Cognition 129 (2013) 212–220

Contents lists available at ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/COGNIT

Grammatical aspect, lexical aspect, and event duration constrain the availability of events in narratives

Raymond B. Becker [a], Todd R. Ferretti [b,*], Carol J. Madden-Lombardi [c]

[a] Cognitive Interaction Technology, Center for Excellence, Bielefeld University, Bielefeld, Germany
[b] Centre for Cognitive Neuroscience & Department of Psychology, Wilfrid Laurier University, Waterloo, Ontario N2L 3C5, Canada
[c] Stem Cell and Brain Research Institute, Inserm U846, Lyon, France

ARTICLE INFO

Article history:
Received 7 June 2012
Revised 24 June 2013
Accepted 29 June 2013
Available online 11 August 2013

Keywords:
Event-related brain potentials
Situation models
Narrative processing
Grammatical aspect
Lexical aspect
Time shifts

ABSTRACT

The present study investigates how readers' representations of narratives are constrained by three sources of temporal information; grammatical aspect, lexical aspect, and the duration of intervening events. Participants read short stories in which a target event with an intrinsic endpoint or not (lexical aspect: accomplishments/activities) was described as ongoing or completed (grammatical aspect: imperfective/perfective). An intervening sentence described either a long or short duration event before the target situation was reintroduced later in the story. The electroencephalogram time-locked to the reintroduction of the target event elicited a larger N400 for perfective versus imperfective accomplishments, and this effect occurred only after short intervening events. Alternatively, the N400 to targets in the activity condition did not vary as a function of grammatical aspect or duration of intervening events. These results provide novel insight into how the temporal properties of events interact to constrain the availability of concepts in situation models.

1. Introduction

Our experience of events is deeply rooted in the perception of time, and these events can take on many, complex, temporal configurations. For instance, we can listen to the radio right now, tomorrow, yesterday, every afternoon, while taking a jog, before having dinner, for several hours, etc. Likewise, this temporal structure is coded in every human language, such that any situation description, no matter how simple, provides temporal information. In narratives, as in experience, events have varying duration, do not always occur in continuous sequence, and do not always wait for the previous event to finish before beginning. Complex systems of language cues are employed to capture this rich temporal structure, and these cues arise from multiple sources, such as grammatical markers, lexical categories, and inherent semantics of events.

While analyses from the field of linguistics provide insights into how these various sources of temporal information function together in the language system, there is a clear lack of empirical data on how they combine to affect our mental representations. Many empirical studies have addressed these sources of temporal information individually, but few, if any, have explored how they interact to constrain language representations during narratives. The present study investigates the interaction of this complex system of temporal cues, with specific focus on lexical aspect (or event telicity), grammatical verb aspect, and event durations causing narrative time shifts, each of which will be described below.

1.1. Lexical aspect and telicity

Lexical aspect refers to the inherent temporal properties of an event (e.g., tire change). Based on these properties, events can be temporally classified into categories, such as states, achievements, activities, and accomplishments. A principal distinction in lexical aspect is that of

* Corresponding author. Tel.: +1 519 884 0710x2986; fax: +1 519 746 7605.
E-mail address: tferrett@wlu.ca (T.R. Ferretti).

0010-0277/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.cognition.2013.06.014

telicity (Comrie, 1976; Dowty, 1979; Lyons, 1977). Telic events progress towards a specific goal or endpoint and are considered completed once the endpoint is reached, whereas atelic events do not have intrinsic endpoints and can continue indefinitely. This distinction of telicity separates two of the lexical aspect categories that are otherwise very similar, namely activities and accomplishments. Activities are durative events that can involve multiple changes of state, but do not have intrinsic endpoints (atelic). For example, *listening to music* is an activity as it can endure indefinitely and has no natural endpoint. Accomplishments are similar to activities because they also involve duration and multiple changes of state, but are different because they have natural endpoints (telic). For example, *listening to a song* is an accomplishment as it typically takes several minutes and progresses toward a natural endpoint, the last note.

Temporal properties such as telicity are considered "lexical" because they are tied to the verb that describes the event. While most verbs fall into a single category of lexical aspect, the example above demonstrates how lexical aspect is sometimes tied not only to the verb, but to a larger verb phrase, such that "listening" can switch between an activity and an accomplishment, depending on what we are listening to. While the issue of lexical aspect has been thoroughly addressed in the field of linguistics (e.g., Dowty, 1979; Lyons, 1977; Mourelatos, 1981; Nordenfeldt, 1977; Vendler, 1967; Verkuyl, 1972; Verkuyl, 1993), it has not received much empirical attention in the field of cognitive psychology. Therefore, we have insights on how these categories function in the language system, but not how they affect our mental representations. In most cases, cognitive psychologist have used verbs from multiple lexical classes without directly contrasting the classes (e.g., Ferretti, Kutas, & McRae, 2007; Magliano & Schleich, 2000), or they have used sets of verbs coming from a single lexical category in order to control for lexical aspect while investigating grammatical aspect (e.g., Madden & Zwaan, 2003; Morrow, 1985). Such investigations will be described in the following section.

1.2. Grammatical aspect

Grammatical aspect refers to the morphosyntactic properties of verbs that differentially cue the temporal flow of situations (i.e., ongoing/completed). The three principal categories of grammatical aspect in English are the imperfective, perfective, and perfect aspect (Comrie, 1976; Lyons, 1977). The imperfective aspect (e.g., *was skating*) is differentiated from the other two aspect categories by referencing the ongoing development of situations in which the onset of the event has occurred, but not yet the endpoint. Thus, the imperfective aspect takes a within-event perspective and the various phases and characteristics of the ongoing event are accessible. The other two forms of aspect refer to situations as completed and collapsed to an indivisible unit, without reference to their internal properties. This creates a punctual perspective, even for events with duration. The main difference between the two completed aspects is that the perfective (e.g., *skated*) focuses the collapsed and completed event itself (often the endpoint), whereas perfect (e.g., *had skated*) refers more directly to the resultant states of the completed event and the continuing relevance of those states. In the present research we contrast imperfective (e.g., *was skating*) and perfective aspect (e.g., *skated*).

Grammatical aspect has been shown to influence the content of activated representations in many empirical investigations (Carreiras, Carriedo, Alonso, & Fernandez, 1997; Coll-Florit & Gennari, 2011; Ferretti, Rohde, Kehler, & Crutchley, 2009; Ferretti et al., 2007; Madden & Therriault, 2009; Madden & Zwaan, 2003; Magliano & Schleich, 2000; see Madden & Ferretti, 2009 for a review). Madden and Zwaan (2003) used a picture verification task to demonstrate how the perfective aspect constrains representations to the endpoint of a situation, whereas the imperfective aspect allows both intermediate and endpoint representations. Information about location (Ferretti et al., 2007) and characters (Carreiras et al., 1997) is more available when the imperfective aspect is used rather than the perfect or perfective aspects. Magliano and Schleich (2000) found that participants recognized event probes (e.g., *change tire*) more quickly when the target events were initially presented in imperfective (e.g., *was changing the flat tire*) than perfective aspect (e.g., *changed the flat tire*), both directly after the aspect sentence, and several sentences later.

Because empirical studies often investigate only one source of temporal information, it is currently not clear how lexical aspect (accomplishments/activities) interacts with grammatical aspect (was listening, listened) to constrain representations. In fact, only a few studies have directly investigated this issue (Gennari & Coll-Florit, 2011; Piñango, Winnick, Ullah, & Zurif, 2006; Piñango, Zurif, & Jackendoff, 1999; Yap et al., 2009). In one such study, Yap et al. (2009) demonstrated that perfective sentences were processed more quickly (and accurately) with accomplishment verbs, whereas imperfective sentences were processed more quickly (and accurately) with activity verbs. Yap and colleagues concluded that because accomplishments have natural endpoints, construction of mental representations of perfective accomplishments was easier than imperfective accomplishments. Alternatively, because activities do not have natural endpoints, construction of mental representations of imperfective (ongoing) activities was easier than perfective activities. The current study goes beyond these findings by embedding grammatical aspect manipulations in short narratives (rather than single sentences) describing target accomplishments and activities, and investigating how resistant these grammatical and lexical aspect effects are to a third source of temporal information, namely time shifts caused by short and long intervening events.

1.3. Event duration and time shifts

The temporal structure of narratives is strongly dependent on the nature of the events themselves. For instance, some events are over as soon as they begin (picking a tomato) whereas some events can take hours (weeding a garden). These differences in event duration help to move along the narrative timeline at a faster or slower pace,

which in turn affects the availability of representations for people, places, and things throughout the story. Past research has demonstrated that narrative time shifts do indeed influence the availability of information throughout narratives (Anderson, Garrod, & Sanford, 1983; Bestgen & Vonk; 1995; Ditman, Holcomb, & Kuperberg, 2008; Kelter, Kaup, & Claus, 2004; Zwaan, 1996). The general finding in these studies is that concepts preceding short temporal shifts, introduced by either temporal adverbials (i.e., *a moment later*) or by events that are inherently short (*she picked a tomato*), are more available later in the discourse than those preceding long temporal shifts (*a day later*) or events (*she weeded the garden*). This finding suggests that following long time shifts, the events that took place earlier in the narrative are no longer going on, so that the persons, places, and things available earlier in the discourse are less accessible.

2. The present study

While previous research has investigated the issues of lexical aspect, grammatical aspect, and event durations, this has almost always been done separately, isolating a single temporal variable from other sources of temporal information in narratives. For instance, to investigate grammatical aspect, Madden and Zwaan (2003) used only accomplishments in their sentences. Likewise, Magliano and Schleich (2000) investigated grammatical aspect on the availability of critical events in texts that were written so as to minimize durations and time shifts of subsequent events, and critical events were uncontrolled with respect to whether they were activities or accomplishments. Such studies have provided important advances in our understanding of time in narratives, but natural discourse allow for multiple sources of temporal information to interact, and we currently do not have a good understanding of how this affects our representation of narratives.

To address the lack of empirical data, the present study investigates lexical aspect, grammatical aspect, and event durations (causing time shifts) all within the same experiment. In this experiment, a target activity or accomplishment (lexical aspect) is presented in the imperfective or perfective aspect (grammatical aspect) early on in a story (see Table 1). After a short or long intervening event, the continued activation of the target event is measured by the N400 elicited to a reintroduction of this target concept. The N400 is a negative deflection of the electroencephalogram (eeg) that typically peaks around 400 ms post-stimulus onset and is broadly distributed over the scalp. The N400 reflects how easily a word can be semantically integrated with the preceding context, including the lexical, sentence, and discourse levels of representation; words with less semantic overlap produce a larger negative deflection than words with greater semantic overlap (Brown, Hagoort, & Kutas, 2000).

Table 1
Examples of the different past tense combinations of grammatical and lexical aspect investigated.

Grammatical aspect	Lexical aspect	
	Activities (atelic)	Accomplishments (telic)
Imperfective (ongoing)	Was exercising	Was packing
Perfective (completed)	Exercised	Packed

Research has shown that the amplitude of the N400 component is modulated by discourse factors that increase the salience of discourse antecedents (Burkhardt & Roehm, 2007; Ledoux, Gordon, Camblin, & Swaab, 2007), including temporal shifts in the narrative timeline (Ditman et al., 2008). For example, Ditman et al. observed a larger N400 amplitude (more difficult integration) when a reintroduced target concept followed a long rather than a short time shift. In the present research, integration of target concepts should be easier (the N400 should be reduced) to the extent that the concept is already active in the situation model, which we expect to vary based on the lexical and grammatical aspect of the verb, as well as the duration of intervening events.

Given previous findings, we expect to observe an availability advantage (reduced N400) for a discourse concept described in the imperfective rather than the perfective grammatical aspect, as the imperfective aspect leaves the event ongoing whereas the perfective yields a representation of the completed event. We also expect that this grammatical aspect effect will taper off after a long intervening event, as long intervening events advance the narrative timeline to the point that the target event is no longer in progress, regardless of the grammatical aspect used to describe it initially. Thus, the availability advantage of an event in the imperfective aspect being left ongoing will fade if the narrative timeline is advanced far enough that the event is presumed to be finished. Furthermore, hypotheses concerning whether these variables will interact differentially for activities and accomplishments (lexical aspect) are even more complex.

When considering hypotheses for lexical aspect, it should be restated that some verbs can flip flop between activities and accomplishments (run vs. run a lap, listen to music vs. listen to a song). Such verbs were avoided in the present study, and care was taken to write the stories in such a way that each target event could only be considered an accomplishment or an activity. Because the same verb could not be used as an accomplishment and an activity, separate stories were written around target accomplishments and activities, requiring separate ANOVAs for these two event types. Consequently, comparisons between accomplishments and activities should only concern how grammatical aspect and duration of intervening events affect their availability later in the story. We do expect different effects of grammatical aspect and duration of intervening events for accomplishments and activities. Specifically, we expect the effect of grammatical aspect described in the paragraph above to be greater for accomplishments than for activities. This is because accomplishments progress towards natural endpoints, and therefore there is a more marked difference between their ongoing stages and their endpoints than in the case of activities. As the imperfective aspect focuses attention more on intermediate stages whereas the perfective focuses on the endpoint, accomplishments would naturally show this

effect more strongly than activities. Stated differently, representations for imperfective and perfective activities would be more similar, as their event structure is similar during the ongoing event and at the end of the event (listening to music), whereas imperfective and perfective accomplishments would show a greater difference (reduced N400 for imperfective), as their event structure is quite different during the ongoing event and at the endpoint (listening to a symphony). These predicted differences between accomplishments and activities are also supported by previous linguistic research suggesting that atelic predicates (without endpoints – activities) tend to be common in the background, whereas telic predicates (with endpoints – accomplishments) tend to be more common in the foreground to move the narrative timeline forward (Givón, 1984; Hopper & Thompson, 1984). If activities function more or less as a backdrop for more dynamic accomplishments, activities may be less likely to show sensitivity to the temporal dynamics of grammatical aspect manipulations.

3. Method

3.1. Participants

Fifty-two participants (21 male) from Wilfrid Laurier University participated for partial course credit or monetary compensation. All participants spoke native English, had normal or corrected-to-normal vision, and were right-handed.

3.2. Materials

124 stories (104 experimental and 20 filler) were constructed in the past tense form (see Tables 2 and 3). Several introductory sentences introduced the context and main character, followed by the critical sentence describing a target event (an activity or accomplishment) in the imperfective or perfective aspect. In Tables 2 and 3, packing a lunch is an accomplishment because it is comprised of multiple stages that progress towards an endpoint, whereas exercising is an activity because it can involve multiple changes of state, but does not have an intrinsic endpoint (see Madden & Ferretti, 2009 for an extensive discussion of this distinction). The following sentence always described an inherently short or long intervening event, and a subsequent filler sentence was presented that did *not* move the time-line along. A probe sentence then reintroduced a target concept (most often the 5th word) that was an integral part of the event described in the previous critical sentence containing the aspect manipulation. The probe sentence was followed by a wrap-up sentence. At the end of each passage, participants answered a comprehension question to assure they were paying attention. The 104 experimental passages were counterbalanced across four lists such that each list contained 52 stories about accomplishments and 52 stories about activities. Each list contained 26 passages with imperfective critical sentences followed by a short intervening event, 26 imperfective – long event, 26 perfective – short event, and 26 perfective – long event (13 of each for both accomplish-

Table 2
An example story where the critical aspect sentence is an accomplishment (to pack a lunch).

Sentence type	The sentence
Context sentence	Isaac was a real adrenaline junkie
Context sentence	He loved to go bungee jumping and skydiving
Context sentence	Lately, Isaac had been training on rock climbing
Context sentence	Today his trainer was taking him to a mountain face that was particularly difficult
Critical aspect sentence	Isaac packed/was packing his lunch in his backpack
Short duration sentence	He grabbed the map so he would not get lost
Long duration sentence	He studied the map so he would not get lost
Context sentence	He hoped the weather would stay nice that afternoon
Probe sentence with target concept (in bold)	Isaac thought about his **lunch** and wondered if he packed enough
Context sentence	He knew he would get hungry with all the difficult climbing that day

Table 3
An example story where the critical aspect sentence is an activity (to exercise).

Sentence type	The sentence
Context sentence	Megan was not very good under pressure
Context sentence	She liked to have everything done way ahead of time
Context sentence	In her business class she found out that her assignment was due earlier than she thought
Context sentence	She went to her room and started to cry
Critical aspect sentence	Megan exercised/was exercising to calm down
Short duration sentence	Megan took out her business books
Long duration sentence	Megan read through her business books
Context sentence	She really needed a good grade in this class
Probe sentence with target concept (in bold)	She thought about the **exercises** and how they really calmed her down
Context sentence	The assignment would not be so difficult to finish on time

ments and activities). The four lists were randomly ordered, and their reversed-orders were generated to yield 8 lists.[1] The 20 filler passages followed the same past tense, length, and form as the experimental passages, and were presented on all eight lists.

To ensure that the intervening events were indeed interpreted as short or long, we conducted a rating study in which 18 participants provided estimates for how long these events typically take. Events were distributed across two lists such that participants either estimated the duration of the short or long event for each passage, but not both. The results indicated that short events (M = 4.25 min) were indeed estimated to be shorter than long events (M = 4.84 h); $t(17) = 4.63$, $p < 0.05$.

3.3. Procedure

Participants read the passages and answered subsequent comprehension questions by pressing "Yes" and "No" labeled buttons. The set of introductory sentences was presented in full in the center of the screen, until the participant pressed a button to signal they had finished reading. Then the critical verb aspect sentence appeared alone on the screen, again until the participant pressed a button. The remaining sentences were presented in fixed serial format (no button presses). Each word was presented for 300 ms, followed by a 200 ms blank inter-stimulus interval, and a 2000 ms blank interval after each sentence. Multiple methods of presentation were employed here because, while experiment-paced, word-by-word presentation is ideal for eeg recordings, this takes longer than normal self-paced reading, and it would have been too taxing on participants to read each story in its entirety this way. Thus, the beginning of each story was presented all at once, then the critical sentence was presented alone as a transition to the word by word presentation for the end of the story (where critical eeg measurements were recorded).

3.4. Recording and analysis

The electroencephalogram (EEG) was recorded from 64 electrodes (including 2 mastoid electrodes) distributed evenly over the scalp (see Fig. 1 for a schematic diagram of the electrode locations over the scalp). Eye movements and blinks were monitored via additional electrodes placed on the outer canthus and infraorbital ridge of each eye. Electrode impedances were kept below 5 KΩ. EEG was processed through a Neuroscan Synamps 2 amplifier set at a 0.05–100 Hz bandpass, and digitized at 250 Hz.

3.5. Design

Separate 3-way ANOVAs were conducted for accomplishments and activities on the mean amplitudes at the standard N400 region (300–500 ms). The variables of interest were grammatical aspect (perfective/imperfective), intervening event duration (long/short), and electrode site. All variables were within-participants, and list was included as a between participants factor to stabilize variance caused by assigning participants across the lists.

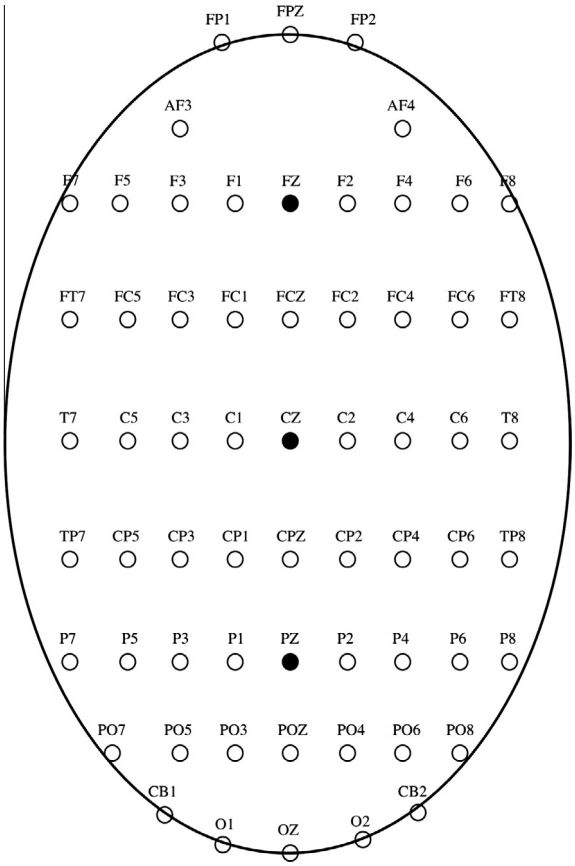

Fig. 1. Schematic diagram showing the electrode labels and sites for the 62 channels used in the analyses. The shaded electrodes are represented in Figs. 2 and 3.

4. Results

Data was re-referenced off-line to the average of the left and right mastoids. High frequency noise was removed by applying a 30 Hz low-pass filter. ERPs from the probe sentences were then computed in epochs that extended 100 ms before the target concept (5th word) to 1000 ms after its onset. Trials contaminated by blinks, eye-movements, and excessive muscle activity were rejected off-line before averaging; a total of 20% of trials were lost due to such artifacts. Figs. 2 and 3 show the mean amplitudes at electrodes down the midline of the scalp for accomplishments and activities, respectively. Fig. 4 shows the grammatical and lexical aspect conditions plotted separately for short and long time shifts.

The ANOVA for accomplishments yielded a significant interaction between grammatical aspect and intervening event duration, $F(1,48) = 4.94$, $p = 0.03$, $\eta_p^2 = .09$. Following a short intervening event, mean N400 amplitudes for

[1] The full set of experimental passages are available at www.journals.elsevier.com/cognition.

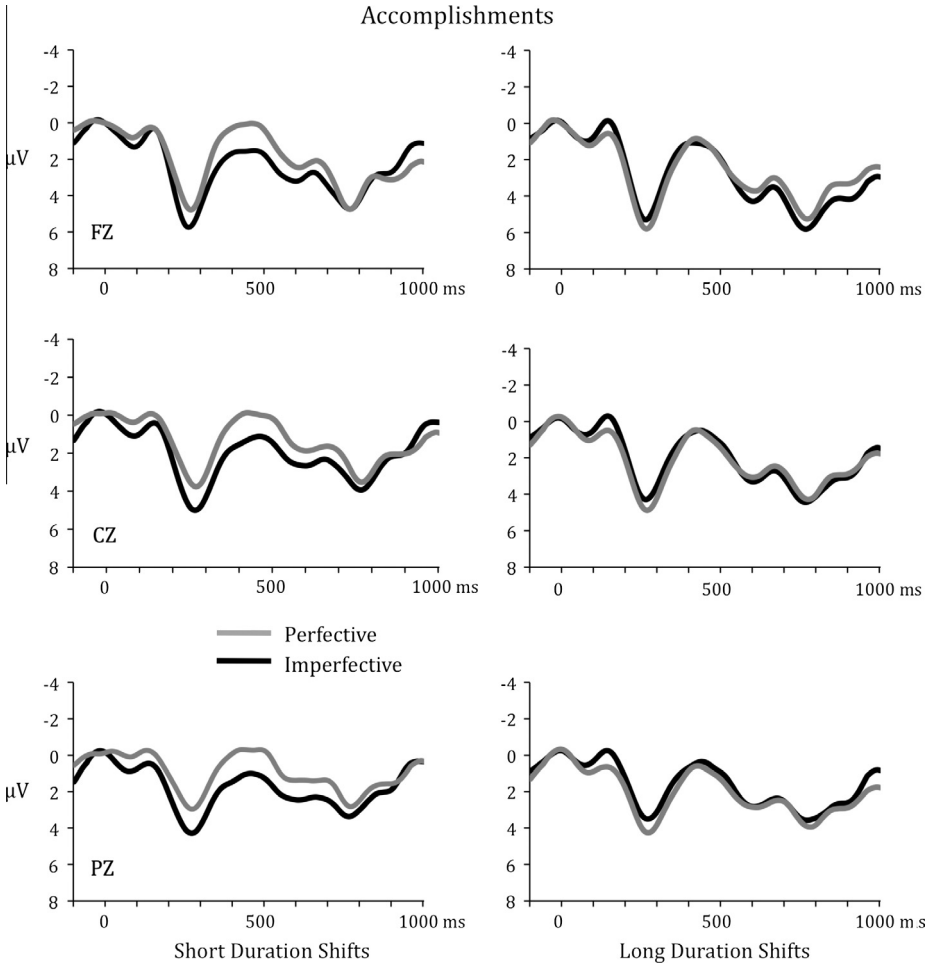

Fig. 2. Grand average ($n = 52$) waveforms for target words that originally appeared in imperfective and perfective accomplishments, and preceded by interleaving events with short or long durations. Shown are frontal (FZ), central (CZ), and parietal (PZ) electrode sites located down the midline.

target concepts initially presented in the perfective aspect ($M = .32$ μV) were more negative than targets initially presented in the imperfective aspect ($M = 1.54$ μV), $F(1,48) = 5.32$, $p < 0.03$, $\eta_p^2 = .10$. Alternatively, following long intervening events, N400 amplitudes for target concepts initially presented in the perfective ($M = 1.36$ μV) and imperfective aspect ($M = .92$ μV) did not significantly differ; $F < 1$. No significant differences were found in the ANOVA for activities (all F's < 1).

There were no significant interactions between electrode site and the theoretical variables of interest (all F's < 1.79), as the N400 differences observed in the accomplishment condition tended to be broadly distributed over the scalp.

5. Discussion

The results demonstrate an increase in availability of target concepts later in the story depending on the grammatical aspect of the verb used to describe the target event earlier in the story. Target concepts that initially appeared in the imperfective aspect showed increased availability relative to those that initially appeared in the perfective aspect, consistent with previous work on grammatical aspect that did not take lexical aspect into account (Carreiras et al., 1997; Ferretti et al., 2007; Magliano & Schleich, 2000). Interestingly, only accomplishments showed the effect, not activities, and only when these targets followed a short but not a long intervening event. The fact that some previous studies used mainly events from this lexical category explains the consistency of the results (Magliano and Schleich used mostly accomplishments but also included some activities).

The manner in which lexical aspect constrained the effect of grammatical aspect is in line with our predictions, such that the grammatical aspect effect was observed for accomplishments, which progress towards a natural endpoint, but not for activities, which do not progress towards an endpoint. The imperfective aspect focuses attention more on the intermediate stages of an event, whereas the perfective aspect describes the event as a collapsed unit, focusing instead on the endpoint. For events that do not have natural endpoints, this grammatical distinction between middle and endpoint would have less impact, such

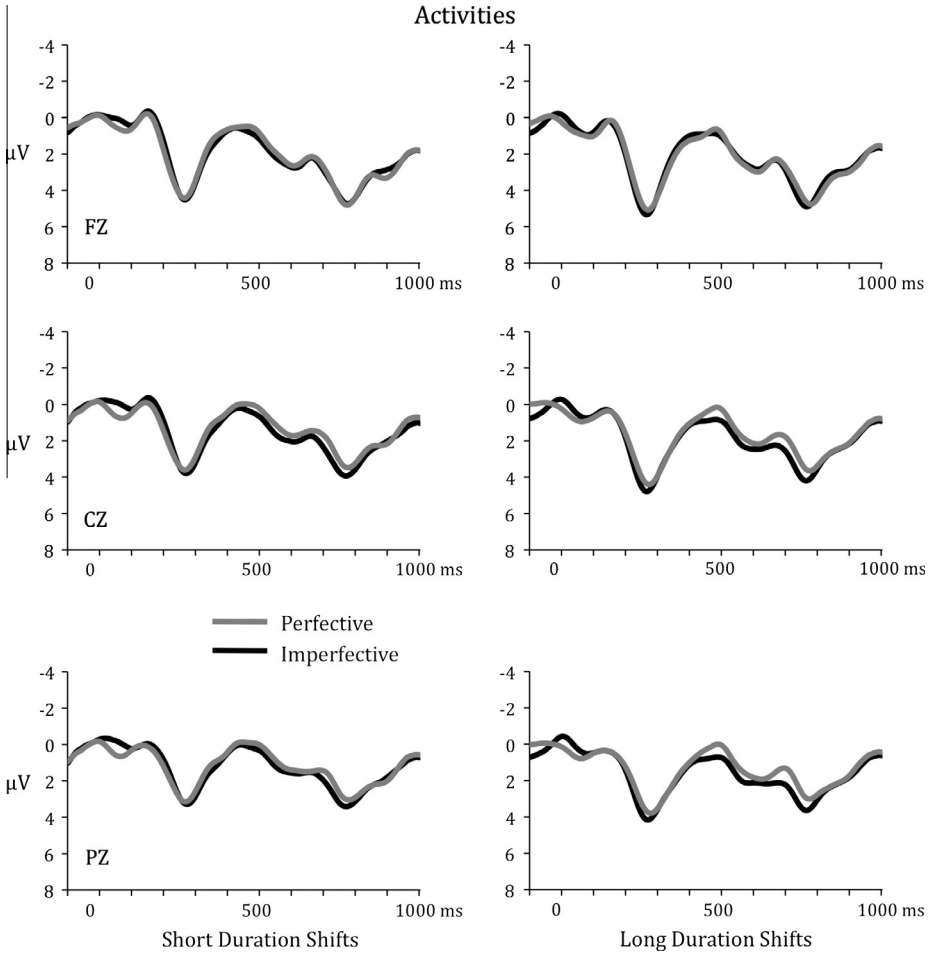

Fig. 3. Grand average ($n = 52$) waveforms for target words that originally appeared in imperfective and perfective activities, and were preceded by interleaving events with short or long durations. Shown are frontal (FZ), central (CZ), and parietal (PZ) electrode sites located down the midline.

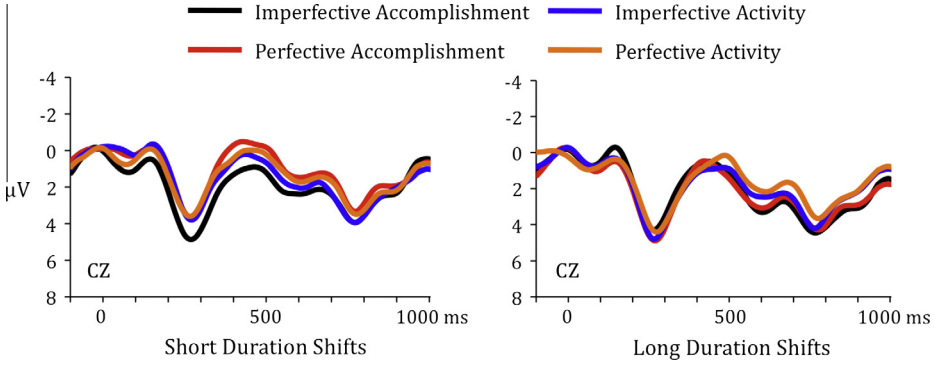

Fig. 4. Grand average ($n = 52$) waveforms for target words that originally appeared in imperfective and perfective activities and accomplishments plotted separately for short and long duration shifts at a central electrode (CZ).

that activities would naturally be less likely to show this effect than accomplishments. Representations for imperfective and perfective activities were demonstrated to be more similar, as their event structure is similar during the ongoing event and at the end of the event, whereas imperfective and perfective accomplishments showed a greater difference, as their event structure is quite different during the ongoing event and at the endpoint. This finding also coincides with hypotheses from linguistics in which telic predicates (with endpoints) tend to be in the

foreground, whereas atelic predicates (without endpoints) tend to be more common in the background (Givón, 1984; Hopper & Thompson, 1984).

Another novel finding of the present research was that long intervening events can wipe out the effects of grammatical and lexical aspect. After a long intervening event, the N400 amplitudes did not vary as a function of grammatical aspect for either accomplishments or activities. This result suggests that, despite the imperfective aspect describing the event as still ongoing, long intervening events advance the narrative timeline too far forward to see an advantage of grammatical aspect, even on activities, which can remain ongoing indefinitely. In this regard, the present results extend previous findings that information becomes less available after long rather than short time shifts by indicating how temporal information associated with verbs interacts with such temporal shifts (Anderson et al., 1983; Bestgen & Vonk; 1995; Claus & Kelter, 2006; Ditman et al., 2008; Kelter et al., 2004; Zwaan, 1996).

In the present study we chose to manipulate the duration of the intervening events by utilizing events that inherently vary in duration rather than using the same events and modifying their duration with temporal adverbs. Although we clearly show that our long duration events were rated by participants as longer in duration than our short duration events, the fact that we used different events in the two conditions means that we cannot be absolutely certain that other inherent differences between the verbs could have also contributed to our observed differences for the short versus long shift conditions.

The present study adds to an expanding body of research showing how lexical semantic features of verbs can have important consequences for how these verbs take on their grammatical inflections, and in turn how they are represented (Ferretti et al., 2009; Rohde, Kehler, & Elman, 2006). As the temporal structure of events (between events *and* within a single event) is a very basic part of our experience of the world, this structure must also be specified in our representation of events experienced through language. Understanding how the semantic constraints associated with activities and accomplishments interact with grammatical verb aspect is crucial to understanding how people construct mental representations of situations during language comprehension.

Previous research by Yap et al. (2009) has demonstrated that the construction of mental representations of activities and accomplishments is faster/easier when they are paired with grammatical aspect that matches (imperfective activities, perfective accomplishments) rather than mismatches (perfective activities, imperfective accomplishments) their inherent temporal properties. The present research suggests that the influence of lexical and grammatical aspect on the ease of constructing mental representations of events does not necessarily entail that the content of those representations is correspondingly more/less available over subsequent discourse. Specifically, we found a discourse availability advantage for imperfective over perfective accomplishments, but no grammatical match advantage for activities. The difference in findings between the two studies highlights the need to examine how multiple temporal properties of discourse interact to constrain the dynamic *construction* and *maintenance* of event information in situation models. Thus, it is important to continue this line of research on verb aspect to further identify other temporal-semantic features that are critical for constraining the way grammatical aspect is represented.

In conclusion, the present research is novel and important because it shows (1) how multiple temporal properties of events interact to constrain discourse availability, (2) that temporal shifts in narratives have a greater influence on discourse availability than grammatical and lexical aspect, (3) the influence of grammatical and lexical aspect on maintaining discourse concepts appears to be different from previous research examining the construction of mental representations of events, and (4) given the observed effects of telicity of verbs on the representation of discourse events in the present study, researchers should be aware that these kinds of lexical semantic properties of verbs can influence the pattern of results obtained in their experiments.

Acknowledgements

This research formed part of Raymond Becker's MSc thesis conducted at Wilfrid Laurier University. This work was supported by a Discovery Grant awarded to Dr. Todd Ferretti by the National Sciences and Engineering Research Council of Canada (NSERC), as well as funding for Carol Madden from the French national agency for research (ANR) for a Blanc project entitled "Comprendre". We would like to thank Alannah Guzak, Jenna Harwood, and Rachel Craven for help with EEG recording.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.cognition.2013.06.014.

References

Anderson, A., Garrod, S., & Sanford, A. J. (1983). The accessibility of pronominal antecedents as a function of episode shifts in narrative text. *Quarterly Journal of Experimental Psychology, 35A*, 427–440.

Bestgen, Y., & Vonk, W. (1995). The role of temporal segmentation markers in discourse processing. *Discourse Processes, 19*, 385–406.

Brown, C. M., Hagoort, P., & Kutas, M. (2000). Postlexical integration processes in language comprehension: evidence from brain-imaging research. In M. S. Gazzaniga (Ed.), *The new cognitive neurosciences* (pp. 881–898). Cambridge, MA: MIT Press.

Burkhardt, P., & Roehm, D. (2007). Differential effects of saliency: an event-related brain potential study. *Neuroscience Letters, 413*, 115–120.

Carreiras, M., Carriedo, N., Alonso, M. A., & Fernandez, A. (1997). The role of verbal tense and verbal aspect in the foregrounding of information in reading. *Memory and Cognition, 23*, 438–446.

Claus, B., & Kelter, S. (2006). Comprehending narratives containing flashbacks: evidence for temporally organized representations. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32*, 1031–1044.

Coll-Florit, M., & Gennari, S. P. (2011). Time in language: event duration in language comprehension. *Cognitive Psychology, 62*, 41–79.

Comrie, B. (1976). *Aspect: an introduction to the study of verbal aspect and related problems*. New York: Cambridge University Press.

Ditman, T., Holcomb, P. J., & Kuperberg, G. R. (2008). Time travel through language: temporal shifts rapidly decrease information accessibility during reading. *Psychonomic Bulletin and Review, 15*, 750–756.

Dowty, D. R. (1979). *Word meaning and montague grammar*. Boston: Reidel.
Ferretti, T. R., Kutas, M., & McRae, K. (2007). Verb aspect and the activation of event knowledge. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33*, 182–196.
Ferretti, T. R., Rohde, H., Kehler, A., & Crutchley, M. (2009). Verb aspect, event structure, and co-referential processing. *Journal of Memory and Language, 61*, 191–205.
Givón, T. (1984). *Syntax: A functional-typological introduction* (Vol. 1). Philadelphia: Benjamin.
Hopper, P., & Thompson, S. (1984). The discourse basis for lexical categories in universal grammar. *Language, 60*, 652–703.
Kelter, S., Kaup, B., & Claus, B. (2004). Representing a described sequence of events: a dynamic view of narrative comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30*, 451–464.
Ledoux, K., Gordon, P. C., Chamblin, C. C., & Swaab, T. Y. (2007). Coreference and lexical repetition: mechanisms of discourse integration. *Memory and Cognition, 35*, 801–815.
Lyons, J. (1977). *Semantics* (Vol. 2). Cambridge: Cambridge University Press.
Madden, C. J., & Ferretti, T. R. (2009). Verb aspect and event representation. In P. Li & W. Klein (Eds.), *The expression of time in language*. Berlin: Mouton de Gruyter.
Madden, C. J., & Therriault, D. J. (2009). Verb aspect and perceptual simulations. *The Quarterly Journal of Experimental Psychology, 62*, 1294–1302.
Madden, C. J., & Zwaan, R. A. (2003). How does verb aspect constrain event representations? *Memory and Cognition, 31*, 663–672.
Magliano, J. P., & Schleich, M. C. (2000). Verb aspect and situation models. *Discourse Processes, 29*, 83–112.
Morrow, D. G. (1985). Prepositions and verb aspect in narrative understanding. *Journal of Memory and Language, 24*, 390–404.
Mourelatos, A. P. (1981). Events, processes, and states. In P. J. Tedeschi & A. Zaenen (Eds.), *Syntax and semantics. Tense and aspect* (Vol. 14, pp. 191–212). New York: Academic Press.
Nordenfeldt, L. (1977). *Events, actions, and ordinary language*. Lund: Doxa.
Piñango, M. M., Winnick, A., Ullah, R., & Zurif, E. (2006). Time-course of semantic composition: the case of aspectual coercion. *Journal of Psycholinguistic Research, 35*, 233–244.
Piñango, M. M., Zurif, E., & Jackendoff, R. (1999). Real-time processing implications of enriched composition at the syntax–semantics Interface. *Journal of Psycholinguistic Research, 28*, 395–414.
Rohde, H., Kehler, A., & Elman, J.L. (2006). Event structure and discourse coherence biases in pronoun interpretation. In: Proceedings of the 27th annual meeting of the cognitive science society.
Vendler Z., Linguistics in philosophy, 1967, Cornell; Ithaca.
Verkuyl, H. (1972). *On the Compositional Nature of the Aspects*. Dordrecht: Reidel.
Verkuyl, H. (1993). *A theory of aspectuality*. Cambridge: Cambridge University Press.
Yap, F. H., Chu, P. C. K., Yiu, E. S. M., Wong, S. F., Kwan, S. W. M., Matthews, S., et al. (2009). Aspectual asymmetries in the mental representation of events: role of lexical and grammatical aspect. *Memory and Cognition, 37*, 587–595.
Zwaan, R. A. (1996). Processing narrative time shifts. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22*, 1196–1207.