

ORIGINAL RESEARCH REPORT

Aspect and Narrative Event Segmentation

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Time is central to human cognition, both in terms of how we understand the world and the events that unfold around us as well as how we communicate about those events. As such, language has morphological systems, such as temporal adverbs, tense, and aspect to convey the passage of time. The current study explored the role of one such temporal marker, grammatical aspect, and its impact on how we understand the temporal boundaries between events conveyed in narratives. In Experiments 1 and 2, participants read stories that contained a target event that was either conveyed with a perfective (e.g., watched a movie) or imperfective aspect (e.g., was watching a movie) and engaged in an event segmentation task. Events described in the perfective aspect were more often perceived as event boundaries than events in the imperfective aspect, however, event duration (long vs. short) did not impact this relationship in Experiment 2. Experiment 3 demonstrated that readers were sensitive to grammatical aspect and event duration in the context of a story continuation task. Overall this study demonstrates that grammatical aspect interacts with world knowledge to convey event structure information that influences how people interpret the end and beginning of events.

Keywords: grammatical aspect; situation models; narrative processing; event segmentation; lexical aspect

Narratives describe events as they unfold over time and understanding the timeline of events is critical for comprehension (Anderson, Garrod, & Sanford, 1983; Zwaan & Radvansky, 1998). An ample amount of research has shown that readers construct situation models to understand a text and the events described in them (e.g., McNamara & Magliano, 2009; Zwaan & Radvansky, 1998). Situation models emerge as readers engage in dynamic processes that allow them to integrate information from the current sentence with activated information from the discourse representation and world knowledge (see McNamara & Magliano, 2009 for review). A situation model is, in essence, a representation of the events that comprise a narrative, the entities that are part of those events, and the situational relationships (time, space, causality, motivation) that bind them (Gernsbacher, 1990; Zwaan & Radvansky, 1998). Situation models for narratives are organized around episodes in which characters perform planned actions that are intended to achieve desired states (Suh & Trabasso, 1993; Trabasso, van den Broek, & Suh, 1989). To build a coherent situation model of a narrative, one must be able to accurately recognize boundaries in narrative episodes (Gernsbacher, 1990; Magliano, Kopp, McNeerney, Radvansky, & Zacks, 2012;

Magliano, Taylor, & Kim, 2005; Suh & Trabasso, 1993). Monitoring time may be important for understanding the boundaries between the narrative episodes that are represented in situation models (Zwaan, 1996; Zwaan & Radvansky, 1998).

There is considerable evidence suggesting that people monitor shifts in event structure as they read (Bohn-Gettler, 2014; Magliano, Zwaan, & Graesser, 1999; Zwaan, Langston, & Graesser, 1995; Rinck & Weber, 2003; Zwaan, 1999). For example, it is well documented that sentence reading times increase when readers perceive shifts in situational dimensions, such as time, space, and causality. This increase varies as a function of the number of shifts (e.g., Zwaan, Magliano, & Graesser, 1995) and can be explained by the fact that situational shifts aid the reader in establishing the boundaries between narrative events (Radvansky, Tamplin, Armendarez, & Thompson, 2014).

While many studies on sensitivity to situation changes rely on discourse analyses to identify situational changes (e.g., Zwaan, Magliano, & Graesser, 1995; Zacks, Speer, & Reynolds, 2009), these analyses are rarely grounded in linguistic features that might signal these changes. What are the linguistic features of a text that help a reader recognize shifts in event structure? Grammatical morphemes (e.g., tense, grammatical aspect, plurality, definitive and indefinite articles) can serve as a set of processing instructions that inform a reader on how to construct a situation model (Carreiras, Carriedo, Alonso, & Fernandez, 1997; Gernsbacher & Shroyer, 1989; Givón, 1992; Magliano & Schleich, 2000; Morrow, 1986).

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Grammatical aspect is a morphological system that conveys information about the temporal structure of events conveyed in language (Comrie, 1985; Madden & Ferretti, 2009; Magliano & Schleich, 2000; Morrow, 1986; Vendler, 1957). It provides information about whether events are dynamic (i.e., have a beginning, middle, or end), have duration (i.e., events are points in time, or take place over time), and are completed or ongoing. Given the interest in understanding factors that affect the perception of the boundaries between narrative events, we were interested in understanding if readers are sensitive to the extent that aspect conveys whether events are completed or ongoing. A perfective aspect (e.g., Johnny *walked* to the store) refers to events in their finished, completed state. As such, the perfective aspect places readers at the end of an event and constrains them to focus on the event as a whole (Madden & Ferretti, 2009; Vendler, 1957). Conversely, the imperfective aspect (e.g., Johnny *was walking* to the store) refers to events as ongoing and incomplete. In this case, the reader is constrained to focus on the internal development of the event while temporarily ignoring its ending (Madden & Ferretti, 2009; Vendler, 1957).

Consider the following example from *The Stand* (King, 1978; p. 252):

- 1) Motorcycles coming,
- 2) small ones by the sound.
- 3) Two-fifties?
- 4) In this great stillness it was impossible to tell how far away.

The imperfective verb *coming* describes an event that is still in the process of unfolding and, as such, the subsequent sentences serve to continue the event. Now, imagine this same passage conveyed in the perfective aspect (i.e., motorcycles *came*). Switching the aspect of the verb changes the meaning and renders aspects of the sentences that follow insensible. The subsequent sentences do not make sense because they cannot occur after the motorcycles have arrived at the location of the narrator. Thus, while the perfective aspect puts the comprehender at the end of an action, the imperfective aspect puts the comprehender within the action.

Magliano and Schleich (2000) conducted a study that illustrated that readers are sensitive to the extent that grammatical aspect signals temporal information regarding whether narrative events are ongoing or completed. They had participants read narratives that had four target sentences. The first sentence described an event that was conveyed either in a perfective or imperfective aspect (i.e., was cooking a meal, cooked a meal). The subsequent four sentences described narrative events that could happen during the aspect event or after (e.g., she thought the meal would help her get a promotion). In Experiments 1 and 2, participants answered probe questions that allowed for an assessment of whether participants thought the aspect event was still ongoing (e.g., Is the character done cooking yet?). Their results showed that participants were more likely to perceive the aspect event to still be ongoing over the subsequent sentences when they were conveyed

in an imperfective aspect than a perfective aspect. Experiments 3 and 4 showed that the aspect event was more accessible in working memory over the subsequent sentences when conveyed with an imperfective aspect than a perfective aspect.

The goal of the present study was to assess the extent to which grammatical aspect conveys information about event structure and, in particular, how it signals that salient narrative events are ongoing or completed. One model that specifies the importance of event structure in understanding events/on cognition is the Event Horizon Model (Radvansky, 2012; Radvansky & Zacks, 2014). The Event Horizon Model outlines processes by which events are perceived and how these affect memory processes (e.g., encoding, memory retrieval), and in particular those that support the construction of a mental model for an event. The Event Horizon Model assumes that people routinely and habitually segment larger events into the smaller events that comprise them, a process called event segmentation (See also Kurby & Zacks, 2008; Zacks & Tversky, 2001; Zacks et al., 2009). For example, if one were to observe a person washing the dishes, they would perceive a series of iterative actions (e.g., picking up an object to be washed, putting it under the stream of water, washing it, placing it in the dish rack). When doing so, we recognize the boundaries between the discrete actions that make up the larger activity of washing the dishes. Event segmentation has been shown to be a habitual and vital part of basic event cognition (Kurby & Zacks, 2008; Radvansky & Zacks, 2014). According to the Event Horizon Model, mental models are updated at event boundaries, which underscores the importance of event segmentation in mental model construction.

Consistent with the Event Horizon Model, event segmentation supports mental model construction in the context of narrative media (texts, graphic narratives, film; Kurby & Zacks, 2012; Magliano et al., 2012; Magliano, Miller, & Zwaan, 2001; Magliano & Zacks, 2011; Zacks et al., 2009). These studies typically employ an event segmentation task (Newtson, 1973) that involves identifying the boundaries between events in a stimulus (video, or text). Participants are typically instructed to identify the boundaries between the meaningful events, but it is left to them to decide what constitutes a boundary and a meaningful event. There is regularity and convergence in where people make those judgments (Newtson & Engquist, 1976; Speer, Swallow, & Zacks, 2003). Moreover, consistent with the Event Horizon Model, segmentation judgments in the context of narrative text are correlated with changes in situational relationships, such as changes in spatial locations, movement of characters, breaks in time, breaks in causal coherence, and changes in characters goals (Kurby & Zacks, 2012; Magliano et al., 2012; Speer & Zacks, 2005; Zacks et al., 2009).

In the context of the present study, we had participants engage in an event segmentation task while reading. We were interested in whether the aspect (i.e., perfective or imperfective) used to describe an event influences the likelihood that participants perceive a boundary after this event. Given that aspect communicates whether events are completed or ongoing, we reasoned that it could

affect the process of event segmentation in the context of linguistically conveyed narratives. If aspect affects the process of event segmentation, then there should be a greater increase in the likelihood of making segmentation judgments when the aspect events are conveyed with a perfective aspect (cooked the meal) than an imperfective aspect (was cooking the meal) because a perfective aspect conveys that an event is completed, whereas an imperfective aspect conveys that it is ongoing in the narrative context.

Experiment 1

Participants read selected stories from Magliano and Schleich (2000) and were instructed to mark sentences that indicated an event boundary. We were interested in whether the grammatical aspect used to describe an event influenced the likelihood of that event being perceived as bounded. In accordance with Magliano and Schleich (2000), we hypothesized that the likelihood of segmentation would be greater at target sentences conveyed in the perfective aspect than sentences conveyed in the imperfective aspect.

Methods

Pre-Registration & Ethical Compliance

In an attempt to foster openness and transparency in science, this project was pre-registered using Open Science Framework (<https://osf.io/gk6r2/>). Experiments 1 and 2 were proposed before data collection began, while Experiment 3 was designed and posted after analyzing data from Experiment 2. Data and materials from the experiments are available on the webpage listed above. All research was approved by an institutional review board and participants completed an informed consent form at the beginning of each experiment.

Participants

Using Amazon's Mechanical Turk (MTurk; <https://www.mturk.com>), one hundred participants were recruited online for the study. MTurk has been used in cognitive research and has been validated for such purposes (see Germine, Nakayama, & Duchaine, 2012; Paolacci, Chandler, & Ipeirotis, 2010). Of the 100 participants, 21 failed to score above 70% on the basic comprehension questions (see below) and were dropped from further analyses. The dropped participants and the remaining participants ($N = 79$, 53.2% female, mean age = 34.5, $SD = 10.0$) were compensated \$1.00 for their participation in a task that required approximately 10–15 minutes. All participants indicated that English was their first language.

Design

A within participants design was used with grammatical aspect (perfective, imperfective) as the independent variable. The likelihood of making a segmentation judgment at the target sentences was the dependent measure and was computed for each participant for the perfective and imperfective conditions (i.e., number of segmentation judgments made by a participant within a condition/total number of target sentences within that condition).

Materials

Ten passages were selected from Magliano and Schleich (2000) for the purpose of this study. There was an imperfective and perfective version of each of the 10 passages. Each passage began with a title and 5 to 8 introductory sentences designed to introduce the story characters and context (see Appendix for story examples). Introductory sentences were followed by an experimental sentence, conveyed in either the imperfective or perfective aspect. Apart from the change in aspect, experimental sentences were otherwise identical. Following the experimental sentence were 2 to 3 sentences that functioned in both the context of the ongoing event (i.e., imperfective condition) as well as the completed event (i.e., perfective condition). An additional 2 to 3 sentences served as concluding sentences, completing the ongoing event when necessary, and providing resolve to the story. In total, stories ranged from 10 to 15 sentences in length. Importantly, as situational change has important implications for judgments of event boundaries (e.g., Kurby & Zacks, 2012), stories were adapted, when necessary, to ensure that the experimental sentences were not confounded by other changes in situational continuity that might affect segmentation. Specifically, in some stories, the target sentence implicitly conveyed that the character changed locations. In these cases, a sentence was added prior to the target sentences that specified that all the prominent characters were located in the location where the action conveyed in the aspect sentence occurred. Assignment of the passages to conditions was counterbalanced and the passages were presented in a random order.

Procedure

Participants were instructed that stories are comprised of events and that experimenters were interested in understanding when readers understand that the events have changed. They were told that they would read a series of short narratives and would be asked to identify sentences that conveyed that the events had changed in the stories. They were instructed that it was up to them to decide where the events in the stories changed and that there were no right or wrong answers. One practice narrative was provided and instructions were reiterated after completion of the practice item. Entire passages were present on the screen at the same time, with each sentence occupying one line on the screen and with a check-box next to it. Participants were instructed to check the box if they felt that the sentences conveyed a change in the events of the stories. Following each story, participants were asked to answer two 'yes/no' questions about the story they had just read. These comprehension questions served to ensure that participants were attentive and engaged in the experiment and performance on them was used as a screening measure (See Participants section above). After completing the segmentation task, participants finished the experiment by completing a brief demographic questionnaire.

Results and Discussion

Participants made a mean number of 4.39 segmentation judgments per text. A paired samples *t*-test was conducted to examine differences in segmentation at sentences

conveyed in the perfective and imperfective aspect. Results showed that participants segmented significantly more often when target sentences were conveyed in the perfective aspect ($M = .39$, $SD = .34$), as compared to the imperfective aspect ($M = .31$, $SD = .32$), $t(78) = 2.55$, $p = .013$, Cohen's $d = .24$.

The results show that grammatical aspect influenced the likelihood of the perception of event boundaries. Target story sentences conveyed in a perfective aspect lead to a significantly greater likelihood of segmentation than target story sentences conveyed in an imperfective aspect. These results are consistent with prior studies that show that grammatical aspect affects the perception of the duration of narrative events (Madden & Zwaan, 2003; Magliano & Schleich, 2000). Presumably, participants were less likely to segment in the imperfective condition than the perfective condition because the use of the imperfective aspect suggested the aspect event was going to continue in the story.

Experiment 2

Experiment 1 demonstrated that readers are sensitive to grammatical aspect as a cue when making judgments about event boundaries. While grammatical aspect may thus be an important cue for segmentation, general world knowledge also supports the construction of situation models (e.g., Kintsch, 1988). This may also be the case with respect to understanding the temporality of events (Sanford & Garrod, 1981, 1989). Moreover, it may be the case that the impact of world knowledge on situation model construction could be influenced by morphological features of the discourse (Givón, 1992; Magliano & Schleich, 2000; Mozuraitis, Chambers, & Daneman, 2013). This was demonstrated in the second experiment of Magliano and Schleich (2000) wherein the temporal semantics of the verbs used in passages were shown to interact with aspect. Specifically, they created stories that conveyed events in the target sentence that took a relatively short time to complete (minutes to an hour) or a relatively long time to complete (several hours to months). They found that relatively long events conveyed with an imperfective aspect were perceived to be ongoing longer than relatively short events conveyed with an imperfective aspect. However, general knowledge about the duration of events did not impact the perceived duration of events conveyed with a perfective aspect. Mozuraitis and colleagues (2013) partially replicated Magliano and Schleich (2000) using eye tracking data. They used passages from Magliano and Schleich, and specifically those that varied in the duration of the target event. Results showed that participants had longer eye fixation times on target sentences when long events were described in the imperfective rather than the perfective aspect. However, eye fixation times for target sentences did not differ by aspect when event durations were short rather than long.

In Experiment 2, we explored the extent to which general world knowledge interacts with aspect in the context of an event segmentation task. As such, we sought to replicate the results of Experiment 1, while introducing events

with relatively long or short durations and investigating a potential interaction of aspect with event duration.

As in Experiment 1, we hypothesized that sentences conveyed in the perfective aspect are associated with a higher probability of segmentation than sentences conveyed in the imperfective aspect. If aspect interacts with one's semantic knowledge of verbs (Magliano & Schleich, 2000; Mozuraitis et al., 2013; Ferretti, Kutas, McRae, 2007), we would expect segmentation to differ between passages containing long and short events. Specifically, it was predicted that there would be a higher likelihood of perceiving an event boundary in the imperfective/short duration condition than in the imperfective/long duration condition. Alternatively, we did not expect duration to affect segmentation in the perfective condition because that aspect conveys that the event is completed.

Methods

Participants

Eighty-three participants were recruited through MTurk and were compensated \$1.00 for their participation, which required approximately 10–15 minutes. As in Experiment 1, participants that scored below 70% on the basic comprehension questions were dropped from the analyses ($n = 6$). All remaining 77 participants (68.8% female, mean age = 35.0, $SD = 13.3$) indicated that English was their first language.

Design

We used a 2 (aspect: imperfective, perfective) by 2 (duration: long, short) within-participants design. The segmentation likelihood scores were calculated in the same way as in Experiment 1.

Materials

As in Experiment 1, passages were selected and adapted from Magliano and Schleich (2000). For this experiment, 12 passages were selected, again with imperfective and perfective versions of each. Ten of these passages were also used in Experiment 1. Six passages contained activities that were relatively short in duration, while six other passages contained activities with relatively longer durations. Duration estimates for the described activities were acquired from a pilot study conducted by Magliano and Schleich (2000). In that study, participants were given verb phrases from target sentences (e.g., doing five pushups, running 100 meters, watching a moving, golfing 18 holes) and were asked to judge their duration. Durations were typed as free responses into a text box with instructions to include units of measurement (i.e., seconds, minutes, hours, days, etc.). Short duration activities for the passages selected had mean estimates ranging from 10.29 seconds to 21 minutes, while long duration activities had mean estimates ranging from 2 hours to 3.46 days. Assignment of the passages to the aspect conditions was counterbalanced and the passages were presented in a random order.

Procedure

We used the same procedure as in Experiment 1.

Results and Discussion

Participants made a mean number of 4.17 segmentation judgments per text. Mean segmentation likelihood scores for Experiment 2 are shown in **Table 1**. These data were entered into a 2 × 2 within participants ANOVA to examine the effect of aspect and event duration on segmentation likelihood. Similar to Experiment 1, results indicated a main effect of aspect such that there was a higher likelihood of segmentation in the perfective condition ($M = .36, SD = .36$) than the imperfective condition ($M = .26, SD = .30$), $F(1, 76) = 12.11, MSE = .833, p = .001, \eta_p^2 = .137$. However, the main effect of duration was not statistically significant, $F(1, 76) = .943, MSE = .052, p = .335, \eta_p^2 = .012$. Additionally, the interaction between event duration and aspect was not statistically significant, $F(1, 76) = .607, MSE = .037, p = .438, \eta_p^2 = .008$.

The results from Experiment 2 were consistent with those of Experiment 1, suggesting that grammatical aspect informs readers about the boundaries between narrative episodes. While previous research suggests that readers use both grammatical information and general world knowledge to guide the construction of situation models (Becker, Ferretti, Madden-Lombardi, 2013; Givon, 1995; Magliano & Schleich, 2000; Morrow, 1985; Mozuraitis et al., 2013), we found no impact of prior knowledge about the temporal duration of events on event segmentation. It may be the case that the event segmentation task was simply not sensitive to the impact of temporal knowledge of events or potential interactions with grammatical aspect.

To explore the impact of grammatical aspect on language processing, Ferretti and colleagues used an event continuation task instead. Participants were given sentence stems (The diver was snorkeling/snorkeled) and needed to continue the sentence (Ferretti et al., 2007; Ferretti, Rohde, Kehler, & Crutchley, 2009). They were more likely to continue sentence stems containing the imperfective aspect with event details that were relevant to the internal features of an event (e.g., was snorkeling *in the ocean*) than when stems contained the perfective aspect (e.g., snorkeled *all his life*). This is consistent with the hypothesis that imperfective aspect does not convey an event boundary. Therefore, in Experiment 3, we also used a story continuation task.

Table 1: Segmentation Likelihoods (SE) as a Function of Aspect and Event Duration.

Aspect	Duration	
	Short	Long
Imperfective	0.25 (.04)	0.26 (.03)
Perfective	0.34 (.04)	0.38 (.04)

Experiment 3

The same 12 stories used in Experiment 2 were used in Experiment 3 with the exception that we removed all sentences after the target aspect sentences.

After reading the stories to the end of the aspect sentences, participants had to write one sentence that described a plausible continuation to the story. We coded the continuations as to whether they reflected events that happened *during* (e.g., laughing at a scene in a movie when the aspect sentence is conveyed *characters watching a movie*) or *after* the aspect event (e.g., characters leaving for home when the aspect sentence is conveyed *characters watched a movie*). We predicted a main effect of aspect, wherein story continuations should reflect events that could happen during the aspect event more often when it is conveyed with an imperfective aspect than a perfective aspect. Conversely, more continuations should reflect events after the aspect event when conveyed with a perfective aspect than an imperfective aspect.¹ In terms of the interaction, we again anticipated aspect and event duration to affect one another. Consistent with the interaction predicted for Experiment 2, it was predicted that the imperfective/short duration condition would have a higher likelihood of after responses than the imperfective/long duration condition. However, event duration should not affect the likelihood of after responses for the perfective conditions because this aspect indicates that there is an event boundary.

Methods

Participants

Fifty participants (50.0% female, mean age = 32.3, $SD = 9.2$) were recruited through MTurk and were compensated \$1.00 for their participation, which required approximately 15 minutes. Data from one participant was dropped from the analysis because it was not compliant with task instructions (i.e., all responses were “this is nice”). Additionally, one response from one participant was dropped because it did not adhere to the instructions (i.e., the response did not pertain to the story). As in Experiments 1 and 2, all participants indicated that English was their first language.

Design

We used a 2 (aspect: imperfective, perfective) by 2 (duration: long, short) within-participants design. As will be discussed below, the dependent measure was the likelihood of continuing a story with responses that reflected events that occurred during or after the events conveyed in the target sentences. Continuation likelihood scores were computed for each participant for the perfective and imperfective conditions (i.e., number of continuations made by a participant within a condition/total number of target sentences within that condition). This was done for both *during* and *after* responses.

Materials

The same 12 passages used in Experiment 2 were used in Experiment 3, with one modification. In this experiment, rather than providing participants with the complete texts, stories were cut off after the target sentences and participants were prompted to provide a sentence to continue the story. Additionally, 12 filler stories, adapted from Magliano and Schleich (2000), were used in order to mask the experimental manipulation. The location of the continuation prompt varied in the filler stories, but was never placed immediately after target sentences when target sentences were present. In cases where target sentences were included, aspect was counterbalanced. Assignment of the passages to the aspect conditions was counterbalanced and the passages were randomly presented.

Procedure

Participants read each of the 24 short stories and were instructed to provide one sentence that naturally continued the story. They were specifically instructed to provide the first thing that came to their mind rather than overthinking it. After reading each story and providing continuation sentences, participants finished the experiment by completing a brief demographic questionnaire. As in Experiment 1 and 2, the entire text (up through the target sentence) was presented on the screen at the same time. For the filler sentences, the entire passage was presented up to the completion prompt.

Coding of Story Continuations

The story continuation protocols were coded to determine if they contained events that happened during or after the target event. However, upon developing a coding scheme, we noticed that sometimes participants continued the story with an event that was temporally ambiguous (i.e., could have happened before, during, or after the target event) or clearly occurred before the event. As such, we added those categories to the coding scheme. To code the protocols, we considered the presence of linguistic markers (e.g., temporal adverbs such as, while, afterward) and world knowledge (e.g., leaving for home could only happen after one was done watching a movie). **Table 2** contains example continuations that indicated continuations for watching a movie that were coded as happening during or after the target event. In cases

where participants produced sentences that contained multiple events (e.g., Kristy went home, and then went to bed), temporal judgments were made in regard to the first mentioned event in a response. Inter-rater reliability was calculated for each category separately and was found to be acceptable (Cohen's Kappas of 1.0, .76, .89, .81 for before, during, after, and ambiguous responses, respectively).

Results and Discussion

Approximately 3% of the responses were coded as *before*, 39% as *during*, 42% as *after*, and 16% as *ambiguous*.² Given that theoretical perspectives of aspect (e.g., Vendler, 1957) only justified predictions based on continuations that reflected events during and after the target events, events coded as before (Imperfective $M = .04$, $SD = .19$, Perfective $M = .03$, $SD = .16$) or ambiguous (Imperfective $M = .18$, $SD = .24$, Perfective $M = .16$, $SD = .23$) were not included in the analyses.

Mean continuation likelihood scores for Experiment 3 are shown in **Figure 1**. Two 2 (aspect: imperfective, perfective) by 2 (duration: long, short) ANOVAs were conducted on continuation likelihood scores for during and after events.

With respect to statements coded as *during*, there was a main effect of grammatical aspect such that statements conveyed with an imperfective aspect ($M = .70$, $SD = .34$) had a higher likelihood of having *during* continuations than those conveyed with a perfective aspect ($M = .27$, $SD = .29$), $F(1, 48) = 85.001$, $MSE = 9.145$, $p < .001$, $\eta_p^2 = .639$. There was no main effect of event duration on the likelihood of continuing a story with a response coded as *during*, $F(1, 48) = .901$, $MSE = .069$, $p = .347$, $\eta_p^2 = .018$. The interaction between aspect and event duration showed a non-significant trend, $F(1, 48) = 3.327$, $MSE = .184$, $p = .074$, $\eta_p^2 = .065$, but this trend was not predicted. An exploratory analysis using simple effects tests showed that there was no statistically significant difference between short and long duration stories conveyed in the imperfective aspect, $F(1, 48) = .191$, $p = .664$, $d = .071$. However, there was a significant difference between short and long duration stories conveyed in the perfective aspect, $F(1, 48) = 4.08$, $p = .049$, $d = .335$.

In terms of the likelihood of continuing stories with an *after* response, again there was a main effect of

Table 2: Sample Responses.

They (Daniel and Kristy) were watching/watched the movie

Responses Coded as During

1. Kristy fell asleep halfway through the movie.
2. Kristy criticized the themes of the movie harshly while she was watching.
3. She fell asleep shortly into the movie, "she better just be tired" he thought.

Responses Coded as After

1. He turned to her, asking, "did you like it?"
2. After the movie, Kristy told Daniel that she loved the movie.
3. Kristy told Daniel that she thought it was the sweetest movie she had ever seen and that was the start of their lifelong relationship.

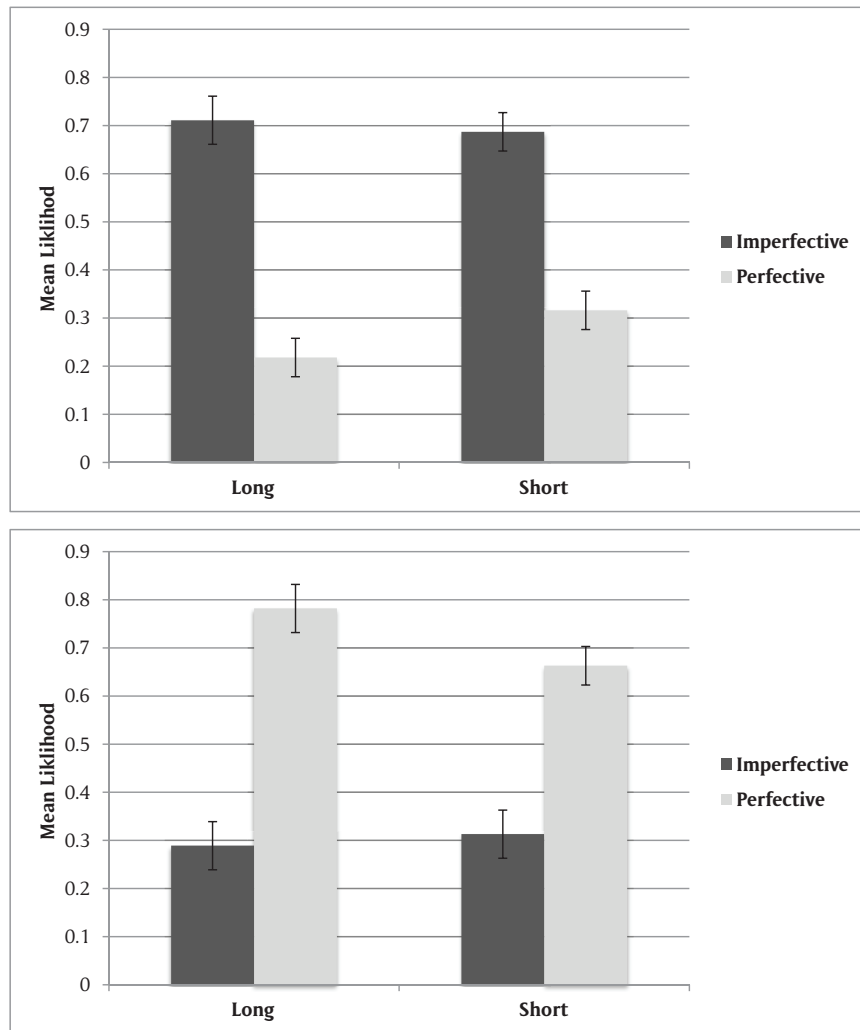


Figure 1: Likelihood (SE error bars) of *During* (Top) and *After* (Bottom) Responses as a Function of Aspect (Imperfective, Perfective) and Event Duration (Long, Short).

grammatical aspect, such that there was a higher likelihood of *after* responses in the perfective condition ($M = .72$, $SD = .30$) than the imperfective condition ($M = .30$, $SD = .34$), $F(1, 48) = 74.845$, $MSE = 8.718$, $p < .001$, $\eta_p^2 = .609$. The effect of event duration on the likelihood of continuing a story with an *after* response was not statistically significant, $F(1, 48) = 1.297$, $MSE = .111$, $p = .260$, $\eta_p^2 = .026$. The interaction between aspect and event duration was statistically significant, $F(1, 48) = 4.645$, $MSE = .250$, $p = .036$, $\eta_p^2 = .088$.

Simple effects were tested for long and short duration conditions with both aspect conditions to further explore the interaction. Results showed that there was no statistically significant difference between short and long duration stories conveyed in the imperfective aspect, $F(1, 48) = .191$, $p = .664$, $d = .071$. However, there was a significant difference between short and long duration stories conveyed in the perfective aspect, $F(1, 48) = 5.23$, $p = .027$, $d = .397$.

The main effects of grammatical aspect on story continuations for *during* and *after* were consistent with predictions and provide converging evidence that aspect affects the perception of event boundaries during story comprehension. Although we found evidence that our manipulation of event duration affected story

continuations, the way that duration influenced the *after* continuations was unexpected. We assumed that prior knowledge would have a greater impact on continuations in the imperfective condition than the perfective conditions. Below we discuss possible reasons why the interaction between aspect and duration was not in the predicted direction.

General Discussion

Linguists have long speculated that verb aspect conveys information about the temporal structure of described events (e.g., Comrie, 1985; Vender, 1957) and this might have implications on narrative structure (Dry, 1983). There is a growing body of psychological research suggesting that readers are sensitive to variations in the extent that events are described with a perfective and imperfective aspect (e.g., Becker et al., 2013; Carreiras et al., 1997; Ferretti et al., 2007; Magliano & Schleich, 2000; Morrow, 1986; Mozuraitis et al., 2013). The purpose of the present study was to examine the extent that grammatical aspect affects the perception of event structure in narrative text (e.g., Madden & Zwaan, 2003; Magliano & Schleich, 2000). Specifically, this study assessed if aspect affects the perception of the boundaries between narrative events such that readers would be more likely to perceive

an event boundary when events are conveyed with a perfective aspect than when they were conveyed with an imperfective aspect. In line with our hypotheses, results from all three experiments indicate that verb aspect has an impact on how readers perceive event structure in texts. In Experiment 1 and 2, readers who encountered sentences conveyed in the perfective aspect were more likely to indicate that an event boundary had occurred than when they encountered sentences in the imperfective aspect. Moreover, in Experiment 3, readers were less likely to continue an aspect event with a response that could have happened during that event when the event was conveyed in the perfective than the imperfective aspect.

Results from the current study are consistent with prior research demonstrating that readers are sensitive to grammatical aspect when constructing situation models (Carreiras et al., 1997; Madden & Zwaan, 2003; Magliano & Schleich, 2000; Morrow 1985; Morrow, 1990; Mozuraitis et al., 2013). The present study extends this body of research in demonstrating that aspect affects the extent that readers perceive boundaries between narrative episodes. There is a growing body of research that suggests that readers routinely segment narratives into the events that comprise them (Zacks et al., 2009), which supports situation model construction (Magliano, Loschky, Clinton, & Larson, 2013). When readers are asked to segment narratives, their judgments are sensitive to shifts in situational continuity (e.g., time, space, and causality) (Kurby & Zacks, 2012; Magliano et al., 2012; Zacks et al., 2009). While there is research demonstrating situation model construction is supported by linguistic features, such as connectives (Millis & Just, 1994), prepositions (Morrow, 1985), and temporal adverbs (Zwaan, 1996), there has been relatively little research regarding the extent that morphological knowledge supports the perception of situational continuities and event structure. The present study demonstrates that grammatical aspect has an impact on the perception of event boundaries in narrative texts. This is consistent with the metaphor of morphological systems serving as processing instructions for situation model construction (Givón, 1992).

This study was motivated, in part, by the Event Horizon Model, which assumes that people naturally segment events into their component parts (i.e., sub-events) and that event boundaries influence memory availability and retrieval (Radvansky, 2012; Radvansky & Zacks, 2014). According to the Event Horizon Model, mental models for events are updated at event boundaries (e.g., Radvansky & Copeland, 2010) and it is well documented that information prior to an event boundary becomes less available after updating has occurred (e.g., see Radvansky (2012) for review). Our results suggest that grammatical morphemes are important in conveying event structure and that these markers inform the process of event segmentation in narrative texts (see also Speer & Zacks, 2005). Moreover, one could speculate that the updating of a mental model is more likely to occur after an event conveyed in the perfective aspect than the imperfective aspect. If this were the case, information preceding an

event conveyed in the perfective aspect would become less available after an event boundary than information preceding an event conveyed in the imperfective aspect. There is indirect evidence that this may be the case. Magliano and Schleich (2000) showed that verbs in target sentences are less available when conveyed with a perfective aspect than an imperfective aspect. Future research should continue to explore the influence of linguistic cues on updating processes.

Another goal of the present study was to explore the extent that verb aspect interacts with event semantics to support segmentation. Prior research has shown that event semantics and aspect are interactive in supporting mental model construction (Ferretti et al., 2007; Magliano & Schleich, 2000; Mozuraitis et al., 2013). To explore this issue, we compared events that were relatively short and long in duration (see Magliano & Schleich, 2000). The results of Experiment 2 showed no impact of world knowledge or interaction with aspect on segmentation. While there was a significant interaction between aspect and duration in the continuation data from Experiment 3, it was not in the predicted direction and the interaction is difficult to explain given the hypotheses regarding aspect and segmentation. Specifically, story continuations for events that happened after the aspect event were more likely in long duration stories than short duration stories, but only for the perfective aspect. We predicted this effect for the imperfective aspect but not the perfective aspect, because the perfective aspect moves the reader past the described event (e.g., Vendler, 1957). Nonetheless, the continuation task was sensitive to the duration of the events. At this juncture, we cannot offer a cogent explanation for the surprising results that the impact of semantics was seen in the perfective aspect, rather than the imperfective aspect. If replicated, this result warrants further investigation.

Why was the segmentation task not sensitive to the manipulation of duration? One possible explanation is that there is a great deal of variability in the grain size at which participants were segmenting the events. Specifically, Zacks and colleagues (2009) typically specify the grain size that they want participants to consider in terms of the smallest or largest meaningful events. We left our instruction open to interpretation in terms of grain size. We did so because the stories were relatively short, and we did not believe that they afforded a manipulation of grain size. It may be the case that with longer texts that afford such a manipulation, an interaction could emerge that was sensitive to the manipulation of event duration.

Another possible explanation is that the effect of event duration and aspect on segmentation likelihood was not manifested at target sentences, but was manifested during subsequent sentences. Magliano and Schleich (2000) showed that event duration interacts with aspect to affect the degree to which activation levels are maintained over time. In their study, short duration events described in the imperfective aspect were less likely to be considered ongoing than long duration events described in the imperfective aspect after readers had read three additional sentences following the aspect/target sentence. However,

our interest was in the impact of aspect on segmentation at the target sentence. Moreover, the segmentation task is not suitable to assess when participants infer that the aspect event is completed.

Finally, Vendler (1957) argued that there is an important distinction between accomplishments and achievements. Accomplishments involve changes in state that take place over a specific period of time and have duration (e.g., he watched the movie), whereas achievements involve changes in state but lack duration in that they are over in an instant (e.g., he slammed the door). In the present study, all our short duration events were accomplishments, rather than achievements. It may be the case that the results of Experiment 2 and 3 would have conformed with the pre-registered predictions regarding an interaction between aspect and duration, if we manipulated the extent that the aspect events were achievements or accomplishments.

One important observation to point out is that although the likelihood of segmentation was significantly higher for sentences conveyed in the perfective aspect than the imperfective aspect in Experiment 1 and 2, judgments were nowhere near 100%. It is important to note that aspect primarily affects the perception of the completion of events (Magliano & Schleich, 2000; Madden & Zwaan, 2003), and segmentation in the context of narratives is correlated with a wider range of shifts situational continuities (changes in characters, causal structure, goal, spatial locations; Kurby & Zacks, 2012; Magliano et al., 2012, 2001; Magliano & Zacks 2011; Zacks et al., 2009). As such, one would not expect a perfective aspect to always lead to the perception of an event boundary. However, aspect in the context of intentional actions may be important in conveying shifts in the goals of characters. Actions conveyed with a perfective aspect may be more likely to convey the incremental progress in accomplishing (a) goal(s) than actions conveyed with an imperfective aspect. Exploring how aspect can affect shifts in goals is warranted and may afford the investigation of how aspect can affect dimensions of a mental model other than time.

This study explored the extent that event semantics can interact with segmentation, and did so by manipulating the duration of the events in the target sentences. However, semantics can interact with aspect in other ways. The texts were written in such a way that the subsequent three sentences after the target sentences could occur during or after the aspect event. However, if they were written such that the events necessarily must occur after the target aspect event (e.g., *Kristy was knitting a sweater. She wore her new garment*), then this would certainly affect segmentation. In fact, Mozuraitis et al. (2013) created versions of the stories in which the post target sentences indicated that the target events were complete. When subsequent sentences indicated the target event was completed, they were read more slowly in the imperfective condition than the perfective condition, and this effect was more pronounced with long duration events. This finding could reflect surprise on the part of the participants (Pettijohn & Radvansky, 2016) because they expected the imperfective target events to continue in the story

(Magliano & Schleich, 2000). This study demonstrates the viability of this approach in exploring the effects of aspect and story semantics on mental model construction.

Our results join a growing body of research that suggests the impact of grammatical aspect on situation model construction is constrained by the temporal semantics of verbs (Becker et al., 2013; Ferretti et al., 2009; Madden & Ferretti, 2009; Mozuraitis et al., 2013; Yap et al., 2009). This research has shown that the inherent temporal differences between the general verb classes (accomplishments, achievements/events, activities/processes, states) leads to a processing cost when grammatical aspect mismatches with the inherent temporal meaning of the classes (Hong, Ferretti, & Hall, 2014; Piñango, Winnick, Ullah, & Zurif, 2006; Yap et al., 2009), and can influence the availability of discourse concepts in situation models (Becker et al., 2013). Furthermore, more specific semantic properties of verbs, such as their thematic role structures, have also been shown to interact with grammatical aspect to constrain expectations for upcoming events in situation models (Ferretti et al., 2009; Gruter, Takeda, Rohde, & Schafer, 2018; Rohde et al., 2006). These results speak to the importance of controlling for verb semantics, and for the need of research that investigates the interactions between the semantic properties of verbs with grammatical aspect (Madden & Ferretti, 2009). The present research clearly shows the importance of being aware of the durative properties of verbs when manipulating grammatical aspect, and also the need for further research on the interaction between duration and aspect.

In conclusion, the present study demonstrates that grammatical aspect affects the perception of event structure in narratives. This study adds to current research in that it specifies the role of aspect in regard to event structure, rather than situation model construction as a whole. General world knowledge was also shown to impact the perception of event structure, however, more research is needed to explore the nature of this interaction.

Data Accessibility Statement

The data that support the findings of this study are openly available at: <https://osf.io/gk6r2/>.

Appendix

The "Forrest Gump" Test

Daniel's favorite movie of all time was "Forrest Gump."
All his new girlfriends had to pass the "Forrest Gump" test.
He invites a girl over to watch the movie.
If she likes it too, Daniel continues to date her.
Tonight, Kristy was being given the test.
Kristy showed up at his apartment at 9pm.
They were watching/watched the movie. (Target sentence)
She told Daniel that she hated historical fiction.
She also said Tom Hanks was an idiot.
She only liked Brad Pitt.
Kristy did not pass the "Forrest Gump" test.
Daniel never called her again.

Malcolm's First Case

Malcolm was fresh out of the Harvard Law School. He was first in his class and editor of the Harvard Law Review. However, none of his achievements in school could have prepared him for his first case. Malcolm's law firm was hired to defend a local mob boss. Malcolm was asked to join the defense team. He didn't like it, but he saw it as his duty as a lawyer. The day of the trial was here. Malcolm parked his car at the courthouse lot. Malcolm was walking/walked into the courthouse. (Target sentence) He was mobbed by reporters. He told them that he didn't have time to talk. He wondered if everyday of the trial would be like this. The trial lasted six months. As the trial went on, Malcolm was more and more convinced that his client was guilty. After the trial, he decided that there were some clients that he could not in good conscience defend.

Notes

- ¹ A main effect of duration (in both Experiments 2 and 3) was originally hypothesized, wherein short duration events would elicit more *after* continuations (or a greater likelihood of segmentation for Experiment 2) than long duration events, whereas the opposite was expected for *during* responses. However, based on a reviewer's comment, we felt the prediction was problematic.
- ² An ad hoc analysis of the ambiguous responses revealed that 73% of them were internal states of characters, 16% were temporally ambiguous events, 11% were evaluative statements, and 3% were states.

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Competing Interests

The authors have no competing interests to declare.

Author Contributions

Daniel Feller and Joseph Magliano conceived the idea for Experiments 1 and 2. All authors conceived and planned Experiment 3. Daniel Feller carried out all experiments and conducted data analysis. Daniel Feller and Joseph Magliano wrote the manuscript with support from Anita Eerland and Todd Ferretti.

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