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Aging and Mind Wandering During Text Comprehension

Sabine A. Krawietz, Andrea K. Tamplin, and Gabriel A. Radvansky
University of Notre Dame

Mind wandering occurs when a person's stream of thought moves from the primary task to task-unrelated matters. Some theories of mind wandering suggest that it is caused by decreased attentional control associated with lower working memory (WM) capacity. Others suggest that it is caused by attention being directed toward internally generated thoughts and that it is associated with higher WM capacity. These ideas were assessed testing older adults because they have been argued to have reduced attentional control and lower WM capacity. The first account predicts that mind wandering should increase in older adults, while the second account predicts the opposite. Two experiments show that older adults exhibited a lower rate of mind wandering than younger adults. However, when using text interest as a covariate, the age difference in mind wandering disappeared. These results are further addressed in light of participants' current concerns and preserved situation model processing in cognitive aging.

Keywords: aging, mind wandering, comprehension, executive control, decoupling hypothesis

Mind wandering, also called zoning out, daydreaming, or task-unrelated, intruding, or stimulus-independent thought, refers to a lapse in attentional awareness, or a decoupling of attention, away from one's primary or external task, and toward more internally generated thoughts and ideas (Barron, Riby, Greer, & Smallwood, 2011; Giambra, 1995; Smallwood & Schooler, 2006). This shift takes attention away toward a goal unrelated to the task at hand, and is often initiated without complete (if any) awareness (Schooler, Reichle, & Halpern, 2004) or intention (Giambra, 1995). That is, attention gets diverted from task-related to task-unrelated information and people often fail to catch their minds wandering, until after some time has elapsed. Examples of everyday mind wandering include reaching the end of a page while reading a book and having no idea what one just read, or thinking about what one needs to pack for an upcoming trip while listening to a podcast. Recently, mind wandering has been associated with activation in the default mode network (e.g., Buckner, Andrews-Hanna, & Schacter, 2008; Weissman, Roberts, Visscher, & Woldorff, 2006), which is active during periods of rest or internally guided thought (i.e., mind wandering) and deactivated during active states of task performance (Mason et al., 2007).

Mind wandering and aging has been investigated with some research suggesting that older adults mind wander less than younger adults (Carriere, Cheyne, Solman, & Smilek, 2010; Giambra, 1977, 1979, 1989; Smallwood et al., 2004) while other research found no age differences (Einstein & McDaniel, 1997; Giambra & Arenberg, 1993). In studies involving retrospective questionnaires (Giambra, 1977, 1979) and others using thought probes during ongoing tasks (Giambra, 1989, 1993), older adults were found to mind wander less. Conversely, in another study, older adults mind wandered as much as younger adults (Einstein & McDaniel, 1997). Giambra (1989) found that mind wandering declined with age and attributed this finding to increased age being associated with reduced unconscious information processing. However, this study used retrospective reports during an ongoing vigilance task that is open to a number of potential confounds such as self-awareness, social desirability, and memory. In another study, Einstein and McDaniel (1997) stopped people during an ongoing word list task and used their memory for recent words as a measure of mind wandering. No age differences in word list performance were found using this rather indirect measure of mind wandering.

Our interest was in how aging impacts the tendency to mind wander during reading. There are two alternative accounts of how working memory (WM) might impact mind wandering. One view of mind wandering is that the rate of mind wandering is meaningfully related to the degree of attentional or executive control, such as one's ability to inhibit task-unrelated thought (Hasher & Zacks, 1988; Kane et al., 2007; McVay, & Kane, 2011, 2009). Compared with younger adults, older adults have less efficient attention regulation (Braver & West, 2008; Hasher & Zacks, 1988), allowing for more irrelevant thoughts to enter WM, thereby increasing the probability that mind wandering will occur. Furthermore, reduced cognitive control has been predicted by lower working memory capacity (WMC) scores that are associated with higher mind wandering rates (McVay & Kane, 2011, 2009). During an extensive study, using a large sample, multiple measures of WMC, and a latent variable approach, McVay and Kane (2011) found that people who score lower on WM span tests are more likely to experience task-unrelated thoughts (TUTs) and are less able to sustain attention to the demands of an ongoing task. Older adults are less efficient at controlling their attention (Braver & West,

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Sabine A. Krawietz, Andrea K. Tamplin, and Gabriel A. Radvansky, Department of Psychology, University of Notre Dame.

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Correspondence concerning this article should be addressed to Sabine A. Krawietz, 254 Haggar Hall, Department of Psychology, University of Notre Dame, Notre Dame, IN 46556. E-mail: skrawiet@nd.edu

2008; Hasher & Zacks, 1988); thus, mind wandering may occur more frequently in older than in younger adults. As such, the prediction from the executive control view is that older adults should mind wander more.

The other view, called the decoupling hypothesis, suggests that people with greater WMC are more likely to fall prey to mind wandering than people with lower WMC (Smallwood, Brown, Baird, & Schooler, 2011; Smallwood et al., 2004; Smallwood & Schooler, 2006). As compared with lower WMC people, people with greater capacities have more resources left when accomplishing the same task that are not needed for the primary task and are free to be used for other tasks. From this view, attention is decoupled from the task at hand and moved to secondary lines of thought when the primary task is not perceived as being engaging and/or the individual is bothered by unresolved goals (Smallwood & Schooler, 2006) or current concerns (Klinger, 1971, 1999; McVay & Kane, 2010).

Support for the decoupling hypothesis has been found during performance on an oddball task using event-related potentials (ERPs) in which mind wandering was associated with a reduction (not an absence) in the orienting and the processing response of target and distractor stimuli (Barron et al., 2011). This finding supports the notion that, during mind wandering, attention is coupled to internally generated thought and decoupled from external stimuli. Thus, it is unlikely that people are simply distracted, not processing external stimuli at all, or that they experience deficits in the processing of task-relevant information. A ubiquitous finding in the cognitive aging research is that older adults score lower on measures of WMC than younger adults (e.g., Salthouse & Babcock, 1991). Older adults have less available WMC to dedicate to a task and so are less likely to have residual capacity left to allow mind wandering to occur. As such, the prediction from the decoupling hypothesis is that older adults should mind wander less than younger adults.

However, WM may not be the only factor contributing to mind wandering during reading. Mind wandering may also be influenced by processing at the situation model level (Smallwood, McSpadden, & Schooler, 2008). Briefly, situation model processing involves creating representations of the core elements of a situation (e.g., the social relations of the characters in a story) in comparison to processing at the surface form and textbase levels, which involve a representation of the text itself such as its wording, syntax, and lexical semantics (e.g., Morrow, Greenspan, & Bower, 1987; Zwaan, Langston, & Graesser, 1995). Active processing at the situation model level may help people stay more engaged with the text because they would be more engaged in processing information concerning what the text is about and, thereby, decrease the likelihood of subsequent mind wandering (Smallwood et al., 2008).

Research has shown that the level of TUT may be associated with how interesting and difficult people find the text they read (Grodsky & Giambra, 1990; McVay & Kane, 2009; Smallwood, Nind, & O'Connor, 2009); that is, interesting tasks engage attention more fully compared with boring tasks. Moreover, previous work has shown that older adults do as well as, if not better than, younger adults at comprehending and remembering text on a situation model level as opposed to surface form or textbase levels (Radvansky, Zwaan, Curiel, & Copeland, 2001; Radvansky & Dijkstra, 2007; Radvansky, 1999). Thus, they may rely more heavily on situation model processing when reading text (Stine-Morrow, Morrow, & Leno, 2002). If older adults are more engaged in processing at the situation model level, then they may mind wander less often than younger adults.

The aim of the current study is to further assess how mind wandering is affected by the aging process using a text comprehension task. More specifically, we test how mind wandering may be affected by age-related changes in attention control (e.g., McVay & Kane, 2011, 2009), WMC (e.g., Smallwood & Schooler, 2006), and situation model processing (e.g., Radvansky & Dijkstra, 2007).

Experiment 1

Experiment 1 tested the accuracy of the two WM accounts by comparing mind wandering in reading between younger and older adults who are known to differ in WM capacity and attentional control ability. Younger adults typically outscore older adults on measures of WM capacity and attentional control (Hasher & Zacks, 1988; Salthouse & Babcock, 1991). If mind wandering is driven by residual attentional resources (e.g., Smallwood & Schooler, 2006), then older adults, who have a lower WM capacity than younger adults, will mind wander less. This hypothesis is supported by older adults relying more heavily on situation model processing than younger adults (e.g., Stine-Morrow et al., 2002). Compared with surface form and textbase level processing, which is predominantly used by younger adults, situation model processing helps the reader to stay engaged with the text (Smallwood et al., 2008) and, thus, may lead to less mind wandering. Conversely, if mind wandering can be explained by inferior executive control (e.g., McVay & Kane, 2009), then older adults, who have lower attentional control than younger adults, will mind wander more.

Method

Participants. Seventy-eight younger adults were recruited from the University of Notre Dame subject pool and given partial course credit for their participation (age range 18–22 years; M = 19.05, SD = 1.26). Two of these had read the text before and were dropped from the analyses. Thus, 76 adults (48 women) comprised the final young adults group. In addition, 26 participants comprised the older group and came from a local senior center (age range 58–87 years; M = 75.1, SD = 6.7). Only data from older participants with a score of 25 or higher on the Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975) were analyzed. The data from three participants did not reach this criterion and were excluded from the analyses, yielding a sample size of 23 (14 women) older adults. None of them reported having read the text before and all of them were given $20 for participating. All participants had normal or corrected to normal vision and were native English speakers. The experimental procedure lasted, on average, 1 hr.

Younger adults scored higher than the older adults on a reading span task (Waters, Caplan, & Hildebrandt, 1987), $F(1, 80) = 14.09$, $MSE = 192.50$, $p < .001$, a complex verbal WM measure involving sentence sensibility judgments and the remembering of the final word of each sentence. The sentences are presented in increasingly longer sequences ranging from two to seven sentences. On the Shipley vocabulary test (Shipley, 1946), older adults scored higher than younger adults $F(1, 95) = 45.43$, $MSE = 9.75$, $p < .001$.

Materials and procedure. After the experimenter obtained informed consent from the participant, the experiment was administered individually on a computer in a small room. Specifically, people read through the text, completed the brief survey and, finally, the two cognitive ability measures.

For the reading portion of the study, the text and thought probes were adopted from a study by Schooler and his colleagues (2004). People read through the first five chapters of *War and Peace* (Tolstoy, 1869/1982), one sentence at a time on a computer screen. People proceeded through the text by clicking a "Next" button located at the bottom of the page. Prior research has shown that text presentation mode (sentence-by-sentence vs. paragraph-by-paragraph) has little to no effect on the rate of mind wandering episodes during reading comprehension (Schooler et al., 2004). We chose the sentence-by-sentence presentation mode to obtain sentence reading times.

People periodically received probes about whether they were mind wandering. These probes appeared intermittently, replacing the text window with the mind wandering probe window. During the probe, people indicated whether they were mind wandering at that time (i.e., "Are you mind wandering?") by clicking either a "Yes" or a "No" button. The frequency and timing of these probes was the same as in Schooler et al. (2004), namely every 2–4 min for the duration of the reading task. As such, the number of mind wandering probes varied across people and was dependent on the overall time taken to read the text.

If people indicated that they had been mind wandering, they were given two follow-up questions. Following Schooler et al. (2004), these questions were: "What were you mind wandering about?" including the multiple answer choices *sensory state*, *yourself*, *school-related*, *text-related*, *fantasies*, *singing a song*, *worries*, *sleepy*, *tired*, *no thoughts*, and *none of the above*, and "How long were you mind wandering?" with the options <5, <10, <20, and >21 s. Regardless of whether they indicated that they had been mind wandering or not, people were given a recognition item consisting of a true/false question ("Have you seen this phrase before?") with either an exact phrase of one of the previously read four sentences (i.e., positive probe) or a slight variation thereof (i.e., negative probe). Negative probes were generated by taking an actual sentence from the text (e.g., "They say she is amazingly beautiful.") and altering it to convey a different meaning (e.g., "They say she is rather dull.") and, thus, easy to answer if one had been paying attention while relatively difficult to catch if one had been mind wandering. Even though verbatim texts were the positive items, it is unlikely that subjects would reject these because of misremembered surface form. Rather, this probe form is a good approximation to a situation discrimination index because it assesses whether participants were representing the situation suggested by the text.

Finally, we composed a brief survey that was administered after people completed the reading task. The survey included questions on how interesting and difficult they found the text. We also assessed whether participants recognized or had read the text before to exclude those that did from further analyses.

After all thought probe measurement was completed, we assessed cognitive ability and administered the vocabulary and reading span test (see Participants section for results). Assistance in using a computer was provided for four people in the older adult group.

Results

Thought probes. Means and *SD*s for all measures are reported in Table 1. Importantly, older adults reported a significantly lower rate of mind wandering (i.e., probe caught ratio) than younger adults, $F(1, 97) = 5.44$, $MSE = .115$, $p = .02$. The probe caught ratio was computed by dividing the frequency of reported mind wandering episodes (i.e., "Yes" responses to the mind wandering probe) by the overall number of mind wandering probes (i.e., count of mind wandering probes). Probe caught ratio was not significantly associated with scores on the reading span for either young or old adults (see Table 2).

Next, we examined whether mind wandering affected text comprehension. We submitted the recognition accuracy (ratio of correct and total number of responses to the recognition items) data to a 2 (Age: older vs. younger adults) × 2 (Occasion: reported mind wandering vs. not mind wandering) mixed ANOVA. Across groups, recognition accuracy was significantly higher after reporting not having been mind wandering than after mind wandering, $F(1, 172) = 11.92$, $MSE = .487$, $p = .001$. The main effect for age group and the interaction were not significant, $F < 1$ and $F(1, 172) = 1.27$, $MSE = .052$, $p = .26$, respectively. Thus, accuracy rates consistently reflect whether a person was mind wandering.

Table 1
Means and SDs (in Parentheses) of Thought Probes and Cognitive Abilities in Experiment 1

	Young adults	Old adults
Probe caught ratio*	.48 (.35)	.29 (.32)
Recognition accuracy when mind wandering	.75 (.21)	.68 (.33)
Recognition accuracy when reading attentively	.84 (.17)	.85 (.12)
Mean reading times**	4,524 (1,194)	7,263 (2,555)
Text interest**	2.34 (1.14)	3.43 (1.24)
Text difficulty	3.21 (.91)	3.00 (1.13)
Vocabulary score**	30.24 (3.08)	35.26 (3.25)
Reading span score**	25.54 (14.74)	11.35 (9.68)

* $p < .05$. ** $p < .001$.

Table 2
Correlation Coefficients Between Probe Caught Ratio and Text Interest and Difficulty per Age Group for Experiments 1 and 2

Probe caught ratio	WM span[a]	Text interest	Text difficulty
Experiment 1			
Young adults	−.07	−.45**	−.09
Old adults	−.36	−.41*	.14
Total	−.12	−.44**	−.04
Experiment 2			
Young adults	−.03	−.51**	.42**
Old adults	−.21	−.18	−.36
Total	−.08	−.43**	.22*

[a] WM span was reading span in Experiment 1 and OSPAN in Experiment 2.
* $p < .05$. ** $p < .001$.

Reading times. Some research has shown that eye movements change when people are mind wandering (Reichle, Reineberg, & Schooler, 2010; Smilek, Carriere, & Cheyne, 2010). For example, Reichle and his colleagues (2010) found that eye fixations were longer and less affected by lexical and linguistic variables in mind wandering as compared with attentive reading. In contrast, mind wandering has also been associated with increased eye blinking and decreased eye fixation (Smilek et al., 2010). First, we analyzed reading times per sentence and found that older adults read more slowly than younger adults, $F(1, 96) = 50.89$, $MSE = 2{,}594{,}461$, $p < .001$. Then, we analyzed reading times with respect to mind wandering by comparing the reading times for the five sentences before each mind wandering probe (that included the probe phrase) for reported mind wandering and attentive reading. However, to use a more sensitive measure, we used reading times per *syllable* instead of reading times per *sentence*. Unlike prior studies, we did not find a significant difference in these reading times between the two states or within each age group, all Fs < 1.

Final survey. Older adults reported the text to be more interesting, $F(1, 97) = 15.65$, $MSE = 1.35$, $p < .001$, but no more difficult, $F < 1$, than younger adults did. Moreover, text interest significantly correlated with probe caught ratio for younger and older adults, while text difficulty did not (see Table 2). This finding is consistent with a negative correlation between text interest and mind wandering (both prospective and retrospective) found by Smallwood and his colleagues (2009).

To further assess the influence of text interest, we ran an analysis of covariance (ANCOVA). After controlling for interest, there no longer was a significant effect of age on mind wandering (i.e., probe caught ratio), $F < 1$. Taken together, text interest may have contributed to the mind wandering rate because, after equating for reported text interest, older adults and younger adults reported mind wandering at a similar rate. The implications of this finding are further explored in the General Discussion.

Discussion

In this study, we found that older adults mind wandered at a lower rate than younger adults. However, after controlling for responses on the text interest survey question, the age groups no longer differed in their mind wandering rates. Moreover, the text was perceived as equally difficult between the two age groups and text difficulty did not have an effect on mind wandering across groups. Comprehension, as indicated by accuracy on the recognition test questions, was at comparable levels between the two groups.

The data, along with the fact that the correlation between mind wandering and WM capacity was not significant, are least consistent with the executive control account that predicts that older adults would mind wander more than younger adults. According to the other two accounts, older adults are expected to mind wander less than younger adults, a finding we could initially support. However, when taking the influence of text interest into consideration, the two age groups no longer showed differences in mind wandering rates. While text interest needs to be considered more deeply, we first sought to replicate the age difference in mind wandering with a similar design that additionally controlled for a factor that might be biasing the basic pattern of results, namely, the care with which people in the two age groups read the text.

Experiment 2

One concern with the results of Experiment 1 is that the older adults spent more time reading the text, so that it is possible that they exerted greater effort to read carefully than did the younger adults. That is, they may have slowed down to a pace that was slower than their normal reading speed to allow them to better encode the information in the text and answer the probe questions. This slow-down in reading speed may have allowed them to mind wander less. Even though the pace of reading among older readers might be expected to be somewhat slower (Salthouse, 1996), our goal was to limit excessive slowing relative to their normal rate. Thus, we controlled individual reading speed in Experiment 2. The basic task was the same as in Experiment 1 except that a brief text was read before the critical one to assess individual reading speed. We then used this assessment to control for reading speed in the critical text to prevent readers from excessively slowing their reading.

Method

Participants. Sixty-five participants (36 women) were recruited from the University of Notre Dame subject pool and given partial course credit for participation (age range 17–22 years; $M = 19.03$, $SD = 1.1$). Three of these had read the text before and were excluded from the analyses, leading to a sample of 63 young adults. In addition, 23 participants (21 women) comprised the older group and came from a local senior center (age range 62–86 years; $M = 71.7$, $SD = 6.4$) and all of them obtained a score of 25 or higher on the MMSE. The older adults were given $20 for participating and none of them had indicated to have read the text before. Younger adults scored higher than older adults on the automated operation span test of WM (OSPAN; Unsworth, Heitz, Schrock, & Engle, 2005), $F(1, 82) = 84.21$, $MSE = 156.38$, $p < .001$, which involves solving arithmetic problems and remembering letters in the correct order presented after each problem. We switched to the OSPAN because we wanted to use a more commonly used measure of WM. On the Shipley vocabulary test (Shipley, 1946), older adults scored higher than younger adults $F(1, 80) = 14.37$, $MSE = 12.02$, $p < .001$. All participants had normal or corrected to normal vision and were native English speakers.

Procedure. The procedure was the same as in Experiment 1, except that we controlled for reading speed and used the OSPAN instead of the reading span as our WM span measure. At the beginning of testing, participants read a 52-sentence excerpt of a different story. People were instructed to read this passage at their normal rate. Here, people were not probed for mind wandering, and mind wandering had not been mentioned up to that point in the study. To compute each participant's reading speed, we divided each sentence's reading time by its number of syllables and then averaged across all reading time/number of syllable ratios. Based on their reading speed for this passage, we were able to set a reading speed cut-off for the critical text (i.e., *War and Peace*). While reading the critical text, people still pressed a button to advance to the next sentence; however, if they had taken longer than their predicted time (based on their estimated reading speed), the program automatically advanced to the next sentence.

Results

Thought probes. Means and *SD*s for all measures are reported in Table 3. First, there were no differences in the rate of auto advancement (the proportion of trials that was ended by the program rather than by the participant) between the two groups, $F(1, 83) = 1.85$, $MSE = .01$, $p = .18$. Importantly, the older adults had a lower rate of mind wandering relative to the younger adults, $F(1, 83) = 5.51$, $MSE = .09$, $p = .02$. Again, probe caught ratio did not significantly correlate with scores on the OSPAN for either young or old adults (see Table 2).

Again, we submitted the recognition accuracy data to a 2 (Age: younger vs. older adults) × 2 (Occasion: reported mind wandering vs. not mind wandering) mixed ANOVA. As in Experiment 1, recognition accuracy was higher after reporting not having been mind wandering than after mind wandering across groups, $F(1, 150) = 20.25$, $MSE = 1.011$, $p < .001$. Contrary to Experiment 1, younger adults had significantly higher scores than older adults, $F(1, 172) = 11.40$, $MSE = .568$, $p = .001$. As in Experiment 1, the interaction was not significant, $F\text{s} < 1$.

Reading times. Again, older adults read more slowly than younger adults, $F(1, 82) = 33.87$, $MSE = 3{,}154{,}243$, $p < .001$, when analyzing reading speed per sentence. Moreover, we did not find significant differences in reading speed between attentive and inattentive reading for either age group, all $F\text{s} < 1$, when considering reading times per syllable in the five sentences before each mind wandering probe. Finally, the auto-advance/reading ratio did not significantly differ between the two age groups, $F < 1$.

Final survey. As in Experiment 1, older adults reported the text to be more interesting, $F(1, 80) = 6.63$, $MSE = 1.44$, $p = .01$, but not more difficult, $F < 1$, than younger adults. For younger adults, we also found significant correlations between the probes caught ratio and text interest and text difficulty; however, neither of these was significant for older adults (see Table 2). Again, an ANCOVA with text interest as the covariate revealed that the two age groups no longer differed in their rate of mind wandering, $F(1, 79) = 1.83$, $MSE = .141$, $p = .18$.

Discussion

As in Experiment 1, after controlling for reading speed, we found that older adults reported mind wandering less often than younger adults. However, like in Experiment 1, using text interest as a covariate removed this age difference. Importantly, there was no indication that older adults were mind wandering more often than younger adults.

General Discussion

In this study, across two experiments, we examined the relationship between mind wandering rate and aging when people were reading narrative texts, and how this mind wandering might be influenced by the contribution of age-related changes in WM, attentional control, situation model processing, and text interest. This study extends prior research that has explained mind wandering in terms of executive control and the decoupling hypothesis (Einstein & McDaniel, 1997; Giambra, 1995; Kane et al., 2007; McVay & Kane, 2011, 2009; Smallwood et al., 2004; Smallwood & Schooler, 2006). Across two experiments, we initially found that the mind wandering rate of the older adults was lower than that of the younger adults. Additionally, there was a significant association between mind wandering and text interest with people who mind wandered less also reporting greater interest in what they read, consistent with work by other researchers (e.g., Giambra, 1993; Smallwood et al., 2004; Smilek et al., 2010).

In general, our data suggest that WMC still plays a driving role in this phenomenon. When comparing the two prominent theories of mind wandering, we find that the results of our study are more consistent with the predictions made by the decoupling hypothesis

Table 3
Means and SDs (in Parentheses) of Thought Probes and Cognitive Abilities in Experiment 2

	Young adults	Old adults
Probe caught ratio*	.48 (.31)	.31 (.28)
Recognition accuracy when mind wandering	.64 (.30)	.67 (.26)
Recognition accuracy when reading attentively*	.84 (.15)	.76 (.08)
Mean reading times**	4,651 (1,475)	7,216 (2,450)
Auto-advance/reading time ratio	.085 (.066)	.113 (.124)
Text interest*	2.15 (1.14)	2.91 (1.35)
Text difficulty	3.25 (.94)	3.09 (1.13)
Vocabulary score**	30.52 (3.43)	33.77 (3.56)
OSPAN score**	50.34 (15.86)	14.39 (16.43)

* $p < .05$. ** $p < .001$.

(Smallwood et al., 2004; Smallwood & Schooler, 2006) than those made by the executive control account (McVay & Kane, 2011, 2009). According to the decoupling hypothesis, people with greater WMC (i.e., here the younger adults group) would be more likely to mind wander as compared with people with smaller WMC (i.e., here the older adults group). For example, when reading a text (like *War & Peace*), people with greater WMC may not require all of their resources to follow the story and may have residual resources available to engage in secondary thoughts which can lead to mind wandering. People whose WMC is exhausted when reading a story are less at risk for mind wandering to occur because they cannot "afford" to engage in secondary thoughts. The data are inconsistent with the predictions made by an executive control view (Kane et al., 2007; McVay & Kane, 2009) because we did not find that older adults mind wandered more than younger adults. Finally, the presence of an age difference in mind wandering when interest level is taken into account suggests that the prediction made by the situation model account is incomplete at best.

One point of concern is that the WM span (reading span and OSPAN) scores and mind wandering rates were not significantly correlated in our experiments while other researchers have found a negative relationship between mind wandering and WM (e.g., McVay & Kane, 2011). However, in their study, McVay and Kane had a large sample size (around 250 participants), an extensive battery of WM measures, and a latent variable approach. Moreover, it should be kept in mind that some measures of language comprehension, such as those aimed more at the situation model level, do not always correlate well with WM span measures (Copeland & Radvansky, 2004; Radvansky, & Copeland, 2001, 2004). There are aspects of WM processing that are not well measured by traditional memory span measures. WM span scores are generally more correlated with tasks that emphasize surface form and textbase memory, such as word and sentence list tasks. This is not to say that situation model processing does not rely on WM capacity. It certainly does. For example, Noh and Stine-Morrow (2009) found that older adults were more likely to have trouble as the number of entities in a described situation increase.

Moreover, mind wandering has also been associated with unresolved goals (Smallwood & Schooler, 2006) or current concerns (Klinger, 1971, 1999; McVay & Kane, 2010). Executive control and resources may influence mind wandering only to some extent while the presence and urgency of current concerns (i.e., automatically generated, personally related thoughts) and the extent to which the testing context triggers those thoughts may be additional important factors (Klinger, 1971, 1999). Consistent with this view, Carstensen (1993, 1995) suggested that younger adults may generate more interfering thoughts because they are said to have more current concerns than older adults and task goals and Parks, Klinger, and Perlmutter (1988–1989) indeed found such a trend. It is possible that differences between current concerns interact with periods of mind wandering in ways not yet determined.

It should also be noted that younger and older adults differed in the contents and duration of the reported mind wandering episodes (see Appendix). Older adults showed more frequent *text-related* and *none of the above* responses while younger adults more *self-* (i.e., "Yourself") and *school-related* ones. This finding may shed some light on the current concerns hypothesis in that younger adults may think more about topics unrelated to the text at hand than the older adults, although it is yet unclear what older adults were mind wandering about when selecting the *none of the above* response. Future research should further explore the relationship between what people report to mind wander about and its underlying mechanisms.

Finally, it should be noted that older adults reported shorter mind wandering durations (i.e., <10 s) more frequently than younger adults who in turn showed more frequent longer durations (>10 s). It is unclear what this trend means. Do older adults reestablish task focus more quickly because they are more prone to mind wander about text-related information while younger adults think about matters unrelated to the text, or are older adults simply more likely to report a shorter mind wandering duration? Moreover, do these variations reflect actual differences in duration or are they confounded with differences in the perception of time between the two age groups?

One difference between the two experiments was that in Experiment 2, older adults responded less accurately on probe items after reporting that they were not mind wandering than younger adults. This result suggests that older adults in Experiment 1 may have been reading more slowly and cautiously than they normally would. When reading speed was better regulated, the classic age differences for surface structure memory between different age groups emerged (e.g., Radvansky et al., 2001). Thus, this one more peripheral difference in our findings in Experiments 1 and 2 is probably because of other well-known age-related memory processes and not to the attentional control issues involved with mind-wandering during online comprehension.

In summary, our results across two experiments do not suggest that older adults mind wander at a greater rate than younger adults as would be expected if mind wandering was driven by a decrease in attentional control. Instead, we found that older adults exhibited a lower level of mind wandering compared with younger adults. These data are more consistent with the decoupling hypothesis and might also be tied to older adults preserved processing at the situation model level.

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Appendix

Mind Wandering Contents and Duration per Group and Experiment (in Proportions)

	Experiment 1		Experiment 2	
	Young	Old	Young	Old
Sensory state	.07	.04	.07	.04
Yourself	.22*	.10*	.20*	.05*
School-related	.11	.00	.11*	.01
Text-related	.10*	.34*	.10**	.51**
Fantasies	.03	.02	.04	.03
Singing a song	.02	.01	.02	.00
Worries	.04	.02	.04	.02
Sleepy, tired	.30*	.14*	.30†	.12†
No thoughts	.06	.13	.06	.06
None of the above	.05*	.20*	.06†	.17†
<5 s	.24*	.46*	.22*	.43*
6–10 s	.39	.46	.39	.46
11–20 s	.20*	.08*	.21*	.09*
>21 s	.18*	.01*	.18	.03

Note. Asterisks are added to the proportions of both conditions being analyzed. Group differences were analyzed within each experiment only.
† $p < .10$. * $p < .05$. ** $p < .001$.

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