Madridge
Journal of Behavioral and Social Sciences

Research Article

Open Access

Does the thought of a cell phone affect false recognition?

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Article Info

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Received: June 1, 2018
Accepted: June 11, 2018
Published: June 16, 2018

Citation: Beauchamp HM and LeVonne J. Does the thought of a cell phone affect false recognition?. *Madridge J Behav Soc Sci.* 2018: 2(1): 37-41.

Published by Madridge Publishers

Abstract

The effect of cell phone questions on false memory rates was examined. Ninety-six participants were shown 10 DeeseRoediger McDermott lists to determine whether cell phone questions versus control conditions that preceded list study influenced recognition. The results showed that participants who were asked about cell phones had significantly lower false recognition rates than control participants. The findings suggest that even when cell phones are not present, intrusive thoughts about cell phone use may reduce relational processing and affect memory.

Keywords: attention; cell phone; distraction; false memory; false recognition

Introduction

Do thoughts about our cell phones consume us, even when we are not actively using our phones? The distracting effects of actual cell phone use are well established (e.g. [1]). Distractions even occur when participants receive but do not respond to cell phone notifications during attentional tasks [2]. Further, the mere sight of a cell phone may decrease attention. For example, Thornton, Faires, Robbins, and Rollins found that the presence of a cell phone decreased performance on demanding attention tasks compared to a cell phone absent condition [3]. These authors suggested that this distraction may be caused by thoughts regarding missed cell phone use. In fact, cell phone thoughts have been reported as so intrusive that obsessive and compulsive behaviours may develop, leading researchers to study cell phone addiction [4]. Yet, such reports have not been tested systematically. This investigation will examine a novel way to study distraction on memory. In doing so, it will extend the existing literature on cell phone use/presence, to be the first to document whether compulsive thoughts about cell phones affect memory. If thoughts about cell phones distract from processing, then such thoughts may compromise many cognitive tasks (e.g., learning in the classroom, driving, and eyewitness testimony). Further even when devices are out of view, we need to examine whether they are a significant distraction that alters memory and a factor that contemporary psychological researchers need to consider as they collect memory data.

The only study that addressed this problem examined actual cell phone use (versus thoughts) on false recognition. Smith, Isaak, Senette, and Abadie [5] used the standard Deese Roediger McDermott (DRM) paradigm, initially developed by Deese [6] and expanded by Roediger and McDermott [7]. Semantic wordlists (e.g. bed, rest, and dream) were presented that related to a critical non-studied lure (e.g. sleep). Report of lures was the measure of false memory. Smith and colleagues' [5] participants were randomly assigned to a control condition or cell phone disruption conditions (i.e. responding to a question from either the experimenter's phone, or the participant's cell

phone via a call or text message). The distraction occurred at varying times while 8-9 DRM or other categorized lists were presented. Participants were shown 24 total lists followed by an immediate recognition test. Smith et al. found that control participants were able to correctly distinguish studied words from non-studied items at significantly higher rates than in cell phone distraction conditions. However, false recognition of critical lures was unaffected by groups.

While it is possible that cell phone distractions do not affect false memory rates, replication is necessary because DRM studies involving distracted encoding conditions have found other distractions affect rates of false memory. For example, some researchers have documented that distraction due to cell phone use increased rates of false recall [8, 9, 10, 11]. These findings are usually interpreted using either fuzzy trace or activation monitoring accounts. Fuzzy trace theory suggests that memories are formed for shared list commonalities (i.e. gist, measured by report of critical lures) and differences among studied items in memory (i.e. verbatim traces measured by report of actual stimulus items) [12]. According to Smith et al. [5] distraction reduces verbatim processing of actual list items, but allows gist processing associated with false report of critical lures to occur. A similar prediction occurs for the activation monitoring model that is based on Underwood's [13] implicit associative response theory. Underwood claimed that while studying a word, participants automatically think of related words. According to the activation monitoring account proposed by Roediger and McDermott [7], studied DRM words incite semantic activation of the critical lure, and participants who report critical rules may make monitoring errors. Both theories suggest distraction consumes cognitive resources. These resources are needed to form verbatim traces or engage in monitoring efforts that make us less error prone. Thus, both positions posit distraction leads to increased false reports.

However, other researchers have not found increased false reports following distracted encoding. In fact, some investigators have documented that distraction reduces false reports [14, 15, 16]. It is difficult to merge these inconsistent findings especially when some researchers have translated word lists to other languages such as Dutch [9] and Spanish [8], have employed different types of tests (i.e., recall vs recognition), have used recognition tests after a delay period which may or may not be filled with distractor tasks [9] or have tested recall before recognition which may contaminate the findings for recognition [9].

In an attempt to reconcile these contradictory findings, Dewhurst et al. [15] endeavoured to control mitigating variables and found that a critical factor, affecting whether false reports increase/decrease during distracted study, is the type of test employed (i.e. recall/recognition, respectively). Dewhurst claimed participants change the response criterion on recall tests, which increased rates of false report. However, when recognition memory was tested, rates of false reports decreased. Thus, it is possible that distraction during encoding may hinder semantic activation, thereby reducing actual and lure activation.

Contradictory findings suggest this area warrants further study. The present goal was to determine whether thoughts about cell phones alone (vs use/presence) are a novel distraction on a false memory task. To accomplish this, in one condition participants were asked cell phone questions (CQ) designed to promote cell phone thoughts. In a second condition, participants received a control question that did not promote cell phone thoughts. They were asked questions regarding their appearance in a mirror (AQ). In a third condition, participants were not asked a question before each wordlist (NQ). Any question (regardless of whether it affects cell phone thoughts) could interfere with list learning and memory, therefore using two control conditions created a stronger comparison for the test of CQ on memory. Finally, Smith et al. used categorized and associative lists, but in the present study list type was held constant. Since list type differences may affect outcome measures [15, 17], the 10 most evocative associative lists from Stadler, Roediger, and McDermott [18] were employed as a control.

Two predictions are thus possible.1.) Fuzzy trace and activation monitoring accounts suggest distraction reduces verbatim processing or monitoring activities. If the CQ group is distracted by cell phone thoughts, they will rely more on gist processing or engage less in monitoring activities resulting in higher false recognition yet lower studied word rates than controls. It is expected that the CQ group will have decreased false and studied word recognition than controls.2.) However, an alternate interpretation is also possible. If cell phone thoughts are distracting, the CQ group may be less likely to engage in relational processing of lists and as a result have lower rates of critical lure reports on tests than control conditions. Since recognition tests will be used to assess memory, it is predicted that false reports will be significantly lower for the CQ condition than the controls (NQ and AQ groups) thereby suggesting that cell phone thoughts decrease semantic activation and attenuate false recognition.

Method

Participants

The 96 participants (63 females and 32 males, 1 unidentified) were enrolled in either Introduction to Psychology or Research Methods classes in a small college in Northern New York (*M* age = 20.02 years, *SD*= 2.33 years, *n* = 32 per condition).

Materials

Study Materials

The top 10 recognition lists were selected from Stadler and colleagues [18]. The lists were randomized and blocked with the words for each list presented from strongest to weakest associate. The stimulus words were presented individually on Power point slides (in black Calibri font, against a white background).

For the CQ group, one CQ item was presented before each stimulus list. The experimenter developed 10 CQ items designed to prompt cell phone thoughts. The questions asked

participants to make estimations for social media use and apps, for texting rates, and for checking their cell phone within time limits. For the appearance question (AQ) group, one AQ item was presented before each stimulus list. Ten AQ items were developed by the experimenter and were designed to prompt thoughts about personal appearance monitoring. The questions asked participants to make estimations of mirror use, rates of thoughts about personal appearance, and for checking their reflection in a mirror within time limits. The AQ questions were selected to be comparable to the CQ questions in item length and wording. For the no question (NQ) group, before each list there was a 15s blank slide. After the 15s blank/question slide, and before each list, the word "PREPARE" was shown and heard.

Recognition Test

The recognition test was developed based on Stadler et al. [18]. The test contained 30 studied words (3 studied words per list, selected from serial positions 1,8, and 10), and 10 critical lures for the studied wordlists. The distractor items were selected from the 10 lowest lists from Stadler et al. that were never studied. The distractors were 30 non-studied words (3 non-studied words per list from serial positions 1, 8, and 10), and 10 non-studied lure words. Each of the 80 recognition test items was randomized and presented on the left side of the test paper followed by OLD or NEW judgments for each test item. The last item was a Likert-type item requiring that participants respond to the following statement "*I thought about my cell phone frequently during this study*" (i.e., ratings ranged from 1 = strongly disagree, 3 = neither to 5 = strongly agree).

Procedure

The female experimenter told participants that this was a memory study, and they would be shown 10 sets of 15 words presented at a 2s rate followed by a recognition test. To ensure that the questions and the procedures were clear, they were previously tested on a different pilot group (*N* = 25 Learning & Memory students). All participants were told to turn off their phones and place them out of view.

Participants in the NQ condition were told that each list began with a 15s blank slide followed by the word "PREPARE". At this point, all procedural questions were answered. The slideshow started with a 15s blank slide followed by the word "PREPARE" for 2s, then each word was presented individually for 2s. After the entire 15 item wordlist was shown, another 15s blank slide appeared followed by "PREPARE" and words from the next list were shown until all 10 lists were presented.

CQ and AQ participants had exactly this same procedure as the NQ group except that at the start, they were given a piece of paper and told to number 1-10 starting at the top and numbering down the left-hand side of the sheet. The numbers referred to a question appearing before each wordlist. For each question, participants were told they had 15s to write a quick response on their paper and place their pencil down to study the 15 item wordlist about to appear. Thus, the NQ participants waited for 15s, and CQ and AQ participants had 15s to answer one question before each list was shown. Immediately after the 10th list for all participants, the experimenter passed out the recognition test and informed participants to circle OLD if the word was previously shown or NEW if the word was not shown previously. This procedure took approximately .5 hr.

Results

Regardless of condition, participants were significantly more likely to report actual stimuli (*M* = .66, *SD* = .18) as OLD from distractor stimuli (*M* = .11, *SD* = .14), *t*(95) = 27.36, *p*<.001. Further to confirm DRM effects regardless of group, participants had significantly higher rates of OLD responses to critical lures (*M* = .77, *SD* = .17) than unrelated distractor lures (*M* = .11, *SD* = .16), *t*(95) = 29.73, *p*<.001. Please refer to Figure 1 for the actual and false recognition means by experimental groups.

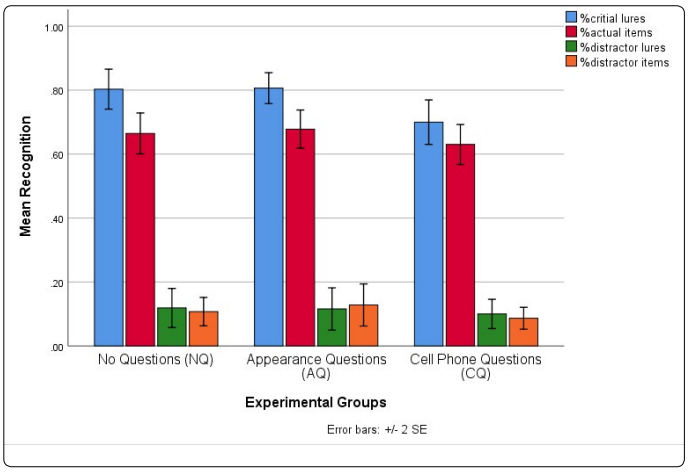

Figure 1. The average percent of actual and false items recognized by group

Veridical Recognition

The mean proportion of correctly recognized studied words for NQ participants was .67 (*SD* = .18), and .68 for the AQ group (*SD* = .17). The mean proportion for CQ participants was .63 (*SD* = .18). Both fuzzy trace and semantic activation accounts posit that correct recognition should be lower in the CQ condition than the control conditions. Although the CQ mean was in the predicted direction, a One-way Analysis of Variance (ANOVA) revealed that groups did not differ on the proportion of studied items correctly recognized, *F* (2,93) = .635, *p*<.53*NS*.

False Recognition

The mean proportion of critical lures falsely recognized as OLD by NQ participants was .80 (*SD* = .18) and .81 for the AQ group *(SD* = .14). The mean proportion of critical lures for CQ group was .70 (*SD* = .20). A One-way ANOVA showed a significant effect for group on false recognition rates, *F*(2,93) = 3.96, *p*<.022, w=.25. Tukey HSD post hoc analyses revealed that CQ participants significantly differed from NQ and AQ groups (*p*<.048, *p*<.040, respectively). The two control

conditions (AQ and NQ) did not differ from each other on rates of false recognition ($p<.997NS$). These findings support the idea that the CQ group would be distracted by cell phone thoughts and critical lure activation would decrease. Consistent with this theory, control conditions had increased rates of critical lures possibly because they had more resources for relational processing at study which increased critical lure activation compared to the CQ group.

Distractors

All distractor stimuli were combined (i.e., distractor lures and distractor stimuli) since these were items and lures from unstudied lists. Distractor items were a measure of guessing since these items were not studied and were not related to items on studied lists. No significant differences were found for group by rates of distractors erroneously selected as OLD, $F(2,93) = .33$, $p<.72$. Thus, groups did not differ in rates of guessing. Therefore, the significantly lower false recognition rate for the CQ condition stated above was not due to participants being less error prone in general but due to them being less likely to report critical lures than the control groups (i.e., AQ and NQ). This finding is consistent with the idea that the cell phone group was less likely to engage in the relational processing necessary for critical lure recognition than the control conditions.

Manipulation Check

A One-way ANOVA was conducted as a manipulation check using the item, *while I studied the words, I thought about my cell phone frequently,* (Likert responses from 1 = strongly disagree to 5 = strongly agree). This analysis revealed that participant groups significantly differed in rates of reported thought about cell phones during the study, $F(2,91) = 17.26$, $p<.001$, w=.51. Planned difference contrasts showed that the CQ group indicated significantly more agreement to thoughts about cell phones than the two control groups, $t(91) = -5.856$, $p<.0005$ (one-tailed), $r = .52$. The two control conditions did not differ on ratings of thoughts about cell phones $t(91) = -.43$, $p<.67NS$. As expected, CQ participants were significantly more likely to agree that they thought about their cell phone during the study ($M = 3.42$, $SD = 1.06$) than the control groups (NQ $M = 1.88$, $SD = .98$; AQ $M = 2.00$, $SD = 1.39$).

Exploring Thought Data

Many students in the CQ group reported high rates of thinking about their phones while answering the experimental questions (e.g., Participants reported checking their phone an average of 9.4 times per hour, $SD = 11.29$/hr. Participants also reported that when they were supposed to be doing something else, they were tempted to check their phones an average of 16 times per hour, $SD = 28.52$/hr, please note responses like "constantly" were omitted from these descriptive statistics). If students obsessively think about cell phones, this could pose an unintended distraction to the control participants in this study. To explore this idea, regardless of experimental group assignment, a correlation between participant's rating for the item, *while I studied the words, I thought about my cell phone frequently* (1= strongly disagree, 5= strongly agree) was conducted with recognition measures for actual, lure and distractor items. This analysis revealed that the more participants thought about their phone, the lower their percent of actual items reported as old, $r(96) = -.32$, $p<.002$ and the lower their percent of critical lure items reported as old, $r(96) = -.33$, $p<.001$. No such effect was found for distractor items $r(96) = -.16$, $p>.05NS$ and distractor lure $r(96) = -.1$, $p>.05NS$. Therefore regardless of group assignment, if participants tended to think about their cell phone during this study, they had significantly lower rates of recognition for actual stimuli and critical lures. This finding is consistent with the prediction based on the idea that cell phone thoughts distract participants from engaging in deep relational processing thereby attenuating activation of additional list items and critical lures.

Discussion

This is the first research to study experimentally the effect of cell phone related thoughts on a false memory task. CQ questions were intended to promote cell phone thoughts. This manipulation proved effective in that CQ participants reported significantly higher agreement ratings for thoughts about their cell phone during study than control participants (i.e., NQ and AQ). It was expected that veridical recognition would decrease for the CQ group compared to the controls. Although the main analyses did not find this effect, support for this was found in the exploratory analyses. That is, the more participants thought about their cell phone, the lower their percent of actual items and critical lure items reported as old. This finding is consistent with the idea that cell phone thoughts distract from relational processing of lists, making stimuli and lures less likely to be reported.

These findings do not support fuzzy trace or activation monitoring accounts that predicted that rates of actual stimuli would decrease while false reports would increase. The present results are consistent with researchers who have found that control participants had higher studied item recognition scores than distraction groups [15, 5]. One reason why this effect may be weaker in the current study is that the prior studies presented the distraction (i.e., answering questions using a cell phone or engaging in a divided attention task) *while* studying words, which was probably more demanding than the present task requiring responses *before* each list was studied. Such differences may account for these effects.

Interestingly, the present findings did show that false recognition for the CQ group was significantly lower than the control conditions (i.e., AQ and NQ). These findings mesh nicely with the work of Dewhurst and colleagues who found divided attention conditions resulted in significantly lower false recognition rates [14, 15]. In contrast, Smith et al. [5] found no significant effects for false recognition, however this

may be due to the type of lists used (i.e. categorized vs. associative). In the present study, only associative lists were selected because of the high critical lure rates associated with these lists.

The existing research examining the effect of cell phones investigated actual cell phone use, notifications, or the physical presence of a cell phone on cognitive tasks. This study is the first to investigate the effect of cell phone related questions on false recognition without the physical presence of a cell phone and demonstrates clearly that CQ evoke cell phone intrusive thoughts that impact false recognition, possibly by reducing elaboration during encoding. The present research also shows that cell phone questions may be more distracting than appearance related questions. As a consequence, it is important for investigators to ask participants about cell phone thoughts during research as such thoughts may impact prospective measures of memory. The exploratory analyses highlight how pervasive cell phone thoughts are for modern participants. In fact, 16 participants reported high agreement to thinking about using their cell phones during this study, despite being assigned to control conditions. These findings indicate a need for future memory researchers to consider assessing this new level of distraction for contemporary participants. This study and Smith et al. [5] also highlight the need for prospective researchers to control the presence of cell phones by requesting that participants place them out of sight during research investigations. The ubiquitous presence of cell phones may perpetuate cell phone intrusive thoughts during experimentation. The current research suggests that participants who are not exposed to a cell phone or asked CQ may still obsess about missed cell phone use opportunities during the course of a memory study.

The present findings are limited to immediate recognition memory. Future investigators will also need to determine whether these results extend to false recall tests. There is some evidence [15] to suggest that CQ may increase false recall, though this awaits exploration. Prospective researchers will also need to determine how long task-irrelevant thoughts persist during the course of a study. A delayed testing procedure will determine the persistence of this effect.

Conclusion

In contrast to other research that shows that cell phone use or presence affects performance, this study demonstrates that CQ presented before learning impacts memory accuracy, possibly by reducing relational processing for participants expected to abstract semantic relationships. These findings suggest that memory researchers need to consider the pervasive and obsessive lure of cell phones that may distract from memory tasks and affect empirical findings.

Acknowledgements

The authors received no financial support for the research, authorship, and/or publication of this article. There is no conflict of interest.

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