TIME IN NARRATIVE COMPREHENSION: A COGNITIVE PERSPECTIVE

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Clothes, spectacles, hair, spinal braces, and so on--these came later. Entirely intelligibly, though, to prevent needless suffering, the dental work was usually competed while the patients were not yet alive. The *Kapos* would go at it, crudely but effectively, with knives or chisels or any tool that came to hand. Most of the gold we used, of course, came directly from the Reichsbank. But every German present, even the humblest, gave willingly of his own store--I more than any other officer save "Uncle Pepi" himself. All those years I amassed it, and polished it with my mind: for the Jews' teeth. The bulk of the clothes were contributed by the Reich Youth Leadership. Hair for the Jews came courtesy of Filzfabrik A.G. of Roth, near Nuremberg. Freight cars full of it. Freight car after freight car.

Martin Amis, *Time's Arrow* (1992), pp. 120-121

The order in which we experience events has important implications for our interpretation of those events, This is wryly illustrated in Martin Amis' novel *Time's Arrow*. The story is told through the eyes of a character, first known as Dr. Tod Friendly and later known as Dr. Odilo Unverdorben, who experiences, in reversed chronology, the events that make up his life story. One of the implications of this reversal of chronological order in this story is a dramatic inversion of the morality of the actions of the Nazis and the general German public. Rather than committing genocide, they are now seen to create a race, providing its members with physical and material goods (as well as pets, which they receive with tears of joy), and welcoming them into German society.

Language allows us to convey events in an order and manner that is different from our everyday experience. We can refer to events, locations, and people and objects that are not in our immediate experiential field (e.g., the Big Bang, the mid-Atlantic ridge, and Napoleon). This property of language, *displacement*, has been considered one of its design features (Hockett, 1960). In real life, we experience events as a continuous flow. Because of its design feature of displacement, language allows speakers and writers to jump forward or backward in time. This creates discrepancies between how we experience events in real life and how we experience them vicariously through language.

Although events *can* be presented in a chronological and continuous sequence, skilled story tellers will often deviate from this. In fact, none less than Aristotle in his *Poetics* (trans. 1967) encouraged writers of fiction to do so. He identified the plot as the major organizing structure of narratives and admonished poets to describe events only when they are relevant to the plot, just like Homer had done centuries before them. They were to refrain from giving a blow-by-blow chronological account of an episode. This Aristotle considered to be the province of historians. The overarching importance of the plot as an organizing structure often necessitates temporal discontinuities, because events irrelevant to the plot (such as the character brushing his teeth or going to sleep) are to be omitted. Also, a plot is often more effectively conveyed by reversing the order of certain events. Obviously, various modern writers, such as Martin Amis, Kurt Vonnegut, Jorge Luis Borges, and William Friedman have exploited the displacement feature of language to great effect as a literary device to defamiliarize our conception of time and chronology.

Because skilled story tellers heed Aristotle's advice, narratives are replete with temporal discontinuities. Given that temporal discontinuities entail a deviation from our normal experience of events, it might be hypothesized that they are marked relative to temporal continuities. Cognitive psychologists have studied the effects of temporal discontinuities and other deviations from everyday chronology on comprehension processes. The purpose of this chapter is to review the exisisting empirical literature on this topic. However, before we do so, we will first briefly review our theory of situation models, and next, the relevant linguistic literature on time in language.

Situation models

Situation models are mental representations of the state of affairs described in a text (van Dijk & Kintsch, 1983). The generally accepted view in cognitive psychology is that language comprehension should be understood as the construction of coherent situation models. Recent reviews of the literature on situation models can be found in Graesser, Millis, and Zwaan (1997) and Zwaan and Radvansky (1998). We have proposed a model of situation-model construction, called the event-indexing model (Zwaan, 1999a; Zwaan, Langston, & Graesser, 1995; Zwaan &

Radvansky, 1998). According to the Event-Indexing Model, comprehenders construct situation models from text by extracting events from the text and integrating these events on five different situational dimensions: time, space, causation, motivation, and protagonist. A recent discussion of the empirical findings directly supporting this model can be found in Zwaan (1999a). In this chapter, we are restricting our focus to the temporal dimension.

Unlike any of the other situational dimensions, time is encoded obligatorily in every clause--in English and other languages--in the form of a tense morpheme attached to one or more verbs. Furthermore, temporal information can be conveyed in every word class (Miller & Johnson-Laird, 1976). The question that concerns us here is how comprehenders make use of these linguistic cues to construct the temporal dimension of situation models. In order to begin to address this question, we first need to consider the mechanisms of situation-model construction. Our general hypothesis is that the mechanisms involved in situation-model construction from language are derived from the mechanisms of situation-model construction in the real world. Children first learn to understand basic events, such as the movement of a person or an object in the environment, before they learn to understand the phrases that describe these events. In fact, these basic event structures are the scaffolding that allow children to learn languages at such an amazing pace (Goldberg, 1999).

Thus, the construction of situation models during language comprehension can be conceived of as the vicarious experiencing of events in the real world (Segal, 1995). Zwaan (1999b) shows that an empirical case can be made for this argument. This notion of vicariously experiencing through language provides the starting point for our analysis.

Time in language

The representation of time in language has historically received a great deal of attention in the field of linguistics (e.g., Dowty, 1986; Reichenbach, 1947; Ter Meulen, 1995; Vendler, 1967; Verkuyl. 1972). More recent approaches in the subfield of cognitive linguistics are particularly relevant to our perspective (e.g., Croft, 1998; Goldberg, 1999; Langacker, 1982). Linguists distinguish among semantic classes of events, such as the movement of an agent, the movement of an object to a new location by an agent, or the transfer of possession of an object. These event classes have meaning in and of themselves and can accommodate just about any verb or modifier in any construction, as long as it is conceptually interpretable. For instance, some verbs that seem generally unacceptable in the present progressive (understand) can assume this construction given the right circumstances, e.g., as in “I am understanding temporal relations more and more each day.” Representing time in language is the comprehender’s attempt to translate words and sentences into a flow of events comparable to normal perceptual experience. The semantic classes of events are the building blocks we use to construct situation models during comprehension.

Comprehenders assume that the order in which events are reported in language matches their chronological order. This is known as the *iconicity assumption* (Dowty, 1986, Fleischman, 1990). Narrative deviations from chronological order are possible only because a default order exists; the default serving as a baseline from which all else can be compared and understood. When the iconicity assumption is not a valid guide, readers must use language cues to determine the order of events. Verb tense and time adverbs and adverbials (e.g., *a week later*) guide the comprehender as to where an event should be located on the time line. Verb aspect is the language cue that guides the classification of events with respect to duration and completion status. A perhaps overly simplistic way to put it is to say that verb tense and time adverbs and adverbials tell the comprehender where to place the beginning of the event in the narrative world and verb aspect tells the comprehender whether the event should be ended before the next one starts or whether it should continue and thus overlap in time with the next event.

Verb tense, time adverbs, and time adverbials. Verb tense is used to indicate the moment of occurrence of an event relative to the moment of its description (Reichenbach, 1947). Together with the iconicity assumption this allows the comprehender to sequence events into their proper chronological order. Time adverbs and adverbials can be used to override the default order. For example, in (1), the time adverb *after* is a cue that the events are reported in reversed chronological order. And in (2), the time adverbial *two weeks later* indicates that there is a two-week gap between the two events on the timeline.

(1) The anchor frowned after he started reading from the teleprompter.

(2) The professor sent the package to his mother in Europe. Two weeks later it arrived.

INSERT FIGURE 1 ABOUT HERE

Figure 1 depicts possible event orders on a timeline. An event may immediately succeed another event (a), or immediately precede another event (b). An event may succeed another event after a certain interval (c), or it may even start before the other event is completed (d). Also, an event may occur during another event (e). Comprehenders not only have to re-order described events, but also monitor for jumps in the narrative timeline, such as flashbacks and flashforwards, and lapses in event descriptions. A lapse in event description may indicate that no events occurred in the time between the reported events, that events did occur during this time but were not relevant to the narrative, or that the former event continued up until the latter event. In any case, whenever the iconicity assumption is overridden, the comprehender must employ temporal markers within the situation model to account for temporal order.

Verb aspect. Verb aspect provides information about duration, onset, and completion status of an event (Ter Meulen, 1995; Vendler, 1967; Verkuyl, 1972). An event may convey a perfective aspect, meaning that it is completed on the narrative timeline (e.g., "He walked to the store."). An event may alternatively convey an imperfective aspect, meaning that it is ongoing on the narrative timeline (e.g., "He was walking to the store."). The duration of an event may be short (he arrived at the party) or long ("He was dancing at the party"). An event that is instantaneous is referred to as a *plug* (Ter Meulen, 1995), or achievement (Vendler, 1967). The onset of the plug event is also the endpoint. *Arrive* is instantaneous in that it merely describes the change of state from not being at a party to being at a party. An event that has unlimited duration and has a unitary description that applies throughout its entire internal structure is called a *hole* (Ter Meulen, 1995), or process (Vendler, 1967). "Drive around" is an example of a hole, because it has unlimited duration and driving around describes every instance within the duration of the event. An event that has a limited duration and has a description that does not apply to any part of the event is called a *filter* (Ter Meulen, 1995), or accomplishment (Vendler, 1967). An example of a filter is "drive home", because there is a limited duration, and the description "driving home" does not apply to any part of the whole event. By this we mean that the event part "turning left on Broad Street" is not, in and of itself, "driving home." In contrast, the example "drive around" is a hole, so the event part "turning left on Broad Street" is, in fact, "driving around."

Plugs and filters are telic, meaning that they have a natural endpoint or resulting state, whereas a hole is atelic, meaning that it has no certain endpoint. Driving home (or arriving at home) is a telic event because there is a natural endpoint: one reaches one's home. If we were to say "He drove west", this would indicate an atelic event because there is no telling how long or far the protagonist may drive. There is no natural endpoint to west. It is not only the nature of an event that determines whether it is a hole, plug, or filter. Tense also influences our categorization. Take our example of driving home. If we say "He drove home" then we have a filter, but if we say "He was driving home" then we have a hole. From our current perspective of time (point of narration) there is no end to the driving home. If we say "He started driving home" then we have made the event a plug. Starting the process of driving is an instantaneous event, going from the state of not driving to the state of driving. Thus, interplay between tense and durative nature of the event make the aspectual classification of holes, plugs, and filters quite dynamic. In our notation in Figure 1, variations in verb aspect are indicated by changing between endbars, which signify onsets and endings of telic events, and arrows, which signify atelic events (shown in f). It is important to note that the traditional aspectual class of states is also covered in ter Meulen's taxonomy. For example, descriptions of transitions between temporary states are anaylzed as plugs (ter Meulen, 1995, p. 11).

Perceptual aspects of time in language. When discussing the representation of time in language, it is relevant to consider the actual mental representations of events. These are the building blocks of our situation models for what we read and what we hear. Many mental representations have an inherent time component, making them dynamic representations. The very essence of some expressions cannot be understood without highlighting a change over time within the representation. An example of this type of representation is "crossing a river". Our mental representation of this expression must incorporate a river with two defined sides. Understanding the word *cross* dictates that we

track the spatial evolution over time of some target, or *trajector* (Langacker, 1986), which starts at one side and ends up at the other side within our representation. Because the trajector cannot be represented at both sides at one time, the very nature of the expressions mandates a dynamic representation. That is, the time component is necessary to the representation (see Figure 2). Langacker (1986) describes the representation that must be formed to understand the word *gone*. In this representation, the final spatial position of a trajector in a temporal series is highlighted or "profiled". To understand the word *gone*, we must represent a closer position at an earlier time (see Figure 3). When all positions of the trajector are profiled, we have the representation for *go*. When only the final position is profiled, we have *gone*.

INSERT FIGURE2 ABOUT HERE

INSERT FIGURE 3 ABOUT HERE

The understanding of these two expressions is dependent on the time component along the x-axes of both of these representations.

Tense, aspect, and time adverbs also affect the comprehender's perspective on the described events. For example, (written) narratives usually employ the past tense in relating information, giving the comprehender the impression that the narrator is describing events that have already happened. Sometimes, however, the narrator will describe events using the *historical present***.** The historical present has the effect of transporting the narrator into the past, such that the act of telling and the unfolding of the event coincide. This violation of the default timeline has the effect, according to Fleischman (1990), of making the "past more vivid." In our terminology, it may enhance the comprehender's vicarious experience of the described events.

Aspect, tense, and temporal adverbs demonstrate their most powerful, and most subtle, effects by determining how deeply the comprehender vicariously experiences the situation. Consider the differences between the perfective and the imperfective aspect. The perfective is generally used to denote telic situations, whereas the imperfective denotes atelic situations. This is seen as the difference in placing the reader outside the situation (perfective) versus placing the reader inside the situation (imperfective).

In many cases, individual events have pre-packaged durations associated with them. Snowstorms, for example, typically have duration measured in hours or days, whereas gunshots are nearly instantaneous. However, aspect can be used to override these default durative features (Fleischman, 1990). Consider the difference between the sentences "The snowstorm *dumps* a ton of snow on the ground," versus "The *snowstorm is dumping* a ton of snow on the ground." The use of the perfective in the first case serves to give an atelic situation a terminal boundary, collapsing a lengthy blizzard into an instantaneous event. It is perhaps instructive to consider this fact in terms of a vicarious experiencer's (Zwaan, 1999b) focus and duration of attention. Dowty (1986) suggests that the temporal fashion in which events are described denotes the *time it takes for an observer to perceive them*. By extending telic events and collapsing atelic ones the author forces the reader to integrate the perceptual information available in the same fashion as the protagonist. This not only serves to bring the reader deeper into the story, but deeper into the protagonist's psyche as well. This phenomenon is analogous to that of a movie camera that either floats behind the protagonist's eyes (thus the audience sees what the protagonist sees) or stands mounted at a distance with a wide-angle view of the entire situation (thus the audience sees the protagonist and everything else around her).

Another perspectival function that tense and aspect serve is to foreground or background certain items within events. Within any story some information will be more relevant than other information, and it is up to the author to let the reader know what that information is. If before we were speaking about a camera whose focus was either individualized or all-encompassing, we speak now of a camera that either zooms in on certain objects or merely pans across the panorama. Generally present-tense perfective verbs equate with foregrounded information while non-present-tense imperfective verbs equate with backgrounded information, though there are exceptions (see Fleischman, 1990). Thus one of the goals of narrative is to not only bound experience into units of time but into units of importance as well, with the objective of making the totality of experience accessible to the reader.

Time in comprehension

In their recent review of the extant research on situation models in language comprehension and memory, Zwaan and Radvansky (1998) concluded that the temporal

dimension of situations has been relatively underinvestigated in cognitive psychology. In this section, we will provide a more detailed review of this literature, as well as some more recent work coming out of our lab and other labs, within the framework we developed in the previous sections. Specifically, we will consider studies that have investigated the role of temporal order, verb aspect, and temporal perspective.

Effects on on-line comprehension. Various researchers have examined the effects of violations of the iconicity assumption on comprehension. Clark (1971) examined the acquisition of the meaning of *before* and *after* by children between 3 and 5 years of age. She assessed the children's comprehension of sentences such as (3a-d).

(3a) The boy kicked the rock before he patted the dog.

(3b) Before the boy kicked the rock, he patted the dog.

(3c) The boy kicked the rock after he patted the dog.

(3d) After the boy kicked the rock, he patted the dog.

The children, and especially the youngest ones, had by far the most difficulty with sentences of types (b) and (c). These are the sentences in which the events are reported in reversed chronological order. Clark's explanation for this finding is that the youngest children used an "order-of-mention" strategy. This supports the idea that comprehenders by default entertain the iconicity assumption. Of course, children eventually learn the meanings of the words *before* and *after* and thus they learn that these can sometimes override the iconicity assumption.

But if children learn the meaning of these time adverbs, then what evidence is there that adult comprehenders entertain the iconicity assumption? The idea of a default iconicity assumption does not mean that adult comprehenders are permanently stumped by a deviation from chronological order. What it suggests is that deviations from chronological order are relatively difficult-- but not impossible-- to process because a default assumption has to be overridden. Consistent with this idea, Mandler (1986) found that adults had longer reading times for sentences that violated chronological order (analogous to sentences (3b) and (3c) above) than for their chronological counterparts, except when there was a very strong causal relationship between the events. More recently, Münte, Schiltz, and Kutas (1998) obtained neuroscientific evidence that supports this prediction. Münte et al. measured modulations of electrical activity in the brain as participants read sentences such as (3b) and (3d) above. These event-related brain potential (ERP) measurements indicate that "before" sentences elicit, within 300 ms, greater negativity than "after" sentences. This difference in potential is primarily located in the left-anterior part of the brain and is indicative of greater cognitive effort.

In short, there is developmental, cognitive, and neurocognitive evidence for the role of an iconicity assumption in language comprehension. Comprehenders' natural tendency is to process narrated events just as they would naturally occurring events: in chronological order. However, they have developed a sensitivity to linguistic cues that occasionally call for this assumption to be overridden. In general terms, this conclusion is consistent with the idea that our ability to construct situation models during narrative comprehension makes use of our previously developed (both phylogenetically and ontogenetically) ability to comprehend events.

Another way in which language allows us to deviate from everyday experience is by (forward) time shifts (see c in Figure 1). Zwaan (1996) has found that such time shifts (e.g., "An hour later") lead to increases in reading time relative to phrases that introduce no major time shift ("A moment later"). Zwaan argued that this supports the idea of a "strong-iconicity assumption", according to which comprehenders not only assume that events occur in chronological order, but also that they occur contiguously. There is some linguistic evidence for a strong-iconicity assumption. Grimes (1975, p.36) notes that in Kâte, a language of Papua New Guinea, events that are contiguous in time are grammatically distinguished from events "that are separated by a lapse in which nothing of significance for the story happens." Although languages such as English and Dutch have not grammaticalized this distinction, it is plausible that time lapses in stories have psychological significance in English as well. The strong-iconicity assumption has to be overridden when there is a time shift and this creates an increase in reading times.

The activation level of events during comprehension. As mentioned in the introduction, in real life, events often overlap in time. This is difficult to convey in the linear

format of language. This leads to two questions. First, what are the cues used to tell comprehenders that an event is still ongoing? Second, how are comprehenders keeping multiple events active in working memory? Research has begun to address these questions. Anderson, Garrod, and Sanford (1983) have shown that the comprehender's background knowledge about the duration of events might play a role. For example, our knowledge about restaurants tells us that a visit to a restaurant typically does not take more than 7 hours. Similarly, we know that restaurants typically employ waiters. Anderson and her colleagues found that probe responses to the word "waiter" in a story about a restaurant were faster after a relatively short time interval (e.g., ten minutes) than after a long interval (e.g., five hours), presumably, because participants assumed that at that point the waiter was no longer in the situation, given that "narrative now" was no longer in the restaurant. In contrast, responses to the name of the main protagonist of the stories did not vary as a function of time shift, presumably because the main protagonist was assumed to still be in the current situation.

Zwaan (1996) made the more general assumption that events that are currently in the situation are more accessible to the comprehenders than events that are not. Consistent with this idea, he found that probe responses to events and objects were faster when the previously mentioned event was still within the same time frame as the current event than when it was not. Thus, responses to "walked" were faster after 4a than after 4b.

(4a)Teresa walked onto the stage. A moment later, she collapsed.

(4b)Teresa walked onto the stage. An hour later, she collapsed.

Carreiras, Carriedo, Fernandez, and Alonso (1997) obtained evidence that is consistent with this.

Zwaan, Madden, and Whitten (in press) showed an even more powerful effect. They found that the explicit discontinuation of an event leads to an immediate decrease in its activation. For example, responses to the word *kicking* were significantly longer after "Steve stopped kicking the soccer ball" than after "Steve was kicking the soccer ball". They also showed that an event can be maintained across other events. For example, in their Experiment 3, they presented participants with sentence pairs such as 5a or 5b.

(5a)John was playing the piano. When his mother entered, he stopped.

(5b)John was playing the piano. When his mother entered, he continued.

Thus, there is an action that is interpreted to be ongoing, because of the past progressive tense, but an interrupting event occurs. We were interested in whether the comprehender would assume that the action was discontinued because of the interrupting event. This did not appear to be the case. Responses to the first action, e.g., *playing* were faster in sentences like 5b than in sentences like 5a, indicating that comprehenders interpreted the initial action as continuing through the intervening event.

Bestgen and Vonk (1995) found that temporal markers can indeed have very subtle effects on the availability of preceding information. Specifically, in sentences such as "He opened the door, [ø, *and*, *then*] went inside," *and* and the absence of a temporal marker (ø) made previous information more available than a sequential marker, such as *then*.

Magliano and Schleich (in press, Experiment 2) recently showed that comprehenders are more likely to consider atelic events to be ongoing in the subsequent context than telic events. Moreover, they found that verb aspect can override the event-related background knowledge that was activated during comprehension. Comprehenders were much less likely to consider events of a typically long duration, such as golfing 18 holes, to be going on in the subsequent context than events of a typically short duration, such as writing a check, when the long events were described as telic and the short events were described as atelic.

Effects on long-term memory organization. Research on autobiographical memory, in which people are probed about events that have happened in their lifetime, reveals effects of temporal organization (e.g., Thompson, Skrowonski, Larsen, & Betz, 1996). That is, people tend to form stronger associations between events that they experienced within the same time frames than to events that they experienced in different time frames. If narrative comprehension is a form of vicarious experiencing, one would expect to find the same effect of time in memory for discourse. The assumption that comprehenders' natural tendency is to associate events in long-term memory that occurred within the same time frame has been tested in various studies. In support of this view, it has been found that

disruptions of the temporal order have a negative impact on the coherence of the situation model in long-term memory (Ohtsuka & Brewer, 1992). Furthermore, Zwaan (1996) found that there was more priming between events from a story that occurred within the same time frame than between events that occurred during different time frames. For example, there was more priming between walking onto the stage and collapsing in (4a) than in (4b). These results suggest that the event in the current model will be attached to events in the integrated model that are within the same general time frame. Further support for the role of time as a basis for organizing information in long-term memory was obtained by Radvansky, Zwaan, Federico, and Franklin (1998), who used a memory task, rather than a language-comprehension task.

Effects of verb aspect. There is very little empirical work on the representation of time within events. However, we have begun to address this question in our lab (Zwaan & Stanfield, submitted). The main finding of the experiments reported in this paper is that the internal temporal structure of an event affects the amount of relevant information in the situation model that is activated to represent this event. To concretize this finding, consider the following story:

(6) Bobby took out a [hammer/saw/screwdriver], but then remembered that he lost his saw [hammer/saw/screwdriver].

He also collected the lumber and paint he had bought.

He had already selected an oak tree as the site for the birdhouse.

He marked the boards and cut them out.

Then Bobby *began pounding/pounded* the boards together.

There are two critical manipulations in this story, the first of which occurs in the first sentence. There are three conditions. A target instrument, in this case the hammer, is or is not available for use in the situation, or it is not mentioned at all. The second critical manipulation occurs in the last sentence. Here, an action is described either as telic (*pounded*) or as atelic (*began pounding*). The action that is being described typically involves the instrument mentioned in the first sentence. However, that instrument either is or is not available for use, depending on the situation.

As our review of the linguistic literature suggests, atelic descriptions are hypothesized to make more information about an event available than telic descriptions. Zwaan and Stanfield (submitted) reasoned that there are two ways in which verb aspect may affect the activation of knowledge pertaining to an action: semantic activation and episodic activation. If atelic descriptions make semantic information more available, then information associated with the action in semantic memory should become more available. For example, *hammer* should be more available after *pounding* than after *pounded* when the instrument was not previously mentioned in the story. Given that the hammer had not been mentioned previously, any activation of "hammer" would have to be due to the semantic association between *pounding* and *hammer*. If atelic descriptions make episodic information more available, then the episodic information, which is encoded in the integrated situation model, that the instrument is or is not available for use should play a role.

Zwaan and Stanfield (submitted) found support for both the semantic and the episodic activation hypothesis, using a variety of methods. For example, recognition responses to *hammer* were significantly *longer* after atelic descriptions than after telic descriptions when the instrument was not available for use but had been mentioned in the text previously. This suggests that atelic descriptions were more likely than telic descriptions to activate the information in the situation model that the instrument was not available. This knowledge presumably interfered with responses to *hammer*, which, in turn, caused the longer response times. When the instrument word had not been mentioned in the text before--and thus the correct recognition response was NO--response were *longer* after atelic than after telic descriptions. This suggests that the telic description had activated the instrument concept in semantic memory, making it more difficult for the subjects to reject the corresponding word.

Conclusion

The role of temporal information in narratives has been studied by researchers in various fields, beginning with Aristotle. Linguists have provided detailed analyses of how the flow of events is conveyed in sentences and in narratives. Cognitive psychologists have begun to test some of these and other ideas empirically, mainly in the context of situation models. There clearly is a great deal of support for the idea that comprehenders entertain a default iconicity assumption. There is also evidence for a strong-iconicity assumption.

Furthermore, assuming that the comprehender has a virtual presence in the narrated situation explains a great number of empirical findings. Protagonists, objects, and events that are in the situation are more accessible to the comprehender than protagonists, objects, and events that are not.

However, it is also clear that a great deal still has to be learned. For example, we are only beginning to understand the role of aspect in language comprehension. Furthermore, we know very little about the role of temporal cues in the establishment of perspective. For that matter, we know very little about the role of perspective in language comprehension in general, although psychologists are beginning to address this issue (MacWhinney, 1999; Sanford, Majid, & Clegg, 1998).

As far as our own research agenda is concerned, we are interested in examining more closely what it means to vicariously experience events by way of reading or listening to narratives (Zwaan, in press b) and what the role of linguistic cues, such as temporal markers, is in this. There are theoretical and methodological developments that allow us to better address these questions. On the theoretical front, proposals have been made that our mental representations of events are not arbitrary and amodal, but do preserve aspects of the initial perceptual input (Barsalou, 1999). Comprehension, in this view, is regarded as the mental simulation of events, using perceptual symbols (this does not just include visual information, but information from the other modalities as well). Although there currently is not a great deal of empirical evidence supporting the idea of perceptual symbol systems, it is clear that they provide a much better conceptual tool to think about situation-model construction as vicarious experiencing than amodal symbol systems (Zwaan, 1999c; Zwaan, Stanfield, & Madden, 1999).

On the methodological front, there are currently methods available to study the human brain as it is performing cognitive tasks. Two of these methods, with complementary strengths, are ERP and functional magnetic-resonance imaging (fMRI). As we discussed, ERP provides information on the changes in brain potential as a function of the presentation of stimuli. ERP has high temporal resolution (on the order of milliseconds), but poor spatial resolution (on the order of centimeters). Thus, ERP provides a good window into when processes occur in the brain, but does not provide much detail on where these processes occur (primarily because electrical activity in the brain has to be measured through the skull). fMRI is used to record changes in blood flow in the brain. The idea is that those areas of the brain that are currently active will need more oxygen and there will thus be an increased blood flow towards those regions. In contrast to ERP, fMRI has relatively low temporal resolution (on the order of seconds), but compared to ERP very high spatial resolution (on the order of millimeters). ERP has already been used to study temporal information processing in language in the study by Münte and colleagues we mentioned before. We are currently exploring the use of fMRI in studying temporal information processing.

We anticipate that the theoretical framework of perceptual symbol systems and related approaches (Barsalou, 1999; Glenberg, 1997; MacWhinney, 1999), which is congenial with current work in cognitive linguistics (e.g., Croft, 1998; Goldberg, 1999; Langacker, 1986) and the methodological tools of cognitive neuroscience will lead to major advances in our understanding of how language allows us to vicariously experience events. Theoretically, a meta-language is being developed that allows us to integrate relevant concepts and findings from cognitive psychology, linguistics, and neuroscience. Methodologically, we will be able to look into the human brain as it processes linguistic and other information. This will provide more insight into which processes are specifically related to language and which are more general mechanisms of event comprehension. Ideally, these anticipated advances will also increase our understanding of the aesthetic, emotional, and moral effects created by literary violations of temporal information processing, such as those in the epigraph to this chapter.

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Figure captions

Figure 1. Potential temporal relations between pairs of events

Figure 2. A dynamic representation of “crossing a river”.

Figure 3. A dynamic representation of “gone”, from Langacker (1986).


TIME

(a)


Event 1
Event 2

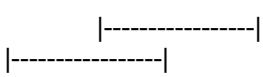
(b)


Event 2
Event 1

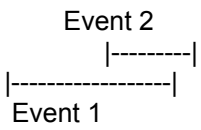
(c)


Event 1
Event 2

(d)


Event 1
Event 2

(e)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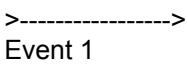
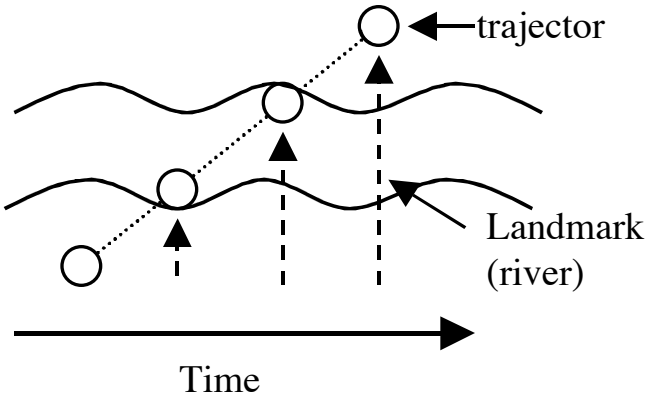
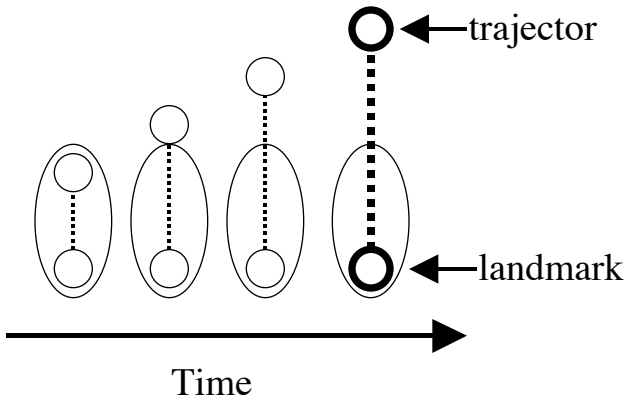
Event 1

(f)


Event 1


trajector
Landmark
(river)
Time


trajector
landmark
Time