Discourse Processes

ISSN: 0163-853X (Print) 1532-6950 (Online) Journal homepage: https://www.tandfonline.com/loi/hdsp20

Distraction and Temporal Order in Narrative Situation Models

Peter Dixon & Ana Sharma

To cite this article: Peter Dixon & Ana Sharma (2019) Distraction and Temporal Order in Narrative Situation Models, Discourse Processes, 56:5-6, 402-414, DOI: 10.1080/0163853X.2019.1609742

To link to this article: https://doi.org/10.1080/0163853X.2019.1609742

Published online: 26 May 2019.

Submit your article to this journal

Article views: 66

View Crossmark data

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=hdsp20

DISCOURSE PROCESSES
2019, VOL. 56, NOS. 5–6, 402–414
https://doi.org/10.1080/0163853X.2019.1609742

Routledge
Taylor & Francis Group

Check for updates

Distraction and Temporal Order in Narrative Situation Models

Peter Dixon and Ana Sharma

Department of Psychology, University of Alberta, Edmonton, Canada

ABSTRACT
Narrative comprehension requires the allocation of resources to the construction of a situation model describing the events and circumstances in the narrative. While mind wandering, fewer resources may be devoted to this task. In the present research, we assessed whether the effects of distraction on memory for narrative event order are qualitatively similar to those of mind wandering. In two experiments, participants read passages, sometimes with auditory noise, and after each passage rated the extent to which they were on task. Both auditory noise and spontaneous mind wandering affected temporal order judgements for narrative events. However, noise also decreased on-task rating, and temporal order memory was a linear function of on-task rating regardless of auditory noise condition. We conclude that the effects of spontaneous mind wandering and auditory noise on memory for temporal order can both be understood as a withdrawal of resources devoted to situation model construction.

Introduction

Comprehension of narrative is commonly assumed to depend on the construction of a situation model describing the events and circumstances in the narrative (e.g., Van Dijk & Kintsch, 1983). Several researchers have argued that while mind wandering, fewer resources are devoted to the construction of a situation model. We developed this idea in the present research by evaluating whether the effects of mind wandering are comparable with other manipulations that might be expected to similarly reduce the resources devoted to situation models. In particular, we assessed whether the effects of auditory distraction are qualitatively similar to those of mind wandering.

Mind wandering has often been argued to affect the development of situation models during comprehension. For example, Smallwood, McSpadden, and Schooler (2008) found that participants who were mind wandering were less likely to make critical situation-model inferences in understanding a mystery story. Dixon and Bortolussi (2013) suggested that the use of resources was critical in developing a situation model retrieval structure (cf. Ericsson & Kintsch, 1995). As a consequence, failing to allocate such resources while mind wandering would be seen particularly in recall measures of passage memory compared with recognition. To the extent that active executive control is involved in developing a situation model, the failure of executive control during mind wandering (e.g., Kane & McVay, 2012) would lead to an impoverished situation model. Thus, there may be good reason to believe that mind wandering depletes the central resources needed to develop a situation model representation. In keeping with that analysis, McVay and Kane (2012) found that the relationship between working memory capacity and reading comprehension was mediated in part by attentional control over task-unrelated thoughts.

Auditory distraction has also been demonstrated to have adverse effects on comprehension. For example, Zeamer and Fox Tree (2013) found that auditory noise interfered with the recall of a short

CONTACT Peter Dixon peter.dixon@ualberta.ca Department of Psychology, University of Alberta, Edmonton, Alberta, Canada T6G 2E9.

© 2019 Taylor & Francis Group, LLC

lecture. More generally, chronic aircraft noise has been shown to have detrimental effects on reading comprehension (Clark et al., 2006). One interpretation is that such distraction effects occur because readers have fewer resources to devote to comprehension and, presumably, fewer resources to devote to the development of a situation model. Indeed, Stawarczyk, Majerus, Maj, Van der Linden, and D'Argembeau (2011) found that thinking about external distractions affected performance in the sustained attention to response task, just as mind wandering did. Thus, one analysis is that both mind wandering and distraction have their effect on situation model construction by reducing resources.

An alternative hypothesis is that mind wandering and auditory distraction have distinct effects. For example, it might be reasonable to suppose that distracting stimuli have a relatively peripheral effect on the processing of lexical items. For example, speech stimuli might affect the phonological processing of words in the text (Besner, 1987; Owen & Borowsky, 2003). Consistent with this possibility, Unsworth and McMillan (2014) investigated the relationship between external distraction and mind wandering as measured by thought probes in an individual-differences study. They found that the two measures of participants' mental state were related but partially dissociable. Robison and Unsworth (2015) manipulated external distraction by comparing a silent and a noise-filled reading condition. They found that distraction added to the comprehension difficulties of mind wandering but that the role of working memory differed in the two conditions. Together, these results suggest that distraction and mind wandering may have somewhat different effects on comprehension and might not both be conceptualized as depleting resources for situation model development.

Our focus in the present research was on the situation model dimension of time. Temporal information is important in a situation model representation for two reasons. First, temporal information is critical to parsing events. For example, Zwaan, Magliano, and Graesser (1995) found that reading time tended to increase when there were discontinuities on the dimension of time (as well as discontinuities in space and causation). One interpretation of this result is that such discontinuities signaled event boundaries with consequent implications for the situation model representation. Zwaan (1996) similarly demonstrated that reading time was sensitive to the duration of time shifts. However, some of these reading time effects may be determined by expectancy based on causal structure rather than temporal information per se (Pettijohn & Radvansky, 2016).

Second, temporal information can be used to organize sequences of events in a situation model. Some event-ordering constraints are related to causal relationships. For example, an event may be represented as the cause of a second event if it precedes the second but not otherwise. However, in general, causal relationships do not suffice to determine the order of events in a narrative, and the situation model must contain other information about the order of events to maintain coherence. Consistent with this idea, Radvansky, Zwaan, Federico, and Franklin (1998) found that temporal information was used to organize events in a situation model. Moreover, temporal order information is crucial for coherent recall of a story. Our assumption is that the construction of a representation containing this temporal information is resource demanding and should suffer with mind wandering or external distraction.

In the present article we describe two experiments that assess whether auditory distraction and mind wandering have comparable effects on situation model information concerning temporal order. In both experiments, participants read a narrative with a series of events and then were tested on their memory for the order in which those events occurred. We argue that temporal order memory for these narrative events is central to readers being able to construct a coherent representation of the events in the narrative and is thus an important component of narrative comprehension. While reading half of the narratives, participants listened to an auditory message that we deemed to be maximally distracting: multiple voices reading similar narratives. After being tested for memory for temporal order, participants rated the extent to which they were on task. The two experiments differed in whether the auditory distraction was also played during memory testing (Experiment 1) or not (Experiment 2).

Experiment 1

In this experiment, participants read eight-sentence narratives that described a sequence of events. The structure of the narratives is illustrated in Table 1. Each narrative began with an introductory sentence and ended with a concluding sentence. In between were six sentences describing events. The first, fourth, fifth, and sixth event were designed to be interchangeable so they could appear in any order without disrupting the coherence of the passage. The second and third were semantically constrained to appear in that particular order. The method we used to assess temporal order entailed presenting two events from the narrative and testing recognition memory for the order. Given the structure of the narratives, we could use three types of memory judgements: adjacent, distant, and constrained. Adjacent event pairs were the events that appeared fourth and fifth in the narrative; we expected these to be the most difficult because they occurred close together in time. Distant pairs appeared first and last; these should be easier. Finally, constrained event pairs appeared second and third in the narrative but included semantic cues to the order; we expected these to be easiest.

Our central research question was whether auditory noise would detract from memory for temporal order in the same way as mind wandering. Consequently, after each passage participants were given on-task probes in which they rated the extent to which they were processing the comprehension task or were thinking of something else. Presumably, the noise would lead people to be less task focused, resulting in weaker temporal order memory. If the effect of both of these variables was to decrease the resources devoted to situation model construction, memory performance should have the same relationship to on-task focus as spontaneous mind wandering. In contrast, if mind wandering and distraction affect situation model processing differently, the same loss of focus could have different effects depending on the source. For example, situation model representations might be particularly susceptible to mind wandering (or, perhaps, to auditory distraction) relative to other components of comprehension.

Methods

Participants read short narrative passages sentence by sentence. After each passage they made a series of temporal order judgements and rated the extent to which they were on task. Reading and temporal order judgements either could be in quiet conditions or with conversational noise heard over headphones.

Materials

The passages were eight sentences long and had the structure illustrated in Table 1. Sentence 1 was an introduction and sentence 8 a conclusion. Sentences 3 and 4 always appeared in those positions and were constrained semantically to occur in that order. The other sentences could appear in any order. In the temporal order judgements, participants were presented with sentences 3 and 4 (the

Table 1. Example Stimulus Passage

Sentence Number	Sentence Type	Sentence
1	Introduction	Ria was glad she got out of work early and had time to take a hike by the valley.
2	Distant 1	She changed into her gym attire for the hike.
3	Constrained 1	She plugged in her iPod, which was dead, for charging so it would be ready when she left.
4	Constrained 2	She started uploading the latest songs on the iPod.
5	Adjacent 1	Ria made a protein shake for the hike.
6	Adjacent 2	She did some on-the-spot exercises to get in the zone.
7	Distant 2	She called her friend and asked whether she wanted to accompany her.
8	Conclusion	Ria eagerly left for the hike.

constrained pair), sentences 2 and 7 (the distant pair), and sentences 5 and 6 (the adjacent pair). There were a total of 24 passages concerning different activities (e.g., preparing for a hike, cleaning house, packing for a trip).

The semantic constraints in sentences 3 and 4 were of several different types. In most passages (17 of 24) sentence 3 described enabling conditions for sentence 4, in which the first event provided objects, conditions, or knowledge that was necessary for the second event (e.g., “Monica met with the director of the play in the auditorium where the drama would be. They went over the exact positioning of the props on stage.”). Six passages involved a typical order of events in an easily envisioned scenario (e.g., “She served main course at the dining table. Joanna asked the guests to get dessert and gather in the living area where the fire place was.”). Only one passage involved a clear causal link between the two events (“He realized he had an aisle seat in the plane, which he did not like. He went to see if his seat could be moved around.”).

Procedure

Participants read the passages sentence by sentence and moved to each succeeding sentence by pressing the space bar. After the last sentence in the passage, three temporal order judgements were made. In each case the question “Are these sentences presented in the correct order?” was near the top of the screen, and two sentences from the passage were presented near the middle, one above the other. Near the bottom of screen was a judgement scale consisting of a 14.6-cm long gray-scale bar with the labels “Definitely not in the correct order,” “Probably not in the correct order,” “Probably in the correct order,” and “Definitely in the correct order” arrayed underneath. Participants responded by using a mouse to click somewhere in the bar. This yielded a (nearly) continuous index of confidence measured in pixels, ranging from −285 to +285. After the temporal order judgements, an on-task probe was presented, consisting of the question “Were you fully focused on the task or were you thinking of something else?” and a similar 14.6-cm response bar with the labels, “Definitely thinking of something else,” “Thinking of something else to some extent,” “Focused on the task to some extent,” and “Definitely focused on the task,” arrayed underneath. Participants clicked in the bar to produce an on-task rating again in the range, −285 to +285.

During half of the passages conversational noise was presented on headphones. The noise consisted of three different female speakers simultaneously reading narratives comparable (but not identical) to the stimulus passages. (An example is shown in Table 2.) The noise stimuli were constructed by recording monaurally the three female speakers each reading a series of passages. The recordings were then superimposed, but with different random starting points (so the speakers did not start sentences at the same time). Eight such superimposed recordings were made with different starting points. One of eight different recordings was started with the onset of each sentence and temporal order judgement in the auditory noise conditions.

Design

The temporal order judgement items were balanced across participants in groups of four. Each of the three temporal order judgement types (distant, adjacent, constrained) could have its sentence pairs in either the correct or incorrect order. This meant there were eight possible arrangements of the sentence pairs for each passage. For the first participant, three passages were randomly assigned to

Table 2. Example Distractor Passage

Nikki worked in a coffee shop and she had a lot to do this morning.
She prepared the batter for doughnuts.
She cleaned all the coffee machines.
She brought out the newest holiday cups from the back.
Nikki went and bought more filters.
She arranged the tables for those who wanted to stay.
She cleaned the floors.
She was happy she could do it all on time.

each of these arrangements, for a total of 24 passages. The order of the three judgements was then randomized, and the order of events in the narrative was randomized for each passage (except for the semantically constrained sentences 3 and 4). Half of the passages were randomly assigned to the quiet condition and half to the noise condition. The second participant received the same materials (and assignment of passage to condition) but with the order of the sentences in each judgement reversed. The materials for the third and fourth participant were the same as the first and second except that the assignment of passage to the quiet and noise conditions was reversed. The presentation order of the passages was then randomized for each participant. There was also an initial practice passage (the same for all participants) that was presented in the quiet condition. This process was repeated for each succeeding group of four participants.

Participants

Forty-eight introductory psychology students served as participants in exchange for course credit. The sample size was set a priori based on experience with similar tasks, and no additional participants were run after the initial analysis.

Analysis

To examine both the effect of on-task response and quiet/noise condition, we divided the passages for each participant and auditory noise condition into relatively on-task passages and relatively off-task passages based on a median split of the on-task responses. We refer to this as the "task-focus" factor. The goal in constructing this factor was to identify spontaneous variation in on-task responses across passages, independent of the effects of noise and independent of individual subjects' overall level of focus. It would also have been possible to construct a comparable continuous measure by, for example, subtracting the mean for each subject and condition from the on-task response. However, we preferred the median split for ease of presentation. With the present approach, task focus and noise condition could be treated as orthogonal predictors of memory (although, as we describe below, the noise condition could affect the overall level of on-task responses).

We eschewed the use of significance testing because of the many well-known problems with this approach (e.g., Cohen, 1994; Dixon, 2003; Wagenmakers, 2007). To assess the evidence for different patterns of results, we compared the fit of nested linear models using likelihood ratios. The likelihood ratio is the ratio of the likelihood of the data given one model to the likelihood of the data given the other. Thus, very large (or very small) values of the likelihood ratio describe strong evidence in favor of one model over the other. Following the suggestion of Glover and Dixon (2004), we then adjusted this ratio for the varying number of parameters in the two models based on the Akaike information criterion (Akaike, 1973), a common approach to model selection. Using this adjusted likelihood ratio to assess the evidence is thus tantamount to selecting a theoretical interpretation based on Akaike information criterion values. By way of comparison, a model comparison with an adjusted likelihood ratio of about 3 would be equivalent to rejecting the null hypothesis with $p < .05$.

The memory confidence rating was used as an index of temporal order memory after reversing the score for sentences presented in the incorrect order. Models were fit using the program lmer (Bates, Maechler, Bolker, & Walker, 2015) running in the R statistical environment (R Core Team, 2016). All models of the temporal order judgements included the order of the sentences as a factor, and responses were assumed to vary randomly over both participants and passages.

Results

As shown in Figure 1 and Table 3, memory confidence was affected by the type of judgement, with constrained being easiest and adjacent being most difficult. (In the tables and figures standard errors are derived from variances of the parameter estimates in the fit of a full mixed-effect linear model. Because the different cell means are estimated from a common set of parameters, they will tend to have similar standard errors.) There was also a large effect of whether participants were on task for

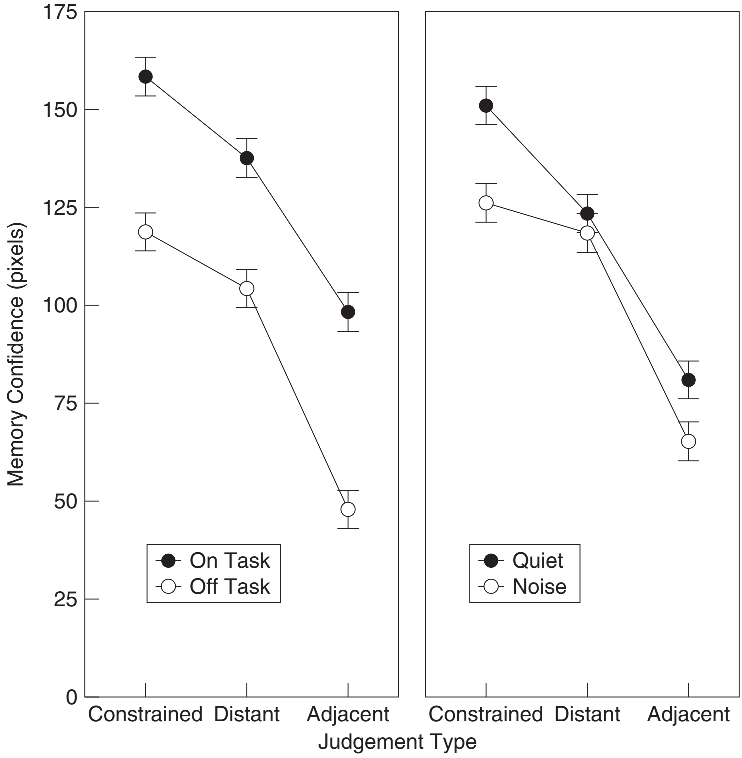

Figure 1. Temporal order confidence rating as a function of judgement type and on- and off-task passages (left) and noise condition (right) in Experiment 1. Error bars represent an estimate of the standard error of the mean derived from the parameter standard error in a full model fit.

Table 3. Temporal Order Confidence Judgements in Pixels in Experiment 1

		Judgement Type		
Task Focus	Condition	Constrained	Distant	Adjacent
On task	Noise	147.2 (7.7)	128.3 (7.7)	96.5 (7.8)
Off task	Noise	110.1 (7.3)	106.4 (7.3)	33.9 (7.4)
On task	Quiet	173.8 (7.3)	148.1 (7.3)	99.8 (7.3)
Off task	Quiet	130.1 (7.3)	106.0 (7.3)	68.4 (7.3)

Values in parentheses are standard errors.

that passage and a smaller effect of quiet/noise condition. There was little indication of any interactions among these effects.

This interpretation was supported by the fit of nested linear models. A model that included the effect of judgement type was substantially better than a model that simply included an effect of sentence order, $\lambda_{adj} > 1{,}000$. Adding the effect of on-task/off-task passages was better still, $\lambda_{adj} > 1{,}000$. Finally, adding the effect of condition also improved the model, $\lambda_{adj} = 147.68$. Adding interactions between judgement type and on/off task, between judgement type and condition, between on/off task and condition, and the three-way interaction failed to improve the model ($\lambda_{adj} = 0.45$, 0.85, 0.38, and 0.79, respectively).

Table 4 shows the effects of condition on on-task probe response, broken down by relatively on- and off-task passages within each condition. On-task responses were greater in the quiet condition than in the noise condition for both passages that were relatively on task and those that were relatively off task. (Of course, the on-task responses must differ as a function of task

Table 4. On-Task Response in Pixels in Experiment 1

	Condition	
Task Focus	Noise	Quiet
On task	108.6 (2.5)	174.6 (2.4)
Off task	−45.2 (2.4)	33.5 (2.4)

Values in parentheses are standard errors.

focus because of the way in which the task-focus variable was constructed. However, it was retained in this analysis to assess the evidence for an interaction with noise condition.) This pattern was supported by the fit of nested linear models. A model that included the effect of condition was better than a model with only the effect of task focus, $\lambda_{adj} > 1{,}000$. There was some evidence for an interaction in which the effect of condition was larger among relatively off-task passages, $\lambda_{adj} = 4.56$.

Because on-task reports varied with quiet/noise condition, it is possible that the effect of condition on memory was due to variations in whether participants were on task. Figure 2 depicts the relation between on-task response and memory performance across quiet/noise conditions. As can be seen, on-task reports provide a simple and parsimonious interpretation of the effects of condition: With noise, participants were less on task (as indicated by their reports) and their memory performance was correspondingly worse. Indeed, a contrast based on the variation in on-task reports across the four groups depicted in Figure 2 provided an accurate account of the effects on memory performance, and there was no improvement with the addition of condition, $\lambda_{adj} = 0.61$.

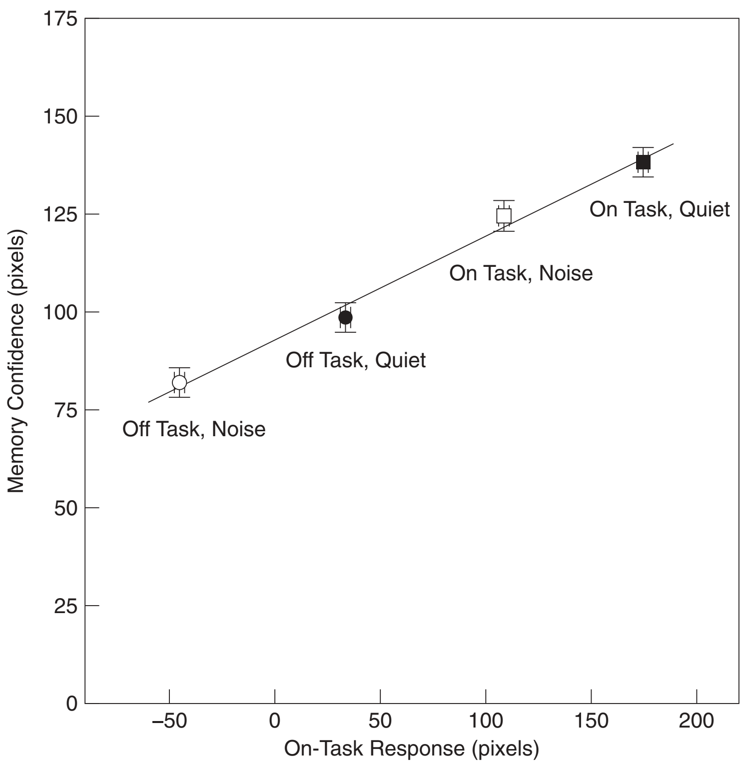

Figure 2. Temporal order confidence rating as a function of on-task response in Experiment 1. Error bars represent an estimate of the standard error of the mean derived from the parameter standard error in a full model fit.

Discussion

The results suggest that the effect of noise distraction is not appreciably different from the effect of endogenous mind wandering. In both cases the effect seems to occur with all three types of memory judgements (although the effect of distraction is smaller). As well, temporal memory was a linear function of on-task rating, regardless of whether readers were distracted internally or externally. These results are consistent with the analysis that the encoding and retention of temporal order information in the situation model is a function of the resources available during comprehension and that allocation of resources to other processing will have the same impact on memory for that information. In contrast, one might not have expected this pattern of results if auditory distraction and mind wandering affected mental model processing differently. For example, if auditory distraction had relatively peripheral effects, it is likely that the effect on temporal order memory would be smaller than the effect of mind wandering (given comparable levels of task focus).

Before considering the broader implications of this result, we note one aspect of the procedure that might limit the interpretation: When noise was played during the reading of a passage, it was also played during the memory test for that passage. This was done to maximize the perceptual similarity between the presentation of the material and its later test. However, it raises the possibility that the effects of noise were on the retrieval of temporal information, not its encoding during reading. This alternative possibility is considered in Experiment 2.

Experiment 2

The second experiment was exactly the same as Experiment 1 except that when a passage was in the noise condition, the noise was only played during the reading of the passage, not the temporal order test. If the effects of noise observed previously were on encoding, the results should be similar. On the other hand, if noise has its effect during test, the effect of noise should be eliminated in these new conditions.

Methods

Experiment 2 was identical to Experiment 1 except that the noise recordings were only played during the presentation of the narrative sentences and not during the temporal order judgements.

Design

Similar to Experiment 1, the materials were balanced across pairs of participants. For the first participant in a pair, three passages were assigned to each of the eight possible orderings of the two sentences across the three temporal order judgements, for a total of 24 passages. The order of the three judgements was then randomized, and the order of events in the narrative was randomized for each passage (except for the semantically constrained sentences 3 and 4). Half of the passages were randomly assigned to the quiet condition and half to the noise condition. The second participant received the same materials (and assignment of passage to condition) but with the order of the sentences in each judgement reversed.

Participants

Participants were 24 undergraduates (who did not participate in Experiment 1) who participated in exchange for course credit. (An additional 24 participants were also run, but because of a programming error, these participants received noise during the testing, regardless of the condition in which the passage was read. Data from these participants are not reported.) The originally intended sample size of 48 was set a priori based on experience with similar tasks, and no additional participants were run after the initial analysis.

Results

As shown in Figure 3 and Table 5, memory confidence was affected by the type of judgement, just as in Experiment 1. Also, as in Experiment 1, there was a large effect of whether participants were on task for that passage and a smaller effect of quiet/noise condition. There was little indication of any interactions among these effects.

This interpretation was supported by the fit of nested linear models. A model that included the effect of judgement type was substantially better than a model that simply included an effect of sentence order, $\lambda_{adj} > 1{,}000$. Adding the effect of on-task/off-task passages was better still, $\lambda_{adj} > 1{,}000$. Finally, adding the effect of condition also improved the model, $\lambda_{adj} = 46.26$. Adding interactions between judgement type and on/off task, between judgement type and condition, between on/off task and condition, and the three-way interaction failed to improve the model substantially (λ_{adj} = 2.05, 0.86, 0.38, and 1.57, respectively).

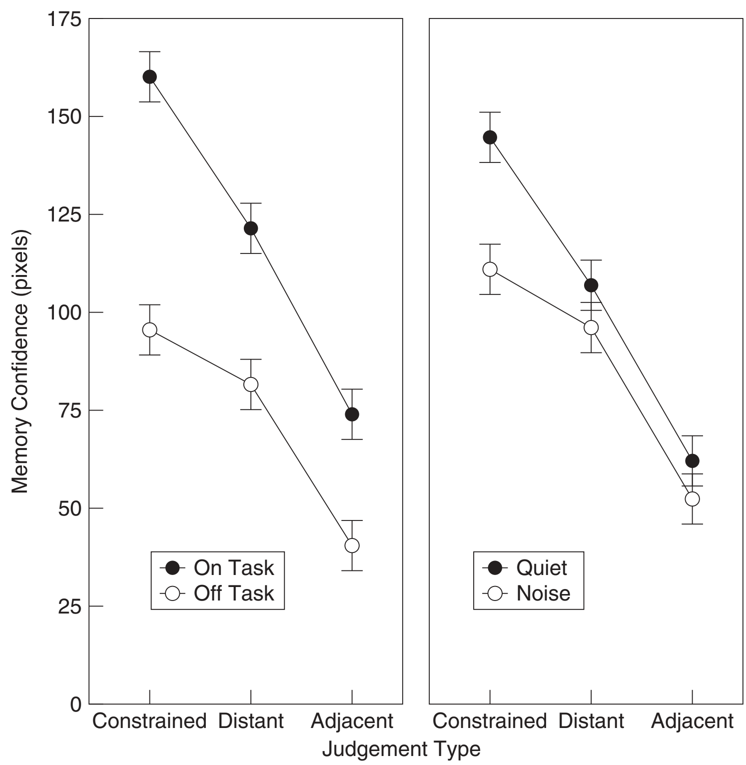

Figure 3. Temporal order confidence rating as a function of judgement type and on- and off-task passages (left) and noise condition (right) in Experiment 2. Error bars represent an estimate of the standard error of the mean derived from the parameter standard error in a full model fit.

Table 5. Temporal Order Confidence Judgements in Pixels in Experiment 2

		Judgement Type		
Task Focus	Condition	Constrained	Distant	Adjacent
On task	Noise	152.1 (9.5)	117.0 (9.5)	61.1 (9.5)
Off task	Noise	69.9 (9.5)	75.2 (9.6)	43.6 (9.5)
On task	Quiet	168.2 (9.5)	125.9 (9.5)	86.8 (9.5)
Off task	Quiet	121.1 (9.5)	88.0 (9.5)	37.4 (9.5)

Values in parentheses are standard errors.

Table 6 shows the effects of condition on on-task probe response. On-task responses were greater in the quiet condition than in the noise condition for both passages that were relatively on task and those that were relatively off task. This pattern was supported by the fit of nested linear models. A model that included the effect of condition was better than a model with only the effect of on-task /off-task group, $\lambda_{adj} > 1{,}000$. There was also evidence for an interaction in which the effect of condition was larger on off-task passages, $\lambda_{adj} = 21.2$.

As in Experiment 1, we assessed the relationship between on-task responses and memory performance across conditions. Figure 4 depicts that relationship. As found previously, memory performance was generally a simple function of on-task reports across condition. A contrast based on the variation in on-task reports across the four groups depicted in Figure 4 provided a reasonable memory performance, and there was no improvement with the addition of condition, $\lambda_{adj} = 1.52$.

Discussion

The pattern of results in Experiment 2 is precisely the same as that in Experiment 1. Thus, we can conclude that the noise played during testing did not have a substantive impact on the effects on

Table 6. On-Task Response in Pixels in Experiment 2

	Condition	
Task Focus	Noise	Quiet
On task	93.6 (5.9)	160.9 (5.9)
Off task	−58.1 (5.9)	48.3 (5.9)

Values in parentheses are standard errors.

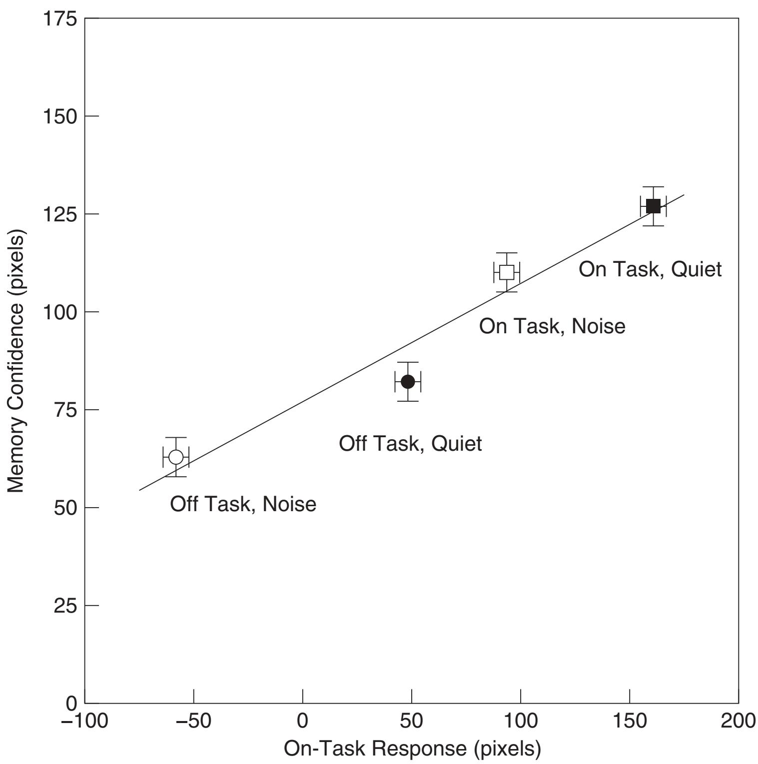

Figure 4. Temporal order confidence rating as a function of on-task response in Experiment 2. Error bars represent an estimate of the standard error of the mean derived from the parameter standard error in a full model fit.

temporal order memory. Indeed, the similarity of the results suggests that the effects occurred during encoding while participants were reading the narrative.

General discussion

In two experiments, we found that both mind wandering and auditory distraction had a comparable impact on readers' temporal order memory for narrative events. In particular, the same reported loss of focus had the same effect on temporal order memory regardless of whether that loss was due to mind wandering or distraction. Although such comparable effects do not necessarily imply a single causal variable, our speculation is that both effects occurred because fewer resources were available for constructing a situation model with accurate and detailed temporal order information. In the case of mind wandering, those resources are likely devoted to internally generated thoughts (cf. Dixon & Bortolussi, 2013); in the case of external distraction, resources are devoted, presumably in an obligatory fashion, to the external noise (cf. Stawarczyk et al., 2011). We constructed the distracting stimuli so that it would be difficult to filter out from the content of the to-be-read passages since they contained comparable passages and events. Consistent with the present results, Boyle and Coltheart (1996) found that irrelevant sound interfered with the maintenance of item order.

We conjecture that the role of resources in memory for temporal order is that those resources are used for elaborative inferences that would aid understanding the coherence and continuity of the passage and that would also support temporal order distinctions. For example, after reading "Ria made a protein shake for the hike" and then "She did some on-the-spot exercises to get in the zone," readers might infer that Ria moved from the kitchen to the living room, got out an exercise mat, and so on. Such inferences are likely involved in constructing a representation of the events described in the discourse; similar inferences would typically not be made in a simple list-learning paradigm. To the extent that such inferences are made and are available during testing, readers would be better able to determine that the first event must have preceded the second. Indeed, we attribute the relatively high accuracy of temporal order judgements for the constrained events to the ease of such coherence inferences.

An alternative interpretation is that both the effects of auditory distraction and mind wandering occur at a relatively peripheral level. Smallwood (2011) argued that mind wandering leads to perceptual decoupling and that this decoupling degrades the lexical information used in subsequent, higher-level processing. As a consequence, deficits at the lexical level can lead to weaker situation-model representations. Similarly, it might be hypothesized that auditory distraction interferes with lexical processing with the same effect (cf. Besner, 1987). Thus, with this view both mind wandering and auditory distraction have comparable effects because they both interfere with lexical processing. Although the present data are consistent with this type of account, we believe an interpretation based on central resources is more parsimonious.

If the effects of distraction and mind wandering are both due to the loss of resources, it may suggest that distraction can provide a proxy for the experimental manipulation of mind wandering. This result could prove to be a useful methodological tool: Although some studies have found increased mind wandering over the course of a session when emotional experiences are primed (Horowitz & Becker, 1971; Smallwood, Fitzgerald, Miles, & Phillips, 2009), mind wandering has proven difficult to manipulate on a moment-by-moment basis. For example, McVay and Kane (2013) attempted to manipulate the prevalence of mind wandering by presenting stimuli that were identified as related to participants' current concerns (cf. Klinger, Barta, & Maxeiner, 1980). Although the method had some effect on reports of task-unrelated thoughts, that effect was small and inconsistent. In contrast, the present results suggest that one might be able to simulate the effects of mind wandering by using external distraction. This could allow a more robust manipulation of the resources devoted to a task and make it more straightforward to investigate how the effects of mind wandering might interact with task variables. Although tantalizing, such a methodological advance must await further evidence on the similarity of effects of distraction and mind wandering across a range of tasks and circumstances.

Unsworth and McMillan (2014; see also 2015) found that reports of mind wandering and external distraction were correlated but were distinct factors and that both factors were related to fluid intelligence. In our view, their results bear on the question of the extent to which different individuals are susceptible to mind wandering tendencies and to distraction. The present research question, however, is whether, regardless of their source, these factors have comparable effects on situation model construction. In particular, it is possible that mind wandering and external distraction depend on somewhat different mechanisms while having similar effects on the allocation of resources and, as a consequence, similar effects on comprehension. Moreover, the present results bear on variations in mind wandering and (experimentally manipulated) distraction within a session rather than susceptibility to mind wandering and distraction as individual traits (as investigated by Unsworth et al.).

Although it is tempting to generalize our conclusions concerning memory for temporal order to situation model memory more broadly, the conclusions are potentially limited by the nature of the test. The recognition judgements we used might have been based on superficial activation or familiarity, and the effects may have been different if participants had been asked, for example, to recall the events. In particular, Dixon and Bortolussi (2013) argued that situation model representations are particularly critical for memory recall. Further, although we attempted to make the auditory noise as distracting as possible, the overall effect on performance was modest. Potentially, more intrusive distractions might have qualitatively different effects. In addition, the narratives that we used were short and relatively unstructured. Naturally occurring narratives typically have much stronger semantic and causal relations among events that would have constrained temporal order (although the effects we observed were at least as strong for semantically constrained events). Finally, other dimensions of situation models, such as space and causation, may be affected differently. Nevertheless, we regard it as an important step to note that, in at least the present circumstances, the situation model development may be similarly affected by available resources, regardless of whether those resources are compromised by external distraction or mind wandering.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Akaike, H. (1973). *Information theory and an extension of the maximum likelihood principle*. Proceedings from 2nd International Symposium on Information Theory, Budapest, Hungary.

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. doi:10.18637/jss.v067.i01

Besner, D. (1987). Phonology, lexical access in reading, and articulatory suppression: A critical review. *The Quarterly Journal of Experimental Psychology*, *39*(3), 467–478. doi:10.1080/14640748708401799

Boyle, R., & Coltheart, V. (1996). Effects of irrelevant sounds on phonological coding in reading comprehension and short term memory. *The Quarterly Journal of Experimental Psychology Section A*, *49*(2), 398–416. doi:10.1080/713755630

Clark, C., Martin, R., Van Kempen, E., Alfred, T., Head, J., Davies, H. W., … Stansfeld, S. A. (2006). Exposure-effect relations between aircraft and road traffic noise exposure at school and reading comprehension: The ranch project. *American Journal of Epidemiology*, *163*(1), 27–37. doi:10.1093/aje/kwj001

Cohen, J. (1994). The earth is round (p<.05). *American Psychologist*, *49*, 997–1003.

Dixon, P. (2003). The *p* value fallacy and how to avoid it. *Canadian Journal of Experimental Psychology*, *57*, 189–202.

Dixon, P., & Bortolussi, M. (2013). Construction, integration, and mind wandering in reading. *Canadian Journal of Experimental Psychology*, *67*(1), 1–10. doi:10.1037/a0031234

Ericsson, K. A., & Kintsch, W. (1995). Long-term working memory. *Psychological Review*, *102*(2), 211–245.

Glover, S., & Dixon, P. (2004). Likelihood ratios: A simple and flexible statistic for empirical psychologists. *Psychonomic Bulletin & Review*, *11*, 791–806. doi:10.3758/BF03196706
Horowitz, M. J., & Becker, S. S. (1971). Cognitive response to stress and experimental demand. *Journal of Abnormal Psychology*, *78*, 86–92. doi:10.1037/h0031386
Kane, M. J., & McVay, J. C. (2012). What mind wandering reveals about executive-control abilities and failures. *Current Directions in Psychological Science*, *21*(5), 348–354. doi:10.1177/0963721412454875
Klinger, E., Barta, S. G., & Maxeiner, M. E. (1980). Motivational correlates of thought content frequency and commitment. *Journal of Personality and Social Psychology*, *39*(6), 1222–1237. doi:10.1037/h0077724
McVay, J. C., & Kane, M. J. (2012). Why does working memory capacity predict variation in reading comprehension? On the influence of mind wandering and executive attention. *Journal of Experimental Psychology: General*, *141*(2), 302–320. doi:10.1037/a0025250
McVay, J. C., & Kane, M. J. (2013). Dispatching the wandering mind? Toward a laboratory method for cuing "spontaneous" off-task thought. *Frontiers in Psychology*, *4*, 570. doi:10.3389/fpsyg.2013.00570
Owen, W. J., & Borowsky, R. (2003). Examining the interactivity of lexical orthographic and phonological processing. *Canadian Journal of Experimental Psychology*, *57*(4), 290–303.
Pettijohn, K. A., & Radvansky, G. A. (2016). Narrative event boundaries, reading times, and expectation. *Memory & Cognition*, *44*, 1064–1075.
R Core Team. (2016, July 1). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from http://www.R-project.org/
Radvansky, G. A., Zwaan, R. A., Federico, T., & Franklin, N. (1998). Retrieval from temporally organized situation models. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*(5), 1224–1237.
Robison, M. K., & Unsworth, N. (2015). Working memory capacity offers resistance to mind-wandering and external distraction in a context-specific manner. *Applied Cognitive Psychology*, *29*(5), 680–690. doi:10.1002/acp.3150
Smallwood, J. (2011). Mind-wandering while reading: Attentional decoupling, mindless reading and the cascade model of inattention. *Language and Linguistics Compass*, *5*(2), 63–77. doi:10.1111/j.1749-818x.2010.00263.x
Smallwood, J., Fitzgerald, A., Miles, L. K., & Phillips, L. H. (2009). Shifting moods, wandering minds: Negative moods lead the mind to wander. *Emotion*, *9*(2), 271. doi:10.1037/a0014855
Smallwood, J., McSpadden, M., & Schooler, J. W. (2008). When attention matters: The curious incident of the wandering mind. *Memory & Cognition*, *36*(6), 1144–1150. doi:10.3758/MC.36.6.1144
Stawarczyk, D., Majerus, S., Maj, M., Van der Linden, M., & D'Argembeau, A. (2011). Mind-wandering: Phenomenology and function as assessed with a novel experience sampling method. *Acta Psychologica*, *136*(3), 370–381. doi:10.1016/j.actpsy.2011.01.002
Unsworth, N., & McMillan, B. D. (2014). Similarities and differences between mind-wandering and external distraction: A latent variable analysis of lapses of attention and their relation to cognitive abilities. *Acta Psychologica*, *150*, 14–25. doi:10.1016/j.actpsy.2014.04.001
Van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension*. New York, NY: Academic Press.
Wagenmakers, E.-J. (2007). A practical solution to the pervasive problems of p values. *Psychonomic Bulletin & Review*, *14*, 779–804. doi:10.3758/BF03194105
Zeamer, C., & Fox Tree, J. E. (2013). The process of auditory distraction: Disrupted attention and impaired recall in a simulated lecture environment. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *39*(5), 1463–1472. doi:10.1037/a0032190
Zwaan, R. A. (1996). Processing narrative time shifts. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22*(5), 1196–1207.
Zwaan, R. A., Magliano, J. P., & Graesser, A. C. (1995). Dimensions of situation model construction in narrative comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*(2), 386–397.