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Time, space, and events in language and cognition: a comparative view

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We propose an event-based account of the cognitive and linguistic representation of time and temporal relations. Human beings differ from nonhuman animals in entertaining and communicating elaborate detached (as opposed to cued) event representations and temporal relational schemas. We distinguish deictically based (D-time) from sequentially based (S-time) representations, identifying these with the philosophical categories of A-series and B-series time. On the basis of cross-linguistic data, we claim that all cultures employ both D-time and S-time representations. We outline a cognitive model of event structure, emphasizing that this does not entail an explicit, separate representation of a time dimension. We propose that the notion of an event-independent, metric "time as such" is not universal, but a cultural and historical construction based on cognitive technologies for measuring time intervals. We critically examine claims that time is universally conceptualized in terms of spatial metaphors, and hypothesize that systematic space–time metaphor is only found in languages and cultures that have constructed the notion of time as a separate dimension. We emphasize the importance of distinguishing what is universal from what is variable in cultural and linguistic representations of time, and speculate on the general implications of an event-based understanding of time.

Keywords: time; space; event; language; cognition; culture

Introduction

The life world of human experience is made up of events, in which selves and other people figure as agents, performing actions directed to other agents and to objects. We are naively accustomed to thinking of objects as the most fundamental ontological category of the physical world, but from earliest infancy human beings orient primarily to *changes* in the surrounding world, learning to anticipate the regularities of events, to realize their intentions and desires through action, and to read the intentions manifested in the actions of others. By the third year of life, infants talk about the events and episodes that have been salient for them in the recent past.[1] The very structure of language attests to the primacy of the event in human cognition. Event structure, the combination of constituents encoding objects, actions, location, and motion, is the fundamental building block for sentence meaning and grammar.[2,3] Narrative, the temporal organization of event sequences expressing the factual or mythic doings of human, animal, or supernatural beings, embedded in cultural systems of meaning and value, is found in every human society, and is foundational to the emergence of self.[4,5]

We propose that the cognitive and linguistic representation of events, and inter-event relationships, is the key to understanding the human conceptualization of time. This proposal is at odds with the widespread assumption that time is everywhere, for all people, a distinct cognitive domain or dimension, perhaps based in an internal "biological clock." Our approach does, however, mesh in some respects with the classic analysis of modes of representation of temporal sequence provided by McTaggart.[6] Cross-cultural comparative analysis of linguistically encoded concepts of time allows us to answer the question: are these two modes (McTaggart's A- and B-series) found in all human groups?

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We also address the relationship in cognition and language between space and time. The universality of concepts or categories of space and time has been a key trope of Western thought since the philosophical reflections of Immanuel Kant. Present-day cognitive science has adopted this hypothesis (sometimes as an unexamined assumption), postulating the existence of a universal cognitive domain of time that (equally universally) recruits its structuring resources from the cognitive domain of space. In many, if not most, languages, space and time are linked by metaphorical mapping relations, in which construals of time in terms of space are more frequent than their inverse.[7] It has been proposed that such mappings reflect a universal conceptual "time as space" metaphor,[8] based upon asymmetries in the nonlinguistic representation of space and time.[8]

In English, it is difficult, if not impossible, to think of and talk about time as an abstract concept without employing metaphors that have as their source domain space and motion. Take, for example, Sir Isaac Newton's exposition, in his *Philosophiae Naturalis Principia Mathematica* of 1686, of his theoretical understanding of time.[10] Newton believed time, like space, to be absolute and infinite: "Absolute, true, and mathematical time, in and of itself and of its own nature, without reference to anything external, flows uniformly and by another name is called duration. Relative, apparent, and common time is any sensible and external measure (precise or imprecise) of duration by means of motion; such a measure—for example, an hour, a day, a month, a year—is commonly used instead of true time."

Paradoxically perhaps, in asserting the metaphysical independence of the dimension of time, Newton availed himself of what we can refer to as a "passage" metaphor, of the "flow" (or passage) of the "River of Time."[11] Newton's separation of time from space was, of course, challenged in the 20th century by the special theory of relativity.[12] Drawing an explicit parallel with Einstein's theory, the linguist Benjamin Lee Whorf formulated what he called "the principle of linguistic relativity" on the basis of his analysis of concepts of time and temporality in the Native American Hopi language.[13] Hopi time, he claimed, is non-Newtonian: the Hopi speaker does not conceptualize time in terms of the passage metaphor, and "has no general notion or intuition of time as a smooth flowing continuum in which everything in the universe proceeds at an equal rate, out of a future, through a present, into a past; or, in which, to reverse the picture, the observer is being carried in the stream of duration continuously away from a past and into a future."[14] Whorf's claims about Hopi are controversial,[15] but, as we shall see, there is mounting evidence that not all languages and cultures employ space–time metaphoric mappings, and that not all space–time correspondences in language are metaphoric in nature. We also draw on our own and others' research to argue that the abstract conceptual domain which we call "time as such"[16] is not transculturally universal, but the product of systems for measuring time intervals, and hence a sociohistorical construction.

First, however, we address a different, but equally fundamental comparative question: is there anything about cognitive event representations in humans that unequivocally distinguishes them from event representations in nonhuman species?

Cued versus detached representations

Many animals base their behavior on relevant time intervals, which suggests that they have the capacity to perceive duration. For example, pigeons have been trained to wait exactly 5 s before they peck on a spot that gives them a reward.[17] However, this does not entail that they have an explicit representation of time, let alone that they can communicate about time. It is useful to distinguish between *cued* and *detached* mental representations.[18,19] A *cued* representation refers to something, or a property of something in the current or recently experienced external situation of the experiencer. When, for example, a particular object is categorized as food, an animal will act differently than if it had been categorized as a potential mate.

By contrast, *detached* representations stand for objects or events that are not present in the subject's current or recent external context and so could not directly trigger the representation. An interesting example of detached representation comes from studies of problem solving in great apes in connection with the so-called floating peanut task.[20,21] In these experiments, a peanut floats in a small amount of water in a tube that is too narrow for the apes to reach into. Some orangutans and chimpanzees solved the problem by taking water in their mouths from a nearby source and spitting it into the tube, whereby the peanut was brought within reach and could be retrieved. The apes had never seen anybody else solve the problem situation previously. Hence the most plausible explanation is that they could imagine, that is, form a detached representation of, the action of spitting water into the tube and the consequences of this action.

A memory that can be evoked independently of the context in which it was created is also an example of a detached representation. There is evidence not only that animals have cued memories for food locations, and that episodic memories can be triggered by cues, but that (in the case of some corvids) they can also anticipate search for food hidden at specific locations.[22,23] But do they have detached event representations, episodic memories that can be recollected when required for planning actions? There is some evidence that apes can remember episodes and use them in planning,[24] a capacity that has been labeled "mental time travel."[25] But nothing in the animal kingdom remotely matches the cognitive and linguistic capacities of even relatively young human children, who at the age of 3 years can represent in their narratives sequences of events linked by connectives, and can use adverbs and tenses to locate events in time relative to the present.[5,26]

Detached representations not only underpin the human capacity for mental time travel, but also make it possible to refer to entities that occur only in the imagination. We argue below that comparative cultural and linguistic research supports the assertion that all human cultures have detached representations of events, and of relations between events, but not all cultures have a detached representation of a separate "time dimension" of the kind that Newton imagined.

Deictic time and sequence time: McTaggart's schemas then and now

Nothing underlines more clearly the difference between human and nonhuman temporal representations than the capacity to entertain detached representations of *relationships* between events "in time," or as we loosely say "on a timeline." In English, we can use words such as "earlier," "later," "before," "after," and "then"; we can relate a referred event to the time of speaking using the tense system; and we can temporally order events by referring to the respective dates and times of their occurrence. We can use the general term *temporal relational schema* (TRS) to designate the general class of cognitive representations conveyed by expressions using these lexical and grammatical resources. The analysis of TRSs can be traced back to McTaggart's (1908) distinction between the A-series and the B-series.[6] McTaggart's intention was, at least in part, to clarify the metaphysics of time. Our concern is rather to build on his analysis to illuminate the cognitive and linguistic representation of events in time, and to determine whether these TRSs can be identified in all cultures and languages.

McTaggart's A-series can be thought of as the representation of events seen from the standpoint of the present moment. Since the present moment is ever changing, any given event must "pass" from future to past, hence its designation by some philosophers as "passage" time. We employ the linguistically-derived, and increasingly widespread, term *D-time* (for deictic time) to designate this TRS.[27–29] D-time is the schematic basis of grammatical tense, in languages that have tenses; it is also the time of deictic adverbs like "tomorrow" or "yesterday," and of nominal temporal landmarks such as "next Christmas."

McTaggart's B-series, in contrast, is tenseless, in that it represents events solely in terms of their ordering in a sequence of events, each of which can be marked as "earlier" or "later" than other events, and in which no event is a privileged deictic center. For consistency, we shall use the abbreviation *S-time* (for sequence time), instead of B-series. S-time is the time in which relations are specified by "before" and "after," as well as "earlier" and "later," "first" and "last." Since the relative positions of events in S-time are invariant (the First World War will always have happened before the Second World War, regardless of the time of observation or utterance), this TRS has also been referred to as "positional time"[16] and as the "field-based" frame of reference.[30,31]

Both D-time and S-time can be schematically depicted as events distributed along linear timelines, and S-time can also be represented as a recurrent cycle; but such attributions should be treated with caution, as not necessarily possessing psychological reality for a given speaker of a given language. Although McTaggart referred to D-time representations as constituting a "series," this terminology is questionable, since references to past and future single events also instantiate the schema (as in "the match is tomorrow"). Calendric time is, by definition, S-time representation, but this does not mean that S-time events are intrinsically "dated" with reference to a calendar;[32] they are, rather, intrinsically *ordered*.

To our knowledge, there are no reports that any language lacks lexical resources for D-time marking, although its grammaticalization is not universal. There are tenseless languages, such as Chinese, and there are some languages in which D-time is marked on the noun rather than through verbal tense;[33] but all languages seem to have at the very least a repertoire of deictic adverbials indicating gradations of pastness and futurity of events with respect to the time of utterance. Lexical D-time systems can be of considerable complexity. The isolate language Yéli Dnye, spoken on Rossel Island off the coast of Papua New Guinea, has highly specific monolexemic terms for days from "the day before yesterday" to "the 10th day in the future," a productive system specifying days further into the future and a tense system that also references the specific day of the referred-to event.[34] The Yéli Dnye day-count system is particularly interesting, because although it is deictically anchored to the time of utterance, it also constitutes an ordinal series, thus blending properties of S-time with those of D-time. This illustrates another point to which we shall return: S-time terms are always invariant in order (e.g., the days of the week), but conceptualizations employing them may be anchored to a literal or virtual reference point, as when we compute which date will be 5 days after February 28th.[35]

S-time relations, as well as D-time, can also be specified by using the tense system, which, although it is deictically anchored to the time of utterance, can also specify sequence (e.g., "she had left by the time he arrived"), sometimes in concert with before/after terms (e.g., "he arrived after she had left") In general, S-time is more cross-linguistically variable in its lexical expression and conceptualization than D-time. Consequently, it is more difficult to establish whether its lexicalization is common to all languages. Despite claims for the universality of the lexical concepts "before" and "after,"[36] not all languages have these terms.[37] Although we know of no languages that have been reported to lack lexemes that can glossed as "early" and "late," in many cases these are deictic adverbs and it is not clear whether the S-time meanings "earlier (than Event)" and "later (than Event)" are analytically or discursively distinguishable from the D-time meanings "earlier" and "later" (than now). More generally, it seems that in many languages, and in both nonmetaphorical and metaphorical expressions, the same words and constructions may be used to express both D-time and S-time relationships; although there is no attested language in which these two TRSs are completely conflated.

Even if a language lacks both tense and before/after lexical equivalents, speakers are able to employ other grammatical resources to express S-time inter-event temporal relations. For example, speakers of Yucatec Maya employ completive and other aspectual markers to convey temporal sequence, in conjunction with the iconic mirroring of the order of occurrence of events in the order of their mention.[23,38] Thus, what might be regarded as gaps in grammar and lexicon constrain but do not preclude the conceptualization and expression of S-time. This point is further reinforced when we consider the universality across cultures of narrative (which by definition involves the representation of event sequences) as a linguistic artifact, often also represented by other, for example, pictorial, means. In fact, linguistic, pictorial, and material-symbolic artifacts can be considered to be important, in some cases the primary, means for enabling the expression of culturally significant S-time concepts. A special case of this is calendar and clock time, to which we turn below.

We conclude from this brief survey that, although both D-time and S-time schemas are almost certainly transculturally present, there is considerable variation in the specific ways in which these are organized and expressed in different languages. There has been much more linguistic research on D-time, because it is fundamental to tense systems, than on S-time, which is not conventionally grammaticalized separately from D-time, and which is expressed both lexically and in constituents of symbolic culture at a level higher than individual words or sentences (narratives, time interval, and kinship systems), often involving other semiotic resources (e.g., pictorial) than language. Investigation of these artifactual systems has been the preserve more of cultural anthropology and psychology than linguistics. S-time representation, we suggest, is more culturally variable than D-time. Furthermore, we shall argue, it is the specific means of material and symbolic mediation and representation of S-time that seems to be correlated with, and possibly causally linked to, the existence in a language of systematic space-time metaphors.

A cognitive model of events

We suggested above that *events* may be more cognitively fundamental than the categories of space, time, and object. Understanding and representing events involves all of these, as well as an understanding of causality. Within philosophy, most treatments of events are metaphysical analyses addressing their ontology. In contrast to these approaches, we briefly present a model that is cognitively grounded, based upon the theory of conceptual spaces.[3,39] An event can be described as built up from an *agent*, an *action*, a *patient*, and a *result*.[2,40] Agent and patient are roles with different properties. We assume that the agent is able to act, which in the proposed framework amounts to exerting a force. Agents are prototypically animate, but may also be abstract. An action is modeled as a force vector (or a sequence of force vectors, as in walking). The result of an event is modeled as a change vector representing the change of properties before and after the event. For example, when somebody (the agent) pushes (the force vector) a table (the patient), the force exerted makes the table move (the result vector). Or when somebody bends a stick, the result may be that the stick breaks. (When the result vector is just a point, that is, the when result is no change, then the event is a state.) The model of events also generates a natural representation of *causation*: the force vector is the cause and the result vector is the effect.

It is important to note that this model of events does not explicitly represent the time dimension. However, since actions and events are dynamic entities—they unfold over time—temporality is implicit in the model. Furthermore, events can be segmented into sequences of subevents, for example, an icicle falling, breaking, and then melting. In this case, the subevents will be a connected set of change vectors. While this segmentation can correspond to metric time intervals, it can also be entirely based on the *order* of changes (i.e., S-time) without explicitly representing duration. Thus, the semantics of verbs can be represented on the basis of this model without presupposing an explicit metric time dimension.[40] Since linguistic expressions employing D-time and S-time TRSs require detached event representations, and there are no attested languages that do not have such expressions, we can conclude that detached event representation is a universal of human cognition. However, there is no entailment in this model that detached event representations will automatically lead to detached cognitive representations of the *time dimension* ("time as such"), and indeed we shall show that there are cultures and languages in which such representations are absent.

Metric versus event-based time intervals

Although McTaggart's exposition of TRSs refers to "series of positions," events in "real time" are characterizable in terms of duration as well as succession. Duration is expressed in terms of *time intervals*, such as hour, day, or week. Within philosophy, it has been proposed that time intervals can be construed as entities derived from S-time.[41,42] The conceptualization and naming of time intervals is known to be widely culturally variable. Much anthropological linguistic research has addressed variability in calendric (or quasi-calendric) systems, and in the social practices of "time reckoning" that they permit.[43] True calendric systems are quantificational, reckoning time in metric intervals. Metric time intervals, such as "hour" and "week," make up what are often referred to as "clock time" and "calendar time."[44,45]

Metric time intervals can be distinguished from event-based time intervals. Metric time intervals are *chronological* (*cf.* ancient Greek χρόνος, *chronos* = year, time), referenced to an objective measure of "elapsed time," whereas event-based time intervals are *kairotic* (*cf.* Greek καιρός, *kairos* = weather, time, (the right) moment), qualitative and normative in nature, nonmetric, and referenced to "happenings" (including activities).[46] Event-based time intervals are intervals whose boundaries are constituted by the event itself. In this sense, there is no cognitive differentiation between the time interval and the duration of the event or activity which defines it, and from which, in general, the lexicalization of the time interval derives. The reference event is often natural (such as "spring," e.g., "let's take a holiday in the spring"), but sometimes conventional (such as "coffee break," e.g., "let's discuss this during coffee break").

Although metric time intervals are based upon natural (astronomical) cycles of events, their divisions are conventional, and measurement of temporal duration is arrived at by counting in a number system. Calendric systems usually possess a recursive structure such that different time intervals are embedded within each other, and/or a structure of metrically overlapping intervals. These intervals are typically cyclical in nature, with both embedded and overlapping cycles. The most familiar to us is the now internationally adopted lunar and solar (more strictly, monthly and annual) Gregorian calendar. A dramatic example of the complexity that numerically based calendric systems can attain is provided by the classical Mayan civilization of Central America, which used three different calendar systems. Calendric systems are not merely "timekeepers," they are expressive of cultural beliefs and values. The Gregorian calendric system, for example, conceptually superimposes on its cyclic structure a linear model of time as motion from an origin (the birth of Christ) to a notional endpoint (the End of Days).[47] This dualistic cyclical–linear conceptualization (with varying relations of dominance between cyclicity and linearity) is characteristic also of other calendric systems, such as the Mayan, the Islamic, and the Vedic.[48]

Calendars and clocks are cultural inventions that provide material–symbolic representations of metric time intervals (Fig. 1). Not all cultures have calendar or clock time or employ metric time intervals. For example, Sinha *et al.* describe the Amondawa language and culture of Amazonia, in which there are only four numbers.[25] Amondawa employs seasonal and diurnal event-based time interval systems (Fig. 2), but has no calendric terms, including terms for month and year. Having a larger number system is a necessary condition for constructing a calendar, but it is not a sufficient one. Levinson and Majid report that the Yéli Dnye language (see above), despite having a productive number system and a numerically based D-time diurnal reference system, lacks calendric terms.[30]

Calendars and clocks represent conventional, metric S-time interval sequences. Pictorial artifacts may serve similar purposes by depicting event-based intervals in their conventional or natural S-time order. Even where pictorial or other material–symbolic time interval representations are culturally absent (as in Amondawa and Yélî Dnye), S-time may be represented by linguistically transmitted symbolic knowledge systems. Noncalendric seasonal and diurnal time interval systems may be regarded as culture-specific S-time artifacts. Kinship systems, genealogical memory, and some other social symbolic systems also clearly involve S-time representation. A striking example of the latter is the Amondawa onomastic system, in which individuals change their names at transition points in their "passage" through different life stages, drawing from an inventory structured by gender and moiety as well as the named life stages (Table 1).[49]

Figure 1. A medieval clock in Lund Cathedral, Sweden (image © Chris Sinha).

Spatial metaphors for time

We noted above that spatial metaphors for time abound in the languages of the world, and this has led some cognitive scientists to propose that the "time is space" conceptual metaphor is a human cognitive universal.[8] It is indeed the case that most, perhaps even all, languages have some words that are used with both spatial and temporal meanings; but not all of these are readily classifiable as metaphoric usages, and it is often difficult to decide whether single-word usages involve metaphor or metonymic fusion.[50] To rigorously test the hypothesis that space–time metaphor is universal, we need to focus on usages that are systematic and unambiguously metaphoric in nature. One class of

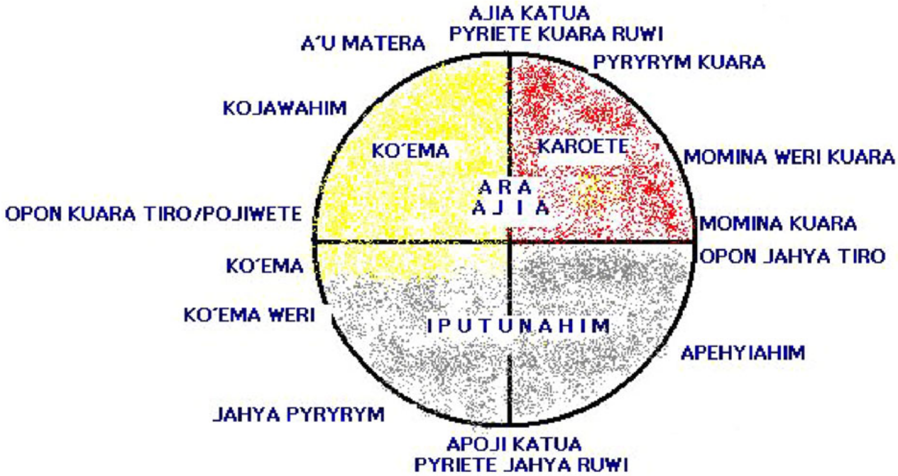

Figure 2. Divisions and subdivisions of day in night in Amondawa: a cyclical representation by researchers (image © Vera da Silva Sinha and Wany Sampaio).

metaphor that fulfills these criteria is exemplified by the quotation from Newton above, in which time passes or flows. This has been called the moving time metaphor.[51] Sometimes, it is not time as a "thing," dimension, or moment that moves, but events in time, as in "my birthday is approaching." In a complementary schema, the moving ego schema, the speaker (or another experiencer) "moves" toward an event, as in "he is approaching his birthday." Moving time and moving ego are the two possible variants of passage metaphor; the movement either of an event past the deictic center, or the deictic center past an event (Fig. 3).

The two passage metaphor schemas are D-time conceptualizations employing motion verbs. An analogical static metaphoric schema in S-time (the earlier than/later than schema) is what we call positional metaphor, exemplified by constructions such as "check-in is ahead of security." Positional metaphor relies for its intelligibility on the shared understanding by speaker and hearer of the metaphoric orientation of a timeline in the front–back, vertical, or horizontal plane. In English, the future is ahead and the past is behind. This is not the case in all languages. In the Aymara language family of the Andes[52] and in Yucatec Maya, the timeline orientation is reversed, so that, for example, in Yucatec Maya "my old age is behind me," means it is in the future.[23] Recall that in Yucatec Maya, there are no equivalent terms to "before" and "after;" and it seems that passage metaphors are also absent. Other languages (e.g., Amondawa and Yéli Dnye) seem to lack both passage metaphor and positional metaphor; we are not aware of any languages

Table 1. Amondawa names (incomplete inventory) by moiety, gender, and life stage

Arara (F)	Arara (M)	Mutun (F)	Mutun (M)	Life stage
Tape	Awip	Morãg	Mbitete	Newborn to toddler
Potei	Tangãe	Pote´i	Kuembu	Child to preadolescent
Poti´I	Pure-Tebu	Mbore´i	Koari	Adolescent (from puberty)
Kunhate	Juvipa	Mboraop	Tarup	Young adult
Mande´I	Purap	Mboropo	Yvaka	Adult
Adiju	Mboria	Kunhápó	Moarimã	
Umby	Mboria	kunhaviju	Mboava	
Mytãg	Jari	Mboréa	Uyra	Elder

Note: Reproduced by permission from Ref. 49.

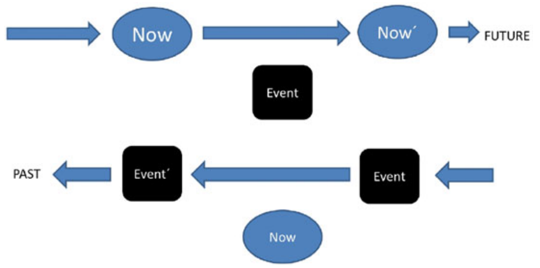

Figure 3. Two metaphoric passage schemas. *Moving ego* (the deictic center "moves" past an event into the future) and *moving time* (an event "moves" past the deictic center into the past).

that have been reported to use passage metaphors but not positional metaphors.

Before we discuss possible reasons for the presence or absence of passage and positional metaphor in particular languages, we can note that positional metaphors, while basically representing S-time relations, often blend aspects of *both* D-time *and* S-time. This is precisely because, unlike nonmetaphoric S-time expressions such as "check-in is before security," positional metaphors like "check-in is ahead of security" can be oriented along a direction anchored to the perspective of the speaker, experiencer, or imagined third party. In this, positional metaphors are a counterpart to the numerically ordered, but deictically anchored, day series in Yéli Dnye, discussed above.

Why do some languages *not* employ systematic space–time metaphor? We can discount, on empirical grounds, the possibility that some cultural groups simply do not understand metaphor in general, or the notion of space–time mapping in particular.[25] We suggest that the answer is to be sought in the cognitive consequences wrought by the invention of symbolic cognitive artifacts like clocks and calendars. Our hypothesis is that the abstract "Newtonian fourth dimension" that we label "time as such" is not a universal conceptual domain, but a cultural model that has shaped our cognitive ecology, to such an extent that it is difficult to think "outside" it.[25,53] Yet it may be that it is only "inside" this cultural model that systematic space–time metaphor has emerged as a regular and productive linguistic and conceptual metaphor.

Other, quite distinct, cultural models, such as "Andean space–time," or *pacha*, are sometimes interpreted as if they were manifestations of a universal, metaphoric, spatial construal of time;[28] but we suggest they are better interpreted as integral constituents of unified social, cognitive, and moral universes.[50,54] In view of this, Whorf, although he was wrong to think that language determines cognition, should be credited with a fundamental insight that still bears repeating: languages reflect and express distinctive worldviews as much as cognitive universals, and it is important to distinguish what is variable from what is shared in human cognition.

Concluding reflections

The mathematician Hermann Weyl famously wrote that "The objective world simply is, it does not happen. Only to the gaze of my consciousness, crawling upward along the world line of my body, does a section of the world come to life as a fleeting image in space which continuously changes in time."[55] In such a view, the subjective experience that is conceptualized and linguistically expressed in passage and positional metaphors bears no clear relationship to ultimate physical reality, in which there are no events. We are not qualified to pass judgment on questions of physics and cosmology, but we can offer the following reflection.

Our argument has been that event representation is the fundamental basis of the human understanding of, and communication about, time. Whether or not the experience of duration is in some way neurologically hardwired, this is neither essential for event representation nor mapped directly to time-interval concepts. Rather, time as a cognitive domain is emergent from event representations, and in particular from detached event representations. Human beings in all cultures construe temporality in terms of event-based deictic and sequential TRSs. However, there are significant variations between cultures in the specific organization of these schemas, and in their relationships with schemas organizing other domains, including space. In some, but not all cultures, time is itself conceptually elaborated into a detached and abstract dimension, which may prompt or enable the systematic spatial construal of time in terms of metaphors of passage and position. If our argument is correct, it is "eventness," not "time as such," that is fundamental to, and universal in, human thinking.

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Conflicts of interest

The authors declare no conflicts of interest.

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