Understanding Timelines: Conceptual Metaphor and Conceptual Integration

Seana Coulson (1,2) and Cristobal Pagán Cánovas (1, 3, 4)

(1) Cognitive Science Department, University of California, San Diego

(2) Center for Research in Language, University of California, San Diego

(3) Cognitive Science Department, Case Western Reserve University

(4) Classics Department, Universidad de Murcia

Corresponding Author:

Seana Coulson

9500 Gilman Drive

Cognitive Science: Mail Code 0515

La Jolla, CA 92093

USA

coulson@cogsci.ucsd.edu

ABSTRACT

One of the most broadly investigated topics in the literature on conceptual metaphor is the importance of spatial construals for thinking and talking about time. Here we address the relationship between conceptual metaphor theory (CMT) and conceptual integration theory (CIT) by exploring how people understand timelines – both as graphical objects, in discourse about timelines taken from newspapers and the web, and in poetic examples. We note that the inferential structure of the timeline is well-captured by the conceptual metaphors TIME IS SPACE and EVENTS ARE OBJECTS. When instantiated graphically, the timeline serves as a material anchor in a conceptual integration network representing partial cognitive models of time, lines, objects, and a hybrid model known as a "blend". When understood with respect to this network, the analogue properties of the line give it novel computational properties that facilitate inferences about the events the timeline represents. The history of the modern timeline suggests it reflects a distributed cognitive process involving multiple individuals over a large span of time, and illustrating the importance of cultural evolution in the development of conceptual integration networks. Analysis of both poetry and everyday discourse about timelines suggests conventional mapping schemas are best viewed not as determining the interpretation of timelines, but rather as providing soft constraints that help guide it. Future metaphor research will best proceed via a merger of techniques from CMT and CIT to characterize metaphor as involving complex networks of mappings that can be flexibly updated as a function of context and goals.

Keywords: cognitive artifacts, cognitive semantics, conceptual blending, conceptual integration, material anchors, metaphor

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1. Introduction

The publication of *Metaphors We Live By* marked a revolution in semantics, and more generally in our understanding of the relationship between language and thought. In this classic work, Lakoff & Johnson (1980) urged readers to throw off the chains of formalism and of rationalism, and to embrace a new, experientialist approach to meaning. According to conceptual metaphor theory, metaphoric language reflects metaphoric mappings, or correspondences between conceptual domains (Lakoff & Johnson, 1999). Metaphor is thus defined both as a linguistic phenomenon in which vocabulary is shared among different domains, and as a conceptual one in which different conceptual domains are linked by metaphoric mappings based either in correspondences in people's experiences (Grady, 1997), or in analogical correspondences between domains (Lakoff, 1993). Viewed as such, language is not an isolated symbolic system, independent of other cognitive processes. Rather, language is an overt manifestation of the human conceptual system, and metaphoric language, in particular, offers a window into the human mind (Lakoff & Johnson, 1980).

This pioneering work by Lakoff & Johnson (1980) marked the rise of cognitive semantics, as other researchers approached language as a cognitive phenomenon, and meaning as involving the activation of concepts (see, e.g., Talmy, 2000). Fauconnier (1994), for example, argues that language serves as prompts for speakers to construct a mental representation of utterance meaning in mental spaces. On Fauconnier's (1994) model, a mental space contains a partial representation of the current scenario which includes one or more *elements* to represent discourse entities, and *frames* to represent the relationships that exist between them. Spaces are used to partition the information evoked by a sentence into a series of simple cognitive models. Mappings between spaces capture the relationships that exist between elements and their counterparts in other spaces. In this way, complex scenarios can be represented by positing a number of mental spaces and connections between them.

Fauconnier's (1994;1997) model, among other things, synthesized the insights underlying frame semantics (Fillmore, 1982) and conceptual metaphor theory (CMT) and applied them to a broad range of topics such as indirect reference and referential opacity. Referential phenomena accounted for by cross-domain mappings in CMT could be similarly accounted for by cross-space mappings in mental space theory. For example, in CMT "winning an argument" is understandable via cross-domain mappings between argument and war; in mental space theory, "winning an argument" prompts the listener to construct a mental space with a partial cognitive model of an argument, another with a partial cognitive model of war, and cross-space mappings between them.

The notion of mapping is, however, a more general notion in mental space theory than it is in CMT, as mappings in mental space theory can be motivated by many different factors, including analogy, identity through time, and, indeed, any sort of understanding of a connection between two apparently different entities. For example, "Iron Man wants to try directing," is understood as being about the career goals of Robert Downey, Jr. in virtue of a mapping between one space with a cognitive model of actor Robert Downey Jr., and another space with a cognitive model of the movie *Iron Man*. Mental space theory suggests that the widespread, culturally and linguistically entrenched, cross-domain mappings described by Lakoff and his colleagues (e.g. Lakoff & Turner, 1990) were the manifestation of a more general ability to establish mappings between structures in mental spaces.

Similarly, conceptual integration theory (CIT; Fauconnier, 1997; Turner, 1996; Fauconnier & Turner, 2002), as the most recent version of mental space theory, has taken Lakoff & Johnson's (1980) insight regarding the cognitive import of mapping and extended it to a vast array of cognitive phenomena. Conceptual integration is a basic, higher-order operation for combining information, and has been argued to be involved in metaphor and many other products of human cognition, such as metonymy, categorization, analogy, and counterfactual reasoning. Fundamental aspects of CIT include the idea that conceptualization involves networks of mental spaces with mappings between them (Fauconnier, 1997), an important role for simulation (Coulson, 2001), the construction of hybrid cognitive models via the selective projection of structure from multiple input spaces (Fauconnier & Turner, 1998), and the generation of novel, emergent structures (Turner, 1996).

Conceptual integration theory (CIT) is motivated in part by developments in cognitive science regarding the plastic nature of conceptual structure. Whereas cognitive psychologists in the 1980s understood concepts as relatively static knowledge structures, such researchers have come to view concepts as temporary structures in working memory (Barsalou, 1993). While they are derived from more stable constructs in long-term memory, concepts – mental representations people use in categorization and reasoning tasks – are not identical to the more stable long-term structures. CIT combines a view of concepts as inherently dynamic, and situated in particular contexts, with a key finding of research in mental space theory regarding the ubiquity of mapping and people's ability to exploit contextually motivated mappings. In sum, CIT is an attempt to characterize regularities in the way that particular concepts change in virtue of their combination with other contextually relevant concepts (Fauconnier & Turner, 2002).

Here we address the relationship between CMT and CIT by exploring how people understand timelines. As a cognitive artifact that anchors spatial metaphors for construing time, the timeline serves as an excellent vehicle for pointing out the similarities between CMT and CIT, as well as their differences. With respect to the latter, section 2 highlights CIT's emphasis on the importance of dynamic mappings and emergent structure. In section 3, we analyze attested examples of statements about timelines to underscore the flexible, context-sensitive way in which speakers recruit conceptual structure to serve their rhetorical goals. In section 4, we turn to what many consider to be a particular forte of CIT, namely its ability to account for novel metaphoric understandings. Analysis of a few lines of Paz's *Mas allá del amor* reveals a deeply creative construal of time with a non-trivial connection to the more pedestrian innovation of the timeline. Finally, in section 5 we discuss the relationship between CMT and CIT, revisiting the previous treatment of this issue by Grady, Oakley, & Coulson (1999).

2. Timelines

A timeline is an information visualization tool for communicating a sequence of related events. Verbal descriptions of events are typically arranged chronologically and displayed on a line oriented either horizontally or vertically. Timelines are frequently used by historians to depict important events in a particular historical period, and by biographers to denote important events in the life history of their subject. Figure 1 represents a fairly typical timeline, both in form and in content. It depicts the 18th century, with the beginning of each decade serving as a temporal landmark. Important events in Franklin's life are described verbally, and anchored to a particular locus on the timeline to indicate the date at which they occurred.

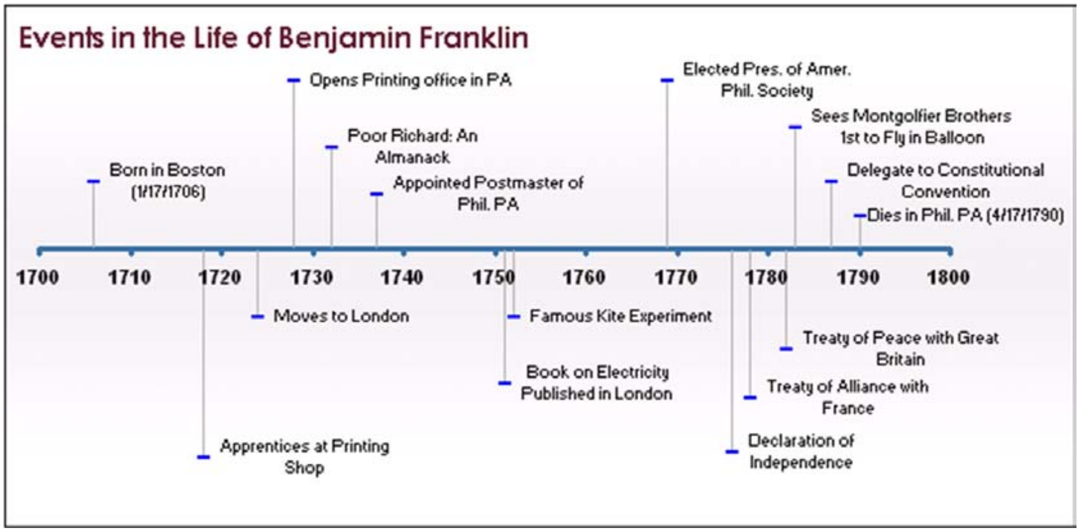

Figure 1. Timeline of Franklin's life. This figure was downloaded from the website www.vertex42.com in an article by Jon Wittwer (9/2/05) on how to use the software package Excel to create a timeline (www.vertex42.com/ExcelArticles/create-a-timeline.html).

As a spatial depiction of time, the timeline conforms nicely to inferences predicted by CMT. For example, the timeline supports two key components of the TIME IS SPACE metaphor described originally in Lakoff & Johnson (1980). These include the tenet that PROXIMITY IN TIME IS PROXIMITY IN SPACE supported by linguistic data such as (1), as well as the tenet that TEMPORAL DURATION IS SPATIAL EXTENT supported by examples such as (2) and (3). Moreover, the fact that events are typically described as objects arrayed on the timeline can be seen as an instantiation of the EVENTS ARE OBJECTS mapping in the event structure metaphor (Lakoff, 1993).

(1) Those two events happened very *close* together in time.

(2) The war lasted a very *long* time.

(3) The life of a butterfly is incredibly *short*.

Conceptual integration theory is thus required to explain the composition of TIME IS SPACE and EVENTS ARE OBJECTS (Lakoff & Johnson, 1999) in our understanding of timelines. The recruitment of conceptual structure from multiple domains is outlined in Table 1, with mappings depicted by their occurrence on a common row in the table.

Table 1

Mappings in the Timeline Blend. Each column represents a mental space; entries in the table are either elements or relations. Entries that occur on the same row are mapped to one another.

Time	Linear Extent	Objects	Ben Franklin's Life	Timeline Blend
Year	Line Segment			Year/Line Segments
Temporal Succession	Spatial Ordering			Left-to-Right Ordering
Date		Tick Mark	Salient Event	Tick Mark/Event

The resultant blended object has an inferential structure well-described by the above metaphors, as temporal duration is expressed via spatial extent of the timeline, the temporal disparity of (e.g.) two events is conveyed via the spatial proximity of two tick marks on the line, and temporal succession is conveyed via spatial ordering. However, there are meanings of the timeline that cannot be easily explained by these binary mappings alone.

2.1 Emergent structure

One major difference between CMT and CIT is that the latter highlights the emergent structure that arises in many metaphoric construals (e.g., Coulson, 1996, 2001; Fauconnier & Turner, 1994, 1998, 2002). In CMT, metaphor involves a set of correspondences between selected aspects of relevant source and target domain concepts. Consequently, novel construals of the target domain in a metaphor originate in the projection of inferences from the source (Lakoff, 1993). In CIT, metaphor involves the integration of structure from multiple inputs, including extant construals of the target. The complexity of integration varies from the relatively straightforward case of *single scope* networks that essentially involve the projection of inferences from the source input as in CMT, to *double-scope* networks that involve the projection of inferences from the blended space (Fauconnier & Turner, 2002). Because double-scope networks involve a blended space that incorporates relational structure from at least two inputs, they afford construals that differ from those available in the source domain, and from extant construals of the target domain, that is, emergent structure. Accordingly, the timeline has properties distinct from those of the cognitive models in each of its input spaces.

A timeline such as that in Figure 1 has some structure that derives from the Linear Extent input (the constituent line segments), and some structure that derives from the Ben Franklin's Life input (the events referred to in the labels). It also has properties that derive from its communicative function, from its purpose as a learning or organizational tool, and from the criteria employed in its elaboration (i.e. the selection of the depicted events as being the most relevant ones). Moreover, although it instantiates the mappings in the TIME IS SPACE metaphor, the timeline itself is an integrated construct with computational affordances that differ from those available in the input domains. For example, studying a timeline might enhance one's memory for the sequence of salient events in Franklin's life, or allow us to more easily recognize Franklin's most productive periods via the density of points. Researchers in the field of information visualization recommend timelines because their visual properties facilitate inferences about temporal events (such as temporal and causal contingency) that are either difficult or impossible to make using different representational formats (Phan et al., 2005).

CIT also provides a useful description of timelines as examples of *compressions*. Fauconnier & Turner (2000; 2002) define compressions as cases in which elements in different input spaces in an integration network are mapped to one or more elements in the blended space.

Whereas the elements in the inputs are related via *inter-space* relations, the elements in the blended space are related via *intra-space* relations. For example, in the timeline of Ben Franklin's life, each event on the timeline (Franklin's birth, flying the kite in a thunderstorm, the publication of *Poor Richard's Almanac*) can be conceptualized in its own mental space. Compression affords the conceptualization of all of these events in a single mental space as event/tick marks that co-exist on the timeline. Whereas the input events are related to one another via the *inter*-space relation of temporal ordering, event/tick marks are related via the *intra*-space relation of spatial succession.

The compression in the timeline in Figure 1 results in emergent structure which proves to be quite useful. In the separate spaces for events in Franklin's life, events have different durations and can be considered separately: moving to London or serving an apprenticeship take longer than being born or dying. In the timeline construal, they do not. All salient events are represented with the same tick mark, as identical objects. For instance, the numerous works, deliberations, meetings, etc. that eventually culminated in the Declaration of Independence have been compressed into one single event-object on the timeline. Thus extended events such as the apprenticeship, shorter events such as the kite experiment, and instantaneous events, such as Franklin's appointment to Postmaster, are all included as analogous elements belonging to the same category. In this category, only saliency matters, and differences in duration and complexity are left unrepresented.

More generally, research in CIT has shown that compressions reduce conceptual complexity, facilitate inference, and can afford novel affective reactions (Coulson & Pascual, 2006). CIT also describes regularities in patterns of compression, such as compression from disanalogy to change, compression from analogy to identity, and compression from identity to uniqueness (see Fauconnier & Turner, 2002). Indeed, much of the emergent structure of the timeline and its novel computational properties result from the compression of temporal relationships to spatial ones, as well as the congregation in the blended space of structures from multiple input spaces.

2.2 Timelines as material anchors and cultural artifacts

The timeline, *qua* visual object, is also an excellent example of a *material anchor*. Hutchins (2005) details the way in which many blends involve an input space constituted by a material object, often a cultural artifact, and refers to such input spaces as material anchors. For example, a queue of people waiting for theater tickets can be construed as involving a blend between two inputs, the physical configuration of people in the line (the material anchor), and a notion of a trajector moving through space in a particular direction. Integration of these two concepts in the blended space yields the emergent property of the queue as an ordered sequence of people moving in a particular direction, from the “back” of the line to the “front”. The perceptually salient material anchor provides stability to the blend, and reduces cognitive load on the part of the individual (Hutchins, 2005).

The culturally sanctioned understanding of a queue as determining the order in which participants will be able to, for example, purchase theater tickets relies on this blend. Moreover, the blend itself is possible because of the cultural practice of queuing, and perhaps the main way this concept is learned is via participation in that practice. The importance of cultural factors, such as material artifacts and cultural practices, is a major theme in CIT, and helps explain how incredibly complex integration networks can be utilized by individual culture members with their limited attentional and working memory resources (Fauconnier & Turner, 2002). Indeed, metaphoric construals of time have been shown to involve a series of successive integrations, often involving the automatization of once creative blends (Fauconnier & Turner, 2008).

While metaphoric language implying a linear conception of time is common to many different periods and cultures, the timeline in its modern form seems to date from just a few centuries ago. In their book *Cartographies of Time*, Grafton and Rosenberg (2010) provide a thorough history of the timeline, with abundant illustrations of its many instantiations, as well as of the numerous, less felicitous attempts that preceded it. These authors describe a long, arduous process through which historians repeatedly tried to create a way to visually represent temporal events. The intermediate steps in this process included chronological tables, human and animal bodies used to represent time periods (for example, the Persian Empire could be assigned to the lung, because under Darius the Jews could breathe freely), or geographical maps representing time instead of space. Finally, in the second half of the 18th century, Joseph Priestly proposed the modern version of the timeline in which spatial and temporal relations are integrated. Once invented, the timeline grew rapidly in popularity and its use was widespread within a matter of a few decades. From the outset, users were surprised by its simplicity and wondered why it had never been used before.

Cultural constructs such as the timeline look obvious in retrospect, thus masking the fact that useful integrations often go unnoticed even by highly intelligent and innovative individuals. In a discussion of a closely related blend, Núñez (2009) notes that human beings had sophisticated knowledge of mathematics for thousands of years before the invention of the number line in 17th century Europe. The archeological record suggests that the Babylonians, for example, had advanced knowledge of arithmetic, including bases, fractions, and so on, but no representations of a number line (Núñez, 2009). Clay tablets from Old Babylonia contain diagrams used to help estimate square roots (Fowler & Robson, 1998), suggesting the Babylonians were aware of potential mappings between the domains of number and of spatial forms. Nonetheless, the integrated construct of the number line was apparently unavailable to them. In the case of the Babylonians, awareness of the potential mapping between spatial forms and numbers did not lead to the integrated concept of the number line. Analogously, awareness of the potential mapping between spatial forms and temporal concepts did not necessarily lead to the integrated construct of the timeline.

The emergence of useful cognitive artifacts such as the timeline is a gradual process that involves multiple individuals and iterations (Hutchins, 1995). The entrenchment of an innovative blend through cultural evolution has been described in some detail for other cases, such as complex, viz. imaginary, numbers (Fauconnier & Turner, 2002; Fauconnier, 2005). Integration networks usually become widely shared within a culture because they can be used to construct relevant meanings at a comparatively low cognitive cost. On most occasions, this success comes only after many failed or less felicitous integrations. Although the timeline looks to the modern observer like a "natural," straightforward way of representing temporal continuity and relatedness, its invention is in fact fairly recent, and represents a quite remarkable conceptual achievement. As in the case of complex numbers, the timeline is an excellent example of the diachronic aspect of blending, and illustrates the extent to which conceptual integration is a distributed cognitive process involving multiple individuals over a large span of time (c.f. Hutchins, 1995).

2.3 Varieties and uses of timelines

The timeline, with its emergent properties, results from compressing spatial and temporal relations into one-dimensional space. This compression procedure can recruit any appropriate object to instantiate the linear schema. The object with relevant length and irrelevant width will then become a material anchor for the timeline blend such that its affordances can be opportunistically exploited. For example, in a timeline outlining company history on their 50 year anniversary, pictures of popular Lego toys were connected to the timeline at the date of the release of those toys. The significance of these pictures is easily understood via a contextually motivated metonymic compression in which a given toy stands for the release of that toy. A conventional TOKEN FOR TYPE mapping helps motivate the MANY-TO-ONE compression in which a picture of a single Lego toy can represent all of its counterparts. However, it is not at all conventional for a picture of a toy to represent the release of that toy by the company. The latter mapping is motivated by its relevance for the timeline.

Conventional mapping schemas are best viewed not as determining the interpretation of timelines, but rather as providing constraints that help guide it. Consistent with this view, in the Lego example discussed above, the timeline itself was constructed from a series of colored Lego blocks laid end to end. In contrast to the picture of the original Lego bricks linked to 1958, the viewer understands that the linear array of blocks does *not* correspond to the invention or the release of those blocks, but rather to time itself. This suggests the TOKEN FOR TYPE mapping is not applied reflexively, as its utilization is influenced by specific aspects of the context, including the spatial configuration of pictures on the page. Spatiality, rather than being a general factor in the interpretation of metonymies, assumes special prominence in the context of a timeline because graphical conventions for their construction exist.

Figure 2. A timeline of events at a wedding. Adapted from an example posted by Lori Decter Wright in a blog entry about wedding planning on loridector.com

CIT thus provides a framework that readily accommodates contextual variability in the instantiation of different timelines. For example, the same software used to create Figure 1, can also be used to construct timelines for future events – another common use of timelines. Figure 2 was adapted from an example found on the web, created for couples to include with their wedding invitations, and intended as a helpful guide for their guests. In Figure 1, space is iconically related to temporal duration with respect to both ordering and spatial extent. By contrast, the space-to-time mapping in Figure 2 preserves the topological correspondence, but not the metrical one. That is, left-to-right ordering of events in Figure 2 maps faithfully onto the temporal order of planned wedding events. However, the mapping between spatial extent and temporal duration is absent, as the same spacing separates 3:30-4, 4-4:30, 4:30-5:30, and 5:30-10:30. Moreover, this is often the case in timelines for future events, as these representations are often employed to convey the sequence of planned events, as much as for their relative timing.

Advocates of CMT will be quick to point out, of course, that mappings are highly selective and need not include all aspects of the source domain. However, the appeal of CMT is its putative generality, and the way in which the same mappings (e.g. between lovers and travelers) underlie numerous expressions classed under a single metaphor (e.g. LOVE IS A JOURNEY). In the case of timelines, Figure 1 suggests the existence of an entrenched mapping between spatial extent and temporal duration, while Figure 2 suggests this mapping is not obligatory. As in the case of the conventional metonymy discussed above, the conceptual metaphor does not determine interpretation of the timeline, but rather serves as a soft constraint subject to the user's goals. In timelines these goals usually privilege saliency and sequential order rather than duration of particular events. Whereas CMT suggests that metaphoric expressions and images (such as graphs) are interpreted via a static set of mappings, conceptual integration theory suggests their interpretation involves a more complex network of mappings that can be flexibly updated as a function of context and goals.

3. Cutting, compressing, and accelerating timelines

Emergent properties of the time-space blend affect not only the timeline as a symbolic object, but also the way that spatial vocabulary is recruited to describe it. Below we discuss how attested examples of statements about timelines incorporate mappings between spatial extent and time (section 3.1) and between motion and time (section 3.2).

3.1 Spatial extent

Consider example (4), from a news story about the potential impact of software on drug design (Drug Week; April 2, 2010; Apriso Joins Dassault Systems Software Partner Community; Pg. 3478).

(4) “This new combined solution addresses the challenge of sharing information between design and planning and production execution…. Design timelines can be *compressed*, products can be accelerated and overall quality can be elevated.” [emphasis added]

In many ways, (4) exemplifies the sort of linguistic data that motivates CMT. It involves a mapping from a concrete source to an abstract target, as a verb describing a physical transformation (viz. compression) has been applied to the abstract domain of scheduling. It can be seen as a specific instantiation of a more general pattern of mappings between spatial and temporal relationships. Additionally, inferences regarding physical compression have analogues in the temporal domain. The result of physical compression is a smaller object with greater density than before. Analogously, events on the new timeline occur in more rapid succession so that their overall duration has been reduced relative to the old timeline.

CIT suggests that this analogy is mediated by a blended model with links both to physical compression and to the scheduled events. The spatiality of the timeline affords its construal as something that can be physically transformed. Entrenched mapping schemas can then be used to interpret the implications of these physical transformations of the timeline for the abstract domain of scheduled events. Compression makes the timeline shorter, which maps onto the reduced duration of scheduled events. Compression also results in a greater density of points on the timeline, which maps onto the more rapid succession of scheduled events. Note, however, that scheduled events in (4) are not construed with a general notion of compression, but rather a specific sort of compression as applied to timelines. This is why the compressed timeline is not bent, but retains its original (1-dimensional) linear shape. Moreover, the blending in (4) conforms to a regularity pointed out by Fauconnier & Turner (2002) in that the *disanalogy* between the length of the two timelines (before and after the adoption of the software) maps onto *change* in the blended space in which we talk about *compressed* timelines.

Disanalogy also maps onto change when people talk about *cutting* timelines, as in (5), from an article about changes to zoning laws for high-density housing projects, such as large apartment buildings, that are proposed for urban areas well-supported by public transportation (The Courier Mail (Australia); March 18, 2010 Thursday; “Fast-track plan in ‘go zones’”; Pg. 14).

(5) “AREAS close to public transport corridors will become ‘go zones’, effectively allowing state and local governments to fast-track approval of high-density developments…. The planning timeline would be *cut from years to months* in ‘go zones’.” [emphasis added]

Construed as an integrated object, a timeline can be changed by being “cut”. Consistent with the mapping between spatial extent and temporal duration identified by researchers in CMT, the reduced length of a cut timeline entails a corresponding reduction in the duration of the planning process discussed in (5). Interestingly, whereas cutting the latter half of a 60” measuring tape leaves one with a scale of 0-30”, cutting the timeline need not imply the omission of any planned events depicted on it. Rather, cutting the timeline “from years to months” implies revising the mapping between tick marks on the timeline and the temporal units in the time space. In the blend, cutting the years means transforming them into months, as manifested by the writer’s use of the construction “from… to” with the verb *to cut*. Thus event/objects spaced years apart on the standard timeline are spaced months apart on the ‘go zone’ timeline.

Similarly, (6) provides an example of a change to a timeline that maps onto a reduced duration for the drug development process (Drug Week; April 2, 2010; “GLOBAL ALLIANCE

FOR TB DRUG DEVELOPMENT: Global Partners Join Forces to Speed Development of New TB Drug Combinations"; Pg. 3632).

(6) "'By working together, CPTR partners can *take years off* the drug development timeline for safer new TB drug regimens,' said Dr. Raymond Woosley, President and CEO of the Critical Path Institute." [emphasis added]

In (6) a temporal unit (years) occurs in the length slot of a construction often used to describe removal from a container or surface, like cutting hair (as in "take a couple of inches off the back"). Here, as in (5), eliminating years from the timeline does not mean omitting the events that were planned for those years, but rather preserving their relative positions in a new, shorter timeline. Further, as in (4) and (5), the grammatically cued change construal in (6) ("take years off") maps onto a disanalogy between the duration of the original and new timelines in the input spaces.

In other cases, however, cutting a timeline *does* imply the omission of planned activities. Consider example (7), from a news article about the UK's Royal Air Force (RAF).

(7) "The RAF already has been forced to reduce the anticipated service life of some of its C-130Js by three years as a result of greater than anticipated use. When first acquired, the aircraft were expected to remain in service until 2030. However, higher operational utilization in more demanding environments has *cut that timeline* to an estimated out-of-service date of 2027." (Aerospace Daily & Defense Report; April 1, 2010 Thursday; "More RAF C-130Js Unlikely Despite A400M Delay"; BYLINE: Douglas Barrie; SECTION: Programs; Pg. 3 Vol. 234 No. 1). [emphasis added]

In both (5) and (7), the disanalogy between the original timeline and the revised timeline is compressed (in the sense of Fauconnier & Turner, 2002) to afford the use of the change predicate “cut”. Interpretation of both (5) and (7) depends on the entrenched mapping between spatial extent and temporal duration (as does example (6)). However, in (7), changing the plane’s out-of-service date implies the omission of 3 years worth of planned flights, whereas in (5) there is no implication that cutting the timeline would result in the omission of any planned activities. The precise implications of cutting a timeline thus seem to be more a function of the discourse context (i.e. whether it involves the rapid development of a drug, or the early retirement of a fighter jet) than it is to the concrete meaning of “cut”. Exclusive focus on the mappings common to all examples (e.g. between spatial extent and temporal duration) can lead one to ignore important differences between them that reveal a tremendous degree of sensitivity to content, context, and goals.

3.2 Accelerating timelines

Besides the mapping between spatial extent and temporal duration, speakers also frequently use motion verbs to discuss timelines. Presumably, this reflects the importance of the time input to the timeline blend, and its connection to entrenched construals of time involving motion. Consider example (8), taken from a newspaper article about the lobbying activity of Los Angeles mayor Antonio Villaraigosa (The Christian Science Monitor; March 11, 2010; Daniel B. Wood; Will Washington fund a Los Angeles subway expansion?). The article describes a trip Villaraigosa took in 2010 to Washington, DC to lobby the federal government for a change in the funding schedule for a planned Los Angeles subway expansion known as “Subway to the Sea”. The original construction plan was projected to last 30 years; Villaraigosa was arguing for a loan to support an alternative plan to last 10 years.

(8) “Mayor Villaraigosa is now trying to *accelerate the timeline* for such projects from 30 years to 10 by asking the federal government for a bridge loan to get started. He's set to speak

before a Senate Environment and Public Works Committee hearing on Thursday. Besides accelerating the start and finish dates of several projects, the loan would save millions and create between 150,000 to 200,000 jobs." [emphasis added]

The example is understood so seamlessly, one almost does not notice the difference between the construal of the timeline in (8) and that of the examples discussed in section 3.1. First and foremost, the timeline in (8) is not a static object in which spatial extent has implications for temporal duration. The article describes a proposed change in the duration of the construction project from 30 years to 10: "Mayor Villaraigosa is now trying to accelerate the timeline for such projects from 30 years to 10..." However, the change in duration is not described in terms of the spatial extent of the timeline. Rather, it is described as acceleration – change in the rate of the timeline.

The use of motion language here can be understood as an instantiation of the conventional metaphor TIME IS A MOVING OBJECT, in which temporal events are construed as objects moving relative to an ego-centered reference point (Boroditsky, 2000; Moore, 2006; Núñez & Sweetser, 2004). On this metaphor, future events are construed spatially as being in front of the reference point, and past events as behind. The metaphor explains why statements about temporal events routinely involve the occurrence of motion verbs ("Dad's birthday is coming,"), rate adverbs ("The deadline is rapidly approaching,"), and spatial deictics ("May Day is almost here."). Important mappings in this metaphor can be seen in Table 2.

Table 2

Important mappings in the TIME IS MOTION metaphor.

Time	Space/Motion
Events	Objects
Now	Ego
Future	Observer-relative Front
Future Events	Objects Moving towards Observer
Immediacy	Spatial Proximity

Fauconnier & Turner (2008) account for similar linguistic data in the framework of conceptual integration theory, as well as statements about the subjective experience of time (“When you’re young, the days fly by, but the years drag on forever; when you’re old, the days drag, but the years fly by”). These authors suggest that a full account of the metaphor TIME IS SPACE requires successive integrations of at least the following inputs: events, motion through space with objective and subjective experience, a blend of the former two (with all possible displacements compressed into the sub-case of traversing a path), the blended cyclic day compressing multiple days into one that repeats, and a natural or technological mechanism that blends with the cyclic day, which provides yet another input, the socially constructed notion of time with emergent universal events like *seconds*, *minutes*, *hours*, etc. The resulting network is dual, depending on viewpoint: the experiencer can move through time or vice versa – although it is also possible to view time motion as a detached observer. If the topology of the constructed notion of time is privileged, we will have “objective” time experience, with regular speed (“an hour must pass before we leave"), while if the experience of events is providing the frame, we will have "subjective" time experience, with varying speed ("this hour is passing very slowly").

This elaborate system of integration networks accounts for numerous emergent meanings, which cannot be explained as the result of direct projections from space to time. For example, time units have the properties of space measures, but are also moving objects ("hours go by"). In the time-space blend all observers are in the same location, they look in the same direction and see the same objects (time units). Rather than encompassing the whole domain of space, this looks like a very particular spatial experience meant to match time relations. Moreover, all objects move along the same path, but the observers can perceive different speeds ("the class went by fast for me and slowly for her") depending on the observer's personal attitude; distant objects can be perceived as close or vice versa ("yes, you are only fifty but retirement is just around the corner," "tomorrow seems light years away").

The meaning of (8), however, follows neither from the standard mappings in CMT (Lakoff, 1993), nor from the account outlined in Fauconnier & Turner (2008). Accelerating the timeline does not imply that the passage of time changes in any way (either objectively or subjectively). Even in subjective time expressions in which time is experienced as an accelerated object/measure, 30 years can go by in an instant, but 30 years cannot become 10. The main discrepancy involves the mapping between rate in the space/motion domain and its counterpart in the domain of time. Although the motion of the object does indeed map onto the "passage" of time, the rate of the object's motion maps neither onto the objective rate of time (as implied by Lakoff & Johnson, 1980), nor to the perceived rate of time (as it does in many of the examples in Fauconnier & Turner, 2008).

Rather, in example (8), *acceleration* implies that the duration of the project will change. This inference differs substantively from those available in the source input of motion through space. Whereas we talk of a car accelerating from 0 to 60 miles per hour, example (8) describes the acceleration of the timeline from 30 years to 10. The use of accelerate here thus involves the use of an entrenched conventional metaphor in a way that omits the standard mapping between rate of motion and rate of time, instead involving a mapping between the rate of the object's motion and the duration of the project. Moreover, the implications of the mapping in (8) are contrary to the conventional mapping between spatial extent and temporal duration that proved to be so important for the interpretation of (4)-(7) in which a longer distance corresponds to a greater amount of time. In (8), *increasing* the rate of travel implies *decreasing* the duration of the project. However, in the source domain of motion through space, increasing the rate of travel either increases the distance covered, (and, consequently, would correspond to a longer line, and be interpreted as increased duration), or has no impact on it. Thus we see that the inferences evoked by the concept of acceleration in (8) cannot be generated using a straightforward correspondence between spatial extent, object movement, and temporal duration.

The inference invited in (8) is, of course, that acceleration will increase the rate at which future events travel, thus allowing them to arrive sooner than they might otherwise. Although slightly different from the mappings outlined in Fauconnier & Turner (2008), the construal in (8) is better captured by the flexible integration processes outlined in CIT, than the CMT account involving the retrieval of fixed mappings. This is because there are aspects of the TIME IS A MOVING OBJECT construal that are relevant for some metaphoric expressions about time, which are not relevant for the invited inference in (8). Indeed, for (8), the critical mappings are not from the space/motion domain to the temporal domain, but rather from time in one imaginary hybrid space/motion construct (i.e. a blend in which dates as landmarks on a timeline move towards an observer) to time in a cognitive model of future events in Los Angeles.

Example (8) can be described in CIT as involving two blended input spaces, each connected similarly to other spaces in the timeline network. In the **present timeline input**, events (the start date and the finish date) move towards the observer at a fixed pace (conveyed by the line). In the **desired timeline input**, event/objects (the start date and the finish date) move towards the observer (again conveyed by the line) at a faster pace than in the present one. Events related by analogy in the inputs each map onto a single identical event/object in the blend via analogy-identity compression. Moreover, the disanalogy between the rate of motion in each input space is compressed to rate *change* in the blend, which affords the construal of the timeline as *accelerating*. The metaphoric use of acceleration is thus motivated not by a straightforward analogy with the domain of motion, but rather for the way it highlights differences between the present and desired timelines. More generally, (8) demonstrates how cognitive models of hypothetical and counterfactual possibilities figure prominently in the semantics of utterances about timelines and the utility of CIT for describing the way these interact with metaphoric construals of the target.

4. Poetic uses of the timeline blend

Fauconnier & Turner (2008) also show how novel metaphors preserve the complex time-space network, by examining a literary example:

(9) Perhaps time is flowing faster up there in the attic. Perhaps the accumulated mass of the past gathered there is pulling time out of the future faster, like a weight on a line. Or perhaps, more mundanely, it is only that I am getting older every year and that it is the accumulated

weight of time behind me that is unreeling the years with ever-increasing speed. What a horrible thing it must be to grow older and find that ever-decreasing number of years hurrying you faster, faster toward your grave, as if time were impatient to be rid of you. (Ian McDonald, "Emily's Diary, November 5, 1913," in King of Morning, Queen of Day, pages 82-83. Discussed in Fauconnier & Turner 2008).

Here we find a derivative of the standard time-space network: “time has a variable speed and now a new blend is constructed according to which that motion is induced by standard physics. Weight is pulling the timeline along” (Fauconnier & Turner 2008). Following up with our analysis, we could say that this is another case of an accelerated timeline. However, there are fundamental differences. In (9) subjective time is accelerated: the number of years to live remains the same, but they pass faster. On the contrary, in (8), as we noted, time is not accelerated in any way, but the duration of the LA subway project is shortened. In (9) we do not have the additional inputs with a present and a desired timeline, but a subjective time-space blend as described by Fauconnier & Turner (2008). The blend in (9) happens to recruit the image-schematic structure of the line, and that is how “standard physics” opportunistically get into it. This is exploited to serve the communicative goals, aiming at the construction of affective meaning related to aging and the sentimental connotations of the attic, which in the blend become the weight that unreels the timeline faster and faster.

However, we also wish to stress that the appearance of the linear schema in such examples is far from trivial or fanciful. Representations of objective or subjective time do not need to include a line. The line is a further input added to the network. It happens to be an especially successful structure for compression, which also matches beautifully the type of motion in the blend and the regular continuity of time. The recruitment of the linear schema confirms the existence of a widely shared *generic integration network* (as defined by Pagán Cánovas 2011) for the compression of time relations into one-dimensional space, of which Priestley's timeline is only one possible instantiation. In (9), the unreeling of a pulley-like device provides quite a different, context-driven anchor, under the pressure to depict speed and intentionality of time as a personified abstract cause. These last aspects are normally absent from chronological timelines, but nothing in the remaining conceptual structure prevents the pulley from being used as a timeline in, say, a history museum, perhaps as an interactive exhibit.

Crucially, we do not always need to interact with material anchors of blends physically. If the material structure is widely shared and simple to operate, as many of them are, they can be virtually manipulated by imagining them, representing them, remembering them, talking about them (c.f. Vygotsky, 1978). For example, we do not need to be shown a clock in order to tell us the time, or even to make us understand complex metaphorical examples such as (10):

(10) "In their anxiety to be scientific, students of psychology have often imitated the latest forms of sciences with a long history, while ignoring the steps these sciences took when they were young. They have, for example, striven to emulate the quantitative exactness of natural sciences without asking whether their own subject matter is always ripe for such treatment, failing to realize that one does not advance time by moving the hands of the clock." (Solomon Asch, Social psychology, 1952, pp. xiv–xv, cited in Rozin, 2001).

Representing a (sometimes peculiar) material anchor for the timeline blend is a procedure common to many metaphoric expressions. In poetic texts instantiations of the timeline can look quite strange, as authors strive to introduce structures that connect with relevant knowledge and become effective prompts for affective meaning. The first lines of a poem by the Mexican Noble Prize winner Octavio Paz provide a spectacular example:

Más allá del amor, by Octavio Paz

Todo nos amenaza:

el tiempo, que en vivientes fragmentos divide

al que fui

del que seré,

como el machete a la culebra;

Everything threatens us:

time, which into living fragments divides

the one I was

from the one I will be,

like the machete the snake;

Time here is not a line, but a personified agent (line 2) that separates your past self from your future self. *Time the Divider*, already a blend, maps onto a mental space with an agent severing a living being ("into living fragments"). However, none of the integrations that we have just sketched justifies the choice of the snake. You can cut many plants or animals into living fragments with a machete. Why the snake? And why is the snake so effective here?

There are several cultural reasons that may make the snake appropriate. It has symbolic values for Paz and for Mexico, although perhaps they are not easy to apply here. Also, as the poem unfolds, we see that Paz is here opposing animalistic, sensual, "full" life, to consciousness (time experience, self-awareness, language, etc.). The snake, as a wild animal, can thus be linked to that primordial life also represented, farther along in the poem, by the jungle and the ocean's foam. The snake can also prompt for the activation of a widely shared cultural frame: Adam and

Eve's story in Genesis. These and other associations can be relevant and productive, but they are not enough to justify the choice of the snake-cutting scene among all other possibilities.

When you finished reading line 5, how did you see the snake? Rolled? Snaking? How many times does the machete cut it? Into how many pieces? No answer to these questions is specified by the text. However, you have probably envisioned the snake as a more or less straight line cut in two. You are prompted to see two pieces by the "living fragments" into which the self is divided in the preceding lines: past and future. But why a straight line? Living snakes are almost never to be found in a position that resembles a straight line. We suggest that this structure has been imported from another input: the timeline.

Mapping back to a timeline is an especially useful property of this snake, driven by the context (*Time the Divider* severing the self into separate parts) and the poet's rhetorical goal of suggesting that your time awareness makes you suffer and die, and prevents you from enjoying life fully. In this blend, the elongated shape of the snake is used opportunistically to activate the line in a context of reflection about time, and thus the snake becomes an imagined anchor instantiating the timeline. The snake-timeline also maps onto the divided self, which was not necessarily linear in the first part of the simile, but becomes so in the final blend. This is crucial for boosting the construction of many affective meanings that we would not normally encounter in other timeline examples.

Some of the most significant mappings and emergent structures include the following:

- In contrast to our conventional understanding of temporal continuity, Paz' timeline, instantiated as a snake, can be broken and separated into pieces that cannot be put together again. It can have a gap between its parts.

- *The one I was / the one I will be* had no spatial definition beyond the fact that they were living fragments of a previous unit. In line 5, they map onto the two linear sections of the snake's body cut by the machete. Interestingly, most readers will probably see the part of the snake containing the head as analogous with the future self, the "tail" with the past.
- The present self maps onto the bleeding wound, which itself corresponds to the gap in the timeline. This differs from standard construals in which the present is not a missing point, but rather a moving point in the timeline.
- The mapping between *divided self-severed snake-"broken" timeline* thus questions basic aspects in the standard notion of time (for poetic metaphors and *questioning* see Lakoff & Turner, 1989: 67-72). For example, the present does not link the past and the future: it separates them. Your selves can no longer meet: the wound is incurable.
- Your living fragments cannot last long: life is short and cruel.
- All this is extremely painful to you. You are a victim just like your analoue the snake. This challenges practically all the archetypical views of the snake, which see this animal as dangerous, powerful, repulsive, etc. However, these archetypical features of the snake remain latent: if you could only liberate yourself from time-awareness, in some counterfactual scenario, you would become that kind of creature, which is also embedded in your nature. Without time, you would be a full snake.
- Your consciousness of time creates the linear self and causes time to divide your linear self into irretrievably separated selves. Your awareness thus puts you in the position of the snake under the machete. Your own consciousness causes your misery and, ultimately, destroys your true identity and the life you could live.

There is nothing you can do. Just like the snake, you are helpless, receiving the blow from a superior position, from an object (time is the machete, not the striker) with which you cannot deal in any human way. Time and temporal consciousness are unavoidable, merciless. Trying to appease *Time the Divider* would be like negotiating with a machete.

5. Looking forward: Image-schematic basis of timeline blends and considerations for future research

The selection of a linear structure to anchor time-space mappings is neither trivial nor whimsical, as shown both by conventional and novel examples. In the input of motion through space, an object can have any trajectory, come from any direction, faster objects can surpass slower ones, and several objects can reach a destination simultaneously. In the time-space blend, by contrast, time units share the same linear trajectory, come from the same direction, cannot overtake one another, and cannot arrive at the same time. If our goal is to order Franklin's life as a series of salient events forming a sequence, we know that these events cannot co-occur, and that the length-duration relationship must be the only one that holds. The properties of the line comply with these constraints, and provide an adequate topology for the blend, although they clash with many other basic aspects of our experience of traversing paths.

As for the integration of the one-dimensional line with the two-dimensional path, spatial cognition often uses the image-schematic structure of the line as a tool for construing narrow shapes as one-dimensional objects, thus discarding the properties that are not relevant for our ad-hoc purposes. Indeed, we often integrate paths, ropes, blades or snakes with linear schemas, allowing us to build cognitive models with a combination of properties of one and two-dimensional objects: e.g. a path that allows only one object to move along it at a time. These are not characteristics of lines that are transferred to time, but needs of time conceptualization that make lines especially appropriate for the mapping. Recruitment of the line as an input to the timeline integration network thus requires extant knowledge of time along with certain representational goals. Rather than understanding time in terms of space, it would seem that the relevant spatial structure has been adjusted to our knowledge of sequences, that is, the spatial topology has been modified to fit the temporal structure. The most creative and complex examples only confirm this fine-tuning of spatial structure to suit temporal structure. In Paz's poem (11), we see that the machete-snake input has adjusted to match its time-self counterpart: among the infinite possibilities available to instantiate the scene described by the poet, we imagine a straight snake cut into two pieces.

Grady, Oakley, & Coulson (1999), in an earlier comparison of approaches to metaphor, argued for the complementary nature of CMT and CIT, with the former well-suited for identifying general cross-domain mappings, and the latter for analyzing individual examples. The implication was that metaphor research could proceed in parallel tracks, with metaphor theorists focusing on conventional language, and blending theorists on creative examples. In the intervening years, however, we have seen an increasing convergence of the two approaches as metaphor research in CIT draws heavily on the methods and findings of CMT (e.g. Oakley & Coulson, 2008), and cognitive linguists in the CMT tradition increasingly advocate the need for additional analytic tools. Lakoff & Johnson (1999), for example, note that analysis of metaphor in everyday language frequently requires the mechanisms of CIT for composing two or more conceptual metaphors. Moore (2006) suggests the definition of conceptual metaphors as cross-domain mappings is overly general, recommending instead their characterization as mappings between elements in simple frames akin to those that structure mental spaces.

Further, CIT research increasingly involves the identification of generalizations (Fauconnier, 2009; Pagán Cánovas, 2011; Pagán Cánovas, in press). For instance, the examples discussed in section 3 suggest that blending disanalogous timelines into a single timeline with emergent properties related to change is a generic integration network. Fauconnier (2009) defines a *generalized integration network* as an abstract blending pattern underlying multiple examples that can subsequently be applied to novel domains. For example, the "Zoloft network" involves a blended space that incorporates incompatible information from the actual circumstances in an episode with structure from a salient counterfactual space in order to emphasize one aspect of the situation. Fauconnier (2009) suggests this example applies to the following excerpt from the San Francisco Chronicle:

(12) "No Smoking" signs were tacked up in bars all over California yesterday, and hard-core smokers nursing a scotch or a beer were so angry that if they had been allowed to light up, the smoke would have been coming out of their ears.

In (12) the relevant structure from the actual episode is that the smoking ban made smokers angry; the salient counterfactual involves a cognitive model incompatible with structure in the actual space: the smokers are allowed to smoke. In the blend, the smokers use their temporary clemency from the smoking ban to express their anger over it by emitting smoke from their ears. Indeed, the Zoloft network gets its name from a court case in which a teenager, who had recently begun taking the medication Zoloft, murdered his grandparents. One of the arguments for the defense was that if his grandparents were alive, they would support a lesser sentence for their grandson. Thus the actual circumstances of the murder of the grandparents are blended with the salient counterfactual in which those victims are alive in order to underscore the accused's lack of culpability. Such examples suggest that intricate generic integration networks can become conceptual templates, easily recruited and modified to suit ad-hoc purposes. The fact that the blending account is more detailed does not imply that it has less generalizing power than CMT's binary mappings. Through processes of automatization, even very complex conceptual recipes can become entrenched, thus systematically rendering emergent structures useful within different communicative contexts.

We suggest that the timeline is paradigmatic of metaphoric understanding. First, as graphical objects, timelines demonstrate the way that metaphor – and indeed conceptual structure – is not a "mere" matter of language, but plays an important role in structuring cognitive activity. Timelines further demonstrate the import of material anchors, input spaces constituted by material structure, frequently tools specifically designed to reduce cognitive load on the individual and to promote efficient, error-free computations. Relatedly, timelines involve compressions, cases in which elements in multiple different input spaces map onto more closely related elements in the blended space, that give it novel computational properties. We have argued that the utility of the timeline is not simply that it involves a metaphoric mapping from a concrete domain to an abstract one, but that the linear schema was selected via a process of cultural evolution to meet the needs of time conceptualization.

Finally, we have stressed the extent to which particular instantiations of timelines have different underlying mappings as a function of their content and the contexts in which they occur. Examination of attested examples reveals a great degree of variation in the particular mappings and inferences promoted. As shown by Fauconnier & Turner (2008), classical conceptual metaphors like TIME IS SPACE are only the tip of the iceberg. Further, our analysis suggests that even the dual system of integration networks connecting events, motion along a path with objective and subjective experience, and the socially constructed notion of time

(Fauconnier & Turner 2008), is not enough to provide a full account of timeline blends. Representational goals often lead speakers to combine two or more conceptual metaphors, metaphoric and metonymic mappings, and to embed their metaphors in hypothetical or even explicitly counterfactual contexts.

In sum, metaphor use is often strategic, as language users seek cognitive models to promote their desired construals of the topic at hand, indeed much as poets do. Moreover, such discourse does not occur in a vacuum, as speakers and listeners together navigate a rich cultural landscape of extant construals with varying degrees of entrenchment. These construals include the binary mappings of CMT, but also detailed blending patterns described via generic integration networks. Sharing these detailed generic procedures for building complex structure makes the meaning construction process more fluid and adaptable to speakers' communicative needs. Understanding metaphor, like understanding timelines, will require the development and refinement of more detailed generalizations of the type proposed by CIT.

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FIGURES

Figure 1. Timeline of Franklin's life. This figure was downloaded from the website www.vertex42.com in an article by Jon Wittwer (9/2/05) on how to use the software package Excel to create a timeline (www.vertex42.com/ExcelArticles/create-a-timeline.html).

Figure 2. A timeline of events at a wedding. Adapted from an example posted by Lori Decter Wright in a blog entry about wedding planning on loridector.com

TABLES

Table 1. Mappings in the Timeline Blend. Each column represents a mental space; entries in the table are either elements or relations. Entries that occur on the same row are mapped to one another.

Table 2. Important mappings in the TIME IS MOTION metaphor.