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Assessing the influence of dimensional focus during situation model construction

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According to Zwaan, Langston, and Graesser's (1995) event-indexing model, when comprehending text, readers monitor changes in a series of critical dimensions: space, time, protagonist, causality, and intentionality. In this study, the influence of dimensional focus was assessed during situation-model construction. Participants read narratives and were instructed to specifically monitor a single dimension while their sentence reading times were recorded. Critical sentence reading times were then analyzed for all shift types. Results support the general prediction that at least the time and protagonist dimensions are resistant to task demands, demonstrating that comprehenders routinely perform dimensional updating processes that are context independent. These results are discussed in the context of the event-indexing model.

An important goal in research on discourse comprehension is identifying which textual elements are attended to and represented in memory. Consider the following example paragraph and its concluding sentence.

> Paul took care of the garden, which he had declared his territory, whereas Frieda started to tidy up the house. The morning air was pleasant and refreshing, so she opened all the windows and let spring reach every corner of the house. Then, in a spirit of adventure, she climbed up to the attic. There she searched old boxes and shaky cupboards, and she checked for mice. At noon, she cleaned the winter dust out of the hall and tidied up her beloved cabinet. The noon sun was quite warm already, so she interrupted this work for some time while she closed all the windows to keep the house pleasantly cool. In the last daylight, Paul stood in the garden and looked around satisfied.

The final sentence of this paragraph is difficult for readers to integrate but certainly understandable. It includes shifts in the character, location, and time course from the previous sentence: It contains information about Paul, who is in the garden in the evening, whereas the previous sentence is about Frieda, who is in the house at noon. What might go on in readers' minds when they encounter these various shift types? In the above example, the reader will have to update time, space, and protagonist information in his or her situation model (Zwaan, Langston, & Graesser, 1995; Zwaan & Radvansky, 1998; Zwaan, Radvansky, Hilliard, & Curiel, 1998). The question of interest here is whether comprehenders routinely perform these updating processes or whether they are context dependent.

We conceptualize a situation model as a complex mental representation of the state of affairs of a text (Zwaan & Radvansky, 1998). This representation includes information from the text as well as from the reader's background knowledge (Graesser, Singer, & Trabasso, 1994). One theory of situation model construction, the *event-indexing model* (Zwaan, Langston, & Graesser, 1995), posits that readers are sensitive to information in the story world at the event level. Readers monitor a series of specific dimensions when attending to events in narrative text. These dimensions are space (location), time (sequence and duration), protagonist (entities and objects), causality (cause and effect), and intentionality (goals and motivation). Typically, events are understood in text as verb phrases because verbs are semantically and situationally rich and often signal state change (Zwaan, Langston, & Graesser, 1995). Thus, readers progress through narrative text indexing each action or event, usually triggered by a verb, along the five dimensions and store these events in memory on the basis of their dimensional relatedness (Zwaan, Langston, & Graesser, 1995).

The event-indexing model presents two general hypotheses regarding the representations formed when reading: the *memory organization hypothesis* and the *processing*

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load hypothesis. The memory organization hypothesis states that the more dimensional indices that two events share, the more strongly those events will be associated in memory. According to the processing load hypothesis, the fewer indices that are shared between the current event and a previous event, the more difficult it will be for readers to integrate the current event into their situation models. Thus, it could be argued that language affords the segregation of input information into event units. It is important to note that the focus on events as the units of analysis is also consistent with research in nonlinguistic domains showing that people segregate nonverbal input into event units using bottom-up and top-down information (for a review, see Zacks & Tversky, 2001). As such, language comprehension can be conceptualized as guided event comprehension (Zwaan, 2001).

Traditionally, empirical research related to situation model construction has examined single dimensions of the event-indexing model (for a review, see Zwaan & Radvansky, 1998). In contrast, few empirical attempts have been made to explore multiple dimensions concurrently (but see Rinck & Weber, 2003; Rich & Taylor, 2000; Zwaan, Magliano, & Graesser, 1995; Zwaan et al., 1998). Single-dimension studies have deepened our understanding of the specifics of each dimension but do not inform us about the necessity of each dimension (or of dimensional interactions) during situation-model construction. Another limiting weakness of single-dimension research is the temptation to highlight the dimension of interest. Graesser, Kassler, Kreuz, & McLain-Allen (1998) have articulated this point, stating that designs exploring situational models often focus readers on particular dimensions, albeit indirectly, through the use of instructions, materials, or experimental tasks. As a result, evidence that readers attend to one dimension of a text (e.g., space, time, or characters) could come at the cost of ignoring others. Therefore, one goal of the present work was to assess the extent to which focusing readers on a particular situation model dimension affects the processing of other dimensions.

Documenting the contributions of space, time, and protagonist shifts and their interactions in narrative situation-model construction could provide a more comprehensive understanding of the reading process. This is not to say that experimentally examining multiple dimensions is a simple matter (Zwaan, 1999). Ostensibly, one stumbling block is the inherent difficulty in equating dimensions along a similar metric—dimensions cannot be compared directly because they do not share a common metric. For example, it is difficult to envision how a single metric could equate a shift in time (e.g., an hour later) with a shift in space (e.g., moving from Chicago to Tallahassee) in the same text.

An alternative approach to exploring multiple dimensions simultaneously, circumventing some of the problems associated with the metric issue, would be to systematically manipulate readers' dimensional focus for the same text. With this approach in mind, we developed a methodology that gauges the degree to which different dimensions are impervious to instructional focus. Specifically, in two experiments participants read narratives and were instructed to attend to a single dimension (time, protagonist, or space) while their sentence reading times were recorded. Questions, presented at the end of each passage, were yoked to instructions to further motivate the participants to attend to a single dimension. For example, participants who received instructions to focus on the time dimension answered time questions exclusively. Critical-sentence reading times were then analyzed for time shifts (the highlighted dimension) and space and protagonist shifts (the *nonhighlighted* dimensions). Increases in nonhighlighted shift-sentence reading times demonstrate the resistance of those dimensions to task demands and, indirectly, their importance in constructing a coherent situation model.

We predicted that temporal discontinuities would increase reading times in all instructional conditions. That is, we expected that time would be impervious to task demands. This prediction is based on prior literature suggesting that readers are constantly making use of time information when comprehending, and on the fact that time information is so densely coded in language (e.g., in terms of verb tense, aspect, and adverbially). Moreover, there is evidence to suggest that readers implicitly make assumptions about time when reading a text. For example, Zwaan and Radvansky (1998) have posited that readers assume that the narrated events in a text also reflect the chronological order of those events (referred to as the *iconicity assumption*). Similarly, Ohtsuka and Brewer (1992) provide evidence for the iconicity assumption (although they refer to it as the *isomorphism principle*). Time is needed to understand the progression and duration of events and their causal relations in the text. Given the pervasiveness of time information in language and evidence suggesting that readers follow an iconicity assumption, we predicted that readers' monitoring of time will be resistant to task demands. Readers are expected to maintain, at the very least, obligatory, minimal monitoring of the time dimension.

We also predicted that protagonist discontinuities would increase reading times in all instructional conditions. Protagonist and objects have been referred to as the meat of situation models (Zwaan & Radvansky, 1998). There is considerable evidence documenting readers' ability to monitor protagonist characteristics (Albrecht & O'Brien, 1993; Cook, Halleran, & O'Brien, 1998; O'Brien, Rizzella, Albrecht, & Halleran, 1998; Rapp, Gerrig, & Prentice, 2001). In addition, Rich and Taylor (2000) provided evidence that protagonists were more likely than any other dimension to serve as event indices. The reviewed research suggests that protagonist information might be one of the most critical dimensions in forming a situation model. Although we cannot directly compare protagonist and other dimensions, it is clear that readers need to attach meaning to objects, characters, and entities in order to comprehend discourse. Consequently, we predicted that readers' monitoring of character information will be resistant to task demands.

The importance of space in situation model construction remains an open question. There is evidence suggesting that readers keep track of the spatial locations of the objects and the protagonist in the story world (Morrow, Bower, & Greenspan, 1989; Morrow, Greenspan, & Bower, 1987; Rinck & Bower, 1995). There is also evidence of a spatial gradient of accessibility of objects in the story world. That is, the accessibility of objects in a text decreases as the spatial distance between the object and the reader's attentional focus increases (Rinck, Williams, Bower, & Becker, 1996). These results indicate that readers do monitor the spatial layout of the story world. However, Zwaan and Oostendorp (1993) and Hakala (1999) present evidence that readers do not normally monitor space unless specific task demands are imposed or readers have a detailed, determinate mental map of the spatial layout before reading. And indeed, much of the above-cited research in spatial representation employs specific task demands or makes use of a visual aid (e.g., a map). Consequently, we predicted that in our experiments protagonist and time dimensions would be more impervious to reading instruction than the space dimension.

It should be noted that goal and causation dimensions were purposely not included in the present experiments. The reason for this is a practical one. Our aim (in Experiment 2) was to experimentally manipulate situational dimensions. It was practically impossible for us to achieve this for all five dimensions. In particular, causation and goal are difficult to manipulate independent of time and space. For example, in earlier attempts we had observed that the plausibility of a cause–effect sequence often changes as a function of temporal distance. Thus, whereas "The pass made it into the end zone. A second later, there was a big roar in the stadium" sounds acceptable, "The pass made it into the end zone. An hour later, there was a big roar in the stadium" sounds puzzling at best. However, the exclusion of causation and motivation should not be interpreted as suggesting that they are not important elements of situation models. On the contrary, there is considerable evidence suggesting the importance of causal (Millis, Golding, & Barker, 1995; Trabasso & Sperry, 1985; Trabasso & Suh, 1993; Trabasso & van den Broek, 1985; Trabasso, van den Broek, & Suh, 1989) and goal (Lutz & Radvansky, 1997; Suh & Trabasso, 1993) information in situation model construction.

In the two experiments presented here, we used complementary methods to explore how critically temporal, spatial, and protagonist situational dimensions are monitored. In Experiment 1, we followed a regression procedure similar to that of Zwaan, Langston, and Graesser (1995; Zwaan et al., 1998). Auxiliary factors (syllable length, sentence positions, clause position, new arguments, mean word frequency, and argument overlap) were identified for each clause or sentence of each of the passages. In our analyses, the term *argument* refers to the semantic units (i.e., propositions) that are introduced (i.e., new arguments) and the degree of shared references (i.e., argument overlap; van Dijk & Kintsch, 1983). These factors have been shown to reliably predict reading times. Situational dimension factors (e.g., discontinuities or shifts in protagonist, space, or time) were also identified. If a shift was evident, it was assigned a 1; if not, a 0. (An example of the auxiliary and situational dimension coding for a portion of a passage is presented in Appendix A.) We then collected the participants' reading times and conducted a multiple regression analysis of the data for auxiliary and situational dimension variables. Standardized regression coefficients (i.e., beta weights) were calculated for each dimension in each instructional condition. We then tested (using single-sample *t* tests) whether or not the beta weights for the variables of interest were significantly different from zero. Variables with beta weights significantly different from zero are considered to be predictive of reading time (Lorch & Myers, 1990). In Experiment 2, dimensional shifts were manipulated orthogonally in an experimental design, as in Rinck and Weber (2003). Also in Experiment 2, the reading times were analyzed using ANOVAs.

EXPERIMENT 1

Using a correlational approach, Zwaan et al. (1998) provided evidence that readers monitor the continuity of temporal, causal, goal, and protagonist information. They demonstrated that narrative reading times increased when participants encountered dimensional discontinuities. In addition, narrative reading time increased as a function of the number of situational continuity breaks. Rinck and Weber (2003) recently replicated Zwaan et al.'s (1998) results experimentally. Rinck and Weber found that added discontinuities also increased reading time, but this relationship was described as negatively accelerated (i.e., additional discontinuities increased reading time but to a lesser degree than an initial discontinuity). These studies represent an important first step at simultaneously examining multiple situational dimensions and provide strong evidence for the event-indexing model. The studies do not, however, provide information about the criticality of each of the dimensions under specific task demands in the formation of a situation model. The goal of Experiment 1 was to gauge the importance of temporal, spatial, and protagonist shift information when instructional strategies focused attention on a single dimension. The results of the focus manipulation provide information regarding whether comprehenders routinely perform dimensional updating processes or whether such processes are context dependent.

Method

Participants and Design. One hundred twelve students from Florida State University participated for course credit. The design was a one-factor, between-subjects design with four instructional groups (space focus, time focus, protagonist focus, and control, the latter defined as having no specific focus and generalized instruction). The primary dependent measures were the standardized regression coefficients extracted from multiple regression analyses of the sentence reading times. Two types of coefficients are reported: auxiliary dimensions (i.e., reading time predictors) and situational dimensions (i.e., predicted shifts in dimensional monitoring). Auxiliary coefficients were reported because these are known to affect reading times and serve as an important control to our dimensional variables. That is, we wanted to make certain that our dimensional variables accounted for variance in reading times beyond the variance associated with syllable length, word frequency, the introduction of new arguments, and so on. The second dependent measure—accuracy on comprehension questions—was evaluated to ensure that the participants had attended to the instructions.

Materials. The same materials were used as those employed by Radvansky, Zwaan, Curiel, and Copeland (2001). The narratives were 58–85 sentences long and described the following: the Beanie Baby craze, spy identification equipment, a rebellion in a small farming town, and future government officials in New York. Radvansky et al. also previously coded these narratives for auxiliary factors and situational discontinuities. Their coding was adopted in the present study to examine the time, protagonist, and space dimensions. Each participant read all four passages. A practice passage was presented at the beginning of the experiment to familiarize the participants with the task. The order of passages was then randomized. Three comprehension questions were administered after each passage was read. Appendix B provides an example of one of the experimental passages used and sample questions for each instructional group.

Procedure. All aspects of the experiment were controlled using E-Prime for the PC (Schneider, Eschman, & Zuccolotto, 2002). Passages were presented one sentence at a time via computer using a noncumulative self-paced reading procedure. All text was displayed in black on a white background using a 19-in. monitor. Text was presented in Times New Roman font. The passage sentences were centered vertically but not horizontally. The horizontal starting position was the same for each sentence (left aligned), and none of the sentences wrapped to a new line. The participants in the three experimental conditions (space focused, time focused, and protagonist focused) were verbally instructed to read the passages with attention to the dimension to which they had been assigned; the control participants were instructed simply to read the stories for comprehension. (Appendix C presents the instructions used.) The participants in each condition were told that at the end of each passage they would be answering comprehension questions about that passage. All questions were tailored to the specific dimension on which the participants were being asked to focus. The participants were informed that they would use three keys on the keyboard to complete the experiment: The space bar was to be used to move forward in the experiment (i.e., to read each sentence of the passages); the J and F keys were labeled "true" and "false," respectively, and were used to indicate answers to questions. The instructions were presented on the screen as well as verbally. The E-Prime program recorded all times between keypresses and the keys pressed.

Results and Discussion

The primary dependent variable in Experiment 1—sentence reading time—was examined using a regression analysis. We followed a procedure developed by Lorch and Myers (1990) and used by Zwaan, Magliano, and Graesser (1995; Zwaan et al., 1998) and Radvansky et al. (2001). To test the effects of each condition and dimension against variability across participants, we conducted multiple regression analyses on each subject's individual reading time data. The standardized regression coefficients (reading time beta weights) were extracted from these analyses. Values above or below 2 *SD*s were removed. The beta weights were then subjected to single-sample *t* tests to determine whether or not the coefficients statistically differed from 0 (i.e., whether or not they were predictive of reading time). A total of 284 clause or sentence reading times contributed to each participant's reading time beta weights. Table 1 presents the participants' average standardized regression coefficients for each dimensional discontinuity variable. The auxiliary variable coefficients were included as a control and are reported in Appendix D. An ANOVA was also conducted to explore whether or not instructional focus differentially affected the reading time beta weights.

These standardized regression coefficients, referred to as *reading time beta weights*, provide information about the relative importance of each variable in explaining reading time variability. Positive significant beta weights indicate that the corresponding variable predicted a meaningful reading time increase, whereas negative significant beta weights indicate a reading time decrease. Not surprisingly, the syllable variable (see Appendix D) was the strongest reading time predictor collapsed across conditions ($\beta = .62$, $p < .001$), which is consistent with other studies in which similar procedures were employed. Inspection of the situational dimensions indicates that protagonist discontinuities predicted reading times in the correct direction when the participants were instructed to attend to time, space, or protagonist, as well as in the dif-

Table 1
Beta Weights (Standardized Regression Coefficients) From the Reading Time Regression Analyses of Experiment 1

Dimensional/ Instructional Focus	Dimensional Shift Type	Beta Weight	*t* Value	Beta Weight *SE*
Space	Space	0.026	3.06*	0.008
	Time	0.053	6.33*	0.008
	Protagonist	0.052	7.21*	0.007
Time	Space	0.026	3.41*	0.008
	Time	0.060	5.88*	0.010
	Protagonist	0.043	5.23*	0.008
Protagonist	Space	0.007	0.96	0.007
	Time	0.064	8.09*	0.008
	Protagonist	0.066	7.03*	0.009
Control	Space	0.026	3.82*	0.007
	Time	0.051	6.41*	0.008
	Protagonist	0.052	5.91*	0.009

*$p < .05$, two-tailed.

fuse control condition. The same pattern of results was obtained for time discontinuities across all instructional conditions. Space discontinuities also predicted reading times across instructional conditions, with one exception: the protagonist focus condition. These results support our general prediction that time, protagonist, and, to a lesser extent, space information was resistant to our (dimensional) focus manipulations. Thus, Experiment 1 provides tentative evidence that readers obligatorily monitor time and protagonist dimensions irrespective of reading instruction.

One assumption of the previous analyses is that the participants truly attended to the focus instructions. It is possible, though, that participants ignored the instructional manipulations, which might result in a pattern of beta coefficients similar to that obtained. To assess the degree to which instructional focus affected the participants, reading times and comprehension accuracy were examined across focus conditions. A one-way ANOVA of reading times for each instructional condition revealed a significant effect of instruction [$F(3,111) = 3.32$, $MS_e = 953{,}945$, $p < .05$]. Mean sentence reading times (collapsed across passages) were 2,748, 2,415, 2,606, and 2,389 msec for the protagonist, space, time, and control conditions, respectively. Post hoc comparisons (using Tukey's HSD statistical procedure) indicated that the protagonist focus condition elicited longer reading times than the space ($p = .05$) and control ($p = .03$) focus conditions. Thus, it appears that the participants did approach the passages differently depending on the focus instructions that they received.

The fact that neither the space instruction nor the time instruction elicited significantly longer reading times in comparison with the control condition does not indicate that the participants ignored the instructions, however. This becomes evident from analyses of the secondary dependent variable in Experiment 1—accuracy on comprehension questions—which was also measured to ensure that the participants followed instructions and attended to the materials. Chance was set at 50%, and 2 subjects were removed from the analyses for having an accuracy level below chance. Overall, mean accuracies for *shared questions* between the dimensional focus conditions and the control condition were 83% and 82%, respectively. Conditional accuracy means were also computed: Accuracy for protagonist questions in the protagonist focus condition was 83%, accuracy for space questions in the space focus condition was 86%, and accuracy for time questions in the time focus condition was 81%. Accuracies in the control condition were 88%, 88%, and 68% for protagonist, space, and time questions, respectively.

If the participants attended to our specific focus instructions, one might expect an increase in accuracy in the focus conditions relative to the control condition. To assess this possibility, in follow-up t tests we compared accuracy levels for the focus and control conditions. These t tests did not reveal significant differences for the space and protagonist comparisons (all ps $> .10$) because of ceiling effects: Accuracy was very high in the focus conditions as well as in the control condition. However, there was a significant difference between the time focus and the control conditions [$t(1,27) = 2.42$, $p \leq .05$]. The participants were more accurate on time questions in the time focus condition than on the same questions in the control condition.

In summary, the results of Experiment 1 provide evidence that readers are sensitive to temporal and protagonist discontinuities even when instructed to pay attention to a different dimension and when answering questions about that dimension exclusively. Thus, Experiment 1 suggests that readers routinely update time and character dimensions and that this updating is largely context independent. Space information was slightly less impervious to instruction. That is, space information was not monitored when the participants were instructed to pay attention to protagonist information.

EXPERIMENT 2

The results of Experiment 1 provide evidence that the time and protagonist dimensions of the situation model, and to some degree also its space dimension, were generally impervious to the task demands we imposed. However, in Experiment 1 we used a correlational approach and, as such, we cannot make strong causal claims about the dimensions. Consequently, Experiment 2 was developed to further test the contribution of the time, protagonist, and space dimensions using an experimental approach. In addition, Experiment 2 varied orthogonally the number and combination of shifts that readers could encounter in a text. Specifically, the participants read sentences that ranged from those containing no shifts to those containing shifts on all three dimensions simultaneously.

Method

Participants and Design. Ninety-six students from Dresden University of Technology participated for course credit or for a small stipend (equivalent to US$5). All instructions and written materials of the experiment were presented in German. The design was a four-factor design in which the within-subjects factors were protagonist continuity (continuous vs. shift), temporal continuity (continuous vs. shift), and spatial continuity (continuous vs. shift). The between-subjects factor was instruction (space focus vs. time focus vs. protagonist focus). No nonfocused control condition was used here because such a control condition was previously reported by Rinck and Weber (2003, Experiment 1). The materials and procedure of the present experiment were identical to those of that experiment. However, in Rinck and Weber's Experiment 1, the 48 participants were not asked to focus their attention on any particular dimension, and the comprehension questions addressed a variety of information. This procedure showed that participants are sensitive to spatial, temporal, and protagonist continuity. Where necessary, the data of that experiment were used as a control condition for the present experiment. In the present experiment, two dependent measures were collected. The primary dependent measure was reading time per sentence. The second dependent measure, accuracy on comprehension questions, was evaluated to ensure that the participants attended to the passages.

Materials. The same narratives were used as those employed by Rinck and Weber (2003). The first part of each experimental narrative introduced two protagonists, the temporal setting, and the spatial setting. The remaining portions of the narratives varied potential discontinuities (i.e., in the protagonists, the time course of events, or the location of events), which were then elicited by a critical target sentence. Eight possible versions of each passage were created, ranging from fully continuous to completely discontinuous. Appendixes E and F provide examples of one of the experimental passages (in its fully continuous and fully discontinuous forms) and sample questions for each instructional condition. Participant instructions were identical to those employed in Experiment 1. The participants read 16 passages, 8 of them experimental passages and 8 of them fillers. A filler passage was always presented at the beginning of the experiment to familiarize the participants with the task. The order of passages was then randomized. Three comprehension questions were administered after each passage was read. As previously, these questions were tailored to the instructional conditions.

Procedure. The procedure closely mirrored that of Experiment 1; therefore, only changes will be noted. The experiment was controlled using rapid serial visual presentation (RSVP) software (Williams & Tarr, 1999). The participants were verbally instructed to read the passages while focusing on space, time, or protagonist. The participants were informed that all of the questions that they would be answering would be about the dimension to which they were being asked to attend. As in Experiment 1, passages were presented one sentence at a time via computer using a noncumulative, self-paced reading procedure. Sentence reading times and keypresses (i.e., answers to questions) were recorded.

Results and Discussion

The primary dependent variable was sentence reading time, which was examined using ANOVAs. Below, F_1 corresponds to participants analyses, whereas F_2 refers to materials analyses. In the latter analyses, the eight experimental texts served as a random factor and instruction was a between-subjects factor. To control for error variance associated with sentence length, sentence reading times were divided by the number of syllables of the corresponding target sentences before the analyses (see Rinck & Weber, 2003). Table 2 presents a summary of the data.

The $3 \times 2 \times 2 \times 2$ ANOVA of target syllable reading times revealed a main effect for the dimensional shift manipulations of protagonist [$F_1(1,93) = 58.7$, $MS_e = 321,810$, $p < .01$; $F_2(1,7) = 30.2$, $MS_e = 80,452$, $p < .01$], time [$F_1(1,93) = 58.2$, $MS_e = 307,881$, $p < .01$; $F_2(1,7) = 27.8$, $MS_e = 76,970$, $p < .01$], and space [$F_1(1,93) = 15.6$, $MS_e = 137,040$, $p < .01$; $F_2(1,7) = 8.3$, $MS_e = 34,260$, $p < .05$]. On average, reading time increased from 151 msec in the no-shift condition to 242 msec in the protagonist discontinuity conditions, 242 msec in the time discontinuity conditions, and 235 msec in the space discontinuity conditions. As is evident from Table 2, a systematic increase in reading times was observed as the number of shifts increased [151, 213, 237, and 270 msec for 0, 1, 2, and 3 shifts, respectively; $F_1(3,279) = 72.98$, $MS_e = 2,056$, $p < .001$; $F_2(3,21) = 27.82$, $MS_e = 4,314$, $p < .001$], mirroring Zwaan et al.'s (1998) and Rinck and Weber's (2003) findings that multiple shifts increase demands on cognitive resources.

As was expected, each dimension yielded the largest discontinuity effect in the group of readers who were focused on that dimension in comparison with the other two instruction groups [protagonist, 58 vs. 32 msec, $F_1(1,94) = 5.1$, $MS_e = 27,608$, $p < .05$; time, 54 vs. 30 msec, $F_1(1,94) = 3.7$, $MS_e = 19,373$, $p < .06$; space, 55 vs. 12 msec, $F_1(1,94) = 8.6$, $MS_e = 75,362$, $p < .01$]. Most importantly, however, only spatial continuity interacted significantly with instructional condition [$F_1(2,93) = 4.47$, $MS_e = 39,234$, $p < .05$; $F_2(2,14) = 3.32$, $MS_e = 9,808$, $p < .10$]. Accordingly, separate analyses for each instructional condition revealed that space shifts increased reading times (by 55 msec) only when readers were focused on the space dimension [$F_1(1,31) = 20.9$, $MS_e = 191,735$, $p < .01$; $F_2(1,7) = 12.8$, $MS_e = 47,934$, $p < .01$]. No effect of space shifts occurred when readers were focused on the time dimension (8 msec, both Fs < 1) or the protagonist dimension [17 msec; $F_1(1,31) = 2.1$, $MS_e = 19,899$, n.s.; $F_2(1,7) < 1$]. In contrast, protagonist and time shifts always yielded significant increases in reading times, irrespective of instructional focus [protagonist, all $F_1(1,31) > 11.3$, $MS_e > 71,623$, $p < .01$ and all $F_2(1,7) > 7.8$, $MS_e > 15,844$, $p < .05$; time, all $F_1(1,31) > 7.3$, $MS_e > 49,506$, $p < .05$ and all $F_2(1,7) > 8.4$, $MS_e > 23,189$, $p < .05$]. Neither the interaction of protagonist continuity and instructional condition nor the interaction of temporal continuity and instructional condition approached significance (both F_1s and both F_2s < 1). Moreover, the effects of instructional focus were specific to the processing of dimensional shifts: There were no significant differences between the protagonist, time, and space focus groups in overall reading time (221, 224, and 219 msec, respectively; all Fs < 1) or in the reading time of the no-shift condition [145, 165, 141 msec, respectively; $F_1(2,93) = 1.78$, $MS_e = 2,940$, n.s.; $F_2(2,14) = 1.30$, $MS_e = 1,256$, n.s.].

In an additional analysis, the data of the present experiment were compared to those of a control condition without any specific focusing instruction (Rinck & Weber, 2003, Experiment 1). The comparison with this control condition addressed the question of whether or not the focusing instructions of the present experiment caused a withdrawal of attention from the nonfocused dimensions. The results of the joint analysis showed that this was clearly not the case: The protagonist focus yielded a larger effect of protagonist shifts than was observed in the control condition [$F(1,78) = 7.97$, $MS_e = 5,993$, $p < .01$], but the effects of time shifts and space shifts did not differ significantly [both $F(1,78) < 1$]. Likewise, the time focus increased the effect of time shifts [$F(1,78) = 4.09$, $MS_e = 7,504$, $p < .05$] while leaving the effects of protagonist

Table 2
Mean Target Syllable Reading Times (in Milliseconds) From Experiment 2

	Instructional Conditions					
	Protagonist		Space		Time	
Shift Type	*M*	*SD*	*M*	*SD*	*M*	*SD*
No shift	145	48	141	51	165	63
Protagonist	241	84	211	85	214	60
Space	199	57	221	70	190	64
Time	202	79	199	92	245	108
Protagonist + space	223	113	248	92	221	68
Protagonist + time	261	101	217	86	259	82
Space + time	222	79	249	95	236	95
All three shifts	275	81	268	119	268	86

shifts and space shifts unaffected [both $F(1,78) < 1$]. The space focus also caused a marginally larger effect of space shifts [$F(1,78) = 2.96$, $MS_e = 13,419$, $p < .10$], whereas the effects of protagonist shifts and time shifts were unaffected [both $F(1,78) < 1$].

As in Experiment 1, accuracy on comprehension questions was measured to ensure that the participants had followed instructions and attended to the focused dimension. Average accuracies for the space, time, and protagonist instructions were 91%, 84%, and 86%, respectively. All of these scores were significantly higher than the chance level of 50%, indicating that the participants had followed instructions.

In summary, the results of Experiment 2 are consistent with the correlational findings of Experiment 1. Specifically, our readers were sensitive to temporal, spatial, and protagonist discontinuities, particularly when they were focused explicitly on the tested dimension. This result suggests that the participants were indeed following the instructions to focus on a single dimension. Moreover, the protagonist dimension and the time dimension were resistant to instructional focus; they yielded discontinuity effects even when the participants were focused on another dimension. The participants were also sensitive to spatial discontinuities, but only if they were specifically instructed to attend to space information before reading. This suggests that time and protagonist information was monitored more globally than space information in these materials. We address this issue in more detail in the General Discussion.

GENERAL DISCUSSION

The experiments presented here represent an important departure from traditional research into situation model representations. Customarily, research exploring situational dimensions focused on a single dimension only. This research approach has been fruitful, but it is unlikely to yield a comprehensive understanding of the reading process. The purpose of the present experiments was to begin documenting the relative contributions of time, protagonist, and space shifts simultaneously within the context of the event-indexing model (Zwaan, Langston, & Graesser, 1995).

One stumbling block in any attempt to examine multiple dimensions is that they cannot be equated along similar metrics and thus cannot be controlled in an experimental design. One alternative method explored in these experiments was to focus readers' attention differently using the same materials. Instructions focused the participants' attention on a single dimension, but reading times for shifts in all dimensions were measured. For example, the participants may have been asked to pay close attention to characters in the story, in which case the comprehension questions would have dealt with characters in the story, but reading times related to time and space shifts were also examined. This approach provides information regarding the importance of the nonhighlighted dimensions. Furthermore, this approach is conservative. The true contribution of time and space information in the example above would be underestimated.

We predicted that the time dimension of the event-indexing model would be impervious to task demands. This prediction was based on research suggesting that readers adopt a particular view of time when comprehending discourse (i.e., the iconicity principle) and on the premise that time is ubiquitous in language whereas space is not. All sentences contain information regarding the absolute or relative time course of events described in those sentences (Zwaan & Radvansky, 1998). That is, most languages have a highly developed tense–aspect system (i.e., a time specification system). This is not the case for spatial descriptions. We would argue that the existence of such a highly developed time specification system underscores the importance of time information in providing the building blocks for situation model construction (Gernsbacher, 1990; Magliano & Schleich, 2000; Zwaan, 1996). Furthermore, we would argue that the robustness of the time dimension is easily understood if one reflects on the functionality of one of Hockett's (1966) linguistic universals: displacement (i.e., the ability to convey information that is not fixed to the present). Our prediction that the time dimension is more critical than the space dimension was confirmed in two experiments in which complementary methods and different sets of materials were used. Temporal discontinuities always increased reading times, irrespective of the instructional tasks given to the participants. These results provide additional evidence of the inclusion of the time dimension of the event-indexing model and suggest that time is indeed fundamental to coherent situation model construction.

We also predicted that the protagonist dimension would be impervious to task demands. This was also confirmed in both experiments: Protagonist discontinuities always increased reading times, providing further evidence that protagonist information is fundamental to situation model construction. The reading time results of Experiment 2 indicate that temporal and protagonist discontinuities increased reading time similarly (222 and 215 msec, respectively).

Finally, we predicted that space might (under certain circumstances) be resistant to task demands. The results obtained across the experiments were mixed. In Experiment 1, we obtained evidence that reading times increased when spatial discontinuities were encountered across time, space, and control focus conditions. In Experiment 2, however, spatial discontinuities increased reading times only when readers consciously focused on the space dimension. This result suggests that the space dimension of situation models is less resistant to task demands. It should be noted, however, that spatial discontinuities had a significant effect on reading times in the nonfocused control condition reported by Rinck and Weber (2003). Thus, effects of the space dimension are not created artificially by instructions. They seem to be rather weak, however, in comparison with other dimensions (see also Hakala, 1999; Zwaan & Oostendorp, 1993; Zwaan et al., 1998). The fact that no effect of spatial discontinuities was observed in our Experiment 2 when the participants were focused on the time or protagonist dimension is probably due to the careful design of the materials: Spatial discontinuities were completely independent of temporal and protagonist discontinuities. Moreover, the texts and the spatial relations were much simpler in Experiment 2 than in Experiment 1; each text involved only two possible locations.

In conclusion, we are heartened by the successful application of our convergent methodologies to simultaneously explore dimensions of the event-indexing model. The present experiments are certainly only a first step in exploring the contribution of dimensional elements of text, but both our regressional and our experimental results suggest that time information, protagonist information, and, to a lesser extent, space information is critical to situation model construction. Further work using this methodology will hopefully bring us closer to understanding the complex relationships between dimensions of the event-indexing model.

REFERENCES

Albrecht, J. E., & O'Brien, E. J. (1993). Updating a mental model: Maintaining both local and global coherence. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **19**, 1061-1070.

Cook, A. E., Halleran, J. G., & O'Brien, E. J. (1998). What is readily available during reading? A memory-based view of text processing. *Discourse Processes*, **26**, 109-129.

Gernsbacher, M. A. (1990). *Language comprehension as structure building*. Hillsdale, NJ: Erlbaum.

Graesser, A. C., Kassler, M. A., Kreuz, R. J., & McLain-Allen, B. (1998). Verification of statements about story worlds that deviate from normal conceptions of time: What is true about *Einstein's dreams*? *Cognitive Psychology*, **35**, 246-301.

Graesser, A. C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review*, **101**, 371-395.

Hakala, C. M. (1999). Accessibility of spatial information in a situation model. *Discourse Processes*, **27**, 261-279.

Hockett, C. F. (1966). The problem of universal language. In J. H. Greenberg (Ed.), *Universals of language* (2nd ed., pp. 1-29). Cambridge, MA: MIT Press.

Lorch, R. F., Jr., & Myers, J. L. (1990). Regression analyses of repeated measures data in cognitive research. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **16**, 149-157.

Lutz, M. F., & Radvansky, G. A. (1997). The fate of completed goal information. *Journal of Memory & Language*, **36**, 293-310.

Magliano, J. P., & Schleich, M. C. (2000). Verb aspect and situation models. *Discourse Processes*, **29**, 83-112.

Millis, K. K., Golding, J. M., & Barker, G. (1995). Causal connectives increase inference generation. *Discourse Processes*, **20**, 29-49.

Morrow, D. G., Bower, G. H., & Greenspan, S. L. (1989). Updating situation models during narrative comprehension. *Journal of Memory & Language*, **28**, 292-312.

Morrow, D. G., Greenspan, S. L., & Bower, G. H. (1987). Accessibility and situation models in narrative comprehension. *Journal of Memory & Language*, **26**, 165-187.

O'Brien, E. J., Rizzella, M. L., Albrecht, J. E., & Halleran, J. G. (1998). Updating a situation model: A memory-based text processing view. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **24**, 1200-1210.

Ohtsuka, K., & Brewer, W. F. (1992). Discourse organization in the comprehension of temporal order in narrative text. *Discourse Processes*, **15**, 317-336.

Radvansky, G. A., Zwaan, R. A., Curiel, J. M., & Copeland, D. E. (2001). Situation models and aging. *Psychology & Aging*, **16**, 145-160.

Rapp, D. N., Gerrig, R. J., & Prentice, D. A. (2001). Readers' trait-based models of characters in narrative comprehension. *Journal of Memory & Language*, **45**, 737-750.

Rich, S. S., & Taylor, H. A. (2000). Not all narrative shifts function equally. *Memory & Cognition*, **28**, 1257-1266.

Rinck, M., & Bower, G. H. (1995). Anaphora resolution and the focus of attention in situation models. *Journal of Memory & Language*, **34**, 110-131.

Rinck, M., & Weber, U. (2003). Who when where: An experimental test of the event-indexing model. *Memory & Cognition*, **31**, 1284-1292.

Rinck, M., Williams, P., Bower, G. H., & Becker, E. S. (1996). Spatial situation models and narrative understanding: Some generalizations and extensions. *Discourse Processes*, **21**, 23-55.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-Prime user's guide.* Pittsburgh: Psychology Software Tools.

Suh, S., & Trabasso, T. (1993). Inferencing during reading: Converging evidence from discourse analysis, talk-aloud protocols, and recognition priming. *Journal of Memory & Language*, **32**, 279-300.

Trabasso, T., & Sperry, L. L. (1985). Causal relatedness and importance of story events. *Journal of Memory & Language*, **24**, 595-611.

Trabasso, T., & Suh, S. Y. (1993). Understanding text: Achieving explanatory power coherence through on-line inferences and mental operations in working memory. *Discourse Processes*, **16**, 3-34.

Trabasso, T., & van den Broek, P. (1985). Causal thinking and the representation of narrative events. *Journal of Memory & Language*, **24**, 612-630.

Trabasso, T., van den Broek, P., & Suh, S. Y. (1989). Logical necessity and transitivity of causal relations in stories. *Discourse Processes*, **12**, 1-25.

van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension.* New York: Academic Press.

Williams, P., & Tarr, M. J. (1999). RSVP: Experimental control software for MacOS (Version 4.0.5) [Software]. Retrieved from http://www.cog.brown.edu/~tarr/rsvp, November 12, 2002.

Zacks, J. M., & Tversky, B. (2001). Event structure in perception and conception. *Psychological Bulletin*, **127**, 3-21.

Zwaan, R. A. (1996). Processing narrative time shifts. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **22**, 1196-1207.

Zwaan, R. A. (1999). Situation models: The mental leap into imagined worlds. *Current Directions in Psychological Science*, **8**, 15-18.

Zwaan, R. A. (2001). Language comprehension as guided experience. In L. Degand, Y. Bestgen, W. Spooren, & L. van Waes (Eds.), *Multidisciplinary approaches to discourse* (pp. 1-9). Amsterdam: Uitgaven Stichting Neerlandistiek.

Zwaan, R. A., Langston, M. C., & Graesser, A. C. (1995). The construction of situation models in narrative comprehension: An event-indexing model. *Psychological Science*, **6**, 292-297.

Zwaan, R. A., Magliano, J. P., & Graesser, A. C. (1995). Dimensions of situation-model construction in narrative comprehension. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **21**, 386-397.

Zwaan, R. A., & Oostendorp, H. (1993). Do readers construct spatial representations in naturalistic story comprehension? *Discourse Processes*, **16**, 125-143.

Zwaan, R. A., & Radvansky, G. A. (1998). Situation models in language comprehension and memory. *Psychological Bulletin*, **123**, 162-185.

Zwaan, R. A., Radvansky, G. A., Hilliard, A. E., & Curiel, J. M. (1998). Constructing multidimensional situation models during reading. *Scientific Studies of Reading*, **2**, 199-220.

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APPENDIX A
Example of Coding Factors Used in Regression Analyses

Text Line	Syll	Pos	Clause Pos	New Arg	Freq	Overlap	Shift Space	Shift Time	Shift Protagonist
Beanie Babies became very popular in Mary's town of Lakewood	18	1	1	3	5,914	0	1	1	1
because they are cute little toys	8	2	2	1	1,595	1	0	0	0
that come in a variety of animals.	12	3	3	2	13,118	0	0	0	0
She purchased them as gifts at Christmas,	9	4	1	2	1,433	2	0	1	0
to give to her children.	6	5	2	1	11,218	0	0	0	1
While most collectors enjoy Beanie Babies,	11	6	1	1	308	1	0	0	1
it is unlikely that they would be valued as highly today	16	7	2	0	3,834	1	0	1	0
as they were in Lakewood last year.	8	8	3	1	4,225	1	1	1	0
For some reason, Beanie Babies became very popular at this time.	18	9	1	1	2,205	1	0	0	0
Beanie Babies were first brought into Lakewood from Los Angeles.	16	10	1	2	1,126	1	1	0	0
In 1996, Ellen Smith told Mary of seeing these toys.	13	11	1	2	6,000	1	0	1	1
She had been quite taken with the cuteness of these stuffed animals.	16	12	1	0	10,301	2	0	0	0

Note—Syll, length of sentence or phrase, in syllables; Pos, position of sentence in passage; Clause Pos, position of clause in sentence; New Arg, number of new arguments introduced; Freq, mean word frequency per million words; Overlap, number of propositions shared with previous sentence or phrase. In right three columns, 0 indicates no shift in dimension and 1 indicates shift.

APPENDIX B
Example Passage and Question Types Used in Experiment 1

Passage

Recent events in New York's news have reflected both progress and decline. For example, the first technology center was established in 2064 in Brooklyn and handles data access and transfer. At present, seven out of ten people are involved in technological advances. The offices in New York are very overcrowded. The city government had previously sent their technology workers to New Jersey, but they were unable to do so now because that state was overburdened. The city government had other motives for building the centers, as well. The commercial considerations of tapping the potential of this growing business were very tempting. In New York, the fledgling industry struggled at first because the entrepreneurs had little capital and were close to bankruptcy. However, progress was made. Ex-hacker James Ruse showed that one could be a successful network processor in New York. James Stevens was a former police officer who introduced titanium-based technologies to New York. This set the pattern for New Yorkers to want to export their products seen well into the current time. Stevens was a man whose sole aim was economic advance. He sought to gain commercial control of New York. Stevens realized that the best chance for success was to deal in high-endurance technologies that were in high demand. The titanium-based products were of an especially high durability and were also of exceptional quality. He also knew that sources of technology from Utah and Vermont were unreliable. Titanium could be stored in warehouses in New York. It was profitable enough, in spite of the high development costs. Stevens had other, less reputable, business ventures. Stevens and other former police officers bought up government stores of goods and managed to establish drugs as the city's primary currency. They almost succeeded in bullying the city council into granting them most of the city's land and low-wage labor to run it. No other group had their economic power. They ran the city unchecked by the state government, which was more concerned with the debates in Washington and Chicago. This drug monopoly resulted in money being invested within the city, instead of elsewhere. The expansion that took place would not have been possible without the trade monopoly of the "Drug Corps." For twenty years the Drug Corps ruled the streets. However, in 2082, a rebellion occurred. William Black was the governor of the state at that time. He had previously been a senator in the national legislature that turned against him in 2078. As governor, Black had a number of powers to evoke change. He did not like the direction the city was taking with the trade of alcohol and drugs. Black felt that the future of the city lay in financial management. He favored the few citizens who had been previously empowered and were developing products in Buffalo, which was about thirty-five miles from the new trade center. Black also passed a law that prohibited the use of drugs as payment. The Drug Rebellion that occurred was rooted in opposition to government policy. Although Governor Black had a number of supporters, they did not live in Albany, which is the seat of the government and so had no influence over the local police forces. Black alienated the Drug Corps by accusing the police of corruption and ineptitude. He wanted to stifle the drug traffic and had Stevens arrested for violation of port regulations on December 16th, 2082. At the trial, Stevens accused the judge of being a swindler and stated that the judge owed him money. Stevens told the court, which was made up of six of his police officers, that the public feared for their property, liberty, and lives. The trial broke up in confusion and Stevens was set free. The next morning he was arrested again. The six police officers asked that he be released but Black refused. Black charged them all with conspiracy, which was his last official act as governor. This provoked Major George Johnston and he declared himself lieutenant governor, set Stevens free, and demanded that Black be arrested. The Drug Corps invaded Black's house on January 26th, 2083, placed Black under arrest and took over the administration until his successor arrived. Black's successor was Dr. Larry MacQueed.

Protagonist

QUESTION: William Black was a governor of New York? (true)
QUESTION: William Black was a proponent of the use of drugs as currency? (false)
QUESTION: James Stevens was a former police officer? (true)

Space

QUESTION: The first technology center was established in Arizona? (false)
QUESTION: Sources of technology from Utah and Vermont were considered unreliable? (true)
QUESTION: The seat of government in New York is in Albany? (true)

Time

QUESTION: The Drug Corps ruled the streets 100 years before the attempted rebellion? (false)
QUESTION: The first technology center was established in the year 2064? (true)
QUESTION: This story takes place in the future? (true)

Control

QUESTION: The Drug Corps ruled the streets 100 years before the attempted rebellion? (false)
QUESTION: William Black was a governor of New York? (true)
QUESTION: The first technology center was established in Arizona? (false)

Note—Correct answers appear in parentheses.

APPENDIX C
Participant Instructions Used in Experiment 1

Space Focused

Read the stories for comprehension so that you can answer as many of the questions correctly as possible. Specifically, pay close attention to *where* events, people, and objects are located in the stories. All of the comprehension questions will ask you in some way about the location of events, people, or objects described in the stories. Please press the SPACEBAR to begin.

Time Focused

Read the stories for comprehension so that you can answer as many of the questions correctly as possible. Specifically, pay close attention to *when and in which order* events occur and the timeline of activities in the stories. All of the comprehension questions will ask you in some way about the timeline of activities described in the stories. Please press the SPACEBAR to begin.

Protagonist Focused

Read the stories for comprehension so that you can answer as many of the questions correctly as possible. Specifically, pay close attention to the *characters* in the stories. All of the comprehension questions will ask you in some way about the characters described in the stories. For example, who did something? Please press the SPACEBAR to begin.

Control (Nonfocused)

Read the stories for comprehension so that you can answer as many of the questions correctly as possible. Please press the SPACEBAR to begin.

APPENDIX D
Auxiliary Beta Weights: Reading Time Predictor Variables

Dimensional Focus Instruction	Reading Time Predictor Variable	Beta Weight	*t* Value	Beta Weight *SE*
Space	Syll	0.595	27.74*	0.021
	Pos	−0.076	−4.32*	0.018
	Clause Pos	−0.040	−5.92*	0.007
	New Arg	0.143	9.05*	0.016
	Freq	−0.099	−14.56*	0.007
	Overlap	0.029	2.55*	0.011
Time	Syll	0.639	52.22*	0.012
	Pos	−0.074	−6.49*	0.011
	Clause Pos	−0.044	−4.77*	0.009
	New Arg	0.117	8.53*	0.014
	Freq	−0.101	−12.61*	0.008
	Overlap	0.023	2.22*	0.010
Protagonist	Syll	0.580	37.39*	0.016
	Pos	−0.062	−4.36*	0.014
	Clause Pos	−0.042	−4.75*	0.009
	New Arg	0.158	12.47*	0.013
	Freq	−0.095	−11.61*	0.008
	Overlap	0.039	4.66*	0.008
Control	Syll	0.645	39.84*	0.016
	Pos	−0.053	−4.23*	0.013
	Clause Pos	−0.041	−5.43*	0.008
	New Arg	0.131	9.50*	0.014
	Freq	−0.106	−12.39*	0.009
	Overlap	0.007	0.74	0.009

Note—Syll, length of sentence or phrase, in syllables; Pos, position of sentence in passage; Clause Pos, position of clause in sentence; New Arg, number of new arguments introduced; Freq, mean word frequency per million words; Overlap, number of propositions shared with previous sentence or phrase. *$p < .05$, two-tailed.

APPENDIX E
English Translation of Excerpt of Sample Text in the Fully Continuous Version, With Different Question Types for Experiment 2

Introduction

Ever since Paul and his wife Frieda had retired, they put a lot of effort into their little house and their garden. On a sunny day in May, they decided to do a big spring cleaning, including everything involved.

Episode With Variation of Protagonist, Time, and Location

Frieda started to tidy up the house, whereas Paul took care of the garden, which he had declared his territory. In the warm midday sun, he started to carefully clean up last year's withered leaves. Then he dug up the beds, sowed beans and potatoes, and he planted pansies and tomatoes. In the evening, Paul fetched his new lawn mower, which he had gotten for Christmas, from the shed, and he cut the small lawn in the garden. Night was already falling, so he had to hurry in order to finish mowing the lawn in time.

Target Sentence

In the last daylight, Paul stood in the garden and looked around satisfied.

Concluding Sentences

Frieda had also finished her work, and she had already prepared a good dinner.
When she called Paul into the house, he smelled delicious roast meat.
Both of them were very satisfied with their day's work.

A. Spatial Comprehension Questions

Did Frieda work in the house?
Was the lawn mower stored in the basement?
Did Paul work in the garden?

B. Temporal Comprehension Questions

Did Paul start his work around noon?
Was Paul finished with his work around noon?
Did Paul plant tomatoes before he mowed the lawn?

C. Protagonist Comprehension Questions

Was it Frieda who planted pansies and tomatoes?
Was it Frieda who prepared the roast meat?
Were both Frieda and Paul satisfied?

Note—Each participant read Parts 1–4 and received Questions A, B, or C.

APPENDIX F
English Translation of an Excerpt of Sample Text in the Fully Discontinuous Version, With Different Question Types

Introduction (see Appendix E)

Episode With Variation of Protagonist, Time, and Location

Paul took care of the garden, which he had declared his territory, whereas Frieda started to tidy up the house. The morning air was pleasant and refreshing, so she opened all the windows and let spring reach every corner of the house. Then, in a spirit of adventure, she climbed up to the attic. There she searched old boxes and shaky cupboards, and she checked for mice. At noon, she cleaned the winter dust out of the hall and tidied up her beloved cabinet. The noon sun was quite warm already, so she interrupted this work for some time while she closed all the windows to keep the house pleasantly cool.

Target Sentence (see Appendix E)

Concluding Sentences and Comprehension Questions (see Appendix E)

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