Topic situations: Coherence by inclusion

Lyn Frazier\textsuperscript{a,b}, Charles Clifton Jr.\textsuperscript{b}

\textsuperscript{a} Department of Linguistics, University of Massachusetts Amherst, Amherst, MA 01003, USA
\textsuperscript{b} Department of Psychological and Brain Sciences, University of Massachusetts Amherst, Amherst, MA 01003, USA

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ABSTRACT

Topic situations have been studied in the linguistic literature but for the most part have not been studied psycholinguistically. Five experiments tested predictions of the hypothesis that a sentence-initial prepositional phrase (PP) in English introduces a Topic Situation, which by default restricts the interpretation of the following discourse. Participants in judgment experiments interpreted later discourse events as more likely to take place in the location specified by a PP when that PP had appeared sentence-initially compared to other sentence positions, and they rated such sentences as less natural when the discourse event was implausible in the specified location. Participants in two additional experiments made naturalness judgments of sentences containing an initial PP that introduced a situation that has a usual range of durations. Sentences with a final temporal phrase that fell outside this range were judged to be unnatural, suggesting that this temporal phrase was (implausibly) interpreted as being included in the Topic Situation introduced by the PP. We suggest that these findings can advance understanding of discourse phenomena such as presupposition and domain restriction.

Introduction

Psycholinguists are familiar with how syntax, morphology, or prosody can be used to mark a phrase as the topic of a sentence or discourse – the entity or eventuality that it is about. Marking a phrase as topic has demonstrable effects on the interpretation and processing of utterances (Reinhart, 1982; Repp, 2017; Ward & Birner, 2004, among many others). For example, other factors being equal, a topic is the preferred antecedent of a personal pronoun (Clifton & Ferreira, 1987; Colonna, Schimke, & Hemforth, 2012).

In the present report, we explore a distinct and less familiar notion, Topic Situation. The basic idea is that an utterance is true of the situation that it is about, an observation that dates at least to Austin (1950) (cited in Kratzer, 2017). What situation an utterance is about can be determined by a multitude of factors. We propose one specific vehicle for introducing a Topic Situation: a sentence-initial temporal or locative prepositional phrase (PP) functions to introduce a Topic Situation and give it specific content: the remainder of the sentence is interpreted as a sub-situation of that Topic Situation. We further claim that following discourse material is by default also taken to be part of the Topic Situation. We advance the Topic Situation Hypothesis in (1):

(1) Topic Situation Hypothesis: Initial temporal and locative PPs introduce Topic Situations. By default, following material is included in the Topic Situation until a new Topic Situation, or incompatible information, is encountered.

In linguistics, Topic Situations are discussed in several guises. Austinian Topic Situations (Austin, 1950) are familiar in situation semantics, where sentences are true of partial worlds, not entire worlds, and people hold attitudes toward partial worlds (Barwise and Perry, 1983; Kratzer, 1989, 2017). Topic situations identify what an assertion is true of. Although the present paper is limited to examining the nature of Topic Situations in English, we conjecture that languages generally have ways of indicating what situation a discourse is to be interpreted in. A particularly convincing instance of how languages do this appears in McKenzie’s (2015) discussion of non-canonical switch reference in a variety of Native American languages. In cases of canonical switch reference, a language will use one morpheme to mark a clause whose subject co-refers to the subject (presumably, the topic) of a previous clause, but a different morpheme when the referent changes. In non-canonical switch reference, the switch reference morpheme is used to indicate that a change of Topic Situation occurs between the two clauses (in McKenzie’s, 2015, terms, ‘to signal an
episodic shift”), even if the subjects of the clauses refer to the same entity.\(^1\)

Although it is not usually discussed under the name of ‘Topic Situation’, the closely related notion of ‘frame-setting adverbial’ has been prominent for some time (Chafe, 1976, who speaks of ‘the frame within which a sentence holds’). Like a Topic Situation, a frame setting adverbial limits the domain of an assertion. Maienborn (2001) showed that German adverbials can have three different interpretations, depending on their syntactic position, similar to our proposal about how syntactic position of an English PP can affect whether it introduces a Topic Situation (we do not, however, claim that the syntactic devices used by English and German are identical; that would require detailed syntactic analysis). In final position a German adverbial may be external, situating the entire eventuality (e.g., *Eva signed the contract in Argentina, Maienborn’s (1a)*), or internal, expressing the location for only one of the eventuality’s parts (*Eva signed on the last page, Maienborn’s (1b)*). However when they appear in initial position (Maienborn’s (1c) *In Argentina, Eva is still very popular*), adverbials are not event-related but “set a frame for the proposition expressed by the rest of the sentence” (Maienborn, 2001, p192).\(^2\)

In the psycholinguistic literature, Bestgen and Vonk (1995, 2000) and Bestgen and Costermans (1994) showed that a sentence introducing a topic shift (in their materials, a shift in the situation that a discourse is about) takes longer to read than one instantiating strong continuity with the current topic. However, this cost is eliminated if the topic shift sentence begins with an initial temporal adverbial (e.g., *Around 2 o’clock*). These results were taken as evidence for the segmentation function of initial temporal phrases. In recent work, Bestgen and Pfierard (2014) have shown a similar effect that provides direct support for our Topic Situation hypothesis. Participants in their study read a French discourse containing a target sentence whose subject was a specific particular location (e.g., *Geneva*). When the discourse had begun with a locative PP that was congruent with this location (e.g., *In Switzerland*), the target sentence was read faster than when the discourse began with an incongruent PP (In Finland). However, this effect was limited to the circumstances when the PP occurred in sentence-initial position. When it occurred at the end of the first sentence in the discourse, its content had no effect on time to read the target sentence.

Schwarz (in press) has presented evidence from a visual world eye-tracking study about the speed with which a sentence-initial PP apparently constrains the Topic Situation. His experimental participants looked at a 2 × 2 array of colored geometrical objects while they were verifying discourses like (2).

\[(2) \quad \text{a. On the top, there is a yellow triangle. The circle is black.} \]
\[\text{b. There is a yellow triangle on the top. The circle is black.} \]

His participants looked away from a circle in the bottom row (and toward a circle in the top row) more quickly after the onset of the second sentence noun (circle) in (2a) than in (2b), suggesting that the sentence-initial PP restricted the Topic Situation to the top row.

We view the Topic Situation hypothesis as contributing to the solution of a very general problem, how comprehenders fill in underspecified information, information that is left implicit in an utterance. We propose that the Topic Situation provides implicit restrictions on material that follows it in a discourse. In the first three experiments reported below, we investigate whether the location specified in a sentence initial PP – which by hypothesis provides the Topic Situation – implicitly restricts properties of the events described later in a discourse, in particular, the location in which it takes place. We compare the effect of a sentence-initial PP with the effect of the same PP occurring in a different syntactic position, where it is not expected to provide a Topic Situation (although it can support a content-based inference about the situation in which events later in the discourse take place).

Experiment 1

In Experiment 1, we obtained interpretations of the second sentence of a two-sentence discourse by asking about the location of the eventuality asserted in that sentence. The first sentence included a locative PP which appeared in one of three positions: in sentence-initial position, modifying the subject, or in sentence-final adverbial position. The Topic Situation hypothesis predicts that a sentence-initial PP introduces a Topic Situation, and that the Topic Situation is by default extended to include subsequent discourse material. If so, then initial PP discourses should show more PP-restricted interpretations of the second sentence subject than do non-initial PP discourses, either subject-modifying or VP-modifying ones.

Experiment 1 obtained likelihood judgments for discourses like that illustrated in (3). We expected to find higher judgments of the like-lihood that the event in the second sentence took place in the same location as the first for the sentence-initial PP condition than the other two conditions. The subject-modifying PP condition (3b) places the subject in the location described by the PP (and inferentially, places the activity there too). The truth conditions of the verb modification condition (3c) are essentially the same as those of the sentence PP condition (3a), but the pragmatics are different. Specifically, (3a) introduces a Topic Situation while neither (3b) nor (3c) does. We thus predict that likelihood-of-same-location judgments for (3b) and (3c) will be lower than for (3a).

\[(3) \quad \text{a. At the Farmer’s Market, the lettuce lady was talking about} \]
\[\text{new discount cards. The musicians were playing loudly.} \]
\[\text{b. The lettuce lady at the Farmer’s Market was talking about} \]
\[\text{new discount cards. The musicians were playing loudly.} \]
\[\text{c. The lettuce lady was talking at the Farmer’s Market about} \]
\[\text{new discount cards. The musicians were playing loudly.} \]

QUESTION: How likely is it that the musicians were at the Farmer’s Market?

Method

Materials

Fifteen items modeled on (3) were prepared (all items appear in Appendix A). Each item appeared in three forms: Sentence PP (3a), Subject PP (3b), and Verb PP (3c). These items were combined with 10 filler items, each of which contained a PP (half sentence-initial, half subject-modifying), but differed from the experimental items in that other aspects of the second sentence were questioned (e.g., the like-lihood that the second-sentence subject performed the action attributed to the first-sentence subject).

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1 McKenzie (2015) gives the following example from Kiowa (citing Watkins, 1993): Kathryn gà = gót gàu Esther = dû gà = gót “Kathryn wrote a letter and Esther wrote one too.” The ‘same subject’ morpheme gàu is normally used to indicate that the following subject has the same reference as the subject or topic of a preceding utterance (while the ‘switch reference’ morpheme nàu indicates that the identity of the subject is different). But in this example, the referents of the subjects of the two clauses differ but the ‘same subject’ morpheme gàu is used to indicate that the conjoined clauses refer to the same writing situation. The same sentence with the ‘different subject’ morpheme nàu indicates that the conjoined clauses refer to different situations.

2 Maienborn (2001, p197) also discusses the fact that locative frame-setting adverbials e.g. (i) may have a non-locative interpretation, like ‘At some time when Britta was in Bolivia, she was blond’ (her example 14). She notes that this is equally true of internal adverbials like (ii). Maienborn also notes that (iii) is not a contradiction. In cases where a frame-setting locative is interpreted temporally, there is no contradiction if the associated event took place in a location other than that specified by the frame setting adverbial.

(i) In Bolivia, Britta was blond.
(ii) Britta was blond in Bolivia
(iii) In Italy, Lothar bought his suits in France.
Participants and procedures

Thirty-six participants were recruited using Amazon's Mechanical Turk (https://www.mturk.com/mturk/) and were paid $1.00 for participating. As in all experiments reported here, they indicated being native English speakers over 18 years old, and all had US web addresses. Twelve participants were assigned to each of three counterbalancing conditions, designed to ensure that each participant was tested on equal numbers of items of each type illustrated in (3), and that each item was tested equally often in each version. Items were presented to participants using Ibex Farm software (Drummond, 2012).

As in all experiments reported here, a session began with a participant reading and accepting an informed consent form that had been approved by the University of Massachusetts Institutional Review Board, filling out a short biographical questionnaire (including language experience), and reading instructions that indicated they were to read a short two-sentence discourse, press the keyboard's space bar when they understood it, and then read and answer one question about it. In the experimental sentences, the question always concerned the likelihood that some aspect of the second sentence of the discourse (the likelihood that the subject of the second sentence was in the same location as event described in the first sentence). Each question was accompanied by a 10-point likelihood scale, where 1 = ‘very unlikely’ and 10 = ‘very likely.’ Following three practice items, the 25 items were then presented in an individually randomized order, and the computer program recorded the participant’s rating choice and time to read the discourse.

Results

The likelihood ratings were analyzed as an ordinal mixed regression (cumulative link mixed model) using the clmm function in R 3.4.3 and the package ordinal 2015-6-28 (Christensen, 2012; R Development Core Team, 2017). The data for one participant were rejected because the participant typically read the discourses in less than 500 ms. Since the data were treated as ordinal categories, rather than being on an interval scale, they are best described by presenting their distributions (Fig. 1). However, some understanding of the data is conveyed by the mean ratings and their standard errors, which appear in Table 1 together with the median ratings (which are not particularly informative, given that they are integers). The fixed effect of PP position was analyzed using Helmert contrasts: the mean ratings for the Sentence PP condition were compared with the combined Subject PP and Verb PP conditions, and then these two conditions were compared with one another. Random slopes by participants and by items were used. The first contrast was significant ($\beta = 0.17$, SE = 0.07, $z = 2.43$, $p = 0.015$); the second was not ($\beta = 0.14$, SE = 0.11, $z = 1.22$, $p = 0.222$). Sentence PP items received higher likelihood ratings than either the Subject or the Verb PP conditions, which did not differ significantly.

Discussion

The results of Experiment 1 suggest that sentence-initial PPs do play a special role in language interpretation. Material later in a discourse that can be taken to be part of a Topic Situation introduced by an initial PP is likely to be interpreted as part of that situation. Comprehenders were likely to infer that the situation described by the second sentence in the Experiment 1 test materials took place at the location specified by the initial PP. The effects are not huge. For instance, comparing Sentence PP and Verb PP conditions, the former resulted in an increase of 12.6% in ratings above the midpoint of the likelihood scale compared to the latter. Further, it may be of interest that much of this increase is concentrated in likelihood ratings of ‘10,’ an increase of 26% between the non-initial PP conditions and the sentence-initial PP condition. It appears that there is something about a sentence-initial PP that indicates substantial certainty that a particular situation is under discussion, more certainty than is afforded by inferences that PPs in other positions can support.

In Experiment 2 and 3 below we again ask whether there is a special role for the initial PP, as claimed by the Topic Situation hypothesis. We manipulate PP position (sentence-initial vs sentence-final). But we also vary plausibility of the second sentence in a discourse to determine whether the Topic Situation hypothesis is general and survives plausibility manipulations. One possibility is that plausibility effects surface differently in sentences with and without an initial PP (with and without an explicitly introduced Topic Situation). Without an explicitly introduced Topic Situation, plausibility may be the central information exploited by the reader to determine the likelihood that the event of the second sentence took place in the location specified by the PP. By contrast, perhaps with a sentence-initial locative PP a relation based on the form of the sentences leads to an expectation about the discourse coherence relations (specifically, that the Topic Situation extends to the second sentence), with a lesser effect of plausibility on the judgment of where the event of the second sentence took place.

On the other hand, it may be that the form of the input introduces one type of information about the intended discourse relations, and the content of the question about the second sentence (its ‘plausibility’) offers another type of information. These might in principle contribute additive effects. The initial PP may increase the likelihood of restricted interpretations (of the second sentence content, as in Experiment 1). Independently, participants might be biased to give a high likelihood rating to a question with plausible content. That is, a question in which the event is plausible in the stated location (the location specified by the PP of the first sentence) could increase the judged likelihood that the event did take place in that location.

Experiment 2

Method

Materials

The second experiment obtained interpretations of the second sentence of two-sentence discourses like that illustrated in (4). Two forms (4a and 4b) were intended to contain second sentences that (in the judgment of the experimenters) were relatively implausible if the event they described took place in the location specified by the PP of the first sentence. The other two forms (4c and 4d) were intended to contain second sentences that were plausible in the specified location. All the first sentences were intended to be reasonably plausible. Orthogonally, two forms (4a and 4c) introduced a location as a sentence-initial PP, and two forms (4b and 4d) introduced the location sentence-finally. Each item was followed by a single question (illustrated in (4)) about whether the participant understood the discourse to convey that the action in the second sentence took place in the location specified by the PP that had been used in the first sentence. Participants were offered three possible answers: NO, ?, and YES. All experimental items appear in Appendix B.

(4) a. In the junkyard, the woman emptied a trash can. The man baked some cookies.
   b. The woman emptied a trash can in the junkyard. The man baked some cookies.
   c. In the apartment next door, the woman emptied a trash can. The man baked some cookies.
   d. The woman emptied a trash can in the apartment next door. The man baked some cookies.

QUESTION: According to your understanding of that discourse, was the man in the [junkyard/apartment next door] when he baked cookies?

In addition, 16 filler sentences were constructed. Four had transparently obvious answers (two YES, two NO), and were designed as ‘catch’ items to identify inattentive participants. Twelve other two-sentence discourses of varying form and varying plausibility and thus
presumably likelihood of YES and NO answers were also constructed, together with three practice items. One practice item was designed to favor each of the three possible responses, NO, ?, and YES.

Participants and procedures
Forty-eight participants were recruited using Amazon’s Mechanical Turk, as in Experiment 1, and met the same qualifications as in that experiment. Each participant completed the informed consent form and language questionnaire, and then received instructions to the effect that they were to read and understand a two sentence discourse and answer a question about it. They were told to answer YES if they understood the author of the discourse to be telling them that the event happened as described in the question, NO if they did not understand it this way, and ? if they were not sure that the discourse meant it.

Ibex Farm was again used to present the instructions and practice items, and then the 36 experimental and filler items in an individually randomized order. Full counterbalancing was used, so that 12 participants received each item in each of the four conditions, and each item was tested equally often in each condition. On each trial, an underscore appeared where the sentences were to appear, the participant pressed the space bar to see the discourse and again to indicate understanding, and then the discourse disappeared and the question and three possible answers appeared. The participant clicked one answer with the mouse, and the computer program recorded the answer and reading and response times.

Results
Data from one of the 48 participants failed to be saved, and data from five additional participants were eliminated because they typically read the sentences or answered the questions in under 500 ms or because they gave inappropriate answers to both of the clear YES or both of the clear NO ‘check’ items (three of the five eliminated participants failed two or three of these tests). The frequencies of choices of NO, ?, and YES responses in each of the four experimental conditions constituted the data. These frequencies appear in Table 2.

As in Experiment 1, the data were analyzed as an ordinal mixed regression using R and clmm. The three possible responses were considered to be ordered in terms of increasing positivity: NO, ?, and YES. The sum-coded fixed effects were position of PP (sentence initial or sentence final – Sen PP vs VP PP) and plausibility of the second sentence. Random slopes of participants and items were used. The results were very clear. Responses were relatively more positive in the sentence initial PP condition than in the sentence final PP condition (β = 0.364, SE = 0.114, z = 3.18, p < .002) and more positive in the plausible than in the implausible condition (β = −1.085, SE = 0.167, z = −6.52, p < .001). The interaction did not approach significance (β = −0.011, SE = 0.093, z = −0.12, p > .90).

Discussion
Both PP-position and plausibility influenced how often participants indicated that the PP restricted the second sentence (treating the ? answer as more restrictive than a NO and a YES as even more
restrictive). When the PP was sentence-initial, introducing a Topic Situation, participants were more likely to say that it restricted the interpretation of the second sentence than when the PP modified the VP. Further, less plausible events received less frequent positive answers than more plausible events. But there was no interaction, as there should have been if event plausibility affected whether the inference that the Topic Situation introduced by the first sentence carried over to the second sentence. The additivity of the effects of PP position and plausibility indicates that these effects operate separately. Presumably, PP position affects the likelihood that a Topic Situation is extended from the first sentence to the following discourse. In contrast, bias in answering the question apparently reflects the plausibility of the situation described in the question itself. Consider the question was the man in the junkyard when he baked cookies?. Taken out of context, the content of this question is likely to be biased toward a ‘no’ answer. Baking cookies in a junkyard is unlikely, at least compared to baking them in the apartment next door. This implausibility might have led to more NO and answers, independently of the interpretation of the initial sentence. Experiment 3 is designed to explore the possibility of an interaction between PP position and plausibility, using a different measure, the judged naturalness of the interpretation of the discourse.

Experiment 3

The third experiment again used situational plausibility to explore the effect of introducing a Topic Situation. Rather than having participants indicate their interpretation of the second sentence in a discourse, it had participants rate the naturalness of two-sentence discourses like those in (5). Two versions of these discourses (5a, 5c) introduced a location as a sentence-initial PP, by hypothesis introducing a Topic Situation, while two versions (5b, 5d) introduced the same PP in the predicate of the first sentence. Orthogonally, in two versions (5a, 5b), the second sentence introduced an event which was (in the experimenter’s judgment) particularly unlikely to take place in the location introduced by the first sentence’s PP (and in many cases, unlikely generally), while the other two versions (5c, 5d) introduced an event that was reasonably likely to take place in the location in question.

(5) a. At MacDonalds, Joe had a burger. Jill drank a can of beer.
   b. Joe had a burger at MacDonalds. Jill drank a can of beer.
   c. At MacDonalds, Joe had a burger. Jill drank a big milkshake.
   d. Joe had a burger at MacDonalds. Jill drank a big milkshake.

The Topic Situation hypothesis predicts that the event described by the second sentence will more frequently be taken to have occurred in the location introduced by the first sentence when it occurs sentence-initially than when it occurs sentence-finally. If the event is implausible when it takes place in this location, the discourse may be judged to be unnatural. Given the hypothesized tendency to take the location of the initial PP as the Topic Situation within which the event takes place, this predicts lower naturalness ratings for items like (5a) than (5b). However, given that the second sentence event in the plausible conditions (5c, 5d) is reasonably plausible whether it occurs in the Topic Situation or not, no difference in judged naturalness is expected. This predicts an interaction between PP location and event plausibility: there will be a difference between (5a) and (5b) that may not appear between (5c) and (5d).

Method

Materials

Twenty quadruples of two-sentence discourses modeled on the example in (5) were constructed. All items appear in Appendix C. Half the versions of each item contained a locative PP sentence-initially, and half contained the same PP at the end of the first sentence. Orthogonally, half contained a second sentence describing an event that is unlikely (in the experimenters’ judgment) to take place in the location specified by the first sentence’s PP, while half contained a second sentence with a more likely event. There were four filler items designed to be unnatural to the point of incoherence (e.g., The jade plant grew taller and taller. Esther fried some eggs on the sidewalk.). These were used to identify inattentive participants: high naturalness ratings on them were taken to indicate lack of careful reading.

Participants and procedures

Forty-eight participants were recruited using Amazon’s Mechanical Turk, and paid $0.75 for participating in an experiment that took about 5 min. Twelve were assigned to each of four counterbalancing conditions, in which each of the 20 discourses described above occurred equally often in each of the four versions illustrated in (5).

Items were presented to participants using Ibex Farm software (Drummond, 2012). A session began with a participant reading and accepting a consent form, filling out a short biographical questionnaire (including language experience), and reading instructions to read some sentences and short discourses and “rate them on a 7-point scale, where 1 is bad or difficult or unnatural and 7 is good and easy and natural.” The 24 items were then presented in an individually randomized order. Each item was presented together with a graphical 7-point scale; a participant could click on a number to indicate the discourse’s naturalness.

Results

The data for seven participants were discarded because these participants gave the four ‘check’ filler items (designed to identify inattentive participants) mean ratings of 4 or greater on a 7-point naturalness scale. For convenience, the naturalness ratings for the remaining participants (with standard errors) appear in Table 3. Fig. 2 presents a richer picture of the data. As in the previous experiments, they were analyzed as an ordinal mixed model. The analysis used sum-coded fixed effects of plausibility and PP position, and interacting random slopes by participants and items. The critical effect was a significant interaction between plausibility and position of the PP ($\beta = -0.272, SE = 0.097, z = -2.806, p = 0.005$). The cost of implausibility of the second sentence in the situation described by the PP was greater when the PP was sentence-initial than when it was sentence-final. In addition, the main effect of plausibility was significant ($\beta = -2.16, SE = 0.261, z = -8.30, p < .001$) while the overall effect of PP position was not ($\beta = -0.023, SE = 0.093, z = -0.250, p > .80$).

Discussion

The plausible sentences of Experiment 3 were rated as highly natural, regardless of the position of the PP: their content is plausible whether or not it occurs in the location specified by this PP. In contrast, while discourses whose second sentence was implausible in the situation described by the sentence one PP were rated as quite implausible overall, the ratings were lower when the PP had appeared in sentence-initial position than when it had appeared inside the VP. Since the situations described by the second sentence were generally quite plausible outside the PP-described situation (it’s quite plausible to drink a beer, just not in McDonalds; see [5]), we assume that the second

<table>
<thead>
<tr>
<th>Plausibility</th>
<th>Sentence Initial PP</th>
<th>Sentence Final PP</th>
<th>MEAN of means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plausible</td>
<td>7 (6.07, 0.10)</td>
<td>6 (6.10, 0.08)</td>
<td>6.09</td>
</tr>
<tr>
<td>Im plausible</td>
<td>3 (3.04, 0.13)</td>
<td>3 (3.52, 0.13)</td>
<td>3.28</td>
</tr>
<tr>
<td>MEAN of means</td>
<td>4.56</td>
<td>4.81</td>
<td>4.649</td>
</tr>
</tbody>
</table>
sentence frequently inherited the constraints of the situation described in the first sentence. The interaction, however, indicated that this was more common when the first sentence contained a sentence-initial PP. This PP, we hypothesize, created a Topic Situation, which is (by default) extended to following elements of a discourse. The across-the-board effect of situational implausibility, to be sure, indicates that grammatical specification of a Topic Situation via a sentence-initial PP is not required for implicit restriction of the interpretation of a sentence. But the increased effect of plausibility in the sentence-initial PP case does support our hypothesis that the PP provides an explicit restriction on an implicit discourse situation. And examination of the histograms in Fig. 2 suggests the existence of an effect that is not picked up in the overall statistical analysis: ratings appear to be more polarized (more ratings of 1 or of 7) in the sentence-initial conditions than in the sentence-final conditions. This appears to be the same effect as was observed in the Experiment 1 distributions: the sentence-initial PP appears to make readers more certain of how a sentence is to be interpreted.

**Experiments 4a and 4b**

The basic hypothesis we are developing claims that what is special about the initial PP is that it introduces a Topic Situation and subsequent sentences (S2, etc.) are taken to be part of that situation. The claim is a strong one. It is not simply that the continuation of the discourse is about the topic situation but rather that it is included in the topic situation, as indicated by (6).

(6) A sentence “PP-X” containing an initial temporal or locative PP and other material “X” is preferably interpreted as:

i. There is a situation s, where the denotation of the PP holds of s, and

ii. the denotation of X, call it situation s’, is a sub-situation of s.

The interesting feature of this hypothesis is that the situation introduced by the temporal or locative PP is minimally specified; it is simply a situation that holds in a particular location or a particular time. It is the inclusion of the sub-situation s’, introduced by X, that elaborates the properties of s.

To this point, we have concentrated on the location specified by a Topic Situation. However, Topic Situations can have other properties. For instance, they provide a frame in which entities can be introduced, and may even introduce stereotyped entities (e.g., In the car… implicates the existence of a steering wheel). In the following two experiments, we investigate the possibility that a Topic Situation can provide constraints on a temporal ‘frame size’. The situation introduced as a Topic Situation can have a particular ‘run time’, limited by its natural duration (e.g., Mary drove to the store takes however long it takes to drive to the store). Later information can provide more information about this ‘run time.’ However, there are limitations to plausible run times. If a later temporal expression that is (following [6]) taken to apply to part of the Topic Situation causes the ‘run time’ to grow outside its natural duration, then an implausibility will arise.

Experiments 4a and 5 test this possibility, using sentences with sentence-initial PPs presumed to introduce a Topic Situation. An example used in Experiment 4a appears in (7). In (7a), the initial PP includes a temporal expression (last week) that provides information about the time of occurrence of the situation introduced by the PP. But in (7b), the temporal expression appears at the end of the sentence. Following the proposal in (6), this temporal expression applies to the sub-situation of the situation introduced by the sentence-initial PP. Assuming that the situation introduced by the PP is taken to occur at some particular but unspecified time and to have a typical duration, the temporal expression potentially extends the duration of the situation. In the sentences used in Experiment 4a (as in (7), this extension goes beyond plausible limits: a school play is unlikely to extend for an entire week or more. Experiment 4a tests whether sentences with such duration-extending sentence-final temporal expressions are rated as unnatural and difficult to understand. (We note that Experiment 5, which we present below, investigates whether the predicted unnaturalness of sentences like (7b) is limited to cases where the constraint imposed by
the final temporal expression is plausibly included in the duration of the situation introduced in the sentence-initial PP.}3.

(7)  
a. At the school play last week, they fell asleep.
    b. At the school play, they fell asleep last week.

Methods

Materials

Twelve pairs of sentence modeled on the example in (7) were constructed. All items contained a prepositional phrase sentence-initially, to introduce a Topic Situation that suggested a typical duration. One version of each sentence (7b) contained a sentence-final temporal modifier (last week in (7)) intended to be inconsistent with the Topic Situation’s typical duration; the other version (7a) introduced the same temporal modifier inside the sentence-initial prepositional phrase, where it specified the time of the situation. All items appear in Appendix D.

These 12 items were combined with 16 items from a different experiment (investigating the cost of accommodating definite vs. indefinite determiners). Half of these 16 items began with a phrase introducing a Topic Situation, while the other half contained the same phrase within the VP. In addition, there were 8 unrelated fillers, four of which (the ‘check’ items) contained syntactic or semantic anomalies and were designed to identify inattentive participants.

Participants and procedures

As in the previous experiments, participants were recruited using Amazon’s Mechanical Turk. Forty participants were recruited, and were paid $1.20 for participating. Twenty were assigned to each of two counterbalancing conditions, designed to ensure that each participant was tested on equal numbers of items of each type illustrated in (7), and that each item was tested equally often in each version. The 36 items were then presented in an individually randomized order. Participants were instructed to judge their naturalness on a 7-point scale, where a low number indicated that the discourse is bad or difficult and a high number that it is good and easy and natural. Each item was presented together with a graphical 7-point scale; a participant could click on a number. A participant’s data were eliminated if the participant rated two or more of the four ‘check’ filler items as 6 or higher.

Results and discussion

Data from one participant were lost because of failure to save the data. Data from eight additional participants were eliminated they rated two or more of the four ‘check’ items at or above 6 on the naturalness scale. After eliminating these data, the median naturalness rating for the items with a sentence final temporal phrase (7b) was 4 (with a mean and SE of 3.63 and 0.13); however, for items where the temporal phrase was included in the initial prepositional phrase (7a), the median naturalness rating was a substantially higher 6 (mean and SE of 5.73 0.12). This difference was highly significant when evaluated using an ordinal mixed model with random slopes by subjects and item (β = −3.09, SE = 0.404, z = −7.63, p < .001). We interpret this difference to reflect the unnaturalness of extending the time of the Topic Situation (introduced by the initial PP in (7b) to include the final adverbial last week. However, an alternative interpretation is possible: there might be difficulty interpreting two incompatible phrases (the initial PP and the final adverbial) when they cannot be analyzed as part of a single constituent. The unnaturalness of (7b) might appear in an example like (8a), where the two phrases in question are separated by another adverb like quickly. We tested this proposal in Experiment 4b.

(8)  
a. They fell asleep at the school play quickly last week.
    b. At the school play, they fell asleep quickly last week.

Experiment 4b

Methods

All methods were identical to Experiment 4a, with the following exceptions: (a) a new group of 40 experimental participants (none of whom participated in Experiment 4a) were recruited through Mechanical Turk; (b) four new items were added (and appear as items 13–16 in the Experiment 4 appendix); and (c) all the Experiment 4a items were revised to have the form see in (8) (moving the sentence-initial PP to a VP-internal position as in (8a) and adding an adverb to separate it from the final temporal adverbial, together with inserting the same adverb immediately before the final adverbial as in (8b)). A list of the adverbs used appears in Appendix E.

Results and discussion

The data were analyzed exactly as in Experiment 4a. Data from 10 of the 40 participants were eliminated because they gave two or more of the ‘check’ items a high rating. The median rating for the ‘Topic Situation’ items like (8b) was 4, as in Experiment 4a; the median rating for the new items like (8a) was 5. The respective means and standard errors were 4.23 and 4.74 (SEs of 0.12). The difference between these (evaluated in an ordinal mixed model, as in Experiment 4a) was highly significant (β = −0.65, SE = 0.195, z = −3.38, p < .001). The effect is clearly smaller than in Experiment 4a. We suspect that this is because the sentence-medial adverb is somewhat felicitous in the PP-medial versions like (8a); it would more naturally appear before the PP, not after it. The removal of the more felicitous items like (7a) may have made the contrast with the Topic Situation cases like (8b) less notable, allowing their ratings to increase modestly. Nonetheless, the results of Experiment 4b do alleviate the concern that the Experiment 4a results were due to the difficulty of integrating incompatible adverbial phrases when they do not occur in a contiguous relationship.

Experiment 5

Experiment 5 was modeled on Experiment 4, but added temporal modifiers that specified a part of the presumed Topic Situation but did not extend its duration implausibly. The experiment can be viewed simply as a control to ensure that the effect of position of the temporal modifier observed in Experiment 4 depended on the extent to which the Topic Situation had to be expanded to include the temporal modifier, and not simply on the position of the temporal modifier. An example appears in (9). Items like (9b) were expected to be judged as less natural than items like (9a), replicating Experiment 4. This difference was expected to largely disappear in the (9d)/(9c) contrast, where the temporal phrase (during the first act) does not require expansion of the Topic Situation.

(9)  
a. At the school play last week, they fell asleep.
    b. At the school play, they fell asleep last week.
    c. During the first act at the school play, they fell asleep.
    d. At the school play, they fell asleep during the first act.

3 An anonymous reviewer notes that our hypothesis need not be limited to temporal inclusion, observing that (i) is infelicitous, presumably because an event happening in Italy is not a part of a substitution of ‘In Rome.’ However, when the final adverbial can be interpreted as such a substitution, as in (ii), the result is felicitous.

(i) In Rome, an earthquake hit Italy.
    (ii) In Italy, an earthquake hit Rome.
Methods

Materials

Four items were added to the 12 used in Experiment 4. Each item appeared in four conditions, as illustrated in (9). The first two of these conditions were the same as in Experiment 4. The other two replaced the temporal modifier used in Experiment 4 with a modifier that was conceptually consistent with the typical time frame of the Topic Situation. This modifier appeared sentence-finally in (9d), but was part of the sentence-initial prepositional phrase in (9c). The items like (9a) and (9b) will be referred to as ‘widening’ items; the others as ‘non-widening’ items. All sentences appear in Appendix F. We note that, in some items, the syntactic form of the sentence-initial prepositional phrase had to be changed to accommodate the modifier. These 16 items were combined with the same 24 items (experimental and filler) that were used in Experiment 3.

Participants and procedures

Forty-three new participants were recruited through Mechanical Turk. Ten or eleven were tested in each of four counterbalancing conditions, designed to ensure that each item was tested (approximately) equally often in each of the four versions illustrated in (8). Payment and procedures were the same as in Experiment 4.

Results

The data from one participant were discarded because that participant rated 2 of the ‘check’ filler items as 6 or higher. Data from three other participants were rejected because they typically responded in under 500 ms, which is too short to have read the item being evaluated. The median ratings (followed by means and standard errors) after eliminating data for these four participants appear in Table 4. These data were evaluated using an ordinal mixed model with interacting random slopes by subjects and items, as in Experiment 4. Sum (ANOVA-style) contrasts were used for the fixed effects of temporal modifier position and type of temporal modifier (widening vs non-widening). The critical effect is the interaction: \( \beta = -0.537, SE = 0.101, z = -5.30, p < .001 \): the cost of the sentence-final modifier (observed in Experiment 4) is essentially limited to modifiers that widen the PP-specified situation beyond its normal limits. This effect also resulted in significant overall effects of modifier position (\( \beta = 0.77, SE = 0.14, z = 5.49, p < .001 \)) and of type of temporal modifier (\( \beta = 0.41 \) m SE = -0.12, \( Z = 3.27, p < .002 \)).

General discussion

The results of Experiments 1 and 2 showed that initial locative PPs play a special role in constraining the interpretation of subsequent material. Including a sentence-initial PP in the first sentence of a two-sentence discourse led to more interpretations in which the subsequent material was restricted by the PP than including it as a subject or VP modifier. By hypothesis the initial PP introduced a Topic Situation which includes as much subsequent material as possible. Experiments 2 and 3 investigated effects of the plausibility of the eventuality described by the second sentence if it was included in the situation introduced by the first sentence’s PP. In addition to showing that a sentence-initial PP increased the likelihood that the second sentence would be interpreted as taking place in the situation introduced by the PP, Experiment 2 showed that making the resulting situation implausible lowered this likelihood. However, the two effects did not interact. Experiment 3 showed that discourses with a sentence-initial PP were judged to be especially unnatural when the second sentence would be implausible if it described an event taking place in the situation introduced by this PP, providing further evidence that such a PP introduces a Topic Situation that is by default extended to subsequent discourse material. Even with a sentence-final PP, to be sure, the ‘implausible’ items received low naturalness ratings, indicating that our participants frequently inferred that the second sentence event took place in the location of the first sentence. The Topic Situation hypothesis simply says that making this inference is the default when the input introduces a Topic Situation.

Experiments 4 and 5 tested the idea that the subsequent material is interpreted as an included part of the eventuality introduced by the Topic Situation. There was a penalty in judged naturalness when a sentence-final temporal modifier required an implausible increase in the duration of the eventuality introduced by a sentence-initial PP (e.g., At the school play).

Our proposal (see (6)) is that initial temporal and locative PPs introduce topic situations (though as will become clear below, the proposal is limited to sentences without stylistic inversion, which seem to behave differently). The statement in (6) “there is a situation s” carries an existential implication: the situation s is taken to exist (at least, in the discourse). As pointed out to us by Peter Alrenga, this can be tested by looking at different quantifiers. The examples in (10) implicate a situation and are predicted to be good.

(10) a. At one of the farmer’s markets, the lettuce lady sold organic lettuce.
b. At several of the farmer’s markets, the lettuce lady sold organic lettuce.
c. At each of the farmer’s markets, the lettuce lady sold organic lettuce.

However, examples without an existential implication should be odd, as in (11).

(11) a. #At none of the farmer’s markets, the lettuce lady sold organic lettuce.
b. #At few, if any, of the farmer’s markets, the lettuce lady sold organic lettuce.

In principle at least, one might think that the higher availability of PP-restricted interpretations might be due to the salience of an initial phrase. This is a possible account for Experiments 1–3, but no more convincing than claiming that sentence-final PPs would be more salient because of their recency-based availability in memory, or the fact that, in English, default focus typically falls on the final constituents of sentences, and focus could reasonably be expected to increase salience.

Another indication that the phenomena investigated in the present paper is not just about being sentence initial comes from a comparison of the topic situation sentences investigated in our studies and the (negative or locative) inversion sentences sometimes discussed under the rubric of ‘stylistic inversion.’ Consider the pairs in (12) and (13) (thanks to Peter Alrenga for the examples). (12a) seems odd. The initial negative PP does not carry an existential implication, and thus does not introduce a Topic Situation within which the second clause can be interpreted. However, (12b) is fine. It is not clear why a Topic Situation is not introduced when stylistic inversion is present. It may be that a temporal or locative PP can occupy a special position high in the syntactic tree that contributes to a conventionalized interpretation of the PP as introducing a Topic Situation. (12b) suggests that it is not enough just for the PP to be sentence initial. In cases of stylistic inversion, it may occupy a different position in the syntactic tree that does not introduce a Topic Situation. However, at present, we can say no more about the relevant syntactic differences between (12a) and (12b).
Returning to the possibility that the results we report simply reflect the salience of a PP, Experiments 4 and 5 did not manipulate salience of a PP. They simply showed that a temporal modifier that appeared after the initial PP lowered the naturalness of a sentence if it required an unreasonable extension of the duration of the situation introduced by the PP. We interpreted this as showing that subsequent material is taken to be included in the Topic Situation, with unnaturalness resulting if extending the situation to allow this inclusion is unreasonable. Salience is not involved.

We view these results as extending our understanding of what makes a discourse coherent. They are compatible with the observation (Bestgen & Costermans, 1994; Bestgen & Vonk, 1995, 2000) that a sentence-initial temporal or locative PP can signal a change in situation, facilitating reading of material that did not cohere with preceding material and altering judgments of how a text is divided into sections.

Further, Bestgen and Piéard (2014) showed that sentence-initial PPs disrupted reading of later material that was inconsistent with the content of this PP more than a sentence-final PP did. Viewing these effects of sentence-initial PPs in terms of how they introduce a Topic Situation makes it clear that a sentence-initial PP does more than mark a potential discourse boundary. It can constrain the interpretation of material that follows it in a discourse.

One important question is whether the notion of Topic Situation is universal. We suspect so. The fact that it shows up in typologically unrelated languages such as English and Kiowa suggests that Topic Situation may be generally available in language. However, it is also clear that the manifestation of Topic Situation depends on the morpho-syntactic details of a language. For example, in Kiowa PPs are not involved at all in non-canonical switch reference/Topic Situation marking; in English they are.

Our results may have some implications for linguistic theory, specifically, claims about scope. Syntactic scope (X scopes over Y if X c-commands Y, basically is higher in the tree) is familiar in psychological effects the interpretation of reflexive anaphors. For example, Sturt (2003) showed that a reflexive like 'himself' is initially interpreted with an antecedent that preceded it in its syntactic binding domain (Chomsky, 1981) (see also Cunnings & Sturt, 2014; Kush, Lidz, & Phillips, 2015). The reflexive has to be in the syntactic scope of its antecedent. However, recent results by Moulton and Han (2018) showed that the interpretation of sentences with bound pronouns is not always governed by syntactic scope, but by what they termed semantic scope (if X semantically scopes over Y then Y is under the interpretive influence of X). They obtained interpretations of sentences like (14a) and (14b). Despite the fact that the antecedent of the bound pronoun he (each boy) is structurally higher than the pronoun (c-commands the pronoun) only in (14a), not in (14b), the pronoun was interpreted equally often as being bound by each boy in both cases. However, the pronoun was interpreted as being bound by any janitor far less often in (14c) (taken from Kush et al., 2015). Moulton and Han suggest that the quantified noun phrase (each boy, any janitor) takes semantic scope over the following pronoun in (14a) and (14b), but not in (14c) (it takes syntactic scope only in (14a)).

We suggest that our analysis of sentence-initial PPs provides motivation for claiming that each boy (14b) has semantic scope over the following bound pronoun. In Moulton and Han, the sentences with such semantic scope all began with a temporal adverbial phrase (generally with after or before). Such a phrase could serve the same function we have claimed sentence-initial PPs do, namely, introduce a Topic Situation. Our claim that a Topic Situation scopes over following material, in the sense that it includes that material as a sub-situation, provides some motivation for claiming that material in the first clause of sentences like (14b) take semantic scope over the following bound pronoun (see Barker, 2012, for other examples of apparent semantic scope, which may or may not yield to an analysis in terms of Topic Situations). Moulton and Han do discuss their semantic scope examples as being possible instances of 'telescoping', which we think may be related to the notion of topic situation (and d-type pronouns, Elbourne, 2005).

Our analysis of Topic Situations suggests some interesting avenues of future research.

One question is whether any type of initial PP behaves like initial locative and temporal PPs. Our claim is only for locative and temporal phrases. But intuitions are not so clear for other types of PPs, as in (15)–(16).

(15) a. By car, John went to New York. Sally went to Boston.
   b. John went to New York by car. Sally went to Boston.

(16) a. For Maria, Max left town. Sam stayed and worked hard.
   b. Max left town for Maria. Sam stayed and worked hard.

We think experimental data are needed in order to be sure what the facts are in (15)–(16). One interesting possibility, we think, is that initial temporal and locative PPs show larger effects of our positional manipulation than do manner or benefactive phrases, for example, because the locations and times are natural ways of picking out situations whereas some coercion is needed to pick out a situation with respect to its manner or beneficiary.

Enc (1986) argued against treating Tense as a sentence-level operator because on this analysis Tense would necessarily scope over all phrases in the clause, not just the verb. In (17) (Enc’s 14, originally due to Cooper), we want the interpretation of the congressmen to be future but a president to be interpreted in the past.

(17) Every congressman who remembers a president will be at the party

Given the present analysis of Topic Situations (s), we expect a preference for interpretations of time-dependent NPs in the associated sentence (X, in (6)) to be preferentially anchored in the sub-situation (s). We informally tested this using six examples like (18) and the time-dependent NPs president, mayor, governor, senator, congressman, and Ford CEO. One form (18a) contained an initial temporal PP. Another (18b) had a final PP. A third form (18c) placed the temporal expression in a preceding sentence in the frame ‘It was __.’.

(18) a. In 1960, the president visited the naval academy
   b. The president visited the naval academy in 1960.
   c. It was 1960. The president visited the naval academy.

The expectation was that a preceding sentence would set up a topical time and thus could serve as a baseline for a topic situation. Thus both the baseline (18c) and the Topic Situation form (18a) were expected to have more ‘back when’ interpretations than the form (18b) that places the temporal phrase in sentence final position. This was assessed by
testing the six examples like (18) in a counterbalanced fashion. Forty participants recruited via Mechanical Turk (three rejected because they consistently read the sentences in under 1000 ms) were asked to indicate their interpretation by answering a question of the form (19).

(19) According to your initial interpretation of this item, does “the president” refer to (a) the current president, or (b) whoever was president in 1960?

The results, in terms of proportion of ‘back when’ interpretations, are presented in (20) (the standard errors of these means range from 0.04 to 0.05).

<table>
<thead>
<tr>
<th>Final PP</th>
<th>Initial PP</th>
<th>Separate Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>.57</td>
<td>.81</td>
<td>.83</td>
</tr>
</tbody>
</table>

As expected the initial PP led to substantially more interpretations where the critical NP (president) was interpreted with the temporal expression as its argument than in the final-PP examples. In fact, the initial PP examples had virtually as many interpretations with the temporal expression as argument as did the prior sentence examples. Although the phenomena warrants additional exploration, these initial findings suggest it is simplest to anchor all temporal expressions to the Topic Situation if no conflict arises.

Beyond exploring potentially different types of restrictors, we think understanding how Topic Situations work in discourse is important for what might be called ‘frame size management’. Consider a context in which an automobile has been introduced. It is easy to understand a sentence containing the steering wheel. The presupposition that a definite noun phrase has a unique referent is satisfied. However, a sentence containing the wheel (e.g., My god, the wheel just fell off) may require accommodation. The frame must be adjusted to contain a single wheel, the one that fell off. Speakers and authors are creating ‘small worlds’ and listeners and readers must be able to set up corresponding small worlds (perhaps at a cost in processing difficulty; Evans, 2006). Having a Topic Situation that provides a ‘partial world of appropriate size may facilitate (or even eliminate the need for) accommodation to the presuppositions of referring phrases.

The interplay of Topic Situations and accommodation may, however, have some interesting complications. Consider (21):

(21) a. At the mall, Mia bought another jacket.
   b. Mia bought another jacket at the mall.

The phrase ‘another jacket’ presupposes that Mia had bought a jacket previously, and (out of the blue) this presupposition must be accommodated. Intuitions suggest that (21a) conveys that Mia had already bought another jacket somewhere other than at the mall, while (21b) is easy to interpret as suggesting that she had bought the first jacket at the mall. It is possible that the presupposition of another tends to be satisfied outside the Topic Situation. In other words, having computed a Topic Situation, that situation may serve as the most natural way to individuate situations for other purposes such as for presupposition satisfaction. Of course further work is needed to pin this down in detail.

The intuitions are subtle. But notice that if the generalization is anything like what we’ve claimed for (21) it would be another case of sentences containing topic situations, sentences with initial temporal or locative PPs, having more limited interpretations than the interpretations available to counterparts without initial temporal or locative PPs.

In very general terms, introducing a Topic Situation may provide one particular source of discourse coherence. In one influential approach to discourse coherence (Kehler, 2002), each sentence introduces a proposition. These propositions are connected by drawing inferences about the connections between propositions. In Kehler’s own formulation, this process is aided by certain highly available discourse coherence relations, e.g., resemblance and cause. What we propose here is that sentences with an initial locative or temporal PP (and canonical syntax in the rest of the sentence) achieve coherence in a different manner. The form of the input has set up an expectation for a situation to be elaborated without the need for extensive content driven inferencing. Rather, as stated in (6), the default or conventional use of language would involve an inclusion relation: coherence is achieved by making the following material part of the description of the Topic Situation (a subsituation).

Conclusions

It has been argued that initial temporal and locative PPs in English are special. Besides signaling a shift from one discourse segment to another (Bestgen & Costermans, 1994; Bestgen & Vonk, 2000), they introduce a Topic Situation which then preferentially scopes over following material. This has an impact on the implicit restrictors that are inferred by comprehenders. Taking subsequent material to be part of the Topic Situation also narrows the interpretations possible for subsequent phrases, e.g., the temporal phrases in Experiments 4 and 5. Many questions remain open. Our emphasis has been on the Topic Situations introduced by initial temporal and locative PPs but questions must ultimately be posed concerning other ways of introducing and limiting Topic Situations. Questions also remain about the effects of having an explicit Topic Situation on the interpretation of time-dependent phrases and on accommodation of different kinds of presuppositions. The present results also raise but do not answer the question of the extent to which semantic scope can be identified with being in the domain of a Topic Situation.

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Appendix A. Materials used in Experiment 1

(All items were following by a question of the form “How likely is it that [the subject of the second sentence] was at [the location specified in the first sentence]”)

1 At the Farmer’s Market, the lettuce lady was talking about new discount cards. The musicians were playing loudly.
   The lettuce lady at the Farmer’s Market was talking about new discount cards. The musicians were playing loudly.

2 At the department store, the salesclerks chatted all day long. The shoppers kept to themselves.
   The salesclerks at the department store chatted all day long. The shoppers kept to themselves.

3 Near the car wash, the employee was screaming at a drunk. The onlooker was looking irked.
   The employee near the car wash was screaming at a drunk. The onlooker was looking irked.

4 In the local grocery store, the housewife shopped with her kids. Her friend was helping her out.
   The housewife in the local grocery store shopped with her kids. Her friend was helping her out.

5 The salesclerks chatted at the department store all day long. The shoppers kept to themselves.
   The salesclerks chatted at the department store all day long. The shoppers kept to themselves.
5 Near the mall entrance, the shopkeeper kept track of some suspicious characters. The cop was busy on an iPad. The shopkeeper near the mall entrance kept track of some suspicious characters. The cop was busy on an iPad. The shopkeeper kept track near the mall entrance of some suspicious characters. The cop was busy on an iPad.

6 At the basketball game, the starting forward suffered due to his ankle. The guard had a torn tendon. The starting forward at the basketball game suffered due to his ankle. The guard had a torn tendon. The starting forward suffered at the basketball game due to his ankle. The guard had a torn tendon.

7 Near the pool, the girl played happily. The boy dug in the sandbox. The girl near the pool played happily. The boy dug in the sandbox. The girl played happily near the pool. The boy dug in the sandbox.

8 In the kitchen, the electrician fiddled around. The house wife cleaned. The electrician in the kitchen fiddled around. The house wife cleaned. "The electrician fiddled around in the kitchen. The house wife cleaned.

9 At the school, the custodian checked things out. The cop looked around the sports arena. The custodian at the school checked things out. The cop looked around the sports arena. The custodian checked things out at the school. The cop looked around the sports arena.

10. At the cheese shop, the proprietor took inventory. The young man eyed the beautiful customer. The proprietor at the cheese shop took inventory. The young man eyed the beautiful customer. The proprietor took inventory at the cheese shop. The young man eyed the beautiful customer.

11 In the meadow, the children ran around. The teenager talked on the phone. The children in the meadow ran around. The teenager talked on the phone. The children ran around in the meadow. The teenager talked on the phone.

12 In the library, the librarian looked around very carefully. The stuffy professor kept his nose in his books. The librarian in the library looked around very carefully. The stuffy professor kept his nose in his books. The librarian looked around very carefully in the library. The stuffy professor kept his nose in his books.

13 Near the supermarket, the pedestrian was screaming her lungs out. The drivers were honking furiously. The pedestrian near the supermarket was screaming her lungs out. The drivers were honking furiously. The pedestrian was screaming her lungs out near the supermarket. The drivers were honking furiously.

14 Near the administration building, the students were protesting peacefully. The secretaries were on their phones. The students near the administration building were protesting peacefully. The secretaries were on their phones. The students were protesting peacefully near the administration building. The secretaries were on their phones.

15 Near the barn, the farmer was talking to himself. The salesman was amused. The farmer near the barn was talking to himself. The salesman was amused. The farmer was talking to himself near the barn. The salesman was amused.

Appendix B. Materials used in Experiment 2

(Each item was followed by a question of the form "According to your understanding of that discourse, was the [subject of the second sentence] in the [location mentioned in the first sentence] when [he/she verb phrase of the second sentence]")

1. In the junkyard, the woman emptied a trash can. The man baked some cookies. The woman emptied a trash can in the junkyard. The man baked some cookies. In the apartment next door, the woman emptied a trash can. The man baked some cookies. The woman emptied a trash can in the apartment next door. The man baked some cookies.

2. In the jail cell, the old man swept the floor. A young man varnished a cabinet. The old man swept the floor in the jail cell. A young man varnished a cabinet. In the workshop, the old man swept the floor. A young man varnished a cabinet.

3. In the parked limousine, the young woman sipped some wine. A violin played some soft music. The young woman sipped some wine in the parked limousine. A violin played some soft music. In the swanky restaurant, the young woman sipped some wine. A violin played some soft music. The young woman sipped some wine in the swanky restaurant. A violin played some soft music.

4. On the roller coaster, the elderly lady held on to her purse. A teenager checked her e-mail account. The elderly lady held on to her purse on the roller coaster. A teenager checked her e-mail account. On the commuter train, the elderly lady held on to her purse. A teenager checked her e-mail account. The elderly lady held on to her purse on the commuter train. A teenager checked her e-mail account.

5. In the grocery store, the woman bought some peanuts. A distinguished gentleman let his dog off the leash. The woman bought some peanuts in the grocery store. A distinguished gentleman let his dog off the leash. In the local park, the woman bought some peanuts. A distinguished gentleman let his dog off the leash. The woman bought some peanuts in the local park. A distinguished gentleman let his dog off the leash.

6. In the darkened auditorium, the saleswoman checked her iPad. The executive read some memos. The saleswoman checked her iPad in the darkened auditorium. The executive read some memos. In the boring meeting, the saleswoman checked her iPad. The executive read some memos. The saleswoman checked her iPad in the boring meeting. The executive read some memos.

7. At the celebration in the church, the grown-ups drank iced tea. The teenagers played frisbee. The grown-ups drank iced tea at the celebration in the church. The teenagers played frisbee. At the celebration in the school gym, the grown-ups drank iced tea. The teenagers played frisbee. The grown-ups drank iced tea at the celebration in the school gym. The teenagers played frisbee.
8. In the park, the elderly artist sketched a drawing. The youngsters watched a TV presentation.

The elderly artist sketched a drawing in the park. The youngsters watched a TV presentation.

In the museum, the elderly artist sketched a drawing. The youngsters watched a TV presentation.

The elderly artist sketched a drawing in the museum. The youngsters watched a TV presentation.

9. In the parking lot, the guitarist practiced all day. A cellist played a Bach prelude.

The guitarist practiced all day in the parking lot. A cellist played a Bach prelude.

In the music hall, the guitarist practiced all day. A cellist played a Bach prelude.

The guitarist practiced all day in the music hall. A cellist played a Bach prelude.

10. In the machine shop, the teenage girl had a tantrum. The hairdresser was calm as always.

The teenage girl had a tantrum in the machine shop. The hairdresser was calm as always.

On the movie set, the teenage girl had a tantrum. The hairdresser was calm as always.

The teenage girl had a tantrum on the movie set. The hairdresser was calm as always.

11. At the gas station, the high school student looked for snacks. The college student searched for videos.

The high school student looked for snacks at the gas station. The college student searched for videos.

At the library, the high school student looked for snacks. The college student searched for videos.

The high school student looked for snacks at the library. The college student searched for videos.

12. At the business meeting, the accountant announced the new tax laws. The receptionist read People Magazine.

The accountant announced the new tax laws at the business meeting. The receptionist read People Magazine.

At the office building, the accountant announced the new tax laws. The receptionist read People Magazine.

The accountant announced the new tax laws at the office building. The receptionist read People Magazine.

13. At the funeral, the teenager cried softly. The 9-year old sang in a loud voice.

The teenager cried softly at the funeral. The 9-year old sang in a loud voice.

At the party, the teenager cried softly. The 9-year old sang in a loud voice.

The teenager cried softly at the party. The 9-year old sang in a loud voice.

14. At the scientific conference, the reporter interviewed the biologist. A disk jockey played some rap music.

The reporter interviewed the biologist at the scientific conference. A disk jockey played some rap music.

At the radio station, the reporter interviewed the biologist. A disk jockey played some rap music.

The reporter interviewed the biologist at the radio station. A disk jockey played some rap music.

15. At the football game, the salesman drove up in a Volvo. The announcer went on about the beauty of the new Mercedes.

The salesman drove up in a Volvo at the football game. The announcer went on about the beauty of the new Mercedes.

At the auto show, the salesman drove up in a Volvo. The announcer went on about the beauty of the new Mercedes.

The salesman drove up in a Volvo at the auto show. The announcer went on about the beauty of the new Mercedes.

16. At the tennis match, the pretty woman took a short nap. A sax player played a solo.

The pretty woman took a short nap at the tennis match. A sax player played a solo.

At the jazz concert, the pretty woman took a short nap. A sax player played a solo.

The pretty woman took a short nap at the jazz concert. A sax player played a solo.

17. At the charity hospital, the reporter investigated an arrest. The guards locked up the embezzler.

The reporter investigated an arrest at the charity hospital. The guards locked up the embezzler.

At the jailhouse, the reporter investigated an arrest. The guards locked up the embezzler.

The reporter investigated an arrest at the jailhouse. The guards locked up the embezzler.

18. At the banquet, the visitors ate a delicious lunch. The marine biologist dissected an octopus.

The visitors ate a delicious lunch at the banquet. The marine biologist dissected an octopus.

At the aquarium, the visitors ate a delicious lunch. The marine biologist dissected an octopus.

The visitors ate a delicious lunch at the aquarium. The marine biologist dissected an octopus.

19. At the elegant restaurant, the middle school student had a hamburger. The well-dressed gentleman ordered a milkshake.

The middle school student had a hamburger at the elegant restaurant. The well-dressed gentleman ordered a milkshake.

At MacDonalds, the middle school student had a hamburger. The well-dressed gentleman ordered a milkshake.

The middle school student had a hamburger at MacDonalds. The well-dressed gentleman ordered a milkshake.

20. At the symphony, the elderly man adjusted his necktie. The toddler banged on a toy drum.

The elderly man adjusted his necktie at the symphony. The toddler banged on a toy drum.

At the birthday party, the elderly man adjusted his necktie. The toddler banged on a toy drum.

The elderly man adjusted his necktie at the birthday party. The toddler banged on a toy drum.

Appendix C. Materials used in Experiment 3

(all items contained a 7-point rating scale and the question: On a scale of 1–7, how natural was that discourse?)
Melissa checked out an art history book at the library. Tom found an
interesting DVD.
5 At the police station, Melvin asked about the winter parking
policy. Lisa went out dancing.
Melvin asked about the winter parking policy at the police station.
Lisa went out dancing.
At the police station, Melvin asked about the winter parking policy.
Lisa started fidgeting.
Melvin asked about the winter parking policy at the police station.
Lisa started fidgeting.
6 At the book sale, the League of Women Voters sold Maria 20 used
books for a reasonable price. John bought a motorcycle.
The League of Women Voters sold Maria 20 used books for a rea-
sonable price at the book sale. John bought a motorcycle.
At the book sale, the League of Women Voters sold Maria 20 used
books for a reasonable price. John bought comic books.
The League of Women Voters sold Maria 20 used books for a rea-
sonable price at the book sale. John bought comic books.
7 At the golf course, the dentist played 9 holes. The assistant went
home.
The dentist played 9 holes at the golf course. The assistant went
home.
At the golf course, the dentist played 9 holes. The assistant went
to the clubhouse.
The dentist played 9 holes at the golf course. The assistant went
to the clubhouse.
8 At the cafe, Maria ordered a caramel latte. Sam bought tickets to a
concert.
Maria ordered a caramel latte at the cafe. Sam bought tickets to a
concert.
At the cafe, Maria ordered a caramel latte. Sam bought a cheese
panino.
Maria ordered a caramel latte at the cafe. Sam bought a cheese
panino.
9 At Yosemite National Park, Fritz spent his time mountain
climbing. Carla sang karaoke.
Fritz spent his time mountain climbing at Yosemite National Park.
Carla sang karaoke.
At Yosemite National Park, Fritz spent his time mountain clim-
bing. Carla mostly hiked.
Fritz spent his time mountain climbing at Yosemite National Park.
Carla mostly hiked.
10 At the White House, Attorney General Sessions met with the
press. His assistant swam in the swimming pool.
Attorney General Sessions met with the press at the White House.
His assistant swam in the swimming pool.
At the White House, Attorney General Sessions met with the press.
His assistant gave an interview to PBS.
Attorney General Sessions met with the press at the White House.
His assistant gave an interview to PBS.
11 At the funeral, the widow adjusted her head covering. The de-
ceased's son had a stiff drink.
The widow adjusted her head covering at the funeral. The deceased's
son had a stiff drink.
The widow adjusted her head covering at the funeral. The deceased's
son had a stiff drink.
The widow adjusted her head covering at the funeral. The deceased's
son had a stiff drink.
12 At the exhibition, Karen studied every painting. Daniel photo-
graphed the cars on the highway.
Karen studied every painting at the exhibition. Daniel photographed
the cars on the highway.
At the exhibition, Karen studied every painting. Daniel photo-
graphed the museum visitors.
Karen studied every painting at the exhibition. Daniel photographed
the museum visitors.
13 At the reception, the CEO gave a speech. His assistant left work
early.
The CEO gave a speech at the reception. His assistant left work
early.
At the reception, the CEO gave a speech. His assistant offered drinks.
The CEO gave a speech at the reception. His assistant offered drinks.
14 At the rodeo, Johnny watched the cowboys roping steers. Mara
took a French lesson.
Johnny watched the cowboys roping steers at the rodeo. Mara took
a French lesson.
At the rodeo, Johnny watched the cowboys roping steers. Mara took
a riding lesson.
Johnny watched the cowboys roping steers at the rodeo. Mara took
a riding lesson.
15 At the party, Julie asked Rex to dance. Marie worked on her math
assignment.
Julie asked Rex to dance at the party. Marie worked on her math
assignment.
At the party, Julie asked Rex to dance. Marie practiced her latin
dance steps.
Julie asked Rex to dance at the party. Marie practiced her latin
dance steps.
16 At Beth Israel hospital, the child had her broken arm set. Her
mother finished a game of pool.
The child had her broken arm set at Beth Israel hospital. Her mother
finished a game of pool.
At Beth Israel hospital, the child had her broken arm set. Her mother
hovered nearby.
The child had her broken arm set at Beth Israel hospital. Her mother
hovered nearby.
17 At Kennedy airport, Lucy ran to catch her plane. Her babysitter
went skiing in Colorado.
Lucy ran to catch her plane at Kennedy airport. Her babysitter went
skiing in Colorado.
At Kennedy airport, Lucy ran to catch her plane. Her babysitter
barely kept up with her.
Lucy ran to catch her plane at Kennedy airport. Her babysitter
barely kept up with her.
18 In the woods, Barbara built a campfire. Jack updated his com-
puter's operating system.
Barbara built a campfire in the woods. Jack updated his computer's
operating system.
In the woods, Barbara built a campfire. Jack looked for a flat spot to
pitch a tent.
Barbara built a campfire in the woods. Jack looked for a flat spot to
pitch a tent.
19 At the beach, Susie put on some sunscreen. Fred did his tax re-
turns.
Susie put on some sunscreen at the beach. Fred did his tax returns.
At the beach, Susie put on some sunscreen. Fred did some body
surfing.
Susie put on some sunscreen at the beach. Fred did some body
surfing.
20 At the shopping mall, Betsy tried to find a nice jacket. Sally
washed her hair.
Betsy tried to find a nice jacket at the shopping mall. Sally washed
her hair.
At the shopping mall, Betsy tried to find a nice jacket. Sally got some
cosmetics.
Betsy tried to find a nice jacket at the shopping mall. Sally got some
cosmetics.

Appendix D. Materials used in Experiment 4a

1 At the interview, they asked tough questions yesterday morning.
At the interview yesterday morning, they asked tough questions.
2 At the wedding rehearsal, they seated us up front last night. At the wedding rehearsal last night, they seated us up front.
3 At the victory party, they praised the athletes last evening. At the victory party last evening, they praised the athletes.
4 At the birthday party they served sugar-free cake yesterday. At the birthday party yesterday, they served sugar-free cake.
5 At the school play, they fell asleep last week. At the school play last week, they fell asleep.
6 At the traffic ticket hearing, they let the driver go free last night. At the traffic ticket hearing last night, they let the driver go free.
7 At the bar mitzvah, they played interesting music last week. At the bar mitzvah last week, they played interesting music.
8 At the Christmas party, they handed out bonuses last week. At the Christmas party last week, they handed out bonuses.
9 At the 4th of July celebration, they lit fireworks yesterday. At the 4th of July celebration yesterday, they lit fireworks.
10 At the ball, they checked the invitations last night. At the ball last night, they checked the invitations.
11 At the celebration, they danced a polka last week. At the celebration last week, they danced a polka.
12 At the marathon, they cheered the runners yesterday morning. At the marathon yesterday morning, they cheered the runners.
13 At the movie, they gave away free popcorn yesterday. At the movie yesterday, they gave away free popcorn
14 At the graduation ceremony, they had 200 faculty in attendance yesterday. At the graduation ceremony yesterday, they had 200 faculty in attendance.
15 At the election, they scrutinized IDs last Wednesday. At the election last Wednesday, they scrutinized IDs.
16 At the Black Friday sale, they sold out of Xboxes yesterday. At the Black Friday sale yesterday, they sold out of Xboxes.
17 At the Black Friday sale, they sold out of Xboxes at noon. At noon of the Black Friday sale, they sold out of Xboxes.
18 The 4th of July celebration, they lit fireworks yesterday. At the 4th of July celebration yesterday, they lit fireworks.

Appendix E. Adverbs added to the Experiment 4a items in Experiment 4b (note, the last four adverbs were used with the first two conditions of items 13–16 from Experiment 5)

Repeatedly, intentionally, loudly, proudly, quickly, unexpectedly, quietly, ostentatiously, excitedly, carefully, energetically, enthusiastically

Appendix F. Materials used in Experiment 5

1 At the interview, they asked tough questions yesterday morning. At the interview yesterday morning, they asked tough questions.
2 At the interview, they asked tough questions at the start. At the start of the interview, they asked tough questions.
3 At the wedding rehearsal, they seated us up front last night. At the wedding rehearsal last night, they seated us up front.
4 At the beginning of the wedding rehearsal, they welcomed us at the beginning. At the beginning of the wedding rehearsal, they welcomed us at the beginning.
5 At the school play, they fell asleep last week. At the school play last week, they fell asleep.
6 At the traffic ticket hearing, they let the driver go free last night. At the traffic ticket hearing last night, they let the driver go free.
7 At the bar mitzvah, they played interesting music last week. At the bar mitzvah last week, they played interesting music.
8 At the Christmas party, they handed out bonuses last week. At the Christmas party last week, they handed out bonuses.
9 At the Christmas party, they handed out bonuses after the champagne. At the Christmas party, they handed out bonuses after the champagne.