else unfolds cannot be directly grounded in embodied experience. This would require an eternal lifespan! However, when the Amondawa acquire Portuguese, they seemingly have little difficulty in acquiring expertise in the language and the time-measurement artefacts of Brazilian Portuguese culture. This suggests that this mental achievement is accessible to the cognitively modern human mind, even if it is not native to the Amondawa culture.

7. Why must time be represented in terms of sensory-motor experience at all?

While it appears that time is grounded in interoceptive experience types that are purely temporal, many temporal concepts do, nevertheless, appear to be represented, at least in part, in terms of sensory-motor representations, especially relating to space and motion through space. A perennial question that has exercised research in cognitive linguistics concerns why this should be the case.

The answer often advanced is that of *experiential correlation* (Lakoff and Johnson 1980, 1999). Time inevitably and ubiquitously correlates with some salient aspects of spatial experience. The best worked out version is the notion of *grounding scenarios* which capture the details of the correlation (Moore 2006).

But a correlation account doesn't, in fact, provide a complete answer. After all, correlation can't account for the asymmetrical relationship between spatial and temporal representations as proposed by Lakoff and Johnson. While duration correlates with spatial length, the correlation doesn't, in and of itself, explain why time recruits structure from space, but space doesn't recruit structure from the domain of time. Experimental findings illustrate that duration and physical length are asymmetrically organised in just this way (Casasanto and Boroditsky 2008).

A more sophisticated correlation solution is provided by Grady (1997). Grady argues that for correlations to give rise to cross-domain mappings of a fundamental sort − *primary metaphors* in his parlance − the correlation must be accompanied by a qualitative distinction in the type of experiences being correlated. For Grady, temporal experiences, and the concepts that accrue, are responses to sensory-motor experiences: when we experience motion along a path we subjectively experience temporal passage, which is a response to our experience of motion. Hence, temporal concepts have what Grady terms *response content*, while sensory-motor concepts have *image content*. On this account, what makes something a source versus a target concept is contingent on whether it is a response or image concept, with target concepts involving response content (rather than whether it is concrete or abstract).

This analysis appears to be on the right track. It is plausible that temporal mechanisms and structures evolved in order to coordinate and thereby facilitate the perceptual process (Evans 2013b). Events are widely acknowledged to be the units of perception (Cutting 1981; Gibson 1979; Heider 1959; Johansson et al. 1980; Pittenger and Shaw 1975; Zacks et al. 2001). Indeed, Cutting (1981: 71) describes events as "our very units of existence". Events appear to be centred on object/action units that are goal directed (Zacks et al. 2001): they involve correlated aspects of both space and time. In seminal work modelling the provenance of conscious awareness, Crick and Koch (1990) argued that the so-called *binding problem* − how percepts are formed in the absence of a central association area for the integration of perceptual information in the brain − is achieved via the coordinated oscillation of neurons. Hence, perceptual binding may result from temporal activities which *bind* perceptual information; binding arises via temporally coordinated activity, rather than integrating information at a specific "association" site in the brain. In short, temporal processes appear to have a critical role in facilitating our perception of sensory-motor experience.

Our experience of the world comes to us via the perception of events, and events are temporally structured. Hence, it may be that it is this temporal structuring that facilitates the perception of our world of sensory experience. Hence, spatial awareness may be facilitated by the temporal mechanisms which control and facilitate perception. In short, not only is there an inevitable correlation between invariant aspects of sensory-motor experience, and time, but temporal experience appears to arise, in part (perhaps large part), so that the spatio-sensory world around us can be perceived in the first place.

But if correct, this implies that our experience of time is epiphenomenal: it arose in order to facilitate the perceptual process. Perception is about sensory-motor experience, but enabled by temporal processes. And as time is not the object of perception, but the manner whereby it is facilitated, our representational systems re-utilise the perceptually-correlated sensory-motor reflexes for purposes of re-presentation of time in the conceptual system. While our experience of time and space are distinct and distinguishable at the neurological level, at the representational level they appear to be largely asymmetrically organised.

8. Empirical research on time in cognitive science

Cross-cultural and experimental research on the nature and organisation of time is now a lively area of investigation in cognitive science, building in part on pioneering research in cognitive linguistics. Some of the key questions being addressed relate to the complex interplay between language, culture and mental representations for time, as well as the representation of time in modalities other than language, especially gesture. Other research addresses cultural and linguistic influences on temporal representation such as the nature of orthographic systems. This section provides a brief summary of some representative highlights of this body of research.

It has been discovered that the Yupno language in Papua New Guinea construes deictic time spatially in terms of allocentric topography: the past is construed as downhill, present as co-located with the speaker and future is construed as uphill (Núñez et al. 2012). Moreover, the Pormpuraawns − a grouping of aboriginal languages − arrange sequential time from east to west, whereby time flows from left to right when a person is facing south, from right to left when a person is facing north, towards the body when a person is facing east, and away from the body when a person is facing west (Boroditsky and Gaby 2010).

Other research has investigated the consequences of orthographic systems on temporal representation. It has been found that the left-to-right orientation of time in English stems from culturally specific spatial representations, i.e., the direction of orthography. As a result, the direction in which time flows along a person's lateral mental timeline has been shown to differ systematically across cultures (e.g., Boroditsky et al. 2010 for Mandarin; Casasanto and Bottini 2010 for Dutch; Bergen and Lau 2012 for Taiwanese; Fuhrman and Boroditsky 2010 for Hebrew; Tversky et al. 1991 for Arabic).

An increasingly important line of research concerns the concurrent use of gesture during spoken language use. English speakers have been found to 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-centred space. When producing co-speech gestures spontaneously, English speakers tend to use the lateral axis, gesturing leftwards for earlier times and rightwards for later times. This left-right mapping of time is consistent with the flow of time on calendars and graphs in English-speaking cultures, but is completely absent from spoken metaphors (Casasanto and Jasmin 2012; see also Cooperrider and Núñez 2009).

In the final analysis, research on the nature of time, in both language and thought, is now a lively and rapidly accelerating arena of investigation. Experimental and cross-linguistic/cultural investigations in cognitive science have been informed by the major research questions, reviewed in this chapter, as developed within cognitive linguistics.

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25. Motion[1]

1. Motion in linguistics

There are converging reasons why linguists in particular feel obliged to talk about motion. One reason is that motion expressions are considered basic and omnipresent; they are widely used not only to express spatial and non-spatial meanings (Heine and Kuteva 2002) but may also employed as structural templates for any other linguistic structure (cf. “localist approaches”, e.g., Jackendoff 1983). Another reason is that spatial organisation and expression are paramount to human cognition and generally considered to be fundamental for our thinking (Miller and Johnson-Laird 1976) and as such space and motion have been considered a crucial testing ground for linguistic behaviour (especially from the relativistic viewpoint, e.g., Levinson 2003).

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