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TECHNICAL REPORT

Doing time: Speech, gesture, and the conceptualization of time

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Doing time: Speech, gesture, and the conceptualization of time

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Abstract

Gesture is intimately linked to speech in both timing and semantic content, and thus provides an extremely rich source of empirical evidence about the nature of abstract conceptual thought. Building on previous research into the metaphorical construal of time as space, we investigate the role of gesture in English speakers' moment-to-moment temporal conceptualization processes. In a controlled observational paradigm, participants were video-recorded telling each other the story of the history of the universe as presented to them in a graphical stimulus. Based on our data, we suggest a classification of English speakers' temporal gestures into five types— placing, pointing, duration-marking, bridging, and animating— and provide examples of each type. Discussion focuses on the following three topics: the usefulness of quasi-experimental approaches for the study of abstract thought; variability in temporal gestures, both across different discursive moments and across different cultures; and how temporal gestures fit into a broader understanding of metaphorical gestures.

Temporal gestures

The study of language has traditionally focused on speech and written texts. Other dimensions of human communication are bracketed off as "paralinguistic" and consigned to the murky category of "nonverbal communication". For those interested in language as a static formal object, this bracketing off may make sense; but for those interested in the dynamic cognitive processes behind situated language production and comprehension, it is unfortunate. Our focus here is on one dimension of so-called "nonverbal communication"— gesture— by which we mean those spontaneous movements of the hands and body that are naturally co-produced with speech. Gesture as such constitutes a universal feature of human linguistic production across cultures. Fortunately, in the last decade or so, the still small field of gesture studies has moved forward dramatically, thanks to the work of pioneers such as Adam Kendon (2004), David McNeill (1992, 2005), Susan Goldin-Meadow (2003), and many others.

The principal finding of gesture studies— which now includes researchers in child development, neuropsychology, linguistics, and anthropology— is that verbal and gestural production are intimately linked. Consider the following sources of evidence that support a view of speech and gesture as two complementary facets of human language production:

1. Speech-accompanying gesture is a cross-cultural universal (Iverson & Thelen, 1999; Kita & Essegbey, 2001; McNeill, 1992; Núñez & Sweetser, 2006).

2. Gestures are co-produced with speech, in co-timing patterns which are specific to a given language (McNeill, 1992).

3. Gestures can be produced without the presence of interlocutors, e.g., people gesture while talking on the telephone, as well as in monologues. Congenitally blind subjects gesture as well (Iverson & Goldin-Meadow, 1999).

4. Stutterers stutter in gesture too, and impeding hand gestures interrupts speech production (Mayberry & Jaques, 2000).

5. Gesture and speech development are closely linked (Bates & Dick, 2002; Goldin-Meadow, 2003; Iverson & Thelen, 1999).

6. Gesture provides semantic content that is complementary— as well as overlapping— to speech. Speakers synthesize and subsequently cannot distinguish information taken from the two channels (Kendon, 2000).

7. Linguistic metaphorical mappings are paralleled systematically in gesture (Cienki, 1998; McNeill, 1992; Núñez & Sweetser, 2006; Sweetser, 1998).

In all these studies, the careful analysis of various parameters of gestures— most importantly, handshape, use of gesture space, palm orientation, trajectories, manner, and speed— as they relate to co-produced speech has yielded deep insight into cognitive processes. In the present article, we focus on composite conceptualizations— that is, spontaneous co-expressive combinations of speech and gesture— that participants produced when reasoning about and communicating concepts in the domain of time (Engle, 2000). By studying these composites productions rather than the verbal output alone, we are able to better understand the highly systematic, imagistic, and culture-specific way that English speakers conceptualize time.

The phenomenon of time-related gestures was first noted by Andrea de Jorio in his nineteenth-century treatise on gesture (De Jorio, 2000). He remarks that Neapolitan speakers refer to past time by thrusting a hand backwards over the shoulder (see pg. 312). Modern readers may recognize this gesture, as well as related gestures produced when talking about the present (e.g. a point downward) or the future (e.g. a point forward). Such actions belong to a class we call here temporal gestures. We report results from a larger, ongoing observational study of how English speakers reason about and communicate temporal concepts in conversation. In our paradigm, participants tell each other a version of the history of the universe. The findings of the study suggest that the phenomenon of temporal gesture is both more textured and more commonplace than previously appreciated. Time, which has long been a paradigm case for researchers interested in human abstraction and conceptual systems, also turns out to constitute an important case study in "metaphorical gesture". Our investigation here involves both zooming in on the microdynamics of form-meaning relations in specific gestures and zooming out to appreciate how different temporal gestures together constitute a domain of embodied knowledge. Such micro- and macro-level analysis demonstrates that English speakers' temporal gestures exhibit a striking degree of systematicity.

Though time as a domain is paradigmatically abstract, temporal concepts are of enormous practical importance. They are deployed in routine activities like baking cakes, setting out agendas, and sharing creation myths. The human cultures studied thus far have all addressed this problem in the same way: by talking about time in terms of a more concrete domain, space (Clark, 1973; Evans, 2003; Fauconnier & Turner, in press; Lakoff & Johnson, 1999; Moore, 2000; Núñez, 1999; Núñez & Sweetser, 2006). Speakers use a vocabulary from the domain of physical objects— and certain aspects of this domain, such as motion, length, and relative position— to talk about temporal entities and temporal relations. For example, in English events can be said to "go slowly" (motion), take a "long time" (size), and occur "before" other events (position). At least at the linguistic level, then, there is a systematic mapping between entities and relations in the domain of time and corresponding entities and relations in the domain of space. As with metaphorical mappings more generally, the systematic nature of this mapping allows that inferences made in the domain of space translate straightforwardly to the domain of time.

One finding to come out of such linguistic analysis is an important distinction between ego-moving and time-moving construals of time. On an ego-moving construal, the subject is conceptualized as moving with respect to static temporal landmarks, e.g. events. Examples in English include, "We are approaching the new year", or "She's getting closer to her birthday". On a time-moving construal, events are conceptualized as moving with respect to a static subject. Examples here include, "The new year is approaching", or "Her birthday is getting closer". Both of these construals assume an ego as the reference point (and will be hereafter abbreviated as ego-RP). Recently, several researchers have argued for another class of temporal construals that take other temporal entities as their reference points (Moore, 2000; Núñez, 1999; Núñez, Motz, & Teuscher, 2006)[1]. Examples of time-RP expressions in English include: "The meeting is after the coffee break", or "January follows Christmas". In using such expressions, no ego is implied. Importantly, these different possible construals are often discernible from co-speech gesture, even when they are not discernible from speech alone. A number of verbal temporal expressions (e.g. "The next conference") might be conceptualized according to either a time-RP or an ego-RP construal. In such cases gesture is an indispensible analytic resource for understanding temporal reasoning processes.

[1] See also Núñez, Motz, and Teuscher (2006) for empirical work on the psychological reality of this distinction

In addition to the purely linguistic data adduced from a range of languages, there is an ever-growing body of experimental literature suggesting that people reason about time in situ using spatial reasoning abilities (Boroditsky, 2000, 2001; Boroditsky & Ramscar, 2002; Casasanto & Boroditsky, in press; Matlock, Ramscar, & Boroditsky, 2005; Núñez et al., 2006; Teuscher, McGuire, Collins, & Coulson, in press; Torralbo, Santiago, & Lupiáñez, 2006). Behavioral experiments most often demonstrate the psychological reality of time-space metaphors by first priming subjects to construe space in a certain way and thenmeasuring how this priming affects subsequent temporal construals[2]. For example, Boroditsky & Ramscar (2002) found that participants' recent embodied experiences (e.g. flying on an airplane) changed how they responded to an ambiguous temporal reasoning question about the time of a future meeting: "Next Wednesday's meeting has been moved forward two days. When is the meeting?". Those who had recently experienced sustained motion (e.g. a plane flight) were more likely answer according to an ego-moving construal (i.e. Friday); those who had not experienced sustained motion were by comparison less likely to adopt a time-moving construal (i.e. Monday). In a related vein, Torralbo, Santiago, and Lupiáñez (2006) explored how manipulating immediate attentional factors affects whether Spanish speakers adopt a temporal frame that is left-to-right or front-to-back. The experimenters manipulated a seemingly irrelevant feature of the task— namely, whether participants provided answers orally or by pressing keys on the left and right of a keyboard— and found that this affected response times to time-related questions. Their findings suggest that people are indeed flexible in adopting either frame, and that which frame subjects adopt is modulated by immediate bodily circumstances.

Convergent evidence for these conclusions can also be found via another method: naturalistic observation of what speakers do with their hands and bodies when reasoning about time in conversation. Yet only a handful of studies have looked specifically at the gestural evidence for spatial construals of time. The most complete discussion of time-related gestures to date is offered by Calbris (1990, pp. 85-93). She observes that, in European cultures, the future is in front of the speaker or off to the right; the past is behind the speaker or off to the left; and the present is at the speaker's feet. Reference to past or future time can thus be made by motions of the head or forefinger in the correct directions. After laying out these basic patterns, her discussion proceeds to describe gestures that accompany expressions of succession, continuity, and interval, among other temporal notions. With these observations, Calbris describes in broad strokes the French pattern of temporal gestures, and her observations generalize with few exceptions to English speakers[3]. Here we build on her important observations by casting temporal gestures in the theoretical framework of cognitive linguistics and metaphor theory. Such a framework is ultimately required, we argue, for a full understanding of the phenomenon of time-space metaphors and their systematicity.

There has been little interest in the specific temporal gesture habits of English speakers. However, in an important early paper on metaphorical gestures, Cienki (1998) does note a tendency for speakers to project events onto an "imaginary timeline" running from left to right, such that earlier events are positioned to the left and later events are positioned off to the right. He makes no mention of the future-front, past-back mapping described by Calbris, a point to which we return in discussion. A key observation to come out of Cienki's discussion is that metaphorical gestures are often unaccompanied by what we would recognize as metaphorical language. In such cases, metaphorical gestures provide the analyst privileged backstage access, as it were, to the imagistic and spatial properties of conceptualization. A good example of this from Cienki's study is a speaker saying "you may get a worse grade" while producing a gesture in low space. The position of this gesture tips the analyst off to the fact that grade quality is being conceptualized in terms of verticality, with better grades higher than worse grades. Such tacit metaphoricity is the norm—rather than the exception— in the data we report on here. Expressions for events (e.g. "the New Year") or specific times of day (e.g. "1:30 pm") are not intrinsically metaphorical, but they can be said to be metaphorical insofar as co-produced gestures spatialize them.

In a recent experimental study of metaphorical gestures, Casasanto & Lozano (2006) had participants take turns telling each other short stories,

[2] However, for recent failures to replicate Boroditsky's important early findings, see January & Kako (in press) and Chen (in press).

[3] A notable point of difference is Calbris' emphasis on head gestures. While we did observe several of these in our data, they were much rarer than hand gestures.

some of which included temporal concepts. They found a left-to-right temporal gesture pattern in English speakers but, again, they do not comment on the back-past, future-front pattern. Both of these English language studies are aimed at questions about metaphorical gesture more generally and do not take up specific questions about temporal gesture. Thus, while the authors point out a coarse-grained left-to-right pattern, they do not discuss in detail how this pattern is constituted across different instances of temporal gesture.

Questions abound. Are all temporal gestures the same? If not, in what ways does one temporal gesture vary from another? In what ways is variation in temporal gestures related to variation in the accompanying speech? Finally, what does it mean exactly for a speaker to produce a gesture that is consistent with a left-to-right temporal trajectory? Detailed analysis reveals that temporal gestures are not conventionalized, but reflect variation in morphology, dynamics, and use of gesture space— in short, they show variation along the same parameters as other co-speech gestures. The pre-analytical intuition that the meaning of such gestures is obvious is no substitute for careful analysis of how this putative obviousness is achieved.

The small literature on time and gesture cited above— in addition to anecdotes and native speaker intuitions— suggests two commonplace temporal gesture patterns in English. The first is the sagittal pattern, in which the past is mapped behind the ego, the present is mapped to a spot collocated with the ego, and the future is mapped to the ego. The pattern seems to be motivated by a metaphor of the gesturing body as locus of movement through space and time: the present is where one currently stands, the past is where one once stood, and the future is somewhere up ahead where one will stand. The unidimensional trajectory of time thus runs from front-to-back. The second is the transversal pattern, in which the unidimensional trajectory of time is from left to right, such that later events are located to the right of earlier events. A crucial difference is that the sagittal pattern most often takes the ego as its reference point, whereas the transversal pattern does not necessarily involve an ego. To sum this idea up intuitively, it may be said that the sagittal pattern is anchored to the deictic “now”; the transversal pattern is not anchored in this way, but construes events relative to each other. Thus, a speaker may use the transversal pattern to talk about two past events, gesturally locating one off to her left and one off to her right.

The present study intends a detailed characterization of the phenomenon of temporal gestures in English. In the next section, we outline our quasi-experimental observational method, which allows us to control certain features of a storytelling setting, while still approximating a naturalistic conversational situation. We then present a taxonomy of temporal gestures with examples of each type, arguing that English speakers' temporal conceptualizations are motivated by a shared and highly systematic body of conceptual knowledge and imagery. Like all spontaneous hand gestures, these examples are idiosyncratic, yet unlike most spontaneous hand gestures, they systematically pair culturally shared imagery with shared affordances of the gesturing body. In the general discussion we: 1) briefly review the advantages of the methodology used here, suggesting it may be a useful one for studies of metaphorical gesture in other domains; 2) consider variability in temporal gestures from one discourse moment to the next, as well as variation across cultures; and 3) explore implications of our data for the study of metaphorical gesture in general.

Methods

The observational paradigm in this study is similar to that used by David McNeill and collaborators in their groundbreaking gesture studies (see McNeill, 1992, pg. 374 for methods discussion). Participants were undergraduate and graduate students who participated either voluntarily or in exchange for course credit. On all recruitment materials and consent forms, our interest in gesture was deliberately concealed, and participants were not told anything about the content (e.g. history of the universe) of the stimulus materials before beginning the task. Participants were told that the investigators were studying storytelling. Unlike McNeill's earlier studies, we chose to manipulate select aspects of the stimulus while holding other aspects of the observational set-up constant. These manipulations do not bear on the questions discussed in the present study, in which we focus on temporal gesture patterns that were observed across all of the studies.

Stimulus materials

The primary stimulus used was an image depicting the history of the universe. It measured 36 by 9 inches. The image was printed on a continuous sheet of paper, laminated, and mounted on foam board. It was presented approximate at eye-level to a first participant (P1) on a tripod. The tripod-based

mounting device for the stimulus was introduced as a means of controlling how the stimulus was viewed. Idiosyncratic handling of the stimulus, we reasoned, may have introduced noise in the subsequent gestures.

On the far left of the image is a depiction of big bang and at the far right a depiction of a satellite in space. Various iconic events in the earth's history— for example, the formation of life in the oceans and the construction of Stonehenge— are shown in between. The image is continuous but there is an implicit segmentation of the narrative into approximately ten events. In addition to the images, there are two timelines. The first timeline, which runs across the top of the image, pegs the events to times on a digital clock. It begins above the image of the big bang (12:00 am) and is introduced with the words, "If the history of the universe were compressed into a single day…". The second timeline, which runs across the bottom of the image, positions the events with respect to today (e.g. 300 million years ago), the system more frequently used in scientific and instructional contexts. On this bottom scale, the big bang is tagged as having occurred 15 billion years ago. Participants were all familiar to some extent with the content of the story— indeed, the stimulus would not be intelligible otherwise.

The stimulus was specifically designed to elicit temporal reasoning. The task requires that P1 first do some conceptual work to figure the stimulus out and some further conceptual work to successfully tell the story to a second participant (P2). Whereas McNeill's original stimuli were dynamic cartoon movies with explicit segmentation of the narrative into events, our stimulus is static and bears only implicit segmentation. As a result, participants are free to view the image in any order they choose, or to linger on certain features of the stimulus while paying little attention to others. Furthermore, any motion that participants attribute to events in the story or to time itself is a product of their own conceptualization processes. But why is the stimulus a good one for eliciting temporal reasoning? At a basic level, the stimulus conveys a narrative, which, like all narratives, is made up of events that occur in a certain order (though again, the nontrivial task of event segmentation was left to P1). Arranging events in correct temporal order is a common task that involves a straightforward but important form of reasoning. Further, as mentioned above, there are two timescales involved— a clock timescale and a cosmic timescale— which must be mapped onto each other if the premise of the image is to be fully understood. While overall participants had little trouble with this mapping, the temporal reasoning involved is hardly pedestrian. Also, the two timescales have different implied vantage points, or reference points. The clock timescale starts at the big bang and continues on to the present day. The implied vantage, or reference point, is thus the beginning of the day at the first midnight. The cosmic timescale also starts at the big bang but the implied reference point is "today". That is, the convention of listing the times in terms of years ago from today suggests a kind of looking back on the history of the universe. Finally, both timelines are non-uniformly compressed. For example, the story jumps from 12:00 am (midnight) to 4:36 pm (mid-afternoon) in a matter of inches. In approximately the same distance, the scale moves from 4:36 pm to 6:48 pm. Thus the scales are not linear but quasi-logarithmic.

The observational paradigm

The first participant, P1, is presented a graphical stimulus that depicts the history of the universe (as described below, an auditory version was also used as a control). P1 studies the stimulus for as long as they choose and then it is removed. At that time, the second participant, P2, who has not seen the stimulus, enters the observational room. P1 then tells P2 the story. When both participants are confident in P2's understanding of the story, P1 leaves and P2 moves to the "narrator's stool" (i.e. the stool formerly occupied by P1, left position in all examples). A third participant (P3)— who, again, has not seen the stimulus— enters the room, and P2 then tells their version of the story. Both narrative sequences—P1 to P2 and P2 to P3— are videotaped. After the second story has been completed, all of the participants are given a brief questionnaire to better understand their handedness and language background.

A few details about the participants' written instructions are worth mentioning. P1 is instructed to pay attention to details and take as much time as needed. They are also instructed to tell the story "as the image depicts it". This phrase was included to deter subjects from trying to flesh out the story from their own knowledge base. Such fleshing out would have complicated the task of trying to analyze how different subjects narrated the same events. Both P1 and P2 are told in their instructions that P2 will have to retell the story later on. Finally, it should be noted that P2 was explicitly encouraged to ask questions in order to promote lively interaction.

We reasoned that the non-verbal behavior of both P1 and P2 (and of P2 and P3 in the second narrative sequence) would be of interest, so they were both given equal space on the film. Stools were used to allow maximal range of motion and to discourage participants from finding a natural resting pose. An additional and unforeseen advantage of stools is that they make shifts in body weight readily apparent. Previous gesture studies have used chairs with armrests, which may suppress certain kinds of expressive movement by offering a natural resting pose.

Overview of five studies

Five different versions of the study were carried out, each involving a different version of the stimulus or paradigm. 20 groups were recorded in all, yielding 38 separate narratives sequences[4]. In total, 50 people participated in the study (26 males; 24 females). Each version of the study was designed to answer specific questions about temporal reasoning—questions that we do not take up specifically in the present paper. We present details of the different studies here not only in the interest of experimental transparency, but also to make the crucial point that the types of temporal gestures we observed transcended the specifics of the task and the stimulus.

Study #1— Standard. The first study followed the standard paradigm described in the previous section and used the standard stimulus (36 in., left-to-right). Four groups (8 narratives total) were recorded involving 12 participants (7 males; 1 female).

Study #2— Mirrored. The second study followed the same paradigm as the first study but involved a manipulation of the standard stimulus. We presented participants with a digitally produced mirror-image of the standard stimulus, in which the story implicitly begins on the right with the big bang and ends on the left. The scale and other formal properties of the stimulus remain unchanged (36 in.). We recorded four groups (6 narratives total) involving 10 participants (9 males; 1 female).

Study #3— Life story paradigm. The third study used the same mirrored stimulus as the second, but involved a manipulation of the paradigm. The instructions and first narrative sequence were identical to those in other studies. However, as soon as the first narrative sequence was completed, P1 was given a new set of instructions: to tell P2 a version of their life story, starting 10 years ago and continuing to the present year. P1 was not given any time to prepare for this second narrative sequence. There was also a third narrative sequence in which P2 chose one of the two stories— the universe story or the P1's life story— and retold it to P1. We recorded 4 groups (12 narratives total) involving 8 participants (7 females; 1 male).

Study #4— Small. The fourth study followed the same paradigm as the first three studies but involved a different manipulation of the form of the stimulus. We presented subjects with a miniature version of the standard stimulus. The dimensions of this mini version were 9 inches across and 2.25 inches tall. The stimulus was otherwise unaltered and runs from left to right. We recorded four groups (8 narratives total) involving 12 participants (6 females; 6 males).

Study #5— Auditory. The final study was designed as a control. We presented participants with an auditory version of the history of the universe. How would participants perform this task given no imagistic resources? In designing this stimulus, we made a deliberate effort to model the narratives given by previous P1s[5]. The script was recorded and presented to participants on an iPod. The audio version is 2:04 minutes, and participants were allowed to listen to it as many times as necessary, or to stop and restart at any point. We recorded four groups consisting of only one narrative sequence each (4 narratives total) involving 8 participants (5 females; 3 males).

Results

In this section we report on five types of temporal gestures produced frequently by our participants in all the above versions of the study[6]. According to

[4] In certain cases a second narrative sequence was not conducted because one of the scheduled participants did not show up.

[5] Based on P1s' earlier stories, we recorded an auditory universe story that reflected the most common: 1) introduction of the narrative frame; 2) segmentation of the story into discrete events; and 3) the most common phrases used to describe those events.

[6] Participants' gestures did vary along certain fine-grained features— specifically, directionality (Studies 2 and 3) and scale (Study 4)— depending on which version of the study they were part of. The nature of this fine-grained variation is a matter of ongoing research. We should also note that, impressionistically, the types of temporal gestures produced by P1s when initially telling the story and by P2s when retelling the story were not qualitatively different.

what criteria should temporal gestures be classified into types? Again, we emphasize that temporal gestures are parts of composite conceptualizations—that is, cognitive acts that minimally include motoric action, speech, and mental imagery. But since the analyst has no direct access to mental content, we must present taxonomical divisions that consider only: 1) the morphology and dynamics of the gesture; 2) the particulars of the accompanying speech. It should be noted that the overwhelming majority of observed gestures in our data set were transversal. The only sagittal gestures we observed were downward points associated with expressions like "now" and "today", and even these were rare. This broad tendency fits with earlier observations of English speakers made by Cienki (1998) and Casasanto & Lozano (2006), even as it contradicts more impressionistic data about English speakers' temporal gesture habits. There are likely good reasons for this observed imbalance, which we take up in the discussion. The important point is that, while the temporal gesture types presented here are in principle abstract enough to apply to either sagittal or transversal gestures, they were developed almost exclusively on the basis of examples of transversal temporal gestures.

Placing

A placing gesture is one in which a named event or time (e.g. "the big bang") is gesturally located in a speaker's peripersonal space. The location of the placement becomes the referent, such that it is possible to refer back to it in later discourse. Events can be placed absolutely, or else they can be placed relative to other previously or concurrently placed events. In terms of morphodynamics, a placing gesture can involve any number of handshapes, but most often involves a downward stroke. There is a strong possibility—which we note here as a hypothesis awaiting future empirical validitation—that different handshapes used for placing gestures enact subtle variations of meaning. For example, while a floppy, open handshape might be used to locate a vague temporal region (e.g. the beginning of the universe), it is unlikely that such a handshape would be used to locate a specific time of day (e.g. 4:15), or any similarly focal event. Conversely, it would be unlikely that a well-articulated, "cutting-edge" handshape would be vigorously downstroked to place a non-focal event (e.g. the early part of the century)[7]. A placing gesture prototypically occurs at an unmarked height, approximately at a speaker's waist when seated.

Because placing gestures involve downward rather than transversal strokes, it is important to specify how any sort of temporal trajectory may be inferred from them. If a single temporal entity is placed in isolation, the temporal trajectory can only be inferred by the location of the gesture in the speaker's gesture space. It is unproblematic to assume a left-to-right temporal trajectory if, for example, the speaker produces a placing gesture in their left peripheral space while saying "the beginning of time". Of course, it is hard to infer temporal trajectory from absolute placing gestures that occur more toward the middle of the speaker's body. Quite often, events are placed relative to other events in such a way that the earlier-than or later-than relation holding between the two is more foregrounded in the discourse than their absolute position on a larger time scale. Relative placing gestures such as these are thus more likely to occur in the speaker's unmarked central gesture space. For example, a speaker says "the dinosaurs were right after the jellyfish", first placing the "dinosaurs" in slightly right middle space and then placing the "jellyfish" in slightly left middle space. In such cases, the temporal trajectory motivating relative placing gestures is straightforwardly inferred: the later event is placed to the right of the earlier event if a left-to-right trajectory is conceptualized.

Example (1)

1. P1: So, that was the history of the universe

2. From [fifteen] billion years ago till [today]

3. In- in twenty four hours

Example 1 is taken from Study #5 (auditory). P1 produces two placing gestures in line 2. In the first, as she says "fifteen" she brings her left hand down to her left thigh, with the palm oriented vertically as though in a chopping motion (see Figure 1a); in the second, as she says "today" she brings her right hand down to her right thigh in a similar chopping motion (see Figure 1b). The left-to-right temporal trajectory can be inferred from the relative position of the events in her gesture space.

[7] Examples presented elsewhere in this paper—as well as throughout the gesture studies literature— support the idea that there are relatively fine-grained form-meaning relations between gesture and speech. The interesting question, of course, is at what level of specificity these relations can be shown to be systematic.

(A)

(B)

Figure 1a and 1b.

Pointing

In certain cases, participants pointed to events or times as though they had concrete, visible locations. As with canonical pointing gestures to perceptible referents, temporal points project a line with some part of the body—usually the index finger, but also the whole hand, the head, or a held object— to a region of space (Kita, 2003). The difference between a temporal placing gesture and a temporal pointing gesture is analogous to such gestures in the context of spatial description[8]. A placing gesture actually positions a temporal entity in space; a pointing gesture, by contrast, projects a line in the direction toward which an entity lies (see Example 2 for comparison). It can be hard for the analyst to make a definitive judgment at times between these two possibilities, but pointing and placing presumably constitute cognitively different conceptualizations. Temporal points often occur after a speaker has already populated the space with an imaginary timeline, but they can also occur before any such population has occurred (see Haviland (2000) for discussion of presupposing versus creative pointing gestures).

This class of temporal gestures is most often distinguished by its handshape, with the index finger extended and the rest of the fingers curled back into a fist. Other morphologies were observed less frequently. For example, full hand flicks in the direction of entities were observed, as were, in rare cases, head and foot points. As with placing gestures, trajectory is inferred in two ways. Either more than one temporal entity is pointed to over a stretch of discourse, thus establishing their relative position; or the underlying temporal trajectory can be inferred from the location of the pointed-to entity in absolute peripersonal space.

Example (2)

1. P2: And then civilization happened

2. Wars et cetera

3. And then [satellite]- was the satellite at like

4. [midnight] or something?

Example 2 comes from Study #1 (standard). P2 is checking to make sure she has understood the story, and produces two temporal gestures in lines 3 and 4. First, as she says “satellite” she points with both hands off to her right (see Figure 2a); then co-timed with “midnight”, she extends her right hand off to her

[8] As one reviewer noted, there is a connection between the placing and pointing categories we suggest here and a related distinction made by Clark (2003). Clark considers the difference to be that an act of placing offers an object up for the listener, while an act of pointing directs the listener’s attention to an object.

peripheral right space and pulses it in the air with an open, loose handshape (see Figure 2b). The satellite to which she refers marks the end of the story, which occurs at midnight. The first gesture is a robust bimanual temporal point; the second is a placing gesture. From the absolute position of these gestures in space, it is again possible to infer that she is conceptualizing time on an axis running across her body from left to right.

(A)

(B)

Figure 2a and 2b.

Duration-marking

Duration-marking gestures express the length of time between two events, or the duration of a single event. We distinguish between two subtypes: 1) one that highlights the size of an interval; 2) and another that highlights the path traversed between two temporal entities. Morphologically, a duration-marking gesture of the first subtype involves the two palms held out at the midline and facing each other, such that the distance between them is demonstrated as though it were an object held between the hands. Here and elsewhere the human hand takes on an image-schematic structure: the palms evoke a filling-in of the space between them. For example, the expression "starting at" would be prototypically gestured with a left hand downward chopping gesture, with the right-facing palm tacitly evoking the time to come; the expression "up until", by contrast, would be prototypically gestured with a right-handed lateral sweep gesture, with the left-facing palm thus evoking the time gone by. Markedly short durations can also be signaled with a single hand, between the thumb and index finger. A speaker's choice of bimanual or single-hand variants is motivated by features of the discourse context. For example, in our data the single-hand variant is repeatedly used to talk about "human existence", which is vanishingly small in the context of the history of the universe. In other discourse contexts, however, a mention of "human existence" might be better accompanied by an outstretched two-handed variant.

For duration-marking (size) gestures, temporal trajectory is inferred in two ways: either the interval is set up in several steps (e.g. "between the Stone age and the present day…")[9]; or, in single-handed cases, the temporal trajectory can be inferred from the position of the hand in relation to the speaker's midline. Otherwise it is only speculatively possible to infer trajectory from the broader context of the speaker's temporal gesture production. A final interesting feature of the duration-marking (size) gestures in our data is that they are often held and then layered over with beats or other gestural "meta-comments"[10]. For example, a single-handed duration-

[9] Note that it is in principle hard to distinguish a duration-marking (size) gesture that is set up in two steps and from a sequence of two consecutive placing gestures. The accompanying speech and broader discourse context would be useful in such cases, but still only tentatively support a judgment.

[10] Two reviewers noted that the prevalence of gestural "meta-commentary" in this class hints at a possible

marking gesture may be brought higher in the gesture space, as if to show it to the listener, or close to the speaker's own eyes, as if its diminutiveness requires further inspection.

(A)

(B)

Figure 3a and 3b

functional difference between duration-marking gestures and the other types of temporal gestures we describe. This is an intriguing possibility. Of course, the more general question is: What kinds of gestures *in any domain can* be layered over with beats?

Example (3)

1. P1: So my story is the history of the universe

2. [compressed] into one single day

3. P2: The history of the universe compressed into

4. one single day?

5. P1: One single day

Example 3 is taken from Study #4 (small). As she says "compressed" in line 2, P1 exhibits both hands, palms facing each other, and pulses them quickly inward (see Figure 3a). She holds this duration-marking gesture until shortly after line 5, as if to maintain reference to the topic at hand. From this gesture alone it is not possible to make a judgment about the directionality of time, but it is clear that time is conceptualized transversally.

A second subtype of duration-marking gestures is a variant in which the path of the duration is profiled rather than the length of the interval. The path is most often enacted by a lateral sweep of the hand across a verbally labeled duration. Because strokes in this subtype are lateral rather than downward, trajectory is easily inferred from the direction of motion.

Example (4)

1. P1: So the whole idea is that the [first

2. morning early afternoon] was just the galaxies

Example 4 features the same speaker from Example 3 (from Study #4) at a later point in her narrative. P1 begins in line 1 with both of her hands clapped together off in her right space. She then quickly brings her left hand off to her left space in preparation, and then as she says "first morning early afternoon" she produces a lateral sweep of her left hand across her body to meet with her right hand (see Figure 3b). The lateral direction of the stroke demonstrates that she is conceptualizing time as moving over the specified interval from left to right.

Bridging

A bridging gesture expresses a transition between two temporally ordered events. The events on either side of the bridge may or may not be marked gesturally. Bridging gestures are co-produced with

expressions like “after that”, “right before”, “later”, “then”, and many others. The precise co-timing of the stroke relative to speech is essential in determining that the transition between events—and thus their temporal relation—is more conceptually salient than either of the events themselves. Morphologically, a temporal bridging gesture may involve a number of different handshapes, such as a pointing handshape that traces a transversal arc through the air, or a loose flick of the hand. Head movements to the side were also observed. Again, since the stroke trajectory is invariably lateral, temporal trajectory is inferred from the direction of motion.

Example (5)

1. P1: And then about seven hundred million

2. years ago So [already] not that long ago

3. We start to get the first complex life forms coming

4. out of the ocean

Example 5 comes from Study #1 (standard). In line 2, as she says “already not that long ago”, P1 brings her left hand in first, in preparation, to touch her right hand and then laterally leftward (see Figure 4). The gesture enacts a bridge between two temporal entities, the implied now and the “not that long ago” marked in speech. Though the stroke of the gesture is transversal from right-to-left, it is possible given the accompanying speech to infer that she is conceptualizing time as moving from left to right.

Figure 4.

Animating

A final class of temporal gestures is those that are co-produced with the word “time”, e.g. “Time moves on from there”, or some comparable expression, e.g. "And things continued from there". In these gestures, the hand (or hands) enacts— or animates— the idea of time as an agent with a motion of its own. These gestures are somewhat rare in our data and vary morphologically. Trajectory is inferred from the direction of motion.

Example (6)

1 . P1: That’s how much- the beginning of the

2. universe where nothing really much happened

3. P2: Okay

4. P1: From 4:48 up to 11:36 pm. Time moves slow-

5. or [development] moves slowly.

Figure 5.

Example 6 comes from Study #5 (auditory). Though P1 produces several temporal gestures in this sequence, we focus on lines 4-5. Co-timed with

"development", P1 moves both hands from left to right across his chest in a lateral trotting motion (see Figure 5). He thus animates time— or "development"— as an agent that moves from left to right.

Discussion

Time offers an important case study in the human capacity for abstract thought. Temporal reasoning is basic and universal: temporal concepts are everyday concepts, and as such they can no more be avoided by hunter-gatherers than they can by schedule-obsessed Westerners. Consider the case of the Pirahã, who are claimed to show a profound indifference to anything outside of the interlocutors' immediate personal experience and whose language reportedly lacks expressions for number and color. Yet they have a relatively elaborate— and deeply metaphorical— system of temporal expressions about the present, past, and future (Everett, 2005, p. 631). As we have argued, spontaneous co-speech gesture provides an indispensable source of data about commonplace but culturally variable temporal reasoning processes.

A number of questions remain about temporal gestures, and many of these questions intersect with ongoing controversies in gesture studies and cognitive science more generally. We address only a handful of these questions below. First, we briefly draw attention to the quasi-experimental methodology reported here. While it is by no means an altogether original methodology— in fact, it is similar in many respects to McNeill's longstanding approach— it is an increasingly useful one as gesture studies and cognitive linguistics partner in exploring specific conceptual domains. Second, we address a cluster of questions concerning micro- and macro-level variability in gesture patterns: a) micro-level variability across different moments of discourse within a given culture or within a single speakerand, and b) macro-level variability across different cultures. A number of hypotheses about both these kinds of variability have been suggested, and we discuss these in light of our own data. Finally, we take on questions about how temporal gestures enrich our understanding of metaphorical gestures more generally. Where do temporal gestures fall in our current classification schemes of gesture? Rather than label the class of temporal gestures a curious platypus, it may be useful to rethink the original reasons for calling certain gestures "metaphorical". Temporal gesture stands at the nexus of language, conceptualization, representational practices, and interaction, and a better understanding of temporal gesture as a phenomenon will result in a richer understanding of this nexus.

A methodological middle way

A natural site for the study of human conceptualization is face-to-face interaction. Students of language use (Clark, 1996), situated interaction (Goodwin, 2000), and conversational organization (Schegloff, 2006) have long recognized the primacy of the face-to-face situation. We extend such claims to the case of conceptualization. Conceptualization is often treated as a private act par excellence, something someone does in his or her own cognitive theater. Here we consider conceptualization as it takes place on an interactive stage, subject to the same recipient design pressures and emergent exigencies as all communication. Gestures are invariably a part of such conceptualization-in-interaction.

The present study thus offers a methodological middle way between, on the one hand, rigorously controlled experimental studies that tend to denature conversation and, on the other, ethnographic studies that offer beautiful specimens but do not always disclose general trends. As gesture studies moves toward consideration of gesture in all of its rich discursive, socio-cultural, and conceptual variation, we suggest that this middle way will prove increasingly valuable. In particular, the quasi-controlled paradigm used here may prove especially useful for future studies of metaphorical gestures in well-circumscribed conceptual domains. Cognitive linguistics has long been in the business of investigating how specific languages treat specific conceptual domains. While there is no reason to suppose that all conceptual domains will show the same gestural systematicity as time, this is an empirical question worth further study. The present paradigm could be easily adapted to investigate how speakers of a given language reason about sound, emotion, thought, and much else besides. While we applaud the recent move to neuroimaging studies of gesture, it should be emphasized that there is no shortage of observational, hypothesis-generating work yet to be done.

Variability in gesture patterns

The literature on time-related gestures has noted both micro- and macro-level variability. First, there is micro-level variability to the extent that there are two patterns available to English speakers: sagittal

gestures, which use the back-to-front bodily axis, and transversal gestures, which use the left-to-right axis. In the data collected for this study, sagittal gestures are much less common among English speakers. But informal in-the-wild sightings, as well as the few instances that we did record confirm that this pattern is fully within the English speaker's gestural repertoire. A natural question, then, is: Why did participants in our task overwhelmingly choose the transversal pattern? Is the choice motivated by cognitive, pragmatic, or other factors?

Several different hypotheses have been suggested in the literature. Calbris (1990) ventures that the transversal axis is used because it allows "dual reference to anteriority and posterity within the same statement" (pg. 89). In our data, however, participants favored the transversal axis even when talking exclusively about events in the past. Casasanto & Lozano (2006) propose that speakers use the transverse axis for temporal statements that treat events relative to each other (in our terminology, time-RP), not relative to the speaker's here-now. By this account, the sagittal axis is reserved for deictic temporal reference. That is, when an event is placed as it contrasts either explicitly (in speech) or implicitly (conceptually but not in speech) with the deictic here-now, speakers favor the sagittal axis. When two events— neither of which is the deictic here-now— are conceptualized (either explicitly in speech or implicitly) with respect to each other, speakers favor the transversal axis. However, given that these conceptual contrasts are often backstage and not evident in spoken discourse, this hypothesis is hard to test.

Here we suggest the explanation that interactive considerations motivate use of one or another gesture pattern. In our task, participants are required to reason about events in the past in a fine-grained way. It is nearly impossible to do so using sagittal gestures, as this would require effortful contortions of the arms and, of course, would be harder for one's interlocutor to see. By this account, the sagittal pattern might be employed for temporal expressions involving rough-and-ready distinctions (e.g. "back then" co-produced with a flick over the shoulder, or "next month" co-produced with a quick point up ahead). But the speaker might immediately switch to a transversal conceptualization if more detail is required. In other words, it is a pressure to communicate and to render conceptualization visible to—and interpretable by— other interactants that motivates the transverse pattern seen in our data. Notice that this explanation makes predictions that in many cases are similar to the hypothesis offered by Casasanto & Lozano (2006). Generally speaking, deictic temporal expressions are more coarse-grained, whereas non-deictic conceptualizations often involve subtle distinctions of relative order among two or more events.

Finally, it should be noted that immediate bodily and situational factors might modulate the choice of one pattern over another. As mentioned briefly above, Torralbo, Santiago, and Lupiáñez (2006) conducted an experiment on Spanish speakers' flexibility in reasoning with different time frames. They found that participants who were experientially primed with a front-to-back mapping would favor an ego-RP understanding of time sentences; participants primed with a left-to-right axis would favor a time-RP understanding. It is thus possible that certain kinds of embodied experiences (e.g. sitting position, recent visual or locomotive experience, etc.) motivate the choice of one gesture pattern over another. An explanation of micro-level variability of this sort will likely require some combination of these disparate factors, and will require careful experimentation to tease apart.

A second kind of variability in temporal gestures is that seen at a macro-level from one culture to the next. A handful of studies demonstrate that there is nothing universal or inevitable about English speakers' temporal gesture patterns. Kita, Danziger, and Stolz (2001) report on the tendency for speakers of Yucatec Maya to gesturally enact time as moving from right-to-left. A recent paper on the Aymara, an indigenous group in the South American highlands, documents speakers' use of a sagittal gesture pattern that is the reverse of the Western pattern (Núñez & Sweetser, 2006). In Aymara, the past is mapped to the front space and the future is mapped to the back space. How do gesture patterns emerge and stabilize in a community of speakers? In developing an explanation of this variability, it must be emphasized that a gesture pattern is not an autonomous cultural practice, but is bound up with ways of conceptualizing, ways of speaking, and ways of representing. As has been emphasized elsewhere, reading and writing directions undoubtedly play a role in how speakers conceptualize time (Casasanto & Lozano, 2006; Tversky, Kugelmass, & Winter, 1991), but they are only one kind of representational practice in a sea of others (consider also graphs, calendars, and timelines, all of which are canonically produced left-to-right in Western cultures). It is possible, also, that gesture patterns constitute a kind of embodied representational practice in their own

right. Certain facets of gesture such as quotables (Kendon, 2004) and pointing morphologies (Wilkins, 2003) are culturally shared and culturally transmitted. Temporal gestures are thus a reasonable candidate for consideration as a representational practice, especially if one accepts our claims that they are both commonplace and systematic. All this is not to say that non-linguistic representational practices are the only, or most important, factor in determining temporal gesture patterns across cultures. Rather, the point is that, in addition to what language someone speaks— or in which direction someone writes— explanations should take into account a broader ecology of conceptual practices.

Metaphorical gesture

Gesture studies is experiencing a recent surge of interest in metaphorical gestures, in part due to a concurrent surge of interest in the embodied mind and the embodied nature of human concepts. The embodiment approach offers new ways of understanding metaphor, and, accordingly, new ways of categorizing and analyzing metaphoric gesture. The most common classification scheme used in gesture research is McNeill's four-way distinction between beat, iconic, deictic, and metaphorics (McNeill, 1992, 2005). The scheme is based on bundles of features, some morphodynamic (e.g. beats show a biphasic movement pattern) and some mentalistic (e.g. metaphorics are used during reasoning about abstract ideas). According to the original formulation, a metaphoric gesture "depicts a concrete metaphor for a concept, a visual and kinesic image that we feel is, in some fashion, similar to that concept" (McNeill, 1992, pg. 14). McNeill's key criterion in distinguishing iconic from metaphoric gestures is a mentalistic one, namely, the nature of the imagery involved. Iconics spring from actual perceptual experience; metaphorics spring from creative connections between concrete and abstract domains. This designation of “metaphoric” has been valuable for heuristic purposes but bears vestiges of an outmoded conception of metaphor. According to this classic conception, metaphors are creative acts, the one-off brainchildren of the artistic mind.

The classic classification scheme as described above has some trouble accommodating the temporal gestures we observed. A first problem with this scheme is its qualitative split between iconic and metaphoric gestures. Embodied cognitive linguistics and conceptual metaphor theory have moved toward a more mundane view of metaphor, according to which canonically abstract domains like emotion, time, and mathematics are constituted by bodily experience (Lakoff & Johnson, 1999; Lakoff & Núñez, 2000; Taub, 2001). On this view, metaphoric gestures are not virtuosic: they are evidence of the pervasive human ability to reason about abstract concepts using concrete, experiential resources. A further problem with the metaphoric-iconic split is that, increasingly, abstract domains like time and mathematics are perceived directly through ubiquitous, culturally constituted ways of representing them. These second-order representations are not simply byproducts of abstract thought, but serve to structure it in deep ways (Hutchins, 1995, 2005). Second-order represenations of time include calendars and timelines (such as the one used in this study), but also a number of other representations over which a temporal dimension is covertly layered, such as graphs and English texts. It is no stretch to say that transversal temporal imagery saturates Western culture. Is a given instance of temporal gesture, then, a case of metaphoric virtuosity, or an iconic gesture that represents commonplace temporal imagery? The same could be asked about gestures in mathematics: is the gestural enactment of a curve iconic for a recently seen graph, or something more venerable?

The line between iconics and metaphorics becomes all the more blurry when we consider the extent to which second-order representations shape all kinds of thought. Take space, the most paradigmatically concrete of domains. Contemporary route descriptions in American English are peppered with instructions to go “up” or “down” certain (flat) paths, and are co-produced with seemingly inappropriate gestures like upward points. In San Diego, for example, it is commonplace to see a speaker trace a quick upward arc when reporting that she is heading up to Los Angeles. If such gestures are iconic, they are iconic for maps— that is, second order representations of space— not for direct perceptual experience of lived space. As such they are perhaps no more “concrete”— or more “abstract”— than many of the temporal gestures we describe here. There is no a priori reason to suppose the mental imagery motivating gesture differs according to whether the domain is concrete or abstract. Of course, sagittal gestures seem to be motivated, not by second-order representations, but by more primary embodied experiences, such as walking for English speakers.

The temporal pointing gestures we observed are also hard to fit to the classic classification scheme. In terms of morphodynamics, they are garden-variety

deictics. Yet they indicate entities that are metaphoric, even as they are— like iconics—motivated by persistent, culturally shared imagery. One option is to assimilate temporal points into the category of "abstract deixis", a designation first discussed in detail by McNeill, Cassell, and Levy (1993). The authors discuss, for example, cases in which narrators point to different characters in their stories as though they were physically present in interactive space. In the broad sense of points to empty space, so-called "abstract deixis" may be a much larger and more variegated category than has been previously discussed in the literature[11]. Unlike the narrative points described by McNeill, which often have the character of creative pronominal reference, temporal points seem to be motivated by a stable set of mental imagery. They are thus only "abstract" in the sense that interlocutor or analyst has no access to that imagery. The compelling question of why speakers ever point to entities that are not visible to their interlocutors will have to await further study. It should be stressed, finally, that concerns about classification are not idle criticisms[12]. Classification schemes enshrine and perpetuate assumptions—in his case assumptions about the nature of conceptual thought.

In this paper we have argued that English speakers' temporal gestures are a patterned enactment of temporal conceptualization processes. Far from being random and analytically intractable, they are systematically related to the speech they accompany. An unfortunate—but all too common— lesson to derive from discussions of co-speech gesture would be that spontaneous gestures are a curious epiphenomenon, always piggy-backing on speech but unrelated to the cognitive and conceptual processes driving language production. According to such a view, language is the true bearer of thought, and gesture is a kind of decoration. To the contrary, gesture affords a look into the imagistic and dynamic properties of thought that speech alone, by virtue of its conventional and linear nature, simply cannot. As cognitive science begins to explore in earnest the intersection of metaphor, language, and embodiment, gesture will provide a critical source of evidence.

[11] Abstract pointing gestures are relatively uncommon in narrative discourse. McNeill reports that a relatively small percentage of gestures in his narrative studies were abstract points, but this scarcity is likely due to the particulars of his task. Impressionistically, we observe that abstract points are much more common in cases of natural conversation in familiar, shared settings.

[12] The divide between metaphoric and iconic gestures is still very much in play. Casasanto & Lozano (2006), for example, have suggested a functional difference between literal spatial gestures and metaphorical spatial gestures. Metaphorical gestures, by their account, serve speaker-internal functions whereas literal spatial gestures are expressly designed to communicate.

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