Mental Perspective in Multiple-Event Memory and Foresight*

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This article investigates mental perspective in mental time travel along a sequence of two or more events. First, perspective in mental time travel along a sequence of two events is examined by cognitive-linguistically investigating the temporal cognition underlying the use of the pluperfect (as one possible window into two-event memory) and the future perfect (as one possible window into two-event foresight). Secondly, perspective in mental time travel along a sequence of more than two events is investigated by applying and extending the previous two-event analysis to these more complex memory structures. For mental time travel along a sequence of two events the following novel distinctions are offered: perspectival mental time travel into “anteriority in the past” versus perspectival mental time travel into “anteriority in the future”; perspectival mental time travel along a mental time line where past/future and anteriority/posteriority form two separate temporal reference frames versus perspectival mental time travel along a mental time line where past/future and anteriority/posteriority conglomerate to a single nondispersible temporal reference frame; single temporal direct viewings versus dual simultaneous temporal direct viewings; and looking into the future from the present moment versus looking into the future from the past. For mental time travel along a sequence of more than two events the following novel distinctions are offered: the combination of one direct temporal viewing with serial prospective temporal viewings versus all serial temporal direct viewings and episodic versus semantic perspectival multiple-event memory and foresight. The memory account developed in this article also extends recent work in memory theory which suggests that certain memory structures/

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processes are “scale-independent,” which means that it is proposed that certain memory structures/processes feature in both long-term and short-term memory. The main contribution of this article to scale-independent memory theory is the cognitive-linguistically derived argument that such a scale-independent memory system consists of two temporal perspective points (up to now only one temporal perspective point has been assumed). Implications for cognitive modeling and for human versus animal cognition are discussed.

Key words: Talmyan perspective point (PP), mental time travel, memory, foresight, temporal cognition, tense system, mental time line, models

1. Introduction

Until recently mental time travel has mainly been characterized as mentally projecting forward or backward in time from the present moment (e.g., Addis, Pan, Vu, Laiser, & Schacter, 2009; Schacter & Addis, 2007a, b; Tulving, 1972, 2002). By synthesizing findings from cognitive psychology and cognitive linguistics and by additionally applying cognitive-linguistic methodology, Stocker (2012a) then introduced the idea—based on a sketch by Talmy (2000, pp. 86–87)—that in addition to this basic type of mental time travel (projecting backward or forward in time from the present moment), there might also be more complex types of mental time travel. For instance: a person may mentally project back from the present moment to a particular point in time in the past, but may additionally also conceptualize mentally projecting forward from this past point to a “later time” that is still in the past. Such examples can be referred to as examples of nested mental time travel (projecting forward in time embedded within projecting backward in time) (cf. Stocker, 2012a, p. 408). Investigating the conceptual structure underlying the linguistic use of before/after sentences that are additionally set in the past or future tense, Stocker (2012a) has thus far basically identified one form of nested mental time travel: mental time travel into anteriority or posteriority (underlying before/after) embedded in mental time travel into the past or future (underlying past/future tense). It is important to distinguish anteriority/posteriority (“earlierness/lateness”)

from past/future since the former is more generic and does not depend upon
the present moment as a reference point (e.g., Núñez & Sweetser, 2006,
p. 404). For instance: One event may have occurred later in time than
another event (say my first day at school versus my birth), but both events
have occurred in the past.

In the first part of this article (Sections 2–3), it is investigated how this
anteriority/posteriority versus past/future distinction can help us to reveal
the complex mental time travel that is underlying the pluperfect and future
perfect. A major goal here is to substantially refine our understanding of
possible cognitive phenomena that can occur in mental time travel along
a sequence of two events; this part of the investigation will lead to a
range of novel distinctions that involve two-event mental time travel and
mental perspective. In the second part of this article (Sections 4–5), the
two-event analysis of the first part is used as a starting point to approach
the cognitive structure of mental time travel along more than two events.
Again, a range of novel distinctions will be offered. In the discussion
(Section 6) implications of the findings of the previous sections are related
to cognitive modeling of time and memory (Section 6.1) and to possible
basic differences in human versus animal temporal cognition (Section 6.2).

The theoretical strategy I adopt is the same as used in Stocker (2012a):
using language as an entree to a conceptual level that seems deeper than
language itself (Pinker, 2007; Talmy, 2000). This strategy is supported by
recent findings that many conceptualizations observed in relation to our
use of language also exist in mental representations that are more basic
than language itself (e.g., Boroditsky, 2000; Casasanto & Boroditsky,
2008; McGlone & Harding, 1998; Núñez, Motz, & Teuscher, 2006). In the
present investigation, language (cognitive-linguistic analysis) can assist us
to identify complex forms of mental time travel—complex forms of mental
projection through time.

The basic theoretical framework used is Talmyan concept structuring
(Talmy, 2000), with the further refinement for temporal cognition by
Stocker (2012a). There are many other basic theoretical frameworks that one
could adopt when investigating the temporal cognition underlying the use
of the tense system or when investigating the conceptual structure of mental
time in general—for example: formal accounts of tense (e.g., Comrie, 1985;
Declerck, 1986; Jespersen, 1924; Reichenbach, 1947), conceptual semantics (Jackendoff, 1987, pp. 398–402; cf. also Pinker 1989, pp. 205–206), formal semantics (e.g., Bennett & Partee, 1978; Montague, 1973; Pendlebury, 1992), or temporal (tense) logic (e.g., Allen, 1984; Kowalski & Sergot, 1986; Lichtenstein & Pnueli, 2000; Prior 1967). While the current investigation is basically set in a Talmyn framework, it also, as we will see, benefits greatly from the formal-tense analysis of Comrie (1985). One of the main motivations for choosing Talmyn concept structuring as a basic theoretical framework for the present investigation is that it offers a ready means to incorporate mental temporal perspective (Stocker, 2012a, b; Talmy, 2000, pp. 68–76+86–87). In the other above-mentioned approaches (formal tense, conceptual semantics, formal semantics, temporal logic), mental perspective is usually not considered or is only mentioned marginally, without incorporating it into the formal descriptive apparatus (e.g., in Jackendoff, 1987, p. 399). In contrast, in Talmyn concept structuring, perspective is an integral part of the overall theoretical descriptive system.

Before we begin with the analysis of mental time travel in multiple-event memory and foresight in the next section, let us attempt to characterize more precisely what cognitive-linguistic analysis suggests what “mental time travel” is. We might first note that language suggests at least two basic conceptual-metaphoric possibilities how mental projection through time might be carried out: whole-body motion and gaze direction. This is exemplified in (1):

(1) How language suggests that we mentally conceptualize progression through time
   a. Whole-body motion: I am leaving my tough past behind and I am moving on to a better future.
   b. Gaze direction: I am looking back at my tough past and I’m looking ahead to a better future.

The conceptualization of whole-body motion (1a) through time corresponds to what has been referred to as the moving-ego metaphor in the conceptual-metaphor literature (e.g., We are approaching Christmas). A variant of this is the moving-time metaphor where not the cognizer is mentally
construed as moving through time, but where time is conceptualized as moving and the cognizer is conceptualized as being stationary (e.g., *Christmas is approaching*). While the moving ego/time metaphor has been treated theoretically (Clark, 1973; Lakoff & Johnson, 1980, 1999; cf. also McTaggart, 1908, p. 470), its psychological reality has also been confirmed in various psychological experiments (e.g., Boroditsky, 2000; McGlone & Harding, 1998; Núñez et al., 2006). For instance, when we see a picture of a person moving toward an object, we are more likely to conceptualize time in the moving-ego mode, and when we see a picture of an object moving toward a person, we are more likely to conceptualize time in the moving-time mode (Boroditsky, 2000). In an embodiment context, it has for example also been found that forward whole-body motion is associated with future cognition (Hartmann & Mast, 2012). Thus, whole-body motion through time (moving ego) as well as its logical counterpart (“whole-body stationariness” where time itself is in motion; moving time) has been investigated quite extensively. However, when it comes to the second basic possibility how language suggests we might mentally conceptualize progression through time—(1b): *looking* rather than moving through time—I am not aware of any study that has directly addressed gaze direction through time in experiments that investigate the psychological reality of conceptual metaphors. Nevertheless, cognitive-linguistic approaches have developed rather elaborate theoretical accounts that involve the idea that we—besides whole-body motion—also construe ourselves as mentally looking through time (Stocker, 2012; Talmy, 2000). Besides the cognitive-linguistic analysis, some successful memory modeling approaches also work with the assumption that we mentally look through time (Brown, Neath, & Chater, 2007); the latter means that the assumption of “looking through time” can explain and predict a vast amount of (free and serial recall) experimental memory data (for more on temporal perspective and memory modeling see Section 6.1). Given the existing cognitive-linguistic and modeling evidence that “mentally looking through time” might be psychologically real, I follow Stocker (2012) in working with the assumption that mental time travel underlying linguistic tense as well as episodic memory/foresight involves stationary temporal perspective points (PPs) that are located on a mental time line or in relation to it (cf. also Talmy, 2000, pp. 72–76). I know
of no cognitive-linguistic (or other) evidence which—unlike in the moving ego/time metaphor—suggests that the PP moves along the time line when constructing a tense or a memory image. Given that the perspective point is assumed to be stationary, what is assumed to move along the time line in the present investigation is the mental gaze (Stocker, 2012a). Looking through time along the mental time line will often be called *perspectival mental time travel* in this article.

For the assumption that we mentally construe a time line when conceptualizing time, there is a lot of empirical evidence—it is just the *mental looking* along the line that has not received experimental attention yet. The mental time line is for instance frequently conceptualized in relation to the cognizer’s body along the sagittal (back to front) axis (Hartmann & Mast 2012; Miles, Karpinska, Lumsden, & Macrae, 2010; Miles, Nind, & Macrae, 2010; Torralbo, Santiago, & Lupíañez, 2006; Ulrich, Eikmeier, de la Vega, Ruiz Fernández, Alex-Ruf, & Maienborn, 2012) or along the transversal (left to right) axis (Bergen & Chan Lau 2012; Casasanto & Bottini 2013; Casasanto & Jasmin 2012; Cooperrider & Núñez 2009; Miles, Betka, Pendry, & Macrae, 2010; Santiago, Lupáñez, Pérez, & Funes, 2007; Sinha, Sinha, Zinken, & Sampaio, 2011; Torralbo et al. 2006; Ulrich & Maienborn, 2010; Tversky, Kugelmass, & Winter, 1991). Thus, when people in Western (and presumably many other, but not all) cultures think of the future, their body unconsciously sways forward and when they think of the past their body unconsciously sways backward (Miles et al., 2010c), suggesting that they in this instance mentally construe a sagittal time line going right through their body, as it were. Also, when people in Western culture (and presumably many other, but not all cultures) are asked to lay out cards in chronological order—say, *tadpole, froglet, frog*—then people order them from left to right, suggesting that they in this instance construe a transversal (left-to-right) time line, passing by in front of them, as it were. Let us then begin to see how such mental time projection along a “mental time line” can deepen our understanding of memory and foresight structures.
2. Perspectival mental time travel along two events in the past (pluperfect)

Since the pluperfect (I had already eaten when ...) makes reference to two points in the past, the pluperfect is used in this section as an entree to perspectival mental time travel to two events in the past. The linguist Bernard Comrie (1985) examines the meaning of the pluperfect with examples from English. However, it is clear that he proposes that this meaning of the pluperfect holds true for the pluperfect in general—for the pluperfect in “so many languages” (Comrie, 1985, p. 67). Traditional grammar books have, for instance, noted the existence of the pluperfect in Latin and Greek, Germanic languages (e.g., English, German, Dutch), and Romance languages (e.g., French, Italian, Spanish, Portuguese). To these, Comrie also adds the languages Maltese and Luganda as using the pluperfect (p. 80). The conceptual analysis of the pluperfect, as it will be developed in this article (which adds mental geometric and perspectival structure to the meaning of the pluperfect), is proposed to underlie the use of the pluperfect in all these languages. Some examples from different languages follow later on in this section. In addition, also later on in this section, it will be proposed that the meaning of the pluperfect, including its geometric and perspectival structure, can also be proposed to underlie a morpho-syntactic form that is sometimes called the “doubled perfect.” This is a form that features in some German dialects in or near Southern Germany which do not use the pluperfect at all. The cross-linguistically valid characterization of the meaning—the temporal-relational structure—of the pluperfect that Comrie offers, is:

The meaning of the pluperfect is that there is a reference point in the past, and that the situation in question is located prior to that reference point, i.e. the pluperfect can be thought of as “past in the past” (1985, p. 65).

As we will see later on in this section, a still more refined characterization of the meaning of the pluperfect—rather than saying that it signifies “past
in the past”—is to characterize it as “anteriority in the past.” To start investigating the temporal-conceptual structure underlying the pluperfect, we use one of Comrie’s own examples for illustration (1985, p. 66):

(2) John had already left when Mary emerged from the cupboard.

According to Comrie the temporal relations underlying the use of the pluperfect can be formalized in the following terms (1985, p. 125):

(3) pluperfect: $E$ before $R$ before $S$

$E$ stands for the event which is to be located in time. In Comrie’s example, the event of John’s leaving is the event to be located prior to Mary’s emerging from the cupboard. Hence the event in the pluperfect clause (John’s leaving) is $E$. $R$ stands for the temporal reference point in relation to which $E$ is defined. Thus Comrie’s formula correctly predicts that $E$ (John’s leaving) occurs before $R$ (Mary’s emerging from the cupboard). $S$ stands for moment of speech (i.e., the present moment). Comrie’s formula again correctly predicts that $R$ (Mary’s emerging from the cupboard) occurs before $S$ (the present moment).

1 Comrie’s (1985) $ERS$ notation for the pluperfect represents a further development—and major departure—from the famous tense formulations of Reichenbach (1947, pp. 287–298; cf. also Jespersen, 1924, pp. 262–264). Comrie’s formulations are mainly taken over because it is Comrie’s analysis that allows one to characterize the pluperfect as involving “anteriority in the past” and the future perfect as involving “anteriority in the future”—which has major temporal-cognition implications when one adds mental perspective to the pluperfect and future perfect constructions, as shall be demonstrated in this article. Taken over from Prior in the analysis in this paper, is the argumentation that there is no need to—as Reichenbach does—“make such a sharp distinction between the point or points of reference and the point of speech” (1967, p. 13). This is so, as also pointed out by Prior, because the present moment (“the point of speech”) itself can function as a reference point (as we will see, in our analysis the present moment will also be the point of memory recall). This argumentation of Prior is taken over by allowing the present moment to function as a Ground (see below in this article). “Ground” is the Talmyan technical term for what one might also refer to as a “reference point.”
As has just been demonstrated, (3) can correctly predict all temporal-relational structure of the pluperfect. The question we now turn to is: How could mental temporal perspective (Stocker, 2012a; Talmy, 2000, pp. 72–76+86–87) be added to this basic account of the temporal-relational structure of the pluperfect? One theoretical solution to this question, the one to be adopted in this article, is to integrate Comrie’s findings into the theoretical framework of Talmyan concept structuring—because Talmyan concept structuring can describe temporal relations and temporal perspective in one coherent theoretical framework (Stocker, 2012a; Talmy, 2000). As a starting point, let us reformulate Comrie’s pluperfect formula in Talmyan terms. In Talmyan concept structuring, spatial or temporal relations are captured with the notions of Figure ($F$) and Ground ($G$) (Talmy, 2000, Chapter 5). In temporal Figure/Ground, one event serves as temporal reference point ($G$) in relation to which the temporal location of the other event ($F$) is defined. Thus (3) can be captured in the following way in Talmyan terms:

$$(4) \text{pluperfect: } F_1 \text{ before } G_1; \ F_2 (G_1) \text{ before } G_2 \ (G_2 = \text{present moment})$$

We again exemplify the formalized temporal relationship with (2). Now it is $F_1$ which stands for the event which is to be located in time (John’s leaving). $G_1$ stands for the temporal reference point (Mary’s emerging from the cupboard) in relation to which $F_1$ is defined. Thus (4) correctly predicts that $F_1$ (John’s leaving) occurs before $G_1$ (Mary’s emerging from the cupboard). However, $G_1$ also functions as another $F$, since the temporal position of $G_1$ is also defined in relation to the present moment. Hence, one is in a position to postulate that $G_1$ (Mary’s emerging from the cupboard) also functions as an $F$ (a second $F$ in the overall temporal complex: $F_2$) whose temporal position is defined in relation to the present moment (which functions as a second $G$: $G_2$). Thus, (4) also correctly predicts that $F_2$ (Mary’s emerging from the cupboard) occurs before $G_2$ (the present moment).

Thus far, Comrie’s pluperfect (3) and the Talmyan pluperfect (4)

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For a different theoretical approach to the notion of a temporal reference point see Declerck (1986, pp. 320–321).
formalization are equipotent in terms of theoretical explanatory power: they both correctly predict the complex temporal relations that underlie our use of the pluperfect. But having it phrased in Talmyan terms allows us now to add mental temporal perspective (Stocker, 2012a; Talmy, 2000, pp. 72–76+86–87) to the temporal-relational description. Both Talmy and Stocker have cognitive-linguistically argued in detail that a complex temporal sentence (a temporal sentence with a main and a subordinate clause) underlies a temporal direct viewing of the F event in relation to the content of the main clause and a temporal indirect (prospective or retrospective) viewing of the G event in relation to the content in the subordinate clause. Taking over this analysis (see Stocker, 2012a; Talmy, 2000, pp. 72–76+86–87 for argumentation), we derive at the perspective-including, temporal-conceptual structure underlying our use of the pluperfect as it is depicted in Fig. 1.

**Figure 1.** Perspectival mental time travel into posteriority (to G₁) embedded into perspectival mental time travel into anteriority in the past (to the F₁-co-located *PP*), a nested dual form of perspectival mental time travel underlying the pluperfect. When processing the sentence *John had already left when Mary emerged from the cupboard*, the cognizer (speaker or hearer/reader) first mentally projects retrospectively to anteriority in the past (F₁; *John’s leaving*) from where the cognizer then mentally projects prospectively to the posterior (simple-past) reference event (G₁; *Mary’s emerging from the cupboard*). Additionally, the present moment serves as a temporal reference point (G₂) to locate the simple-past event (F₂) before the present moment.
When taking a look at this figure, the temporal structure—and perspectival cognition thereof—might at first glance seem identical to the conceptual structure underlying our use of a temporal complex sentence containing before and the past tense (a before/past-tense construction like I shopped at the store before I went home; cf. with Fig. 9 in Stocker, 2012a, p. 408). This is also not surprising: Comrie’s characterization of the pluperfect clause as “past in the past” could also be paraphrased as “past event before another past event.” We should also note that Comrie’s pluperfect characterization of “the past in the past” just serves him as a first rough characterization of the pluperfect (he uses the phrase to introduce the pluperfect). Crucially, Comrie notes that in relation to (3):

Since the relation before is transitive (i.e. if X is before Y and Y is before Z, then necessarily X is before Z), one can deduce $E$ before $S$ from the representation of the pluperfect, but this is not part of the formal representation of the pluperfect; the importance of this observation will become clear when we discuss the future perfect (1985, p. 125).

In other words, what Comrie is saying is that the pluperfect is basically speaking not “a past in the past” (i.e., this can only be deduced), but anteriority in the past (since he says that $S$, the present moment, is in no way directly related to $E$). All that is inherent in (3)—or (4)—is that the event in the pluperfect must occur earlier than its reference event in the past. As with Comrie, we examine the importance of this observation when we examine the temporal-conceptual structure and mental perspective underlying the future perfect (see next section). The observation that the pluperfect signifies “anteriority in the past” also leads us to the basic temporal-conceptual difference between before/past-tense constructions and complex sentences containing a pluperfect in the main clause and the simple past in the subordinate clause. In a before/past-tense construction, one can identify two distinct temporal Reference Frames (RFs): an anteriority/posteriority RF (underlying before) that is embedded in a past/future RF (underlying past/future-tense; as examined in Stocker, 2012a, where the term RF is also technically defined). But in a pluperfect construction, one
cannot disentangle the anteriority/posteriority RF and the past/future RF. The observation that the pluperfect stands for “anteriority in the past” means that the temporal conceptual structure underlying the pluperfect has fused these two RFs into a larger complex whole: the pluperfect carries components of both these RFs within it—since “anteriority” is part of an anteriority/posteriority RF and “past” is part of a past/future RF. Trying to tease the two RFs apart would result in the dissolving of the sine qua non of the pluperfect: that it refers to an event that must occur earlier than another event in the past. It is in this sense that a pluperfect construction is more complex than a before/past-tense construction: underlying a pluperfect structure is a more complex RF where components of two separate RF-systems have formed a new complex whole.

Additionally cognitive-linguistic analysis of complex temporal sentences in relation to Talmyan mental perspective points (PPs) suggests that F and G are cognized as points (punctual events) on the mental time line and they are mentally cognized from a distal PP (as detailed in Stocker 2012a; cf. also Talmy 2000, pp. 61–62). A distal PP means mentally zooming out as much from an event as to collapse the entire duration of an event to a single temporal point. The self needs to zoom out this much in order to be able to cognize two events—that is the relationship between the two events—from one perspective point. Note also that the observation that the pluperfect indicates that self travels back from the present moment to a point in time prior to another past event (to F₁) means that the reference point in the past (G₁) can only be located in a prospective (later) direction when viewed from the perspective of F₁. Thus the self at the point in the past that is prior to another event in the past must mentally travel (look) forward in order to establish the posterior reference point (in order to establish G₁). That

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² Note that this article follows Comrie in viewing the perfect (have eaten) and the pluperfect (had eaten) as—despite their formal similarities and despite the fact that many linguists treat them in a uniform way—as fundamentally different from one another from a temporal-conceptual viewpoint. Many arguments for a principal temporal-conceptual separation of the perfect and the pluperfect are given by Comrie (1985, pp. 77–82). To follow them up would go beyond the scope of the present investigation. The interested reader might also find Talmy’s temporal-conceptual analysis of the perfect relevant (2000, p. 95).
the self travels from temporal F co-location to G (to establish a reference point at the temporal G point) has been examined in detail for before/after temporal constructions (Stocker, 2012a).

What does the Talmyan approach to analyze mental time travel underlying the pluperfect add to the more traditional approach of Comrie? In other words, what is the advantage of having a geometric/perspectival complex as represented in Fig. 1 over having a temporal-relational formula as in (3)? I see three main advantages. First, the use of Talmyan Figure (F) and Ground (G) brings out clearly the notion that the past event which is not in the pluperfect clause (and for instance is in a subordinate clause) has two formal functions: that this event serves as temporal reference point (G₁) as well as a point that is related to a reference point (F₂). This double function comes out less clearly in Comrie’s formula, since the event that is not in the pluperfect clause is only assigned one symbol (only R). Secondly, the perspectival analysis of Fig. 1 reveals that although we are essentially dealing with a past construction, one can nevertheless propose a prospective (a looking-forward-in-time) element to the construction (the prospective viewing from F₁ to G₁). That there should be a prospective element when dealing with a past construction is not something that is intuitively immediately accessible; only systematic cognitive-linguistic analysis has ferreted this out. Thirdly, the perspectival analysis of Fig. 1 also leads to the proposal that such a past construction involves not only one temporal perspective point (PP), but two. Again, the idea that there should be another temporal perspective point than the one looking back from the present moment into the past, is not necessarily intuitively immediately accessible, but is brought out by the cognitive-linguistic analysis. That there should be more than one temporal perspective point when constructing a past or future mental scene, is, in my opinion, also highly relevant for memory models (see Section 6.1).

Thus far in this section, we have investigated the meaning of the pluperfect. Morpho-syntactically speaking, most modern European languages form the pluperfect by combining an auxiliary verb that is marked for the past (e.g, simple-past or imperfect) with a verb in past-participle form. Simple-past/past-participle combinations to express the pluperfect feature for example in English (had heard), German (hatte
gehört) or Dutch (had gehoord) and imperfect/past-participle combinations for example in Spanish (había oído), Italian (avevo sentito), or French (j’avais entendu). However, within some German dialects there is a morpho-syntactic variant how anteriority in the past can be expressed which differs from the pluperfect. This form is sometimes called the “doubled perfect” (Blidschun, 2011, p. 134; Fabricius-Hansen, 2006, pp. 463–464; Litvinov & Radčenko, 1998; Rödel, 2007). It features in German dialects of Southern Germany and Austria and in Swiss German. These are dialects where the simple past and the pluperfect have fallen out of use (Comrie, 1985, pp. 81–82; Häcki Buhofer & Burger, 1998, p. 25; Lötischer, 1983, pp. 96–97; Wyler, 1990, p. 28). The following Swiss-German doubled-perfect example is from Lötischer (1983, p. 97) (Lötischer “only” provides the example; the glossing analysis is from me):

(5) **Expressing anteriority in the past with the doubled perfect (Swiss German)**

S Huus isch scho abe-prännt gsyy, wo d Füürweer cho isch.

a. s Huus isch scho abe-prännt gsyy,

the house is.AUX.PRS already down-burned.PST.PTCP been.PST.PTCP

b. wo d Füür-weer cho isch.

when the fire-brigade come.PST.PTCP is.AUX.PRS

‘(a) The house had already burned down, (b) when the fire brigade came.’

(AUX = auxiliary, PRS = present, PST = past, PTCP = participle)

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3 There are two doubled-perfect variants, one with an auxiliary verb in the present tense and one with an auxiliary verb in the the simple-past tense (Blidschun, 2011, p. 134; Fabricius-Hansen, 2006, pp. 463–464; Litvinov & Radčenko, 1998; Rödel, 2007). However, in Swiss German (as well as in other dialects in or near Southern Germany) only the double perfect with the auxiliary verb in the present tense is in use (since the simple-past morpho-syntactic form is, as just mentioned, no longer in use). The present investigation only addresses the doubled perfect with an auxiliary verb in the present tense, since the main focus here is how language users who morpho-syntactically speaking have no simple past, nevertheless have a specific morpho-syntactic form that seems to have the same semantic function as the pluperfect does (to express anteriority in the past).
Since Swiss German (as other dialects in or near Southern Germany) lacks both the simple past and the pluperfect, it must resort to different means to express simple past as well as anteriority in the past. In such Alemannic dialects the compound perfect with the auxiliary verb in the present tense covers both the perfect (have come) and the simple past (came) (Comrie, 1985, pp. 81–82). Thus in (5b), one finds a compound perfect (cho isch) in the subordinate clause that expresses a simple-past situation (that the fire brigade came). The expression of anteriority in the past in the main clause (5a) is achieved by turning the verb to be (syy) of a compound perfect into a past participle (gsyy), which leads to a doubled past-participle (abeprännt gsyy). This composite past participle is combined with another
to-be auxiliary verb in the present tense (isch ... abeprännt gsyy). What is achieved semantically by this complex perfect-doubling construction is to signify anteriority in the past—the same meaning that is signified by the pluperfect.

A geometric and perspectival analysis of the doubled perfect leads to the same geometric and perspectival structure that has been proposed for the pluperfect (cf. Fig. 1). This is exemplified in Fig. 2.

Thus the analysis of the pluperfect and the doubled perfect allows one to propose that the same temporal-conceptual (geometric, perspectival) structure underlies these two different morpho-syntactic forms: perspectival mental time travel into posteriority that is embedded into perspectival mental time travel into anteriority in the past. That a language that lacks a pluperfect (like Swiss German) develops its own morpho-syntactic means to express “anteriority in the past” can be taken as evidence that the expression of this concept is important. Such a mental representation allows one to not only relate past events to the present moment, but also to relate past events in relation to other past events (cf. Comrie, 1985, p. 67).

Stocker (2012a) also argues in detail (by providing cognitive-linguistic evidence) that the schematic geometric representations, as for instance shown in Fig. 1–2, are not merely a didactic aid that allows us to illustrate the underlying cognitive-temporal structure. Rather it is proposed that such geometry is actually construed in our mind when we conceptualize time. For instance: the depicted time line is proposed to be an actual, mentally construed spatial structure in our mind that allows for mental time travel—for instance in relation to the pluperfect/doubled perfect by projecting one’s mental gaze along this mentally construed line once in a retrospective direction (to “anteriority in the past”) and once from there in a prospective direction (to the reference point in the past). As mentioned in the introduction already, the proposal that the “mental time

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4 Morpho-syntactically comparable forms to the doubled perfect (with comparable temporal semantics) seem to exist within the so-called temps surcomposés (“super-compound forms”) in French. However, native speaker judgments are not always in agreement on the meaning of these super compounds (Comrie, 1985, p. 76). For this reason, they are left out of the present discussion.
line” is mentally construed when we engage in mental time travel is also supported by a growing number of recent experimental and other empirical findings. As also mentioned, the mental time line is for instance frequently conceptualized in relation to the cognizer’s body along the sagittal (back to front) axis or along the transversal (left to right) axis.

3. Perspectival mental time travel along two events where at least one of the events is in the future (future perfect)

Since the future perfect (I will have eaten when ...) is best known in its function to make reference to two points in the future, the future perfect is used in this section as an entree to perspectival mental time travel to two events in the future. However, as will also be examined in this section, the future perfect can also underlie perspectival mental time travel along two events where one event is in the future and the other in the present or where one event is in the future and the other in the past. As with the pluperfect (see Section 2), Comrie (1985) illustrates the meaning of the future perfect with examples from English. However, it is clear that he proposes that the suggested meaning of the future perfect holds true for the future perfect cross-linguistically. The existence of the future perfect has been noted traditionally for Latin and Greek, for Germanic languages (e.g., English, German, Dutch), and for Romance languages (e.g., French, Italian, Spanish, Portuguese). Comrie also adds the languages Maltese and Luganda as using the future perfect (1985, p. 80). The mental geometric and perspectival analysis of the future perfect, as developed in this article, is proposed to underlie the use of the future perfect in all these languages. The three distinct temporal interpretations that can be found in relation to the future perfect (future, present and past interpretation) also seem to hold true cross-linguistically (Comrie: “In other languages I have investigated that have a future perfect, this form [future perfect with future, present, or past interpretation] behaves in exactly the same way as has just been described for English” (1985, p. 74).

Comrie concludes that the temporal-conceptual structure underlying the future perfect differs to the one underlying the pluperfect in only one way: the reference point (G1 in the Talmyan framework) is set in the future rather
than in the past (Comrie 1985, pp. 69–74). Accordingly, Comrie (p. 126) formalizes the temporal-relational structure underlying the pluperfect in the following way (cf. with (3)):

(6) future perfect: $E$ before $R$ after $S$

Reformulation in Talmyan concept structuring (cf. with (4)); this will again enable us to integrate mental perspective (PP) into the temporal cognition:

(7) future perfect: $F_1$ before $G_1$; $F_2$ ($G_1$) after $G_2$ ($G_2 = \text{present moment}$)

Both formulations, (6) and (7), encode a remarkable finding of Comrie about the future perfect, a finding that holds true cross-linguistically: that all that the future perfect indicates is that there must be a reference point ($G_1$) in the future—but while the event referred to ($F_1$) most typically also occurs in the future, it can also occur in the present or even in the past. Comrie:

Let us start with the example *John will have finished his manuscript by tomorrow*. Let us suppose moreover that I do not know whether or not John has already finished his manuscript (or at least do not wish to reveal this knowledge), but I know (and am prepared to divulge) that he will have finished it by tomorrow – say, because he made a promise to this effect several days ago, and is judged by me to be reliable. Then there are three sets of circumstances in which I can felicitously and truthfully utter this statement. One set of circumstances is where John finishes his manuscript between the moment of my uttering this sentence and the reference point “tomorrow”. The second is where John is in fact finishing his manuscript at this very moment, but I am unaware (or wish to give the impression that I am unaware) of this fact. The third is where John has already finished his manuscript, but I am unaware (or wish to appear unaware) of the fact. Thus the time reference of John’s finishing his manuscript is left open as to whether it is future, present, or past relative to the present moment, the only stipulation being that it must be prior to the reference point in the
future, the sine qua non of the future perfect (1985, p. 71).

This leads to three kinds of temporal relations that can underlie our use of the future perfect: future perfect with future interpretation, future perfect with present interpretation, and future perfect with past interpretation (Comrie, 1985, p. 70). Comrie has found these three possible temporal-relational interpretations of the future perfect in every language he has investigated that has a future perfect. However, he has found “no language” in which these three different interpretations are marked grammatically (e.g., marked morpho-syntactically) (p. 74). Hence, it seems that this degree of temporal-relational freedom of the future perfect is a nondispensable characteristic of the meaning of the future perfect. As further evidence that the event being referred to (F₁; see below) in a future-perfect construction can be in the future, present, or past, Comrie also offers the following analysis:

(8) *Further evidence that F₁ cannot only be in the future in the future perfect (adapted from Comrie, 1985, pp. 72–73)*

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<td>a. Q: Will John finish his manuscript between now and tomorrow? A: *Yes; in fact, he has already finished it.</td>
<td></td>
</tr>
<tr>
<td>b. Q: Will John have finished his manuscript by tomorrow? A: Yes; in fact, he has already finished it.</td>
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As (8a) demonstrates, when the event being referred to (F₁) is clearly restricted to taking place in the future only, then a past interpretation is no longer possible; the “yes” directly contradicts the question. However, this restriction does not apply to a future-perfect construction, as (8b) demonstrates; the “yes” does not contradict the question.

It is in this context of the possible future/present/past interpretation of the pluperfect where the anteriority/posteriority versus past/future distinction becomes highly relevant: whereas the structure underlying the pluperfect (by deduction) can be characterized as “past in the past” (but is more precisely “anteriority in the past”; cf. previous section), this is no longer (in analog
Figure 3. Perspectival mental time travel into posteriority (to $G_1$) embedded into perspectival mental time travel into anteriority in the future (to the $F_1$ co-located PP), where the anterior event is also set in the future—a nested dual form of perspectival mental time travel underlying the future perfect with future interpretation. When uttering the sentence *John will have finished his manuscript by tomorrow*—while knowing/assuming that John has in fact not finished it yet—the cognizer (speaker and knower/assumer) first mentally projects to anteriority in the future ($F_1$; *John's finishing of the manuscript*) from where the cognizer then mentally projects prospectively to the posterior reference event, which is still further in the future ($G_1$; *by tomorrow*). Additionally, the present moment serves as a temporal reference point ($G_2$) to locate *by tomorrow* ($F_2$) after the present moment.

ways) true for the structure underlying the future perfect. As the analysis of Comrie demonstrates, the temporal relations underlying the future perfect could not (also not by deduction) be characterized as “past in the future” (since this would only correctly characterize the future perfect with past interpretation). The only characterization that can capture the sine qua non of the future perfect is “antiority in the future”—that is, a reference point ($G_1$) in the future in relation to which an earlier event ($F_1$) is defined, an event that can be located in the future, present, or past.

If we now add—as we did with the temporal-conceptual structure underlying the pluperfect—mental temporal perspective (Stocker, 2012a; Talmy, 2000, pp. 72–76+86–87), then these three possible interpretations of the future perfect naturally lead to three different kinds (subtypes) of nested
dual mental time travel, as illustrated in Figs. 3–5.

The temporal-conceptual structure and perspective underlying the future perfect with future interpretation (Fig. 3) is largely identical to complex before-sentences that would additionally be marked as occurring in the future (cf. Stocker, 2012a). However, the vital difference is again—as in before-past-tense constructions (cf. previous section)—that in a before-relation where both events are set in the future there are two distinct temporal Reference Frames (anteriority/posteriority and past/future RFs) whereas in a construction containing a future perfect these two RFs have fused to one larger, more complex anteriority/past-posteriority/future RF
The novel finding in the temporal-conceptual structure and perspective underlying the future perfect with present interpretation (Fig. 4) is that computational logic requires us to place the self twice at the present moment: the self must be located at the present moment in order to look out at the embedded self that is a distal distance removed from the time line (cf. Figs. 1–3); the second (embedded) self a distal distance away from the time line (but still co-located with the present moment) needs to look at the present moment on the time line so that F₁ can be cognized in a temporally direct way (cf. also Figs. 1–3). More technically speaking, the novel

**Figure 5.** Perspectival mental time travel into posteriority (to G₁) embedded in perspectival mental time travel into anteriority in the future (to the F₁ co-located PP), where the anterior event is set in the past—a nested dual form of perspectival mental time travel underlying the future perfect with past interpretation. When uttering the sentence *John will have finished his manuscript by tomorrow*—while knowing/assuming that John has in fact already finished it—the cognizer (speaker and knower/assumer) first mentally projects to anteriority in the future (F₁; *John’s finishing of the manuscript, which is in the past*) from where the cognizer then mentally projects prospectively to the posterior reference event, which is in the future (G₁; *by tomorrow*). Additionally, the present moment serves as a temporal reference point (G₂) to locate the *by tomorrow* (F₂) after the present moment.

where the two RFs can no longer be disentangled.

The novel finding in the temporal-conceptual structure and perspective underlying the future perfect with present interpretation (Fig. 4) is that computational logic requires us to place the self twice at the present moment: the self must be located at the present moment in order to look out at the embedded self that is a distal distance removed from the time line (cf. Figs. 1–3); the second (embedded) self a distal distance away from the time line (but still co-located with the present moment) needs to look at the present moment on the time line so that F₁ can be cognized in a temporally direct way (cf. also Figs. 1–3). More technically speaking, the novel
proposal is the existence of a dual form of simultaneous temporal direct viewing, where both viewings are located at or co-located at the present moment. Note also that “mental time travel” into anteriority in the future is not really mental time “travel” in the present-interpretation case—since the anterior point happens to be at the present moment, the self at the present moment must cognize an embedded self a distal distance away from the timeline (but since this all happens at the present moment, the self does not really “travel” anywhere, at least not in a “forward/backward in time” sense).

The major novel observation in the temporal-conceptual structure and perspective underlying the future perfect with past interpretation (Fig. 5) is a looking forward from a past point (from the PP that is co-located with F₁) to a future point (to G₁)—that is, a prospective projection through mental time that starts off in the past and extends right into the future. This represents mental time travel into the future with the past as a departure point, passing by the present moment as it were. This is a novel finding since mental time travel into the future is normally always described as having the present moment as a point of mental departure (e.g., in Addis et al., 2009; Schacter & Addis, 2007a, b; Stocker, 2012a; Tulving 1985, 2002).

4. Perspectival mental time travel along a sequence of more than two events

The previous sections have demonstrated that the temporal perspective underlying the complex linguistic temporal forms of the pluperfect (as a window into two-event memory) and the future perfect (as a window into two-event foresight) can be described with the same basic perspectival dichotomy that has been used in describing the combinatory use of before/after and the past/future tense (Stocker, 2012a): as a combination of a temporal direct perspective and a temporal indirect (retrospective/prospective) perspective. This section now generalizes this finding by demonstrating that the distinction between direct and indirect temporal perspectives can be applied to any memory or foresight situation that involves recalling or anticipating a sequence of two or more events. As Talmy (2000, p. 86) has pointed out, a series of four events (plus the present
moment as a reference point) can be identified in a single sentence like:

(9) At the punchbowl, John was about to meet his first wife-to-be.

The first event (event A) that is evoked by this sentence is established by the expression *be about to*: it establishes a point in time that is shortly before John’s encountering of a particular woman. Event B is the actual first-time encounter of John with the woman, which is also a point in time that (9) refers to. Event C is established by the expression *wife-to-be*, which suggests a period in John’s lifespan where he and the woman were husband and wife. Finally, event D is evoked by the word *first*, which suggests a later period in John’s lifespan, where John will have a subsequent wife (or later series of events in John’s lifespan, where John will consecutively have more than one subsequent wife).

Comparably, recalling a series of items in a typical recall task can also be viewed as remembering a sequence of more than two events—for instance, a five-item list (A-B-C-D-E) in a serial recall task (e.g., Brown et al., 2007). However, a multiple-event memory structure A-B-C-D underlying a sentence like (9) and a multiple-item memory structure A-B-C-D-E underlying serial recall are, of course, quite different in terms of their timescale (in terms of long-term versus short-term memory). The multiple-event memory structure underlying (9) involves a conceptually larger timescale, a mental timescale that must allow marriage, divorce, and remarriage to occur (and thus involves long-term memory.) The multiple-item memory structure underlying five-item serial recall typically involves a much smaller mental timescale, typically one of seconds (e.g., Brown et al., 2007, p. 541) (and thus involves short-term memory). Despite these differences in timescale and memory system (long-term versus short-term), I would like to point out the theoretical possibility that these two examples of recalling a sequence of more than two events (or memory items) can be described with the same direct/indirect temporal perspective dichotomy that has been used in this article to describe the perspectival structure underlying the pluperfect or future perfect (Sections 2–3). This will be demonstrated below in this section. Given the proposed underlying similarities, I will refer to recalling a series of large-timescale events and to recalling a series
of small-timescale memory items collectively as *multiple-event memory*. Similarly, I will refer to multiple *foresights* of large-timescale events or small-timescale memory items collectively as *multiple-event foresight*.5

It is certainly the case that the distinction between the mental construals of large-timescale events (long-term memory) and small-timescale memory items (short-term memory) is conceptually relevant for many psychological and neurophysiological aspects of memory (e.g., Atkinson & Shiffrin, 1968; Baddeley, 1976; Glanzer, 1972; Izawa, 1999). However, this distinction does not seem relevant for the present mental-geometric (time line) and mental-perspectival investigation into memory. Both of these memory systems (or perhaps memory subsystems) can be described with the same mental-geometric and mental-perspectival properties. The proposed long/short-term neutrality for certain aspects of multiple-event memory and foresight is also in line with the assumptions of the memory-retrieval model SIMPLE (*scale-independent memory, perception, and learning*), as proposed by Brown and colleagues (2007). This model also assumes neutrality in terms of time scale or long term versus short term memory for certain basic properties of memory. The theoretical model developed in this article and the SIMPLE model will be further compared in the discussion (Section 6).

The two principal perspectival solutions that emerge for such A-B-C-D-… structures in relation to multiple-event memory and foresight are what I term the *one-direct-and-multiple-prospective-viewings solution* and the *all-direct-viewings solution* (or combination of one direct temporal viewing with serial prospective temporal viewings and all serial temporal direct viewings). They are presented in Figs. 6 and 7 (cf. Talmy, 2000, pp. 86–87, where these solutions are also partially implied, but not fully worked out as two principle solutions).

At present, it is not clear if a cognizer typically uses the one-direct-and-multiple-prospective-viewings solution (Fig. 6), the all-direct-viewings solution (Fig. 7), or a combination of the two when recalling a sequence that involves two or more events (or yet another perspectival solution that has

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5 On the distinction between episodic memory and episodic foresight see Suddendorf, 2013; Suddendorf & Redshaw, 2013; on the distinction between episodic and semantic memory see Section 6.1.
We may note, however, that the all-direct-viewings solution would most likely involve greater economical cost. The self at the present moment (at recall) would have to constantly update its retrospective viewing: from recall to A, from recall to B, and so on to E. In contrast, in the one-direct-and-multiple-prospective-viewings solution, the retrospective viewing from the present moment could remain at A during the entire cognition of the complex memory, since everything unfolds prospectively from this one perspective point in the past. Future investigations could address the issue which direct/indirect-temporal perspectival viewings are used when recalling a sequence of multiple events.

In terms of Figure and Ground, the present moment in Figs. 6 and 7 can (as in all the previous figures) serve as a reference point (G) in relation to...
which the events A-B-C-D-E are located in the past (Fs).

We may further note that the all-direct-viewings solution is also logically possible for memory situations that only involve recalling two events (cf. Talmy, 2000, p. 74) and not only for memory situations that involve recalling more than two events (as has been investigated in this section). The all-direct-viewings solution for two-event memory structures seems possible, as long as the direct/indirect perspectival arrangement is not preset in some way—not preset for instance by devices like the pluperfect/doubled perfect or future perfect, which seem to evoke fixed arrangements of direct/indirect temporal perspectives, as examined in Sections 2 and 3.

5. Episodic versus semantic perspectival mental time travel along a sequence of more than two events

This article has thus far investigated mental time travel in episodic multiple-event memory and foresight—events that happen at a particular
time, a particular place and involve a particular person (the rememberer or “foresighter” herself). However, it can be argued that both episodic and semantic memory involve mental time travel (Stocker 2012, pp. 403–404+406–407; cf. also Irish & Piguet, 2013). Stocker’s rationale for this has been that generalized knowledge about time (and not only an episodic experience) can also involve mental projection through time. Nevertheless, what still critically distinguishes episodic and semantic mental time travel is the following: in episodic mental time travel one gets a strong sense of mentally projecting oneself into the remembered scene and one is thus in a sense subjectively “reliving” the event. Tulving calls this reexperiencing of a personal memory “autonoesis” (1985, 2001). Thus episodic mental time travel is clearly autonoetic. In contrast, semantic mental time travel is clearly not autonoetic. It lacks the subjective sense of “reliving” a scene, as it only involves projection through time to process temporal structure that relates to general knowledge. Thus, the distinction between episodic (autonoetic) and semantic (“nonautonoetic”) memory is highly relevant. Nevertheless, as both episodic and semantic memory can be argued to involve the projection of a mental gaze along a mental time line, the current article characterizes both types as perspectival mental time travel (cf. Introduction).

Stocker has demonstrated semantic mental time travel only for two-event semantic memory; so the question remains if semantic mental time travel can also be found in multiple-event-memory and foresight that involve more than two events. This seems indeed possible, as can be demonstrated with language-as-an-entree analysis (for the proposal of identical or similar mental mechanisms underlying mental projection through time in episodic and semantic serial recall cf. also Kelley, Neath, & Surprenant, 2012; Neath, 2010; Neath & Brown, 2006; Neath & Saint-Aubin, 2011):

(10) Around here the wind first starts blowing before the sun sets.

This sentence (an adapted version of a semantic-memory sentence from Stocker, 2012, p. 406) involves at least three underlying events. The first event (event A) that is evoked by this sentence is established by the temporal F (temporal Figure) of before: it establishes a general point in
time when the wind first starts blowing in a given geographic region \((F_1)\). Event B is the general time when the sun sets, the temporal G (temporal Ground) of before \((G_1)\). Note now that—comparable to the use of first in (9)—first in (10) now establishes still a further point in time: a point in time after the sunset (event C). Given that it is stated that the wind starts blowing for the first time before the sun sets, the speaker expresses the belief that it is generally the case that there is also at least one more point in time after the sunset where the wind will start blowing for a second time (and possibly a third and still further times). In terms of Figure and Ground, this suggests that the sunset event also functions as a second G \((G_2)\), in relation to which the third event (the wind blowing a second time) is temporally placed as a second Figure \((F_2)\). Thus, in terms of multiple-event memory structure, what (10) evokes is at least a three-event A-B-C structure with a specific complex Figure/Ground temporal-relational structure \((F_1-G_1/G_2-F_2)\). The geometric and perspectival cognition proposed to underlie (10) is shown in Fig. 8 (cf. Stocker 2012a, where semantic mental time travel underlying before (and after) is investigated extensively).

Thus, the mental-geometric structure (line and regions thereupon) and the mental-perspectival structure of multiple-event memory and foresight can be argued to exist in both episodic and semantic memory. This provides evidence that multiple-event structure and perspectival cognition thereof are general properties of memory, general properties underlying both episodic and semantic memory (such general memory is sometimes also referred to as propositional or declarative memory). Despite the proposal that episodic and semantic memory share some basic mental-geometric and mental-perspectival properties, it is certainly the case that episodic and semantic memory are also different in many respects (cf. also above in this section). Episodic memory for instance involves a self at the present moment projecting into the past (or into the future in episodic foresight) (cf. Figs. 1–7) while semantic memory involves no self at the present moment as an inherent part of the temporal conceptualization (Fig. 8) (see Kim, 2013 for a systematic contrast of episodic and semantic memory and how this contrast can reflect in language).
The current investigation has proposed a range of novel notions for mental perspective in multiple-event memory and foresight, some of which have been shown to be relevant for mental time travel along two events and some of which are additionally also relevant for mental time travel along a series of events (along more than two events). The following novel distinctions have been identified in relation to perspectival mental time travel along two events: perspectival mental time travel into “anteriority in the past” versus
perspectival mental time travel into “anteriority in the future” (Sections 2–3); perspectival mental time travel along a mental time line where past/future and anteriority/posteriority form two separate temporal reference frames versus perspectival mental time travel along a mental time line where past/future and anteriority/posteriority conglomerate to a single nondispersible temporal reference frame (Sections 2–3); single temporal direct viewings versus dual simultaneous temporal direct viewings (Section 3); and looking into the future from the present moment versus looking into the future from the past (Section 3). The following further novel distinctions have been identified to relate to mental time travel along two or more events: the combination of one direct temporal viewing with serial prospective temporal viewings versus all serial temporal direct viewings (Section 4) as well as episodic versus semantic perspectival multiple-event memory and foresight (Section 5). These novel notions have only been possible to identify because the current investigation uses a basic theoretical approach—Talmyan concept structuring (Talmy, 2000) with the further refinement for temporal cognition by Stocker (2012a)—that inherently incorporates temporal mental perspective into the explanatory framework. Including perspective is an aspect that most approaches to temporal cognition have not incorporated in their basic descriptive framework (cf. Introduction).

In this discussion section, implications of the findings of the previous sections are now related to cognitive modeling of time and memory (Section 6.1) and to possible basic differences between human and animal temporal cognition (Section 6.2).

6.1 Mental geometry and mental perspective in memory models

One advantage that in general comes out of the current work (and of Stocker 2012a, 2012b) is that it offers a systematic and detailed explanatory framework how mental perspective can be included in a theory of temporal cognition and memory. The relevance of this can for instance be illustrated in relation to cognitive models of memory retrieval. Brown et al. (2007) have introduced a retrieval model they call SIMPLE (scale-independent memory, perception, and learning):

… memory traces can be seen as located and individuated at least partly
in terms of their position along a temporal continuum receding from
the present into the past. This time line is logarithmically compressed,
such that recent locations are more easily discriminable from one
another than are more temporally distant locations (p. 541).

As in SIMPLE, the current investigation has also identified a self who is
looking back from the present moment (point of recall) along a mental
time line to multiple temporal points (locations) in the past (Sections 4–5).
Unlike the current investigation, SIMPLE additionally also considers
proximal and distal aspects of these temporal points on the time line.
What the current investigation has identified in addition to SIMPLE is an
embedded remembered self who is looking at the time line from a given
point in the past (see also Sections 4–5). Future modeling approaches
could address the question, whether it might be fruitful for temporal-
perspective-including models (like SIMPLE) to incorporate this “additional
self” in the past. This then would allow such models to investigate if this
embedded self (i) cognizes the memory items in the past in a temporally
direct or temporally indirect (prospective or retrospective) way and (ii) if
the embedded self cognizes the items in an embodied (field) or disembodied
(observer) perspective (Crawley & French, 2005; Henri & Henri, 1896;
Lorenz & Neisser, 1985; Nigro & Neisser, 1983; Piolino et al., 2007; Rice &
Rubin, 2009, 2011; Stocker, 2012b). Such perspectival refinements are likely
to be relevant for a recall model. For instance: In embodied-perspective
memories one is known to retrieve richer accounts of affective reactions,
physical sensations, and psychological states whereas in disembodied-
perspective memories one is known to retrieve richer accounts of the
external environment, such as where things were located in the remembered
surroundings (e.g, McIsaac & Eich, 2002, 2004).

6.2 Mental geometry and mental perspective in human versus animal
memory and foresight
The current investigation has provided evidence that mental geometry
(time line and temporal regions on it) and mental perspective are relevant
dimensions of mental time travel. More generally, this raises the question if
these two cognitive properties—mental geometry and mental perspective—
are basic and indispensable properties of human mental projection through time (cf. also Stocker, 2014).

Indeed, the question if mental time travel fundamentally involves mental geometry (spatializing time) and mental perspective, might also be helpful in the long-standing debate if animals mentally travel through time the way humans do or not. This debate has recently been resumed anew in a dialogue between Corballis (2013a, b) and Suddendorf (2013). Adding to this dialogue, Casasanto & Stocker (2013) point to work which suggests that the critical factor that distinguishes mental projection through time between the human and animal species might be the human capacity to spatialize time (Casasanto & Boroditsky, 2008; Stocker, 2012a), a capacity that has not yet been shown to exist in the animal species (Merritt, Casasanto, & Brannon, 2010).

Corballis (2013a, b) takes hippocampal place-cells in rats as evidence for animal mental time travel. Such neurons indicate that rats recall paths which they walked through in the past and even that rats imagine possible paths which they could walk through in the future (Foster & Wilson, 2006). Casasanto & Stocker (2013) point to a crucial difference between the spatial path for mental time travel in humans (Casasanto & Boroditsky, 2008; Stocker, 2012a) and the spatial path that the rat mentally projects through (Foster & Wilson, 2006): The rat can anticipate what spatial object might lie ahead when it for instance projects into the future along a mentally construed spatial path. But in humans, what lies ahead in a mentally construed spatial path cannot only be a spatial object, but also an abstract temporal concept—such as what my future might be like in four years’ time (Miles et al., 2010c). Yet, despite this “aheadness” as well as “the path” being purely metaphorical, we (as one spatial possibility) nevertheless sway our body forward in this spatial path as we mentally time travel to this future point (Miles et al., 2010c). Put succinctly: Animals have only been shown to mentally travel along nonspatialized time (time that progresses abstractly through three-dimensional cognitive space) while humans have also been shown to mentally travel along a one-dimensional mental time line (with some minor exceptions where time is spatialized along more complex trajectories; Núñez & Cooperrider, 2013). Spatializing time (geometrizing time) makes the abstract domain of mental time more
concrete and available for mental perspective. Perhaps then it is this combination of geometrized time and perspectival cognition thereof that gives human mental time travel its distinguished character.

7. Conclusion

Findings of theoretical cognitive linguistics, experimental cognitive psychology, and mathematical cognitive modeling point to the possibility that mental geometry and mental perspective are indispensable dimensions of human temporal cognition and human memory and foresight.

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