

Origin and Control of Persistent Mental Content

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ABSTRACT

Some thoughts and experiences persist in our minds on the scale of minutes. For example, topics discussed earlier in a conversation remain fresh in mind and may persist in our thinking after the conversation is over. What cognitive mechanisms underlie this persistent mental content and how can it be controlled? To answer these questions, we induced persistent mental content using immersive narrative stimuli and measured the rate and influence of persistent thoughts. First, we found that mental persistence was not simply a consequence of intentional memory retrieval: participants could volitionally suppress the story's behavioral influence, but could not prevent story-related thoughts from entering awareness. Second, we found that mental content was not abolished by distractor tasks, and similar low levels of interference were observed from tasks with very different semantics and cognitive demands. Finally, we found that when new information was construed as related to the preceding experience, the persistence of the preceding experience was prolonged. These data indicate that memory models must be augmented with a slowly changing, internally-oriented context representation, which is robust to stimulus-driven interference and which continually biases both retrieval and thought.

MAIN

As one thought leads fluidly to another, we often experience our mental life as a “stream of thoughts” (James, 1890). But mental life is not only continuous from one second to the next: specific ideas and general motifs recur over minutes, thoughts wind back on themselves, and some ideas and experiences resonate in our minds long after their first occurrence. For instance, when we read an immersive story, its themes, characters and events repeatedly reenter our conscious thought and influence our behavior. This phenomenon continues even after we have moved on to another task (Bellana et al., 2022). What cognitive mechanisms underlie this persistence of experiences in human thought?

The persistence of past experiences has been studied as an element of spontaneous thought (Christoff et al., 2016; Faber & D’Mello, 2018), as an aspect of psychopathology (Abramowitz et al., 2001; Andrews-Hanna et al., 2022; Marks et al., 2018; Seli et al., 2017; Spinhoven et al., 2018; Wegner et al., 1987), as a pathway to goal attainment (Gable et al., 2019; Klinger et al., 2018; c.f. Nieuwenstein et al., 2015), as a source of interference on subsequent tasks (Leroy, 2009), and as an expression of curiosity and self-regulation (Sethi et al., 2022; Ulusoy et al., 2022). However, the cognitive processes that give rise to mental persistence remain unknown. Therefore, we asked which kinds of memory representations and control processes could underlie this phenomenon. To answer this question, we induced persistent thoughts using an immersive narrative, then measured how narrative persistence was affected by manipulations of volitional control, by time, and by related and unrelated distractor materials.

The simplest explanation for an experience persisting in mind is intentional retrieval. Perhaps the experiences that persist are ones that individuals explicitly want to think about. However, in a previous study in which participants read an immersive narrative, only 1 in 10 participants said that their subsequent thoughts about the story were intentional (Bellana et al., 2022). Moreover, the clinical literature has voluminously documented people’s experiences of unwanted thoughts (Abramowitz et al., 2001; Wegner et al., 1987) and involuntary memories (M. C. Anderson et al., 2004; Mace, 2008; Yeung & Fernandes, 2023), with recent work suggesting involuntary memories are commonplace, reflecting the basic functions of our memory system (M. C. Anderson et al., 2025; Berntsen, 2021). We quantified whether the persistence of narrative stimuli could be stopped by volitional control – explicitly asking participants to avoid thinking about the story – expecting that it would at best have a partial effect. But if persisting content is not intentionally retrieved, then how can it persist in mind?

An alternative explanation for the persistence of mental content may be found in memory processes such as context-based retrieval or short-term memory. Memory retrieval is thought to be guided by

41 volatile short-term representations, such as a drifting temporal context representation in single-store models
42 (Howard & Kahana, 2002; Manning, 2020; Sederberg et al., 2008), or a capacity-limited short-term
43 memory store in dual-store models (Atkinson & Shiffrin, 1968; Baddeley, 2012; Davelaar et al., 2005;
44 Glanzer, 1966; Glanzer et al., 1984). These models can account for diverse characteristics of human
45 memory, including “recency effects”, where recently encoded items are more readily retrieved (Kahana
46 et al., 2024). It may be that the persistence of recent experiences in thought reflects the same underlying
47 phenomenon. Critically, recency effects are generally abolished if participants perform a distractor task
48 after the original encoding. In single-store models the distractor material is thought to shift the temporal
49 context vector away from the representation of the preceding material (Sederberg et al., 2008), while in
50 dual-store memory models the distractor material is thought to displace or corrupt the content that was in
51 short-term or working memory (Davelaar et al., 2005). Therefore, we set out to quantify the effects of such
52 distractors on the persistence of mental content.

53 Past and present information need not only interact via interference: how might newly arriving
54 information re-shape or update persisting mental content? For example, consider the case of reading one
55 immersive story immediately after another. One possibility is that the second story could displace or
56 corrupt the persistence of the first story, as might be expected by a volatile short-term memory account
57 (e.g., displacement from a short-term store; Glanzer et al., 1984). Another possibility is that, if we think of
58 narrative comprehension in terms of the gradual construction and updating of situation models (Radvansky
59 & Zacks, 2014; Zwaan & Radvansky, 1998), then information from the second story may be integrated
60 into the situation model of the first story. In extreme cases, the situation model of the first story could
61 fundamentally alter the interpretation and experience of the second story. Yet another possibility is that the
62 two stories could be maintained in parallel, persisting independently without interfering with one another.
63 Therefore, we tested whether the persistent mental content of an initial story might be interrupted, extended,
64 or maintained alongside the content of a second story.

65 We investigated the mechanisms underlying mental persistence by measuring behavioral biases and
66 subjective reports in 1551 human participants across 16 experimental conditions. To measure mental
67 persistence, we used our previous experimental framework in which participants perform a verbal free
68 association task, before and after reading an immersive short story (Bellana et al., 2022). First, we replicated
69 our earlier results, and extended them to quantify the moment-to-moment conscious experience of story-
70 related thoughts. Second, we set out to establish the contributions of explicit retrieval by testing whether
71 intentional suppression of story-related thoughts could block mental persistence. Next, we examined
72 the role of drifting temporal context or short-term memory, by testing whether distractor tasks blocked
73 mental persistence. Lastly, by instructing participants to read two stories back-to-back, and experimentally
74 manipulating whether participants believed they were related, we characterized the effect of new narrative
75 content on mental persistence.

76 Overall, we found that persistence of narrative content could not be explained by explicit retrieval,
77 by a limited-capacity short-term memory store, or by standard models of drifting temporal context. We
78 propose that the persistence of mental content that manifests in our subjective experience and shapes our
79 behavior requires a slowly changing and internally-oriented context representation. Such a “deep” context
80 representation is resistant to immediate interference, integrates new information, and continually biases
81 long-term memory retrieval.

82 RESULTS

83 Narrative content persisted in mind, influencing conscious thought and behavior

84 To investigate the persistence of narrative content, following Bellana et al., 2022, we asked participants
85 to generate chains of associates before and after reading an immersive 2347-word story (Fig. 1A-C). On
86 average, participants read the story for 10.6 (SD= 5.7) minutes and generated 55.7 (SD= 18) associates
87 during each 180 second block of free association. To quantify the story relatedness of each associate, we
88 normed 14, 150 English words for their relatedness to the story on the scale of 1 (least related to story) to 7
89 (most related) (Norming story relatedness; Methods). In order to measure the specific moments when a
90 story-related thought entered a participant’s awareness, we instructed participants during post-story free
91 association to report the occurrence of thoughts about the story by double-pressing the space bar. During
92 pre-story free association, participants were instructed to report thoughts about the category “food”: this
93 provided them with experience in the thought monitoring task, and also established an approximate baseline
94 for the number of thoughts participants reported when instructed to monitor them, and how these would
95 vary over time. Participants reported an average of 13.1 (SD= 10.5) story thoughts over the post-story free
96 association period, approximately one thought every 14 seconds (Fig. 1E). The rate of conscious story
97 thoughts also decreased over time from 3.4 (double-presses) in the first 30 seconds to 1.4 in the final 30
98 seconds. By comparison, participants generated an average of 1.5 food thoughts in the first 30 seconds of

99 the pre-story association phase, and 0.9 in the final 30 seconds.

100 We replicated the main signatures of persistent mental content in this new paradigm, finding that
101 the story persistently influenced both subjective experience and behavior. First, the associates generated
102 during post-story free association were more story-related than those generated during pre-story free
103 association ($M_{Intact\ post} = 2.98$, $M_{Intact\ pre} = 2.5$, Wilcoxon signed-rank test, $W = 1796.0$, $p < .0001$,
104 Cohen's $d = .72$; Fig. 1D, see Supplementary Table S1 for most common associates). This effect was
105 especially pronounced during the first 30 seconds of free association ($d = .77$). Second, we observed
106 substantially more story-related thoughts entering awareness than thoughts induced by a generic thought-
107 monitoring instruction, such as monitoring food thoughts. Participants reported almost double the number
108 of story thoughts compared to food thoughts ($S_{Story\ thoughts} = 13.14$, $S_{Food\ thoughts} = 6.72$, Wilcoxon signed-
109 rank test, $W = 1497.5$, $p < .0001$, $d = .55$). Moreover, the rate of story thoughts decreased more over time
110 than the rate of food thoughts. Thus, the story thoughts did not simply arise from the thought monitoring
111 process, which participants performed in both conditions (Supplementary Note 6). Finally, participants
112 who read the intact story generated associates with significantly higher story-relatedness compared to those
113 who read a word-scrambled control (associate data for word-scramble condition from Bellana et al., 2022,
114 $M_{Intact\ post} = 2.98$, $M_{Scrambled\ post} = 2.69$, Mann-Whitney U test, $U = 7517.0$, $p = .0009$, $d = .51$). After
115 completing the post-story free association, participants further reported an overall “lingering” score: to
116 what extent the story had lingered in their mind on a scale from 1 (least) to 7 (most). Participants that read
117 the intact story reported substantially greater subjective lingering of the story ($L_{Intact} = 5.15$, $L_{Scrambled} =$
118 2.62 , $U = 9927.5$, $p < .0001$, $d = 1.47$, Fig. 1F). These results demonstrate that the story persisted in the
119 participants' minds, influencing their thoughts and behavior.

120 Narrative persistence was not abolished by volitional suppression

121 We tested whether persistent mental content arose due to intentional retrieval: were story experiences
122 being explicitly recalled for further consideration? Most participants (61.9%) who read the intact story
123 reported that thoughts about the story came to mind unintentionally, rather than intentionally (5.6%) or a
124 combination of both (25.0%) (Fig. 2A, see Supplementary Note 8). When responding to an open-ended
125 question about whether story thoughts were intended, a representative response was: “The story was very
126 fresh in my mind so it was always in the back of my mind, at least. I did my best to shut it out while
127 thinking of new words but it would often come up again”. Restricting our analyses from the previous
128 section to only participants who explicitly reported that story persistence was unintentional, we still found
129 strong persistence of the narrative's content (Fig. 2B&C, Supplementary Note 9). These results suggest
130 that most participants were not intentionally trying to think about the story. However, the reliability of
131 such self-reports has regularly been questioned (Frith, 2013; Nisbett and Wilson, 1977, c.f. Corneille and
132 Gawronski, 2024), and a more direct test requires an interventional manipulation of volition. Indeed, if
133 intentional retrieval underlies the persistence of mental content, then the persistence should be eliminated
134 when participants lack the intention to retrieve. To assess whether participants could suppress persistent
135 thoughts in our paradigm, we instructed a separate group of participants ($n = 161$) to perform such thought
136 suppression (“Suppress” condition; Methods). During the pre-story phase these participants were instructed
137 not to think about “food”; during the post-story phase they were instructed not to think about the story.
138 They were also asked to double-press the space bar whenever a story (or food) thought entered their
139 awareness.

140 In the Suppress condition, the free associates generated before and after story reading did not differ in
141 story relatedness ($M_{Suppress\ Post} = 2.48$, $M_{Suppress\ Pre} = 2.46$, Wilcoxon signed-rank test, $W = 6119.0$, $p =$
142 $.5$, Fig. 2B). This was true even for the words generated in the first 30 seconds of free association
143 ($M_{j30s\ Suppress\ Post} = 2.53$, $M_{j30s\ Suppress\ Pre} = 2.51$, Wilcoxon signed-rank test, $W = 6355.0$, $p = .78$). Part-
144 icipants in the Suppress condition also did not generate words more slowly than in the standard Intact
145 condition (Supplementary Note 21). However, participants in the Suppress condition reported more story-
146 related thoughts than food-related thoughts, despite identical suppression instructions for both types of
147 content ($S_{Story\ thoughts} = 8.05$, $S_{Food\ thoughts} = 4.83$, Wilcoxon signed-rank test, $W = 1589.5$, $p < .0001$, d
148 $= .58$). Finally, participants reported comparable levels of subjective lingering regardless of whether they
149 were told to suppress the story or not ($L_{Intact} = 5.15$, $L_{Suppress} = 4.85$, $U = 14106.0$, $p = .13$). These data
150 suggest that persistent mental content is not fully subject to volitional control.

151 Follow-up experiments indicate the reliability of this effect. We replicated these results in a separate
152 suppression group in which participants did not simultaneously report their story thoughts (Supplementary
153 Note 16). Furthermore, we collected data for a separate within-participant condition, in which participants
154 performed the Baseline condition on Day 1, and the Suppress experiment on Day 2 with another story.
155 Again, the number of story-related words before and after reading did not significantly differ (Supplemen-
156 tary Note 19). However, the self-reported lingering on Day 2 (with suppression) was reduced compared
157 to Day 1 (without suppression), but still substantially above the self-reported lingering in the Scrambled

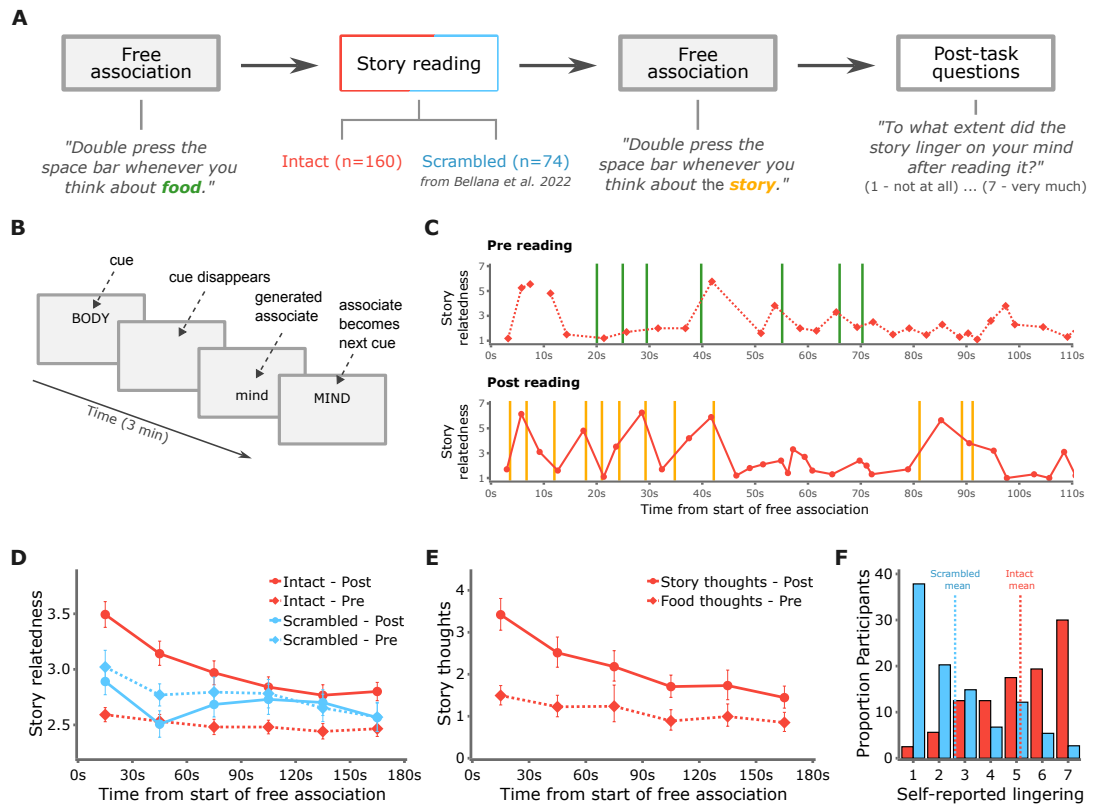


Figure 1. Narrative content persists in mind. **A** Participants performed free association before and after reading a story. During pre-story free association participants were asked to report food thoughts by double-pressing the space bar. Post-story participants reported story thoughts. **B** During free association participants generated an associate to a cue, after which the associate became the next cue. Participants started by entering any word they thought of. **C** Story relatedness of associates generated by a participant before and after reading. A gap in the line indicates the existence of an associate that was not rated. Food thoughts are marked by green lines, story thoughts by orange lines. **D** Story relatedness in 30-second bins during the 180 seconds of free association. **E** Number of story thoughts (i.e., double space bar presses) in 30-second bins. **F** Proportion of responses about self-reported lingering: “To what extent did the story linger in your mind after reading it?” (1 = not at all, 7 = very much). All error bars depict bootstrap 95% CI.

158 condition. Thus, although participants were largely able to suppress the expression of story-related content
 159 in their free associations, the story content continued to enter their minds¹. Moreover, when participants
 160 employed overt strategies during free association (e.g. naming objects in the room around them in order to
 161 avoid generating story-related words), there was no reliable reduction of the story relatedness of generated
 162 associates or the number of story thoughts (Supplementary Note 10).

163 Altogether, the results suggest that the persistence of mental content cannot be explained by intentional
 164 retrieval. Instead, mental content persists spontaneously and automatically, continuing to exert influence
 165 on thought and behavior without volition – sometimes even against volition.

166 Persistence was invariant to the content of post-reading tasks

167 Even if participants were not retrieving story content intentionally, the persistence of mental content could
 168 have originated in a volatile short-term representation, such as a drifting context or a short-term store that
 169 cues long-term memory retrieval. If this is true, then it should be possible to disrupt this process using
 170 an appropriate distractor task (Davelaar et al., 2005; Glanzer, 1966; Sederberg et al., 2008). Therefore,
 171 we tested whether a distractor task, inserted after the story and before the free association phase, would
 172 abolish the persistence of story content during free association (Fig. 3A). We reasoned that a distractor task
 173 that required similar internal representations to those used in narrative comprehension should maximize

¹This is further supported by the finding that even in the Suppress condition the number of story thoughts reported by a participant was correlated with the mean story relatedness of their free associates, see Supplementary Note 7.

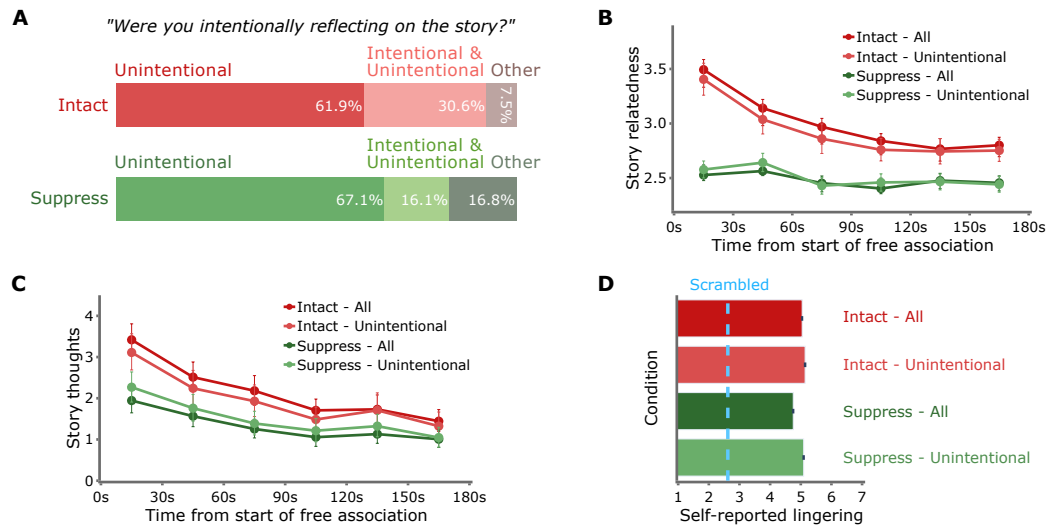


Figure 2. Narrative persistence was not abolished by volitional suppression. **A** The distribution of participants' answers as to whether they were intentionally reflecting on the story. Participants were able to choose between "Unintentional", "Intentional", "Both", "Neither", and "Don't know". Participants who answered "Intentional" and "Both" were grouped into "Intentional & Unintentional". Participants who answered "Neither" or "Don't know", and participants who were not asked the question because they reported a lingering score of 1, were grouped into "Other". **B** Story relatedness of post-story associates in 30-second bins. The lighter colors in the figure display the data from participants who reported unintentional persistence. **C** Number of story thoughts (i.e., space bar double-presses) in 30-second bins. **D** Amount of self-reported lingering: "To what extent did the story linger in your mind after reading it?" (1 = not at all, 7 = very much). All error bars depict bootstrap 95% CI.

174 the interference. Therefore, we began with distractor tasks that required either situation or theory of mind
 175 (ToM) reasoning.

176 On the first screen of the distractor task, participants read a brief vignette (2-3 sentences presented at
 177 once); on the second screen, participants answered a yes/no question about the situation described in the
 178 vignette. Thus, participants needed to comprehend the situational or social content and hold it in mind
 179 (Fig. 3A, purple & yellow). The distractor tasks took 26 seconds to complete (Situation/ToM condition;
 180 **Methods**). Critically, the vignettes still involved characters, locations and goals – essential dimensions of
 181 narrative comprehension – but unrelated to the specific content of the main narrative and thus potentially
 182 able to interfere with its persistence. The vignettes were taken from a battery of social and non-social
 183 tasks that has been widely used to functionally localize theory of mind processes (Dodell-Feder et al.,
 184 2011). The Situation and ToM conditions were compared to a Baseline condition, in which participants
 185 performed free association without any interference task. Unlike the preceding experiments which probed
 186 volition, participants in these distractor interference experiments performed free association without having
 187 to monitor and report their conscious story thoughts in the moment (Baseline condition; **Methods**).

188 Overall, the persistence of mental content was robust to the interference generated by either the
 189 Situation or ToM distractor task. The story relatedness of the first 30 seconds in the Situation con-
 190 dition was not different from the Baseline condition ($M_{Baseline} = 3.37$, $M_{Situation} = 3.13$, independent
 191 t-test, $t(161) = 1.42$, $p = .16$; Fig 3B), and the same held true for the ToM condition ($M_{Baseline} =$
 192 3.37 , $M_{ToM} = 3.14$, independent t-test, $t(164) = 1.38$, $p = .17$). To account for the time participants
 193 spent on the distractor task in the Situation and ToM condition, we aligned the associates by the time
 194 passed since the story ended and compared the semantic biases of the associates generated between 30s
 195 and 60s after the end of the story (Fig. 3C). Again, the semantic biases towards the story were indistin-
 196 guishable from Baseline in both the Situation condition ($M_{Baseline} = 3.23$, $M_{Situation} = 3.14$, independent
 197 t-test, $t(149) = .51$, $p = .61$) and the ToM condition ($M_{Baseline} = 3.23$, $M_{ToM} = 3.2$, independent t-
 198 test, $t(154) = .16$, $p = .88$). Lastly, the self-reported lingering of the story was indistinguishable from the
 199 Baseline in both the Situation condition ($L_{Baseline} = 4.8$, $L_{Situation} = 4.74$, $U = 3368.5$, $p = .98$) and the
 200 ToM condition ($L_{Baseline} = 4.8$, $L_{ToM} = 4.95$, $U = 3173.5$, $p = .37$).

201 While the previous results seem incompatible with an account of persistence based on volatile short-
 202 term representations, one possibility may have been that the distractor tasks were too simple to interfere
 203 with the content of the story. To investigate this possibility, in the New Story condition (**Methods**), the

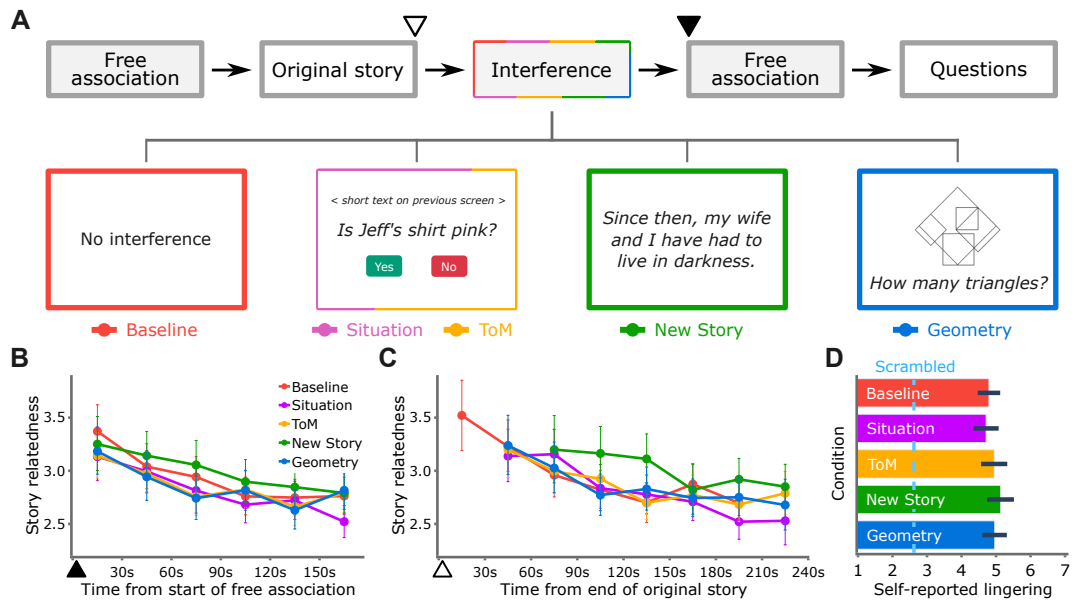


Figure 3. Persistent mental content was invariant to the type of post-reading interference. **A** Immediately after reading, participants performed no distractor task, a reasoning distractor task, a new story distractor task, or a geometry distractor task. **B** Story relatedness in 30-second bins when aligning data by the start of free association. **C** Story relatedness in 30-second bins aligned by the end of the story. Data points with fewer than 300 associates in a time bin are not shown (for all data points, see Supplementary Fig. S19A). **D** Amount of self-reported lingering: “To what extent did the story linger in your mind after reading it?” (1 = not at all, 7 = very much). All error bars depict bootstrap 95% CI.

204 distractor task was to read a new story. While the Situation and ToM vignettes consisted of 38 - 54 words,
 205 the new story was 173 words long and took on average 48.08 seconds to read. More than just longer, the new
 206 story constituted a full narrative, and so should occupy the same narrative-comprehension capacities as the
 207 original story. We chose the new story to differ in style, perspective, content and emotional tone. To ensure
 208 that the new story was sufficiently engaging, we demonstrated its ability to induce persistent content (albeit
 209 reduced) in a separate sample of participants (New Story Alone condition; Methods and Supplementary
 210 Note 18). If the persistence of story content was driven by capacity-limited short-term memory systems
 211 involved in narrative comprehension, the semantic biases should be eliminated or dramatically reduced
 212 after reading the new story.

213 Reading a new, albeit brief, story did not reduce semantic biases toward the original story. Participants in
 214 the New Story condition did not show a reduction of overall semantic biases towards the story ($M_{Baseline} =$
 215 3.37 , $M_{New\ Story} = 3.25$, independent t-test, $t(162) = .67$, $p = .5$). After accounting for the time participants
 216 spent reading the new story, the semantic biases towards the story were also not distinguishable from
 217 the Baseline condition (i.e., comparing the mean story relatedness between 60s and 90s after reading
 218 the original story, $M_{Baseline} = 2.96$, $M_{New\ Story} = 3.2$, $U = 2357.0$, $p = .31$). If anything, participants in
 219 the New Story condition reported marginally greater subjective lingering of the main story ($L_{Baseline} =$
 220 4.8 , $L_{New\ Story} = 5.14$, $U = 2793.5$, $p = .06$).

221 Switching to distractor tasks that were cognitively similar to reading a story (i.e., situational, social,
 222 and narrative distractor tasks) did not decrease the persistence of mental content. However, switching to a
 223 very different task could also limit persistence, particularly if it leads to a change in “task set” (Monsell,
 224 2003). For example, interrupting reading with an arithmetic task has been found to be more costly than
 225 interruption with a different reading task (Fischer & Glanzer, 1986), thought to reflect the additional effort
 226 to reinstate the reading task set when switching back from an arithmetic task. If the persistence of story
 227 content was tied to such a task set, we then might be able to decrease it by giving participants a distractor
 228 task that is cognitively distinct from reading. Therefore, we asked participants to perform a 30s visuospatial
 229 counting task after reading; in this “Geometry Task”, participants counted the number of triangles in an
 230 image that contained overlapping geometric forms (Fig. 3A).

231 Narrative content persisted across a shift in task-set. After the geometry task, participants exhibited
 232 comparable semantic biases to the Baseline condition in the first 30s of free association ($M_{Baseline} =$
 233 3.37 , $M_{Geometry} = 3.18$, independent t-test, $t(161) = 1.11$, $p = .27$; Fig 3B). When aligning the data by

234 the time since the story ended, the semantic biases between the Geometry and Baseline conditions also
235 were equivalent in the 30s to 60s window ($M_{Baseline} = 3.23$, $M_{Geometry} = 3.24$, independent t-test, $t(154) =$
236 -0.05 , $p = .96$; Fig 3C). Mirroring our previous results, participants in the Geometry condition reported the
237 same amount of subjective lingering as participants in the Baseline condition ($L_{Baseline} = 4.8$, $L_{Geometry} =$
238 4.96 , $U = 2977.5$, $p = .25$).

239 Because the additional distractor tasks did not reduce story relatedness beyond what was seen in the
240 Baseline condition, we next tested for a different signature of short-term memory: recency effects. If story
241 content is persisting in a form of short-term memory, then the post-encoding distractors should interfere
242 more with later stimulus segments, which compose a greater portion of short-term memory. Therefore,
243 we investigated the effects of distractors on persistence of later versus earlier stimulus segments. We first
244 divided the story stimulus into 9 segments. Next, we attempted to match each free associate generated by
245 each participant to a segment or segments of the story stimulus. This linking was done in two ways: first,
246 via verbatim matching (each free associate was matched to story segments that contained that exact word);
247 and second, via semantic matching (each free associate was matched to story segments which were strongly
248 semantically related to it). Overall, the recency effects and the impact of distractors were inconsistent.
249 There was weak evidence for a verbatim recency effect in the Baseline condition: words from later parts
250 of the story were slightly more likely to appear as free associates (Supplementary Note 13). However,
251 with the possible exception of the New Story condition, the distractor tasks did not block persistence of
252 late-story elements more than early-story elements (Supplementary Note 14), and the pattern of results
253 varied across analysis methods, story stimuli, and replications.

254 These data suggest that recent content is more likely to persist in mind, but the persisting content does
255 not exhibit the conventional signatures of short-term memory, where recency effects are strongly disrupted
256 by distractors (Glanzer, 1966).

257 Altogether, the minimal interference from external distractor tasks suggests that the persistence of
258 mental content is neither driven by volatile short-term representations nor by information tied to task-sets.
259 Contrary to most short-term memory models, which posit susceptibility to interference from related
260 distractors, unrelated distractors, or both (Baddeley, 2003; Fernandes & Moscovitch, 2000; Fischer &
261 Glanzer, 1986; Ledoux & Gordon, 2006; Logie et al., 1990), neither task eliminated, or even substantially
262 reduced, the persistence of the original story's mental content. In fact, when the participants read a
263 new story following the original story, the persistence of the original story appeared to be increased
264 (Supplementary Note 15).

265 Integrating unrelated material prolonged mental persistence

266 In the preceding experiments, we had limited success in blocking persistent mental content via interference
267 from similar and dissimilar distractor stimuli. However, Bellana et al., 2022 argued that persisting content
268 may be driven by the construction of a situation model (Kintsch & Van Dijk, 1978) or event model
269 (Radvansky & Zacks, 2014)². Such representations are not thought to only function as passive repositories
270 of information, but also to continually integrate new input, updating and restructuring past information.
271 This opens a new possibility: if new incoming information is construed as potentially related to the current
272 event, then the current event should remain accessible in mind in service of contextualizing the new event
273 (Zacks et al., 2007). Consistent with this view, we observed that, for participants in the New Story condition
274 who failed to realize that the original and new stories were distinct, there was a trend towards increased
275 persistence of the original story (Supplementary Note 15). Therefore, we asked whether the persistence of
276 mental content would be affected by participants' subjective construal of whether new information (i.e. the
277 interfering information) was related to what came before.

278 Similar to the New Story condition, we asked participants to read the same unrelated new story after the
279 original story and before free association (Fig. 4A). However, before the start of the new story, half of the
280 participants were informed that it was a continuation of the original story (Continued condition), while the
281 other half were informed that the new story was a separate story (Separated condition; Methods). Thus, the
282 content presented during the distractor phase was identical across conditions, but participants differed in how
283 they construed the relationship between the distractor content and the original story. Indeed, instructions
284 were effective in shifting the participants' construal: In the Continued condition participants reported a
285 significantly higher effort to relate both stories to each other ($M_{Continued} = 5.88$, $M_{Separated} = 2.42$, one-
286 sided Mann-Whitney U test, $U = 5829.0$, $p < .0001$, Fig. 4B).

287 When participants believed that the new story was a continuation of the original story, the persistence
288 of the original content was extended, even if the new material was designed to be unrelated. First,

²Situation models were originally proposed for text comprehension (Kintsch & Van Dijk, 1978; Zwaan & Radvansky, 1998), while event models extend the same framework to non-linguistic experiences (Radvansky & Zacks, 2014). We refer to both because our stimuli are textual, but we expect our claims about persistent mental content to apply to event representations constructed from other immersive stimuli such as films.

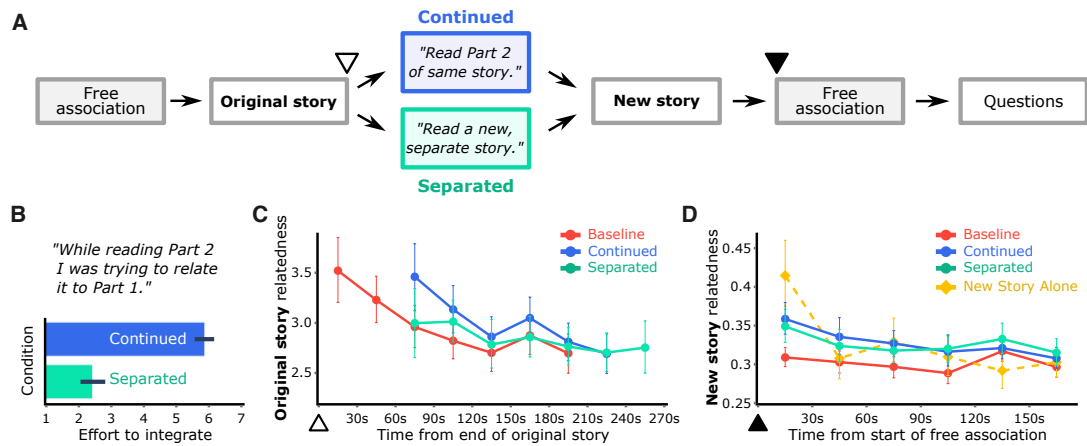


Figure 4. Construing unrelated material as related prolonged persistent mental content. **A** After reading the original story, participants in the Continued condition were instructed that they would read the second part of the same story. Participants in the Separated condition were instructed that they finished with the first story, and that they would read a new story. In both conditions, participants read the same new story that was unrelated to the original story. **B** To ensure our manipulation worked we asked participants to report to which extent they agreed with the following statement: “While reading Part 2 I was trying to relate it to Part 1”. Participants answered on a 7pt scale (1 - Not at all, 7 - Very much). **C** Story relatedness in 30-second bins aligned by the end of the story. Bins with fewer than 300 associates are not shown (for all bins, see Supplementary Fig. S19B). **D** Theme similarity (Methods) to the new story in 30-second bins aligned to the start of free association. Theme Similarity was computed as the maximum word-embedding similarity between an associate and 19 theme words (Methods). All error bars depict bootstrap 95% CI.

289 when comparing story-relatedness throughout all time bins in a pre-registered analysis (permutation
 290 test of the mean difference within 30s bins; Methods), story relatedness was greater in the Continued
 291 condition than in the Baseline condition ($\text{diff}_{\text{Continued} - \text{Baseline}} = 0.25$, one-sided permutation test, $n =$
 292 $5000, p = .01$). In contrast, the Separated condition was not significantly different from the Baseline
 293 condition ($\text{diff}_{\text{Separated} - \text{Baseline}} = 0.07$, one-sided permutation test, $n = 5000, p = .27$). When comparing
 294 the Continued and Separated conditions directly, participants generated more story-related words (to
 295 the original story) in the Continued condition compared to the Separated condition (60-150s window,
 296 $\text{diff}_{\text{Continued} - \text{Separated}} = 0.22$, one-sided permutation test, $n = 5000, p = .06$; Methods). Although this
 297 effect was only marginal, the test was a pre-registered follow-up prompted by the New Story condition
 298 (Supplementary Note 15). To further investigate the effect, we focused in post-hoc tests on the earliest 30s
 299 bin for which participants generated words – as the persistence effect was strongest at the beginning of all of
 300 our previous experiments. The Continued condition exhibited greater story-relatedness than the Separated
 301 condition when aligning the data to the end of the original story ($M_{\text{Continued}} = 3.46, M_{\text{Separated}} = 3.0$, one-
 302 sided Mann-Whitney U test, $U = 1791.0, p = .03, d = .36$; Fig. 4C), and when aligning the data
 303 relative to the end of the new story ($M_{\text{Continued}} = 3.37, M_{\text{Separated}} = 3.0$, one-sided Mann-Whitney U
 304 test, $U = 2348.0, p = .04$).

305 Did the new story, presented as a distractor, also persist in mind? We found that the new story persisted
 306 in mind much less when it was presented after the original story than when it was presented alone. Semantic
 307 biases towards the new story were greater in the New Story Alone condition than they were in the Continued
 308 condition ($M_{\text{New Story Alone}} = 0.41, M_{\text{Continued}} = 0.36, U = 2034.0, p = .03, d = .50$, Fig. 4D), and in the
 309 Separated condition ($M_{\text{New Story Alone}} = 0.41, M_{\text{Separated}} = 0.35, U = 2164.0, p = .004, d = .57$). The same
 310 was true for self-reported lingering ($L_{\text{New Story Alone}} = 4.51, L_{\text{Continued}} = 2.22, U = 2770.5, p < .0001, d$
 311 $= 1.54$, and $L_{\text{New Story Alone}} = 4.51, L_{\text{Separated}} = 2.48, U = 2613.0, p < .0001, d = 1.17$). We found the
 312 same pattern of results in the other conditions in which participants read the new story after the original
 313 story (Supplementary Note 20). Thus, it appears that the prior experience of the original story was either
 314 preventing the new story from persisting in mind or preventing it from being well-processed in the first
 315 place.

316 Overall, when participants attempted to integrate the new story with the original story, the content of
 317 the original story persisted more, relative to the Baseline condition. Conversely, when participants were
 318 told that the stories were separate, although they still exhibited semantic biases towards the original story,
 319 these biases were not greater than those in the Baseline condition. It appears that when individuals construe

320 distractor content as part of the same experience, the distractor content induces little or no reduction in
321 mental persistence, and the overall duration of mental persistence is prolonged.

322 DISCUSSION

323 Recent experiences persist in our minds for minutes, influencing our thoughts and actions. Approaching
324 the persistence of mental content as a memory process, we set out to understand the cognitive processes
325 underlying it. First, we confirmed that story content biased semantic associations for several minutes after
326 reading (Bellana et al., 2022) and found that it also manifested as conscious story-related thoughts 3-6
327 times per minute (Fig. 1). Second, we established that this mental persistence was largely spontaneous:
328 intentional suppression eliminated the behavioral influence of story content on free associates, but only
329 partially reduced the entry of story-related thoughts and subjective lingering (Supplementary Note 19,
330 Fig. 2). Third, we failed to block the persistence of mental content using distractor tasks designed to
331 overwrite volatile short-term representations, with comparable levels of interference from cognitively
332 similar and dissimilar distractors (Fig. 3). Finally, we found that when participants were told that a new
333 and unrelated story was a continuation of the original story, the persistence of the original story content
334 was extended (Fig. 4). On the basis of these data, we propose that the narrative content persists via a “deep”
335 context representation which is resistant to standard stimulus-driven interference, continually integrates
336 new information, and continually biases memory retrieval.

337 What kind of representations and processes might explain the persistence of mental content? In
338 many memory models, new information generates interference by shifting or overwriting volatile short-
339 term memory representations (Baddeley, 2012; Davelaar et al., 2005; Sederberg et al., 2008). These
340 models explain how distractor tasks interfere with previous information (Kahana et al., 2024), or how this
341 interference varies as a function of the cognitive similarity between the original content and the distracting
342 content (Bunt & Sanders, 1972; Fischer & Glanzer, 1986; Logie et al., 1990). In contrast, we found that
343 story content was not abolished after distractor tasks (Fig. 3C&D); that it persisted in the same way after
344 cognitively similar and dissimilar distractors; and that it was even lengthened in the “continued story”
345 distractor condition (Fig. 4C).

346 We propose that the phenomenon of persistent mental content depends on a slowly changing and
347 internally-oriented context representation which biases memory retrieval, shaping the stream of thought.
348 This proposal can be understood as a variant of the context maintenance and retrieval model (CMR, Polyn
349 et al., 2009). In CMR, the items that are retrieved at any moment are determined by a context representation.
350 This context is composed of “temporal” and “source” components, which can update at different rates.
351 If the source-context associated with a narrative changes very slowly (via a high β_{source} parameter), then
352 story-related content may continue to be retrieved for minutes after encoding.

353 In addition to a slowly changing context representation, mechanisms are required to explain why
354 persistence was lengthened after some distractor tasks but not others, and why high-level situational content
355 seems to persist most readily. First, story-relatedness decreased during the free association task, but did
356 not decrease during the presentation of the Continued story distractor (Fig. 4C) or during a silent Pause
357 (Supplementary Note 17). Relative to the standard machinery of CMR, an additional mechanism must be
358 modifying the story’s source-context as a function of how new information is thought to relate to preceding
359 information. Second, content seems more likely to persist only when it is tied to the high-level meaning
360 of an experience, and does not necessarily reflect the basic (e.g. lexical) semantics of input. Persistence
361 was longer when the same stimulus was construed as related to preceding material, relative to when it
362 was unrelated (Fig. 4C), and even a word-list could generate persistent content when that word-list was
363 construed to be the skeleton of a narrative (Bellana et al., 2022). Models such as CMR, however, are
364 defined over discrete items, whereas a narrative is an interconnected structure whose elements do not map
365 straightforwardly onto the item-level representations these models assume. Memory models therefore need
366 mechanisms that flexibly integrate or overwrite representations as a function of incoming information, and
367 that operate over abstracted, high-level meaning rather than over lexical and lower-level semantic features³.

368 Narrative persistence may reflect processes of long-term memory consolidation and prioritization,
369 including hippocampal replay (Buzsáki, 2015) and cortical reactivation (Liu et al., 2019). In rodents,
370 hippocampal neurons active during the encoding of an experience reactivate in specific sequences during
371 sleep and wakeful rest (Diba & Buzsáki, 2007; Foster & Wilson, 2006). In humans, fMRI work has shown
372 analogous reactivation of experience-specific hippocampal patterns during post-encoding rest (Staresina
373 et al., 2013; Tambini & Davachi, 2013, 2019). Sharp-wave ripples (SWRs), associated with hippocampal
374 replay, are increased during moments of off-task spontaneous thought (Iwata et al., 2024). Notably,
375 rewarded and salient experiences are preferentially replayed (Ambrose et al., 2016; Michon et al., 2019;

³To see how the persistence of mental content may connect to other theories of memory, see Supplementary Note 1

376 Singer & Frank, 2009), which parallels the longstanding observation that personally significant concerns are
377 more likely to occupy our spontaneous thoughts (Klinger, 1978). Contextual memory models such as CMR,
378 which we invoked to explain aspects of the narrative persistence, can also predict which memories are
379 more likely to be replayed (Zhou et al., 2025). It is unknown, however, whether attending to the high-level
380 meaning of an experience modulates hippocampal replay in the same way that it modulates behavioral
381 and self-report metrics of narrative persistence (Bellana et al., 2022), because replay has typically been
382 studied with simple items and associations (e.g., Staresina et al., 2013). To determine the links between
383 persistent content and hippocampal replay, a crucial question is whether patients with hippocampal amnesia
384 experience persistent thoughts in the minutes following a salient experience.

385 The persistence of mental content joins a broader family of phenomena in which a state induced
386 by recent experience continues to shape subsequent cognition (Honey et al., 2023). Recent experiences
387 have been found to bias perception, attention, mood, and memory through the persistence of specific
388 retrieval orientations (Madore et al., 2015), affective states (Eldar et al., 2016; Tambini et al., 2017), and
389 cognitive mindsets such as “broad” versus “narrow” modes of processing (Herz et al., 2020). However, the
390 persistence we report differs from these in that it is content-specific, directly tied to the high-level meaning
391 of the recent experience, rather than a retrieval orientation, affective tone, or global processing mode. An
392 important question to address in the future is how the persistence of specific content interacts with these
393 other forms of persisting cognitive states.

394 The persistence of mental content also seems to be closely associated with the architecturally deep
395 and slowly changing representations of default mode regions (Hasson et al., 2015; Margulies et al., 2016;
396 Stephens et al., 2013). These default mode circuits represent episodic and situational content in the past,
397 present and future (Addis et al., 2007; Barnett & Bellana, 2025; Buckner & Carroll, 2007; Hassabis &
398 Maguire, 2007; Ranganath & Ritchey, 2012) and are thought to provide the mnemonic basis of spontaneous
399 thought (Christoff et al., 2016; Mildner & Tamir, 2019) and self-relevant information (Gusnard et al.,
400 2001). The resistance to interference of persistent content could then correspond to the physical separation
401 between sensory and default regions; the direct access of default network regions to the hippocampus; and
402 perhaps to cellular and circuit processes that stabilize potentiated synapses and protect recent information
403 from interference (Barak & Tsodyks, 2014; Dunsmoor et al., 2022). An important direction for future work
404 is to test whether activity in default-mode regions tracks the degree of persistent mental content reported
405 by individual participants.

406 The cognitive mechanisms underlying the immediate persistence of a narrative are likely connected to its
407 longer-term persistence and how individuals engage with narratives across months and years. Participants
408 who reported immediate mental persistence following reading also reported lingering thoughts outside of
409 the experiment. Specifically, in a two-day experiment (Multi Day; **Methods**) participants reported on the
410 second day the lingering they had experienced since Day 1, and completed a retrospective imaginative
411 involvement scale – a trait-level measure of narrative engagement over months and years (RII; Sethi et al.,
412 2022; Slater et al., 2018; Ulusoy et al., 2022). The extended lingering was positively correlated with
413 both the increase in semantic biases towards the story and the immediate lingering reported on Day 1
414 (Supplementary Note 19.3). RII was not correlated with the increase in semantic biases, but correlated
415 with subjective lingering on Day 1 (Supplementary Note 19.4). These data suggest that there is ecological
416 validity in our experimental approach, which will be useful in future studies that aim to guide interventions
417 on unwanted thoughts in everyday life.

418 When participants were instructed to suppress story thoughts, they were able to eliminate the occurrence
419 of story content in generated associates (Fig. 2B), but were only able to attenuate the entry of story-related
420 thoughts (Fig. 2C), and still reported substantial amounts of subjective lingering (Fig. 2D, Supplementary
421 Note 19). This pattern indicates that the generation of associates can mostly be controlled by volition, and
422 it will be interesting to assess in future work whether participants employ reactive or proactive strategies
423 to achieve such suppression (Fradkin and Eldar, 2022, also see Supplementary Note 4). Although the
424 difference between the story-relatedness before and after reading disappeared under suppression, story-
425 relatedness still was associated with more story thoughts (Supplementary Note 7), suggesting that the
426 volitional control over the generation of associates was not absolute. Moreover, the entry of story thoughts
427 and the feeling of lingering were reduced, but not eliminated by volitional control, suggesting that story
428 content remained in mind even in the absence of intentional retrieval. These results are broadly consistent
429 with the literature on thought suppression, in which suppression also reduced, but did not eliminate thoughts
430 about story-like stimuli (Abramowitz et al., 2001) (Supplementary Note 3).

431 The non-volitional persistence of recent experiences may play a role in mental health disorders. A
432 longstanding hypothesis is that impaired inhibitory control is not only a symptom of disorders such as
433 depression, but is also causal (Wenzlaff et al., 1988). More generally, tendencies toward involuntary
434 memories and ruminative thinking are associated with variation in mental health (Andrews-Hanna et al.,

435 2022; Yeung & Fernandes, 2023, 2024). Promisingly, individuals can learn to prevent memory cues
436 from automatically driving retrieval of unwanted memories (M. C. Anderson & Green, 2001; Mamat &
437 Anderson, 2023). However, most interventions target memories triggered by specific cues; it is less clear
438 how control over involuntary thoughts can be learned when a novel recent event is persisting in mind, such
439 as when a person perseverates on a recent awkward social interaction. We found that participants were able
440 to partially control story thoughts when instructed to suppress them (Fig 2), which is consistent with the
441 overall findings of a meta-study on thought suppression (Abramowitz et al., 2001, see Supplementary Note
442 3). It remains an open and important question what strategies enhance volitional control over persisting
443 recent experiences.

444 Mental content persisted more when individuals were transported into the narrative. Narrative transporta-
445 tion has been found to be increased when readers have had prior knowledge of or personal experience with
446 a story's themes (Green, 2004) and when story content was personally relevant to the reader (Kuzmičová &
447 Bálint, 2019). We found previously (Bellana et al., 2022) and again in this study (Supplementary Note
448 11) that transportation during reading strongly predicted whether content spontaneously persisted in mind.
449 Such transportation typically reflects a feeling that the narrative temporarily becomes one's subjective
450 reality (Busselle & Bilandzic, 2008; Slater et al., 2014). If the persistence of mental content is a product of
451 the mechanisms which cause an individual to "shift their center of perception into the mental model of the
452 story world" (Bilandzic et al., 2019, p. 804), it may be represented as part of the representation of the self
453 (Koban et al., 2021), continuously influencing retrieval as part of the representation of a person's 'current
454 situation'.

455 What could be the function of mental content persisting? One answer is that the present relevance
456 of past information can be predicted from its recency and frequency of use (J. R. Anderson & Schooler,
457 1991). The persistence of recent experiences then would be the product of a process by which relevant,
458 slow-changing features of the world are kept more available, enabling humans to integrate incoming
459 information more easily and to pursue their goals in the face of interruption and open-ended or uncertain
460 environments (Honey et al., 2023; Klinger, 1978). This normative framework makes the direct prediction
461 that a word or concept that recurs should be kept more accessible; importantly, narratives often repeat
462 or modulate particular concepts, and so an important question for future work will be whether narratives
463 containing more repetition persist more in mind. A similar, but more action-oriented theoretical framework,
464 arises in normative theories of hippocampal replay. For example, Mattar and Daw, 2018 proposed that past
465 episodes should be replayed proportional to the product of the 'gain' and 'need' of those episodes. Here,
466 'gain' is a measure of how much future behavioral success (increased reward) is expected to arise from
467 updating decision policies associated with this scenario, while 'need' is a measure of the likelihood that the
468 organism will encounter similar scenarios in the future. Although readers may not seem to 'need' to replay
469 fictional episodes which they will never encounter, it is possible that persistent thoughts about fictional
470 worlds may lead to better internal models, and perhaps better decision making, within real scenarios.

471 Several limitations will need to be addressed in future work. First, many of our conditions used a
472 single story, whose idiosyncratic features may shape some of the data, such as the memorability of earlier
473 versus later story elements (Supplementary Note 13). Comparable patterns were obtained with a different
474 story in Bellana et al., 2022 and across two stories in our Multi Day condition (Supplementary Note 19),
475 but extending the repertoire of stories will be an important future extension. Second, our findings on the
476 effects of volition are subject to the confounding effects of thought monitoring and suppression, which can
477 elicit the very thoughts they are intended to track or inhibit (Abramowitz et al., 2001; Wegner et al., 1987).
478 An important objective for future work is to develop indirect probes that track story thoughts better than
479 free association whilst avoiding conscious monitoring. Finally, the contrast between the Continued and
480 Separated conditions rested on a subtle manipulation, and the advantage of the Continued condition was
481 statistically marginal ($p = .06$) in our pre-registered tests. This finding will need to be replicated with a
482 stronger manipulation, and with stimulus pairs matched in length, style, and emotional intensity.

483 We began this work with the observation that our mental life exhibits continuity, not only on the scale
484 of seconds, but also on the scale of minutes. We previously invoked the term "psychological momentum",
485 as if our mental states carry both weight and direction (Honey et al., 2023). The present manuscript first
486 established that the persistence of mental content is automatic and only partly subject to volitional control.
487 We then proceeded to connect the persistent character of recent experiences in mind with the underlying
488 memory processes. We proposed that the persistence of mental content originates in a slowly changing
489 'deep' context representation. Drawing from the notion of event models, this context representation
490 integrates situational information, continually biases memory retrieval, and is robust to the content of
491 immediate external interference. We aim to eventually understand the mechanisms that determine which
492 thought will next surface in the stream of thought; here we take another step by connecting the subjective
493 experience of lingering thoughts with cognitive models of memory processes.

494 **METHODS**

495 This research was approved by the Johns Hopkins University Homewood Institutional Review Board. All
 496 participants were recruited from Prolific (<https://www.prolific.com/>), provided informed consent, and were paid a prorated \$12 per hour.

Table 1. Conditions reported in the study.

Condition	N	Description	Story Thoughts	Pre-registration/ Code
1. Intact	160	Participants performed free association immediately before and after reading a story. During the pre-reading free association phase, participants reported thoughts about food by double pressing the space bar. During the post-reading free association phase, participants reported thoughts about the story by double pressing the space bar.	✓	pre-registration source code
2. Scrambled	74	Participants generated words immediately before and after reading a word-scrambled version of the same story used in the Intact condition.	✗	Data sourced from “Word-Scrambled” in Bellana et al., 2022.
3. Suppress	161	Before reading, participants were instructed not to think about food, but to report any food thought that came to mind. After reading, participants were instructed not to think about the story, but to report any story thoughts that came to mind, by double pressing the space bar.	✓	pre-registration source code
4. Baseline	83	Participants performed free association before and after reading. Unlike the Intact condition, participants did not report food or story thoughts during free association.	✗	pre-registration source code
5. Suppress No Button Press ¹	135	Before reading, participants were instructed not to think about food. After reading, participants were instructed not to think about the story.	✗	(no pre-registration) source code
6. Situation	81	Participants performed a situational reasoning task for 26s as a distractor task immediately after reading and before their second free association phase.	✗	(no pre-registration) source code
7. ToM	83	Participants performed a theory of mind reasoning task for 26s as a distractor task immediately after reading and before their second free association phase.	✗	pre-registration source code
8. New Story	81	Participants read a new story (“Lightbulb”, 173-words, ~50s) as a distractor task immediately after reading the original story and before their second free association phase.	✗	pre-registration source code
9. Geometry	80	Participants counted triangles in an image for 30s as a distractor task immediately after reading and before their second free association phase.	✗	pre-registration source code
10. Continued	80	Participants read an unrelated new story (“Lightbulb”, 173-words, ~50s) as a distractor task after the original story. Immediately before reading the new story, participants were told that they were about to read a story that was a continuation of the original story.	✗	pre-registration source code
11. Separated	80	Participants read an unrelated new story (“Lightbulb”, 173-words, ~50s) as a distractor task after the original story. Immediately before reading the new story, participants were told that they were about to read a new story that was separate from the original story.	✗	pre-registration source code
12. Delayed Continued ¹	82	After reading the original story, participants performed a triangle counting task for 2 minutes before reading an unrelated new story (“Lightbulb”, 173-words, ~50s). Immediately before the new story began, participants were told that what they were about to read was a continuation of the original story.	✗	pre-registration source code
13. Pause ¹	81	Participants pressed a space bar for 30s immediately after reading and before the second free association phase.	✗	pre-registration source code
14. End Cue + Pause ¹	81	Participants pressed a space bar for 30s after reading and before the second free association phase. However, immediately before the space-bar-pressing phase they were explicitly informed that the story they had been reading had ended.	✗	pre-registration source code
15. New Story Alone	41	Instead of reading the original story, participants read only the new story (“Lightbulb”, 173-words, ~50s). Participants also produced 10 keywords for the new story in the questionnaire phase.	✗	pre-registration source code
16. Multi Day ¹	168	Participants performed the Baseline condition on Day 1 and the Suppress No Button Press condition on Day 2. Participants read a different story on each day.	✗	pre-registration source code

¹ Condition not reported in main body. For results, see Supplementary Notes 16, 17, 19, 24.9.

498 **Intact condition**

499 **Experimental procedure**

500 The experiment consisted of seven sections: (I) pre-story free association; (II) self-paced story reading; (III)
501 post-story free association; (IV) narrative transportation questionnaire; (V) comprehension questionnaire;
502 (VI) experience and strategy questionnaire; (VII) demographics questionnaire. At the start of the experiment,
503 participants were assigned randomly to either the Intact condition (described here) or the **Suppress condition**
504 (described below).

505 I *Pre-story free association*: Participants were informed that they would play the “word chain game”
506 in which their goal is to type a sequence of words. They were instructed to type any word that
507 entered their mind into a textbox and to submit it by pressing enter. Participants were instructed not
508 to generate sentences in their word sequences. Participants began with a practice block in which they
509 had to generate a chain of 10 words. The task display consisted of an empty text box displayed in
510 the middle of a white screen. The text “Enter a word to begin!” was displayed above the text box
511 until participants submitted their first word. That word then became a cue that was displayed above
512 the text box for 2000ms and then faded away gradually over 500ms. After the participant generated
513 each associate, that associate was displayed as a cue in the same way for 2000ms + 500ms. After
514 completing the practice block, participants were provided with a new instruction: “If at any point a
515 thought about food enters your mind, immediately double-press the space bar, then resume the task”.
516 Two space bar presses within 1000ms registered as a double-press, and would cause a blue circle
517 (100 × 100px) to appear that faded away within 1000ms. Participants performed five practice double
518 presses. Finally, participants started the free association phase with the instruction “Enter a word
519 to begin!”. This phase ended after 3 minutes, during which participants produced a mean of 56.5
520 (SD= 17.7) associates.

521 II *Self-paced story reading*: Second, participants read the story “So Much Water So Close To Home”
522 by Raymond Carver. The story was presented one sentence at a time. Participants were instructed
523 to press the enter key to read the next sentence. On average, participants finished reading in 10.59
524 minutes (SD = 5.7, min = 4.65, max = 68.41).

525 III *Post-story free association*: Participants were informed that they would play the “word chain game”
526 again. The instructions for the word chain game were presented again. The task was identical to the
527 pre-story free association, except for two factors. First, participants did not perform practice trials.
528 Second, participants were instructed to double press the space bar whenever a thought related to the
529 story came up, instead of a thought related to food. Participants began post-story free association an
530 average of 31.94 seconds (SD = 10.64, min = 14.01, max = 57.39) after completing the self-paced
531 reading section and produced 54.9 (SD= 18.3) words on average.

532 IV *Narrative transportation questionnaire*: Participants completed a modified version of the Narrative
533 Transportation Questionnaire (Bellana et al., 2022; Green & Brock, 2000). The questionnaire
534 consisted of 13 questions measuring the extent of transportation into the story. The first 11 items
535 corresponded to the “general items” of the scale (e.g. “1. While I was reading the story, I could
536 easily picture the events in it taking place”; for all items see the [source code](#)). Items 12 and 13 were
537 story-specific questions (“12. I had a vivid mental image of Claire.”, “13. I had a vivid mental image
538 of Claire’s husband, Stuart.”). Participants responded on a 7-point scale ranging from “1 - Not at
539 all” to “7 - Very much”. To compute the final transportation score, responses to items 2 and 9 were
540 flipped, and then all responses except for item 5 were averaged. Following Bellana et al., 2022,
541 Item 5 (“5. After the story ended, I found it easy to put it out of my mind.”) was excluded from the
542 transportation score to better distinguish engagement *during* reading from the subjective persistence
543 of narrative content *after* reading, which we measured separately.

544 V *Comprehension questionnaire*: Comprehension of the story was measured with a 24-item four-
545 alternatives-forced choice questionnaire. To compute the final comprehension score, the score for
546 each question (1 = correct, 0 = incorrect) was averaged. Two additional items served as an attention
547 check.

548 VI *Experience and strategy questionnaire*: Participants were asked about their experience during reading
549 and the word chain game. Questions included: “Please describe *any strategies* you may have used
550 while playing the *Word chain game*.” - text response; “Please describe *any differences* you felt
551 playing the word chain game *before* versus *after* reading the story.” - text response; “To what extent
552 did the story linger in your mind after reading it?” - 7-point scale from 1 (least) to 7 (most); “Were
553 you *intentionally* reflecting on the story while playing the word chain game? Or, did aspects of the

554 story come to mind *unintentionally*?” - five-alternative forced choice; “Did you know this story
555 before the study?” - Yes/No.

556 VII *Demographics questionnaire*: Participants answered a series of demographic questions, which
557 included current location, time, age, gender, handedness, language proficiency, race, education, and
558 reading habits.

559 **Stimulus**

560 During self-paced reading participants read “So Much Water So Close To Home” by Raymond Carver
561 ([link to text](#)). The story was 2347 words long and comprised 209 sentences. A separate line with three
562 stars (“***”) was displayed before the first sentence of the story, after the last sentence, and when there
563 were paragraph breaks.

564 The story is narrated from the perspective of Claire. It centers around a camping trip on which her
565 husband Stuart and his friends found the dead body of a girl, but only reported it to the police after two
566 days of camping. Claire becomes increasingly suspicious that Stuart may have been involved in the murder.
567 The story then describes the growing tension in Claire’s and Stuart’s everyday activities.

568 Unless otherwise specified, we used the same story across all experimental conditions.

569 **Participants**

570 Data for the Intact condition were collected between 02/05/2024 and 03/06/2024. In total, 229 participants
571 finished this condition of the experiment. 69 were excluded (Exclusion criteria; [Methods](#)). The remaining
572 160 participants formed the final sample ($N_{\text{female}} = 105, N_{\text{male}} = 54, N_{\text{neither}} = 1$). Median age range
573 was 35-39 years of age ($Q_1 = 25 - 29, Q_3 = 45 - 49, \text{min} = 18 - 19, \text{max} = 65 - 69$). Median level of
574 education was “Bachelor degree” ($Q_1 = \text{“Some college but no degree”}, Q_3 = \text{“Bachelor degree”}, \text{min} =$
575 $\text{“Less than high school degree”}, \text{max} = \text{“Doctoral degree”}$). The majority of our participants identified as
576 “White” (58.75%), followed by “African American or Black” (16.25%), “Asian” (13.75%), “More than one
577 race” (6.88%), “American Indian or Native American” (1.88%), and 2.50% choosing not to identify.

578 **Words generated during free association**

579 Across all conditions participants produced 178,560 words. Using pspellchecker (Barrus, [2018](#)), we
580 identified potentially misspelled words and manually corrected 1,943 of them (e.g. “ammendment” →
581 “amendment”). A fluent English speaker then confirmed this mapping. Additionally, we discarded 132
582 words for which the correction was ambiguous or unclear. After applying all corrections, participants
583 had produced a total of 19,050 unique words. The corrections and discarded words can be found in the
584 accompanying repository ([link to corrections](#)).

585 **Norming story relatedness**

586 We collected human ratings of story relatedness for 14,150 words. Participants generated in total 178,560
587 words, of which our ratings covered 170,343. Counting only unique words, participants generated 19,050,
588 of which our ratings covered 11,263. Participants read the story “So Much Water So Close To Home” one
589 sentence at a time, self-paced. Following reading, participants rated the story relatedness of approximately
590 390 words. For each word, participants were asked how related that word was to a specific moment of
591 the story: “How related is the word to a specific moment within the story? (e.g. the word reminds you of
592 particular details in the story)”. Participants responded on a scale between 1 (least related) and 7 (most
593 related). Participants were also asked how related each word was to the general theme of the story; however,
594 we did not use these ratings in this study. The order of questions was held constant within participants
595 and counterbalanced across participants. Each participant was pseudo-randomly assigned a unique set of
596 words, which were then presented in random order. Each word was rated by at least ten participants, and
597 the story relatedness was defined as the mean rating across all participants.

598 Ratings were collected between 01/28/2023 and 03/05/2023, and between 04/23/2024 and 05/12/2024.
599 In total, 644 participants finished the experiment. 213 participants were excluded (Exclusion criteria;
600 [Methods](#)). Data from the remaining 431 participants was used to determine the story relatedness of each
601 word. In total, 155,124 ratings were collected. The ratings are available on the Open Science Framework
602 (<https://osf.io/uv5br>).

603 **Scrambled condition**

604 **Experimental procedure**

605 Data for the Scrambled condition were taken from Bellana et al., [2022](#) (“Word-Scrambled”). In this
606 condition, the words of the story were fully scrambled within 5-sentence chunks. To ensure participants
607 were attentive, they performed 66 yes/no probe trials during reading, in which they indicated whether the
608 probed word was in a previous sentence or not. The full experimental procedure is described in the “Story
609 scrambling” paragraph of the Methods section in Bellana et al., [2022](#).

610 **Participants and exclusion criteria**

611 The exclusion criteria used by Bellana et al., 2022 are described in their Supplemental Methods under
612 “Experiment 1: Free association, pre- and post-story” within the “Participants and exclusion criteria”
613 paragraph. From the 80 participants in Bellana et al., 2022, we further excluded six participants because
614 they did not produce any words during the 0s-30s or 150s-180s time window of free association before or
615 after reading. The remaining 74 participants formed the final sample ($N_{\text{female}} = 37, N_{\text{male}} = 37, N_{\text{neither}} =$
616 0). Median age range was 35-39 years of age ($Q_1 = 30 - 34, Q_3 = 40 - 44, \text{min} = 20 - 24, \text{max} =$
617 $60 - 64$). Median level of education was “Associate degree” ($Q_1 =$ “Some college but no degree”, $Q_3 =$
618 “Bachelor degree”, $\text{min} =$ “High school degree or equivalent”, $\text{max} =$ “Doctoral degree”). The majority of
619 our participants identified as “White” (85.14%), followed by “African American or Black” (9.46%), “More
620 than one race” (2.70%), “Asian” (2.70%).

621 **Suppress condition**

622 **Experimental procedure**

623 The experimental procedure was identical to the **Intact condition**, with the key difference that participants
624 were instructed to suppress thoughts about food during pre-story free association and thoughts about
625 the story during post-story free association. After an initial free association practice block (“word chain
626 game”), participants were introduced to the following two rules:

627 “**Rule 1:** When playing the game, concentrate on **not thinking about food.**”

628 “**Rule 2:** If at any point a thought about food enters your mind, immediately double-press the space
629 bar. Then, resume the task and continue trying to suppress any thoughts related to food.”

630 After reading the story, participants received the same instructions as before reading but were asked to
631 suppress and report thoughts about the story instead of thoughts about food.

632 **Participants**

633 The data for the Suppress condition were collected simultaneously with the data from the Intact
634 condition between 02/05/2024 and 03/06/2024. In total, 262 participants finished this condition
635 of the experiment. 101 were excluded (Exclusion criteria; **Methods**). The remaining 161 partic-
636 ipants formed the final sample ($N_{\text{female}} = 91, N_{\text{male}} = 66, N_{\text{neither}} = 4$). Median age range was 35-
637 39 years of age ($Q_1 = 30 - 34, Q_3 = 40 - 44, \text{min} = 18 - 19, \text{max} = 65 - 69$). Median level of ed-
638 ucation was “Bachelor degree” ($Q_1 =$ “Some college but no degree”, $Q_3 =$ “Bachelor degree”, $\text{min} =$
639 “Less than high school degree”, $\text{max} =$ “Doctoral degree”). The majority of our participants identified
640 as “White” (63.98%), followed by “Asian” (17.39%), “African American or Black” (13.04%), “More than
641 one race” (3.11%), and 2.48% choosing not to identify.

642 **Baseline condition**

643 **Experimental procedure**

644 The experimental procedure for this condition was the same as the **Intact condition**, with the exception that
645 participants were not instructed to press a button when they had thoughts about the story (post story free
646 association) or food (pre story free association phase). The experiment was preregistered as a replication of
647 the “Neutralcue” condition in Bellana et al., 2022.

648 **Participants**

649 Data for this condition were collected between 04/04/2024 and 04/06/2024. In total, 119 participants fin-
650 ished this condition. 36 were excluded (Exclusion criteria; **Methods**). The remaining 83 participants formed
651 the final sample ($N_{\text{female}} = 35, N_{\text{male}} = 43, N_{\text{neither}} = 3$, with 2 participants selecting “Prefer not to identify”).
652 Median age range was 30-34 years of age ($Q_1 = 25 - 29, Q_3 = 45 - 49, \text{min} = 18 - 19, \text{max} = 60 - 64$, with
653 1 participant selecting “Prefer not to identify”). Median level of education was “Bachelor degree” ($Q_1 =$
654 “Some college but no degree”, $Q_3 =$ “Bachelor degree”, $\text{min} =$ “High school degree or equivalent”, $\text{max} =$
655 “Doctoral degree”). The majority of our participants identified as “White” (69.88%), followed by “African
656 American or Black” (12.05%), “More than one race” (7.23%), “Asian” (4.82%), “American Indian or
657 Native American” (1.20%), and 4.82% choosing not to identify.

658 **Suppress No Button Press condition**

659 The results of this condition are shown in Supplementary Note 16.

660 **Experimental procedure**

661 The experimental procedure of this condition was exactly the same as the **Suppress condition**, with the
662 exception that participants were not instructed to press a button when they had thoughts about food or the
663 story.

664 **Participants**

665 Data for this condition were collected between 10/06/2023 and 10/26/2023. In total, 220 participants
666 finished this condition. 85 were excluded (Exclusion criteria; **Methods**). The remaining 135 partici-
667 pants formed the final sample ($N_{\text{female}} = 77, N_{\text{male}} = 52, N_{\text{neither}} = 5$, with 1 participant selecting “Prefer
668 not to identify”). Median age range was 35-39 years of age ($Q_1 = 25 - 29, Q_3 = 40 - 44$, min =
669 18 - 19, max = 65 - 69, with 1 participant selecting “Prefer not to identify”). Median level of edu-
670 cation was “Bachelor degree” ($Q_1 =$ “Some college but no degree”, $Q_3 =$ “Bachelor degree”, min =
671 “Less than high school degree”, max = “Doctoral degree”). The majority of our participants identified
672 as “White” (66.67%), followed by “African American or Black” (12.59%), “Asian” (10.37%), “More than
673 one race” (5.93%), “American Indian or Native American” (0.74%), “Native Hawaiian or Pacific Islander”
674 (0.74%), and 2.96% choosing not to identify.

675 **Situation condition**

676 **Experimental procedure**

677 The experimental procedure was similar to the **Baseline condition** with the key difference that participants
678 performed a situation reasoning task immediately after reading and before post-reading free association.
679 The task required participants to read a scene description for 18 seconds and then answer a yes/no question
680 within 8 seconds. Participants were introduced to the reasoning task at the beginning of the study. The
681 scene description was presented with dark-purple font on a white background, and a purple shaded border
682 on the edges of the screen. Participants were instructed to press the enter key after finishing reading the
683 scene; a green bar then appeared as visual feedback. The scene description remained on screen for the full
684 18 s. The question then replaced the scene description, accompanied by a green ‘Yes’ and a red ‘No’ button.
685 Participants had to click one of the buttons, after which both were grayed out and the question remained on
686 screen for the remainder of the 8 s. After reading the story, participants were randomly assigned to one of
687 two scene/question pairs. The correct answers are highlighted in bold.

688 **Scene 1:** “When Jeff got ready this morning, he put on a light pink shirt instead of a white one. Jeff
689 is colorblind, so he can’t tell the difference between subtle shades of color.”

690 **Question 1:** “In reality, is Jeff’s shirt pink?” (yes/no)

691 **Scene 2:** “A window wiper was commissioned by a CEO to wipe an entire building. He finished the
692 right side, but his platform broke before he could do the left side. The next morning the CEO arrived
693 with foreign investors.”

694 **Question 2:** “When the CEO comes to work, do they discover that all of the windows are cleaned?”
695 (yes/no)

696 Participants then started doing the post-reading free association for 3 minutes and proceeded with the
697 experiment.

698 **Participants**

699 Data for this condition were collected between 04/06/2024 and 04/08/2024. In total, 119 partici-
700 pants finished this condition. 38 were excluded (Exclusion criteria; **Methods**). The remaining 81
701 participants formed the final sample ($N_{\text{female}} = 55, N_{\text{male}} = 25, N_{\text{neither}} = 1$). Median age range was
702 35-39 years of age ($Q_1 = 30 - 34, Q_3 = 45 - 49$, min = 18 - 19, max = 60 - 64). Median level of
703 education was “Bachelor degree” ($Q_1 =$ “Some college but no degree”, $Q_3 =$ “Bachelor degree”, min =
704 “High school degree or equivalent”, max = “Doctoral degree”). The majority of our participants identified
705 as “White” (67.90%), followed by “Asian” (13.58%), “African American or Black” (9.88%), “More than
706 one race” (7.41%), “American Indian or Native American” (1.23%).

707 **ToM condition**

708 **Experimental procedure**

709 The experimental procedure was identical to the **Situation condition**, with the exception that participants
710 were shown one of two theory of mind scene/question pairs. The correct answers are highlighted in bold.

711 **Scene 1:** “The morning of the high school dance Sarah placed her high heel shoes under her dress
712 and then went shopping. That afternoon, her sister borrowed the shoes and later put them under
713 Sarah’s bed.”

714 **Question 1:** “When Sarah gets ready, does she assume her shoes are under her dress?” (yes/no)

715 **Scene 2:** “Expecting the game to be postponed because of the rain, the Garcia family took the
716 subway home. The score was tied, 3-3. During their commute the rain stopped, and the game soon
717 ended with a score of 5-3.”

718 **Question 2:** “When the Garcia family arrives home, do they believe the score is 5-3?” (yes/no)

719 Participants then started doing the post-reading free association for 3 minutes and proceeded with the
720 experiment.

721 **Participants**

722 Data for this condition were collected between 04/10/2024 and 04/15/2024. In total, 117 partici-
723 pants finished this condition. 34 were excluded (Exclusion criteria; **Methods**). The remaining 83
724 participants formed the final sample ($N_{\text{female}} = 55, N_{\text{male}} = 27, N_{\text{neither}} = 1$). Median age range was
725 35-39 years of age ($Q_1 = 25 - 29, Q_3 = 45 - 49, \text{min} = 18 - 19, \text{max} = 65 - 69$). Median level of
726 education was “Bachelor degree” ($Q_1 = \text{“Some college but no degree”}, Q_3 = \text{“Bachelor degree”}, \text{min} =$
727 $\text{“Less than high school degree”}, \text{max} = \text{“Doctoral degree”}$). The majority of our participants identified as
728 “White” (73.49%), followed by “Asian” (9.64%), “African American or Black” (8.43%), “More than one
729 race” (3.61%), “Native Hawaiian or Pacific Islander” (1.20%), “American Indian or Native American”
730 (1.20%), and 2.41% choosing not to identify.

731 **New Story condition**

732 **Experimental procedure**

733 The main experimental procedure was similar to the **Baseline condition**. However, participants read
734 another story immediately after reading the original story. At the start of the experiment, participants were
735 instructed that they would read short stories presented in different colors of text, with each story displayed
736 in its own color, and it never being interrupted by another story. For practice, participants first read a short
737 story presented in dark-green font on a white background, and green shaded borders on the edges of the
738 screen. Next, participants continued with the experimental paradigm of the Baseline condition until the end
739 of the original story, which was displayed in black font. Immediately after finishing reading the original
740 story, participants were shown the third story (“Lightbulb”, Stimulus; **Methods**), with dark-purple font on a
741 white background, and a purple shaded border on the edges of the screen. All stories were self-paced and
742 presented sentence by sentence. Participants had to press a button to advance to the next sentence. During
743 the questionnaire phase, participants were reminded to distinguish between the stories by referring to their
744 order of presentation and text color.

745 **Participants**

746 Data for this condition were collected between 07/08/2024 and 07/09/2024. In total, 136 participants
747 finished this condition. 55 were excluded (Exclusion criteria; **Methods**). The remaining 81 participants
748 formed the final sample ($N_{\text{female}} = 48, N_{\text{male}} = 30, N_{\text{neither}} = 2$, with 1 participant selecting “Prefer not to
749 identify”). Median age range was 30-34 years of age ($Q_1 = 25 - 29, Q_3 = 40 - 44, \text{min} = 18 - 19, \text{max} =$
750 $60 - 64$). Median level of education was “Bachelor degree” ($Q_1 = \text{“Some college but no degree”}, Q_3 =$
751 $\text{“Bachelor degree”}, \text{min} = \text{“Less than high school degree”}, \text{max} = \text{“Doctoral degree”}$). The majority of our
752 participants identified as “White” (61.73%), followed by “African American or Black” (18.52%), “Asian”
753 (9.88%), “More than one race” (8.64%), and 1.23% choosing not to identify.

754 **Geometry condition**

755 **Experimental procedure**

756 The experimental procedure was similar to the **ToM condition** with the difference that participants performed
757 a geometry task rather than a theory of mind task. In the geometry task, participants were presented with
758 an image of multiple intersecting geometric shapes for 18 seconds and instructed to count the number
759 of triangles in the image (for an example see Fig. 3A, blue screen⁴). Participants then had 8 seconds
760 to enter their answer in a text field, followed by a 4-second blank screen. During the task, a purple shade
761 appeared on the borders of the screen. At the start of the experiment participants were introduced to the
762 geometry task and performed a trial task that was repeated until the right number of triangles was reported.
763 The experiment then followed the usual paradigm up until the end of the original story. Immediately
764 after reading the original story, participants performed the geometry task, afterwards continuing with free
765 association and the questionnaires.

⁴The image contains six triangles.

766 **Participants**

767 Data for this condition were collected on 05/21/2024. In total, 127 participants finished this condition.
768 47 were excluded (Exclusion criteria; **Methods**). The remaining 80 participants formed the final sample
769 ($N_{\text{female}} = 46, N_{\text{male}} = 32, N_{\text{neither}} = 2$). Median age range was 35-39 years of age ($Q_1 = 25 - 29, Q_3 =$
770 $45 - 49, \text{min} = 18 - 19, \text{max} = 60 - 64$). Median level of education was “Bachelor degree” ($Q_1 =$
771 “Some college but no degree”, $Q_3 =$ “Bachelor degree”, $\text{min} =$ “High school degree or equivalent”, $\text{max} =$
772 “Doctoral degree”). The majority of our participants identified as “White” (75.00%), followed by “African
773 American or Black” (15.00%), “Asian” (7.50%), “More than one race” (2.50%).

774 **Continued condition**

775 **Experimental procedure**

776 The Continued condition was almost identical to the **New Story condition**. Participants were trained on a
777 triangle counting task (to equate the experiment design with the Delayed Continued condition), performed
778 free association, read the original story, read the new story, performed free association, and answered
779 questions. Immediately after reading the original story and before reading the new story, participants
780 were shown a screen with the following sentences: “*You have reached the end of Part 1 of the story.*
781 *Next, you will read Part 2 of the story. Part 2 is told from a different perspective.*”. At the beginning of
782 the questionnaire phase participants were informed that both texts actually were two separate stories. In
783 addition to our usual questions, we asked participants to respond to the following questions on a 7pt scale:
784 “*To what extent do you agree with the following statements?*”

- 785 (a) *While reading Part 2 I was trying to relate it to Part 1. (1 - Not at all ... 7 - Very much)*
- 786 (b) *Part 1 and Part 2 felt like they were part of the same story. (1 - Not at all ... 7 - Very much)*
- 787 (c) *When I was told that Part 2 would be a continuation of Part 1, I believed this instruction.*
788 *(Yes/No/Can't remember)*

789 **Participants**

790 Data for this condition were collected together with the data for the Separated and Delayed Continued
791 condition between 02/10/2025 and 02/16/2025. Participants were randomly assigned to one of the three
792 conditions. In total, 143 participants finished this condition. 63 were excluded (Exclusion criteria; **Methods**).
793 The remaining 80 participants formed the final sample ($N_{\text{female}} = 52, N_{\text{male}} = 28, N_{\text{neither}} = 0$). Median age
794 range was 35-39 years of age ($Q_1 = 25 - 29, Q_3 = 45 - 49, \text{min} = 18 - 19, \text{max} = 60 - 64$). Median level
795 of education was “Bachelor degree” ($Q_1 =$ “Some college but no degree”, $Q_3 =$ “Bachelor degree”, $\text{min} =$
796 “High school degree or equivalent”, $\text{max} =$ “Doctoral degree”). The majority of our participants identified
797 as “White” (70.00%), followed by “African American or Black” (11.25%), “Asian” (8.75%), “More than
798 one race” (3.75%), “American Indian or Native American” (2.50%), and 3.75% choosing not to identify.

799 **Permutation test: Difference of binned series**

800 To determine whether the bin values in one condition differed significantly from those of another condition,
801 we tested whether the average difference of bin values was statistically unlikely under a null distribution
802 constructed by permuting condition labels. Bin values were the mean of participants’ means of the measure
803 of interest.

804 More precisely, for each of two conditions α and β , we have for each participant p a set of values x^p of
805 our measure of interest (e.g. story relatedness) which were submitted at different time points t_{xp} . First, we
806 set for each bin $b \in B$ bin boundaries ($t_b^{\text{min}}, t_b^{\text{max}}$), for example (0, 30) in seconds. For each participant p ,
807 for each bin b , we compute its average value:

$$\bar{x}_b^p = \sum_{x^p \in X_b^p} \frac{x^p}{|X_b^p|}$$

808 where $X_b^p = \{x^p | t_b^{\text{min}} < t_{xp} \leq t_b^{\text{max}}\}$.

809 We then computed for each condition $c \in \{\alpha, \beta\}$, for each bin b the mean of the participant means:

$$\bar{m}_b^c = \sum_{\bar{x}_b^p \in \bar{X}_b^c} \frac{\bar{x}_b^p}{|\bar{X}_b^c|}$$

810 where $\bar{X}_b^c = \{\bar{x}_b^p | p \in P_c\}$ and P_c is the set of participants in condition c .

811 To arrive at our final value, we took the mean of the differences between the bins of the two conditions:

$$\text{diff} = \sum_{b \in B} \frac{\bar{m}_b^\alpha - \bar{m}_b^\beta}{|B|}$$

812 To compute the null distribution $\overline{\text{diff}}^{\text{perm}}$, for each of n iterations, we randomly shuffled condition labels
813 between participants, creating permuted participant sets P_c^{perm} . For a two-tailed test, we considered $\overline{\text{diff}}$
814 significant if it fell below the 2.5th or 97.5th percentile ($\alpha = .05$), reporting the p value as:

$$p = 2 \min \left[\text{percentile_of}(\overline{\text{diff}}, \overline{\text{diff}}^{\text{perm}}), 1 - \text{percentile_of}(\overline{\text{diff}}, \overline{\text{diff}}^{\text{perm}}) \right]$$

815 Unless otherwise stated, we used two-tailed tests and $n = 5000$ permutations.

816 **Separated condition**

817 **Experimental procedure**

818 The Separated condition was identical to the **Continued condition**, except that after reading the original
819 story and before reading the new story, participants were shown a screen with the following sentences:
820 *“You have reached the end of the story. Next, you will read a new story. This new story concerns different*
821 *characters and events.”*.

822 **Participants**

823 Data for this condition were collected together with the data for the Continued and Delayed Continued
824 condition between 02/10/2025 and 02/16/2025. Participants were randomly assigned to one of the three
825 conditions. In total, 144 participants finished this condition. 64 were excluded (Exclusion criteria;
826 **Methods**). The remaining 80 participants formed the final sample ($N_{\text{female}} = 41, N_{\text{male}} = 38, N_{\text{neither}} = 0$,
827 with 1 participant selecting “Prefer not to identify”). Median age range was 35-39 years of age ($Q_1 = 25 -$
828 $29, Q_3 = 45 - 49, \text{min} = 18 - 19, \text{max} = 65 - 69$). Median level of education was “Bachelor degree” ($Q_1 =$
829 “Some college but no degree”, $Q_3 =$ “Bachelor degree”, $\text{min} =$ “High school degree or equivalent”, $\text{max} =$
830 “Doctoral degree”). The majority of our participants identified as “White” (72.50%), followed by “African
831 American or Black” (12.50%), “Asian” (8.75%), “More than one race” (6.25%).

832 **Delayed Continued condition**

833 The results of this condition are shown in Supplementary Fig 24.9.

834 **Experimental procedure**

835 This condition was similar to the **Continued condition**, except that participants were delayed after the story
836 by performing geometry tasks. After reading the original story, participants were shown a screen with a
837 sentence indicating the first part of the story ended, (*“You have reached the end of Part 1 of the story.”*).
838 They then performed four trials of the triangle counting task (for a total of 2 minutes). Next, in order to cue
839 participants to explicitly recall the content of the original story, they were shown a screen with a sentence
840 indicating the story would continue again (*“Next, you will read Part 2 of the story that you read earlier.*
841 *Part 2 is told from a different perspective.”*). Finally, participants read the new story.

842 **Participants**

843 Data for this condition were collected together with the data for the Continued and Separated conditions
844 between 02/10/2025 and 02/16/2025. Participants were randomly assigned to one of the three condi-
845 tions. In total, 151 participants finished this condition. 69 were excluded (Exclusion criteria; **Methods**).
846 The remaining 82 participants formed the final sample ($N_{\text{female}} = 48, N_{\text{male}} = 34, N_{\text{neither}} = 0$). Median
847 age range was 35-39 years of age ($Q_1 = 30 - 34, Q_3 = 45 - 49, \text{min} = 18 - 19, \text{max} = 65 - 69$, with 1
848 participant selecting “Prefer not to identify”). Median level of education was “Bachelor degree” ($Q_1 =$
849 “Some college but no degree”, $Q_3 =$ “Bachelor degree”, $\text{min} =$ “High school degree or equivalent”, $\text{max} =$
850 “Doctoral degree”). The majority of our participants identified as “White” (74.39%), followed by “African
851 American or Black” (15.85%), “Asian” (4.88%), “More than one race” (1.22%), “American Indian or
852 Native American” (1.22%), and 2.44% choosing not to identify.

853 **Pause condition**

854 The results of this condition are described in Supplementary Note 17.

855 **Experimental procedure**

856 The experimental procedure was similar to the **ToM condition** with the difference that participants were
857 instructed to pause for 30 seconds instead of performing a theory of mind task. In order to ensure focus
858 on the task during the pause phase, participants had to press and hold the space bar throughout the pause
859 period. The passage of time was shown in the form of a moving progress bar. The progress bar stopped
860 moving whenever a participant released the space bar, and resumed when they pressed it again. Throughout
861 the pause phase, a light-blue shade appeared around the border of the screen. At the start of the experiment,
862 participants performed two practice trials before continuing with the usual paradigm until the end of the

863 original story. After they finished reading the original story, participants were shown the progress bar
864 with the prompt to press and hold the space bar for 30 seconds, and the pause phase began. Afterwards,
865 participants continued with free association and the rest of the experiment.

866 **Participants**

867 Data for this condition were collected between 03/19/2024 and 03/20/2024. In total, 122 partici-
868 pants finished this condition. 41 were excluded (Exclusion criteria; **Methods**). The remaining 81
869 participants formed the final sample ($N_{\text{female}} = 51, N_{\text{male}} = 30, N_{\text{neither}} = 0$). Median age range was
870 35-39 years of age ($Q_1 = 25 - 29, Q_3 = 45 - 49, \text{min} = 20 - 24, \text{max} = 60 - 64$). Median level of
871 education was “Bachelor degree” ($Q_1 = \text{“Some college but no degree”}, Q_3 = \text{“Bachelor degree”}, \text{min} =$
872 “High school degree or equivalent”, $\text{max} = \text{“Doctoral degree”}$). The majority of our participants identified
873 as “White” (72.84%), followed by “African American or Black” (16.05%), “Asian” (6.17%), “More than
874 one race” (2.47%), and 2.47% choosing not to identify.

875 **End Cue + Pause condition**

876 The results of this condition are described in Supplementary Note 17.

877 **Experimental procedure**

878 The experimental procedure was similar to the **Pause condition** with the difference that, before the start of
879 the pause phase, participants were presented with an explicit cue that the story had ended. Specifically,
880 after the last “***” participants saw the words “The End.”, after which they were presented with a separate
881 screen stating that the phase ended. After clicking the “Next phase” button, participants were shown the
882 progress bar with the prompt to press and hold the space bar for 30 seconds, and the pause phase began.

883 **Participants**

884 Data for this condition were collected between 10/05/2024 and 10/07/2024. In total, 141 partici-
885 pants finished this condition. 60 were excluded (Exclusion criteria; **Methods**). The remaining 81
886 participants formed the final sample ($N_{\text{female}} = 47, N_{\text{male}} = 32, N_{\text{neither}} = 2$). Median age range was
887 35-39 years of age ($Q_1 = 30 - 34, Q_3 = 45 - 49, \text{min} = 20 - 24, \text{max} = 65 - 69$). Median level of
888 education was “Bachelor degree” ($Q_1 = \text{“Some college but no degree”}, Q_3 = \text{“Bachelor degree”}, \text{min} =$
889 “High school degree or equivalent”, $\text{max} = \text{“Doctoral degree”}$). The majority of our participants identified
890 as “White” (77.78%), followed by “Asian” (12.35%), “African American or Black” (6.17%), “More than
891 one race” (2.47%), and 1.23% choosing not to identify.

892 **New Story Alone condition**

893 The results of this condition are described in Supplementary Note 18.

894 **Experimental procedure**

895 The experimental procedure of this condition was largely the same as the **Baseline condition**. Instead of
896 reading the original story, participants read the “Lightbulb” story and produced story keywords immediately
897 after free association.

898 **Stimulus**

899 The story “Lightbulb” was taken from a [reddit post](#) written by user [moby323](#) and shortened. The story used
900 in the study ([link to text](#)) was 173 words in length, and split into 15 sentences. Before the first sentence and
901 after the last sentence a line with three stars (“***”) was shown.

902 The story is a short and humorous scenario written in the first person voice. The narrator explains how
903 he and his wife lived without an overhead light for six years because they did not realize the lightbulb was
904 dimmable.

905 **Theme similarity**

906 To measure the semantic similarity between free associates and the content of the Lightbulb story, we used
907 the “theme similarity” method introduced by Bellana et al., 2022.

908 After performing the post-reading free association, participants were asked to produce 10 words that
909 related to central themes and ideas of the story. The 19 most common theme words generated were used as
910 the “theme words” for Lightbulb.

911 To compute the theme similarity for a word, the word was embedded into the 300-dimensional GloVe
912 semantic space (Pennington et al., 2014). The story relatedness rating was the maximum cosine similarity
913 between a word and the 19 theme words.

914 **Participants and exclusion criteria**

915 Data for this condition was collected between 06/30/2024 and 07/02/2024. In total, 75 participants finished
916 this condition. 34 were excluded (Exclusion criteria; **Methods**). The remaining 41 participants formed the
917 final sample ($N_{\text{female}} = 19, N_{\text{male}} = 21, N_{\text{neither}} = 1$). Median age range was 35-39 years of age ($Q_1 = 30 -$
918 $34, Q_3 = 40 - 44, \text{min} = 18 - 19, \text{max} = 55 - 59$). Median level of education was “Bachelor degree” ($Q_1 =$
919 “Some college but no degree”, $Q_3 =$ “Bachelor degree”, $\text{min} =$ “High school degree or equivalent”, $\text{max} =$
920 “Master degree”). The majority of our participants identified as “White” (73.17%), followed by “African
921 American or Black” (21.95%), “More than one race” (2.44%), and 2.44% choosing not to identify.

922 **Multi Day condition**

923 The results of this condition are described in Supplementary Note 19.

924 **Experimental procedure**

925 Participants conducted the experiment over two consecutive days. On Day 1, the experimental procedure
926 was identical to the **Baseline condition**. On Day 2, the experimental procedure was identical to the **Suppress**
927 **No Button Press condition**, except that participants read a different story than on Day 1 and were asked
928 additional questions at the end. The two stories used were “So Much Water So Close To Home” by
929 Raymond Carver (**Stimulus; Intact condition**) and “Roy Spivey” by Miranda July. Participants were
930 randomly assigned to one of the two story orders: *Carver-July*, in which participants read “So Much
931 Water So Close To Home” on Day 1 and “Roy Spivey” on Day 2, or *July-Carver*, in which participants
932 read the stories in the reverse order. On Day 2, participants completed two additional questionnaires after
933 the experience and strategy questionnaire. First, to assess the persistence of the story on Day 1 after the
934 experiment, participants rated how much they agreed with the following statements: 1. “*The story lingered*
935 *in my mind after the experiment.*” 2. “*The story affected me emotionally.*” 3. “*I wanted to think about the*
936 *story after the experiment was over.*” 4. “*After the experiment, I noticed myself having thoughts about the*
937 *story even without trying.*”. Participants answered on a scale from “1 – Not at all” to “7 – Very much”.
938 Second, participants completed the Retrospective Imaginative Involvement (RII) questionnaire (Sethi et al.,
939 2022), a trait-level measure of the extent to which individuals retrospectively and imaginatively engage
940 with narrative content after exposure.

941 The questionnaire consisted of 16 items spanning four dimensions: characters (4 items), events (4
942 items), universe (4 items), and backstory (4 items). Participants responded on an 8-point scale ranging
943 from “1 – Never” to “8 – Very often”.

944 **Stimulus**

945 During self-paced reading participants read “So Much Water So Close To Home” by Raymond Carver ([link](#)
946 [to text](#)) or “Roy Spivey” by Miranda July ([link to text](#)). “Roy Spivey” was 4352 words long and comprised
947 263 sentences. A separate line with three stars (“***”) was displayed before the first sentence of the story,
948 after the last sentence, and when there were paragraph breaks.

949 The story is told from the first-person perspective of a woman reflecting on her past. She sits next
950 to a famous actor on a flight, and they share an intimate, playful connection. Before landing, he gives
951 her a phone number with a missing digit and tells her to remember it. She treats this moment as deeply
952 meaningful and carries the number with her throughout her life. Years later, she realizes she misunderstood
953 his intention and feels regret over the missed opportunity.

954 **LLM-based Story Relatedness**

955 Because we did not have the required quantity of human story-relatedness ratings for July, we generated
956 story-relatedness ratings by prompting Large Language Models. To keep comparisons between July and
957 Carver consistent, we also generated story-relatedness ratings for Carver. We used these ratings only
958 for the Multi Day condition. We used OpenAI’s gpt-5-mini-2025-08-07 to rate the story relatedness of
959 participant-generated words — 28,779 words for “So Much Water So Close to Home” and 28,751 words
960 for “Roy Spivey”. The model was prompted with the full text of each story and asked to rate each word
961 on a 7-point scale (1 = least story related, 7 = most story related). Each prompt included 19 few-shot
962 examples consisting of human ratings and explanations ([instruction prompt](#); [input prompt](#)). To validate the
963 LLM-based ratings, we computed Pearson correlations between GPT ratings and averaged human ratings.
964 For the Carver story ($N = 431$ raters, 14,150 unique words, **Methods**), the correlation between GPT and
965 mean human ratings was $r = .71$. In comparison, the average correlation of a single human’s rating to the
966 leave-one-out average was $r = .679$. For the July story ($N = 40$ raters, 1,089 unique words), the correlation
967 between GPT and mean human ratings was $r = .70$, compared to a leave-one-out human correlation of
968 $r = .691$. We replicated the main findings of our study using LLM-based story-relatedness, suggesting
969 they can be used as a replacement for human story-relatedness ratings.

970 **Participants**

971 The data for the Multi Day condition were collected between 02/21/2026 and 03/18/2026. In total, 201 participants finished the Multi Day condition in the *Carver-July* order. 119 were excluded (Exclusion criteria; **Methods**). The remaining 82 participants formed the final sample ($N_{\text{female}} = 47, N_{\text{male}} = 33, N_{\text{neither}} = 2$). Median age range was 30-34 years of age ($Q_1 = 25 - 29, Q_3 = 35 - 39, \text{min} = 18 - 19, \text{max} = 60 - 64$). Median level of education was “Bachelor degree” ($Q_1 = \text{“Associate degree”}, Q_3 = \text{“Bachelor degree”}, \text{min} = \text{“Less than high school degree”}, \text{max} = \text{“Doctoral degree”}$). The majority of our participants identified as “White” (59.76%), followed by “Asian” (20.73%), “African American or Black” (9.76%), “More than one race” (6.10%), and 3.66% choosing not to identify.

979 188 participants finished the Multi Day condition in the *July-Carver* condition. 102 were excluded (Exclusion criteria; **Methods**). The remaining 86 participants formed the final sample ($N_{\text{female}} = 57, N_{\text{male}} = 26, N_{\text{neither}} = 3$). Median age range was 30-34 years of age ($Q_1 = 25 - 29, Q_3 = 35 - 39, \text{min} = 18 - 19, \text{max} = 65 - 69$). Median level of education was “Bachelor degree” ($Q_1 = \text{“Some college but no degree”}, Q_3 = \text{“Bachelor degree”}, \text{min} = \text{“Less than high school degree”}, \text{max} = \text{“Doctoral degree”}$). The majority of our participants identified as “White” (75.58%), followed by “More than one race” (10.47%), “Asian” (6.98%), “African American or Black” (3.49%), “Native Hawaiian or Pacific Islander” (1.16%), and 2.33% choosing not to identify.

987 **Exclusion criteria**

988 Participants were excluded from the study if they failed to meet any of the following criteria. The threshold values are specified in Tables 2, 3, and 4. Lesser outliers ($< Q_1 - 1.5$ interquartile range (IQR)) and greater outliers ($> Q_3 + 1.5$ IQR) were computed based on the distribution from the “Neutralcue” condition reported in Bellana et al., 2022. Note that exclusion criteria i–ix applied to all conditions, whereas criteria x–xxi were specific to only some conditions.

993 Exclusion criteria were adapted to account for specific experimental conditions. After collecting data for the Pause condition, we changed the criteria from an outlier-based approach to absolute value thresholds to improve clarity.

996 **General exclusion criteria:**

997 i *Inattentive reading:*

998 Participants were excluded if the correlation between the reading time of a sentence with its number of characters was too low. For the purpose of this calculation, the 5% of sentences with the longest reading times and the 5% of sentences with the shortest reading times were discarded within each participant, in order to generate a statistic more robust to outliers.

1002 ii *Frequently off-task:* Participants were excluded if they clicked outside of the browser too often.

1003 iii *Slow association:* Participants were excluded if their mean submission time during free association was too long.

1005 iv *Pause during free association:* Participants were excluded if they took more than 30 seconds to submit any individual word during free association.

1007 v *Pause between reading and post-story free association:* After participants finished reading, they were again presented with the instructions for free association. Participants were excluded if they spent too much time between completing the reading task and beginning post-story free association.

1010 vi *Low comprehension:* Participants were excluded if the ratio of correct answers out of all 24 comprehension questions (four-alternative forced-choice) was too low.

1012 vii *Failed catch trial:* Participants who failed both catch trials were excluded.

1013 viii *Story known:* Participants were asked whether they knew the story before the experiment, and were excluded if they did.

1015 ix *Extended break during the experiment:* Participants who spent too much time away from the browser in the period between the start of pre-story free association and before the demographics questionnaire were excluded.

1018 **Condition specific exclusion criteria:**

1019 x *Break during reading:* Participants were excluded if they spent too much time outside of the browser during story reading.

- 1021 xi *Break during rating*: Participants were excluded if they spent too much time outside the browser
1022 during word rating.
- 1023 xii *Forgotten what to suppress*: After the experiment, we asked participants to note which topics they
1024 were supposed to suppress thoughts about. Participants were excluded if they failed to answer in a
1025 text field that they had to suppress food-related thoughts before reading and story-related thoughts
1026 after reading.
- 1027 xiii *Releasing the space bar*: Participants in the pause conditions had to hold the space bar for 30 seconds.
1028 Participants were excluded if they released the space bar for more than 5 seconds.
- 1029 xiv *Pause during reading*: Participants who spent more than 15 seconds reading a single sentence were
1030 excluded.
- 1031 xv *Reading too fast*: Participants who spent less than 20 seconds reading the entire story were excluded.
- 1032 xvi *Inattentive reading (new story)*: Participants were excluded if the correlation between the reading
1033 time of a sentence with its number of characters was too low for the *new story*. Again, the 5%
1034 of sentences with the longest and shortest reading times and the 5% within each participant were
1035 discarded for this computation.
- 1036 xvii *Unverified captcha*: We implemented a captcha (<https://www.hcaptcha.com/>) test before data sub-
1037 mission. Participants whose hcaptcha token could not be verified on our server were excluded. No
1038 participants were excluded based on this criterion.
- 1039 xviii *No screen recording*: We asked participants to record their screen during the entire study, and submit
1040 their recording after finishing the study. Participants who did not submit a screen recording were
1041 excluded.
- 1042 xix *Used AI*: Participants for which the screen recording shows they used help from artificial intelligence
1043 or similar tools were excluded.
- 1044 xx *Did not follow instructions*: Participants for which the screen recording indicates they were not
1045 following the experiment instructions were excluded.
- 1046 xxi *Not consecutive days*: In multi-day condition, participants who did not participate on Day 1 and Day
1047 2 in consecutive days were excluded.

1048 **Discrepancies between exclusion criteria and pre-registrations**

- 1049 • *Continued, Separated, and Delayed Continued conditions*: Halfway through data collection we
1050 found that we were excluding more than 60% of participants. This was largely because participants
1051 were systematically slower in generating associates than they had been in previous data collection,
1052 and showed slightly lower correlation between sentence reading times and sentence character-counts.
1053 Thus, we relaxed the following exclusion criteria:

- 1054 i **Inattentive reading**: .37 → .25
- 1055 iii **Slow association**: 6700 → 10000
- 1056 xvi **Inattentive reading (new story)**: .37 → criterion removed.

- 1057 • *Baseline and New Story Alone condition*: We erroneously registered criterion (v) (*Pause between*
1058 *reading and post-story free association*) with a threshold of 100 seconds. We used a criterion of 70
1059 seconds instead.

Table 2. Exclusion criteria (Part 1). The table shows the exclusion criteria applied to each condition. Values represent the threshold or value for exclusion. An empty cell indicates that the criterion was not applied to the condition. Conditions are ordered by data collection date.

Condition	i inattent. reading	ii freq. off-task	iii slow asso.	iv pause (FA)	v pause after (read - FA)	vi comp. score	vii catch score	viii knew story	ix break (general)
Story relatedness rating	< .5					< .7	< 1		> 60
Suppress-no-button-press	< outlier	> outlier	> outlier	> 30	> 60	≤ .25	< .5	Yes	> 45
Intact	< outlier	> outlier	> outlier	> 30	> 60	≤ .25	< .5	Yes	> 45
Suppress	< outlier	> outlier	> outlier	> 30	> 60	≤ .25	< .5	Yes	> 45
Pause	< outlier	> outlier	> outlier	> 30	> 60	≤ .25	< .5	Yes	> 45
Baseline	< .37	> 5	> 6700	> 30	> 70	≤ .25	< .5	Yes	> 45
Situation	< .37	> 5	> 6700	> 30	> 100	≤ .25	< .5	Yes	> 45
ToM	< .37	> 5	> 6700	> 30	> 100	≤ .25	< .5	Yes	> 45
Geometry	< .37	> 5	> 6700	> 30	> 100	≤ .25	< .5	Yes	> 45
New Story Alone	< .25	> 5	> 6700	> 30	> 70	≤ .25	< .5	Yes	> 45
New Story	< .37	> 5	> 6700	> 30	> 70 (to new)	≤ .25	< .5	Yes	> 45
End Cue + Pause	< .37	> 5	> 6700	> 30	> 100	≤ .25	< .5	Yes	> 45
Continued	< .25	> 5	> 10000	> 30	> 70 (to new)	≤ .25	< .5	Yes	> 45
Separated	< .25	> 5	> 10000	> 30	> 70 (to new)	≤ .25	< .5	Yes	> 45
Continued-Delayed	< .25	> 5	> 10000	> 30	> 70 (to new)	≤ .25	< .5	Yes	> 45
Multi Day	< .25	> 5	> 10000	> 30	> 70	≤ .25	< .5	Yes	> 45

Table 3. Exclusion criteria (Part 2). The table shows the exclusion criteria applied to each condition. Values represent the threshold or value for exclusion. An empty cell indicates that the criterion was not applied to the condition.

Condition	x break (reading)	xi break (rating)	xii suppress check	xiii space bar released	xiv pause (reading)	xv reading too fast	xvi inattent. reading (new story)	xvii failed captcha
Story relatedness rating	> 60	> 360						
Suppress-no-button-press			wrong answer					
Intact								
Suppress			wrong answer					
Pause				> 5				
Baseline								
Situation								
ToM								
Geometry								
New Story Alone					> 15	< 20		
New Story							< .37	
End Cue + Pause				> 5				
Continued								failed
Separated								failed
Continued-Delayed								failed
Multi Day			wrong answer					

Table 4. Exclusion criteria (Part 3). The table shows the exclusion criteria applied in the Multi Day condition. Values represent the threshold or value for exclusion.

Condition	xviii no recording	xix Used AI	xx failed instructions	xxi not consec. days
Multi Day	no recording	Detected	Detected	No

1060 **Statistical approach**

1061 All statistical tests were two-sided unless specified otherwise. We assessed normality and homoscedasticity
1062 prior to parametric testing. Non-parametric alternatives were employed when assumptions were violated or
1063 to maintain consistency across related comparisons. The details and reproduction of each test can be found
1064 in our online data and code repository (<https://github.com/GabrielKP/oc-pmc/blob/main/analysis/main.py>).

1065 Error bars in all figures represent 95% confidence intervals from bootstrap resampling (n=5000
1066 iterations, resampling participants with replacement).

1067 **DATA AVAILABILITY**

1068 Experimental stimuli and anonymized data to replicate figures and analyses are publicly available at
1069 <https://github.com/GabrielKP/oc-pmc> (GitHub) and at <https://osf.io/cx4n7> (Open Science Framework).

1070 The “Scrambled” data (e.g. Fig. 1) was sourced from Bellana et al., 2022, and can be found at
1071 <https://osf.io/dmbx4/> (OSF).

1072 **CODE AVAILABILITY**

1073 All code for data collection, data analysis, and figure generation is available at <https://github.com/GabrielKP/oc-pmc>
1074 (GitHub) and at <https://osf.io/cx4n7> (OSF).

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1343 The contributions refer to the definitions in CRediT (<https://credit.niso.org/>): Gabriel Kressin Palacios:
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1350 All authors have read and agreed to the published version of the manuscript.

1351 **ETHICS DECLARATION**

1352 The authors declare no competing interests.