They forgot their “baby”?!: Factors that lead students to forget their cell phone

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Abstract

Remembering intentions is critical for daily life, yet errors happen surprisingly often, even when there are fatal consequences, as in the “forgotten baby syndrome”. To study how people forget personally-important intentions, we took 192 students’ cell phones and attached an activity tracker to their clothes while they participated in an unrelated experiment in our lab. We examined how often students forgot to retrieve their cell phone (personally important task) and return the tracker (experimenter relevant task) when they left the lab, and whether it mattered if the instructions were explicitly encoded or not. Students only forgot the tracker 10-13% more often than their cell phone, and explicit instructions did not reduce forgetting; neither did longer, more distracting ongoing tasks. Between 60-70% of participants said the intention “popped into mind”. We suggest that PM intentions are “autonomically” encoded, yet even personally important tasks are forgotten at surprising rates.

Introduction

Remembering to perform intentions–*prospective memory* (PM)–is critical for daily life. Yet, PM forgetting happens often, constituting 50-80% of everyday memory failures (Crovitz & Daniel, 1984; Haas et al., 2020). Most errors, like forgetting to pick up the mail, result in minor annoyances. However, many errors, such as forgetting one’s cell phone (on the table at a café after lunch), or turning off the stove, can have harmful outcomes (e.g., theft, starting a fire). Some errors, like forgetting your sleeping baby in the backseat when you leave the vehicle, can be fatal. Since 1998, over 467 children died in the US alone because their caregiver forgot them in the car (nhtsa.gov, noheatstroke.org). This does not include unreported close calls in which caregivers briefly forgot a child in the car, but remembered before the event turned fatal. Moreover, approximately 25% of parents with children under three reported that they had momentarily forgotten that their child was in the car with them at some time during a drive at some time during a drive (Public Opinion Strategies, 2014).

How could a caregiver forget about their most important responsibility? Expert testimony suggests that this “Forgotten Baby Syndrome” can happen to anyone, and does so irrespective of sex, socio-economic status, race, and age (Diamond, 2019). The forgotten baby syndrome was uncommon until the 1990s, but skyrocketed when laws mandated that car seats were to be in the back seat (kidsandcars.org). The absence of salient visual and auditory cues from the child creates a scenario conducive to forgetting the baby.

It has been suggested that the forgotten baby syndrome is fundamentally a PM error. Remembering to perform a PM intention (e.g., dropping a child off at daycare) involves multiple cognitive processes that support at least 4 phases: encoding the intention, retaining the intention while engaged in distracting ongoing activities (e.g., driving to work), detecting cues that signal that it is the appropriate moment to switch from ongoing activities (e.g., approaching the street to turn for daycare), and executing the intention (e.g., turn left towards the daycare rather than right towards work). Problems at any stage can cause PM failures (Kliegel et al. 2012; Kvavilashvili & Rummel 2020). For example, the absence of salient

visual and auditory cues from a child who is sleeping in the backseat creates a scenario conducive to forgetting the child in the car. This idea is supported by the fact that the forgotten baby syndrome was uncommon until the 1990s and then skyrocketed when laws mandated that car seats were to be in the back seat (kidsandcars.org).

It may seem odd to consider remembering to retrieve one's baby from the car a PM task because caregivers are unlikely to explicitly encode the intention to do so. Throughout this paper, we argue that such intentions are formed, albeit at a *latent* level. We propose a new term, "*autonomic PM*", to capture PM tasks that are encoded in the absence of explicit/conscious awareness.[1]

Until now, there has been no empirical research on how PM forgetting can happen in a situation analogous to the forgotten baby syndrome. Prior research on PM mainly involves abstract or 'one-off' computer tasks (e.g., push the space bar anytime you see the word "spaghetti" during a word rating task, McDaniel & Einstein, 2000) that are usually introduced explicitly, not personally important, and have little consequence to the participant if they forget.

The Current Study

Here, we designed a naturalistic procedure to measure how our participants (college students) could forget something that they are really attached to–something that could have real consequences if forgotten. When we asked colleagues what they thought was the equivalent of a college student's "baby", most were quick to respond – "Their cell phone!" Although nothing is of comparable importance as remembering to care for one's baby, the task of remembering one's cell phone has several notable similarities. The typical student brings their cell phone with them everywhere. If forgotten, even briefly, there can be serious consequences. In addition to the cost and inconvenience of losing the phone and its data, it often includes their ID, debit, or credit cards.

In the present study, depicted in Figure 1, students came to our labs to participate in a separate, unrelated experiment. Before beginning that experiment, we asked them to give us their cell phone so they would not be "distracted or tempted to check their phone." We also gave them an activity tracker to attach to the back of their waistband "to monitor their fidgeting." One group of participants was told to remember to ask for their cell phone back and return the tracker after the experiment (explicit encoding group); the other group was not (autonomic encoding group). Upon completion, we gave them a debriefing sheet and guided them to the exit. The experimenters pretended to go on with their business and watched to see if and when the participant remembered to ask for their phone back or return the tracker.

The hypotheses that we aimed to address in this study were as follows:

1. Because personally important tasks are prioritized during encoding (Myers et al., 2017), and task importance has previously been shown to reduce PM forgetting rates (Walter & Meier, 2014), we hypothesized that there would be less forgetting of the personally relevant task of retrieving one's cell phone than the less relevant task of returning the experimenter's tracker.

2. To test our theory that intentions are autonomically encoded, we compared forgetting rates following autonomic vs. explicit encoding. Based on the idea that explicitly encoding an intention should enhance the ability to detect PM cues and retrieve the intended action, we hypothesized that people who encoded tasks autonomically would forget more than those who encoded explicitly.
3. Because the other experiment varied in length, we could examine whether there was an association between forgetting and delay. According to the Preparatory Attentional and Memory processes (PAM) theory, successful PM requires continuous conscious monitoring for the cues in the environment (Smith, 2003), which should be more difficult for longer delays, so PM failures should become more frequent with longer delays. In contrast, the Multi-Process Model suggests that there should be no association because people also rely on spontaneous retrieval processes that cause the intention to "pop into mind" at the appropriate moment (McDaniel & Einstein, 2000).
4. We also evaluated the strategies and cues that participants used to help them remember. The PAM theory predicts that people will monitor for the tasks between intention formation and execution of action, and that this monitoring would be beneficial for success in performing those tasks. We did not have strong predictions about what would cue participants in this atypical situation, but we suspected that participants would frequently report that the task "popped into mind", especially for their cell phone vs. the tracker, and that they "thought about" or monitored for the tasks more often in the explicit than the autonomic encoding condition.

5. Finally, colleagues encouraged us to assess whether men or women were more likely to forget. We were resistant to make any predictions regarding sex.

[1] We believe that the terms 'incidental' and 'implicit' fail to capture this type of PM because A) such intended actions are intentionally encoded—one knows that one needs to care for one's child—and B) the situation requires explicit/declarative/volitional retrieval—the behavior does not occur implicitly. The term "autonomic" is used here to describe this unique type of PM, and is adopted from the term used to describe the body's regulation of involuntary actions via the autonomic nervous system, although we do not intend to directly connect the two.

Method

Participants

192 students from the University of Notre Dame participated [autonomic encoding condition: n=108 (76 female); explicit encoding condition: n=84 (47 female)[1]]. Participants were recruited for participation in this study when they arrived to the laboratories to participate in another, unrelated experiment. All procedures for this study were approved by the University's Institutional Review Board.

Design and Materials

The study had a 2 [Task Relevance: personally relevant (cell phone) vs. experimenter-relevant (tracker), within subjects] x 2 [Encoding Condition: autonomic vs. explicit instruction, between subjects] x 2 (Encoding Context: outside vs. inside the testing room, mixed) design. Within each group, half the participants encoded the personally relevant task outside the testing room and the experimenter relevant task inside the testing room, and the other half of participants did the opposite (for details, see the Supplemental Material). A Jawbone Up (San Francisco, CA) clip-on activity tracker was used for this experiment.

Procedure

When participants arrived to the laboratories for their testing session, they gave informed consent for that experiment. We then asked them if they would like to participate in this add-on experiment, which we told them was to “track how much people fidget during experiments”. Willing participants signed a separate consent form that indicated that the experiment was about remembering intentions, without referencing the cell phone and tracker tasks; full details were disclosed to participants during debriefing. Either before or after entering the testing room, the experimenter asked for the participant’s cell phone so that they were not “distracted or tempted to check their phone” during the other experiment, and later stored out of their sight in a cabinet. Then, either before or after entering the testing room (opposite from where the cell phone was taken), the experimenter gave the participant an activity tracker and asked them to clip it onto the back of their waistband, shirt, or dress so that it was out of sight. Participants in the autonomic encoding group did not receive an explicit instruction or reminder to remember either object. The procedure was identical for the explicit encoding condition except that participants were explicitly instructed to remember the tasks. They were told “Don’t forget to retrieve your cell phone and return the tracker after the experiment” at the time that the tasks were introduced.

Participants then completed the other experiment. When the participant opened the door to exit the testing room, the experimenter debriefed them on that experiment and guided them out of the lab. The experimenter pretended to be busy with other paperwork. A confederate experimenter outside the lab surreptitiously watched to see where they remembered each item and marked the participant’s location on a floorplan (Supplemental Figures 1 and 2). If participants did not retrieve their phone or return the tracker before they reached a stairwell to exit the building an experimenter stopped them and asked, “Did you forget something?” If that did not prompt the participant to remember either object, the experimenter told them what they forgot and then took the person back to the lab to get the object(s). If the participant remembered just one of the two objects, the experimenter did not mention the second one. The experimenter either took the tracker or returned the cell phone, whichever one was remembered, and then allowed the participant to proceed to the exit before asking, “Did you forget something else?”, if necessary. When the participant retrieved their phone and returned the tracker, they were debriefed about the experiment and asked the following questions: about their memory for the tasks:

1) Autonomic group only: When we took your phone and attached the tracker, did you make a mental note to remember to retrieve your cell phone or return the activity tracker later?

2) Did you think about your phone or the tracker during the experiment?

3) What made you remember to get your phone or return the tracker? Was there anything specific, or did it seem to pop into your mind spontaneously?

Data Analysis

Forgetting was deemed to have occurred if the student had to be stopped before they started to leave the building.[2] Chi-square and logistic regression analyses with Wald tests were conducted to analyze whether there were differences between the two tasks or two conditions for this bivariate measure of memory accuracy (Cohen et al. 2013). We also computed the distance from the location in the lab where the tasks were to be remembered and the location where the participant actually did stop to ask for their phone or return the tracker in an attempt to assess performance using a less stringent/categorical definition of memory success that may be more sensitive to differences between conditions; however, the psychometric properties did not allow valid inferences using this dependent measure (see supplemental analysis and results). McNemar's Chi-square tests were used to examine potential differences between the conditions in the distribution of responses to the post-experiment questions.

[1] The difference in sample sizes is because data were collected for the autonomic condition before the explicit condition and the Psychology Department moved to its new building before the sample sizes could be matched.
[2] The results separated by whether participants forgot, but then remembered after leaving the lab (i.e., a less extreme form of forgetting), or whether they forgot the other item, are in supplemental Tables 1 and 2.

Results

Personal Relevance and Type of Encoding

The frequency with which students forgot to ask for their cell phone back or return our activity tracker before leaving to exit the building is shown in Figure 2 for the autonomic and explicit encoding conditions. Students forgot to return our tracker only 10-13% more often than they forgot to ask for their cell phone back. Although this difference was smaller than expected, it was significant (McNemar's χ^2=12.41, p<.001) for both the autonomic (p=.04) and explicit (p=.002) encoding groups. Surprisingly though, explicit instructions did not reliably reduce forgetting. A logistic regression analysis showed that the type of encoding did not significantly predict whether participants would remember either their cell phone [β=0.770, Wald (1,192)=1.234, p=.267] or the tracker [β=-0.013, Wald (1,192)=.002, p=.962].

Delay

Next, we assessed potential associations between memory success and the retention interval between when the intention was formed and when it was to be performed. The delay ranged from 5 to 197 minutes [M=32.6 (SE=3.1) and M=70.74 (SE=5.33) for the autonomic and explicit conditions respectively]. Binary logistic regression analyses revealed that there was no association between memory success and the retention interval for either the cell phone in the autonomic [$t(106)=.65$, $p=.52$, $\beta=.001$, $r^2=.004$] or explicit [$t(82)=.96$, $p=.34$, $\beta<.001$, $r^2=.01$] encoding conditions, or the tracker for the explicit encoding condition [$t(82)=1.87$, $p=.07$, $\beta=.002$]. The one exception was for the tracker in the autonomic encoding condition [$t(106)=2.64$, $p=.009$, $\beta=.003$]. As discussed below, this suggests that the amount of time that passes before a personally relevant task is to be performed may not influence whether or not it will be remembered. That is, forgetting can be very rapid.

Reported Strategies and Cues

Next, we examined the participants' responses at the end of the experiment regarding the strategies and cues that helped them remember. First, participants in the autonomic encoding condition were queried to see if they had intentionally encoded the need to retrieve their cell phone or return the activity tracker. The majority (69.4%) reported that they did so for their cell phone; 63.1% did so for the tracker. However, a chi-square test on participants in the autonomic encoding condition revealed that, compared to participants who did not intentionally encode the intention, participants who self-generated an explicit intention were not more likely to remember to ask for their cell phone before they left the lab, $\chi^2(1)=1.77$, $p=.34$. Participants who explicitly encoded the tracker were more likely to remember, $\chi^2(1)=4.61$, $p=.04$. Therefore, although many participants in the autonomic encoding condition did explicitly encode the intention to retrieve their cell phone at the end of the experiment, doing so did not make them less likely to forget. That is, a self-generated intention did not improve memory for the personally relevant task, but it did for the tracker task.

In response to the question, "Did you think about your phone or the tracker during the experiment?", participants reported thinking about their phone 28% of the time in the autonomic encoding condition and 19% in the explicit encoding condition. For the tracker, 73% reported doing so in the autonomic condition; 51% did so in the explicit condition. Chi-square tests revealed that thinking about the need to remember to retrieve one's phone was not associated with memory success for either the autonomic ($\chi^2=3.32$, $p=.10$) or explicit ($\chi^2=.73$, $p=1.0$) condition. In contrast, thinking about the tracker was associated with better memory for the autonomic condition ($\chi^2=7.80$, $p=.009$), but not the explicit condition ($\chi^2=2.33$, $p=.16$). Therefore, although most participants reported monitoring about the tracker, and this helped them remember, most did not monitor about their phone, and those who did were just as likely to forget. Thus, the PAM theory can only partially explain how people remembered these PM tasks.

Next, we examined what cued participants to remember. Most people (60-70%) responded that remembering to ask for their cell phone simply "popped into mind," (see Supplemental Figure 2). A 3-way chi-square test was used to analyze the distribution of cues reported for the cell and the tracker in the autonomic vs. explicit encoding conditions. This rate did not differ whether participants were explicitly

told to remember or not ($G^2(10)=.50$, $p=1$). A McNemar's Chi-Square test did reveal a significant difference between the distribution of responses for the cell vs. the tracker [$\chi^2(3)= 25.23$, $p<.001$]. A visual examination of the distribution shows that participants reported that the intention to retrieve one's cell phone popped into mind more often than the intention to return the tracker, suggesting that participants relied on spontaneous retrieval more often to remember the personally relevant task than the less relevant task.

Differences in Sex

Finally, we assessed potential differences in memory success between males and females. Men and women did not differ in how often they forgot their cell phone in either condition (autonomic: $\chi^2= 1.71$, $p=.233$; explicit: $\chi^2=.65$, $p=.58$). The same was true for the tracker (autonomic: $\chi^2=.042$, $p=1$; explicit: $\chi^2=3.79$, $p=.08$).

Discussion

The key findings of this study were that students forgot to retrieve their cell phone before leaving the lab fairly often. Forgetting was greater for the less personally relevant tracker task, yet an explicit instruction to remember to perform the tasks did not improve memory. Moreover, forgetting the cell phone was as frequent whether or not participants in the autonomic encoding condition reported explicitly encoding the intention. Forgetting was similarly frequent regardless of the length of delay between intention formation and performance. Although several people reported monitoring the need to retrieve their cell phone during the delay, doing so did not improve memory for the task. Forgetting was reduced for participants who reported processing salient environmental cues such as feeling that their phone was missing or feeling that the tracker was attached to their clothing. Each finding is discussed in turn.

Forgetting of Personally Relevant vs. Abstract PM Tasks

Unsurprisingly, participants forgot their cell phone (a personally relevant task), less often than the activity tracker (the experimenter relevant task); what may be surprising is that there was only a 10 to 13% difference in forgetting rates. Task importance is known to have strong effects on PM forgetting rates (Walter & Meier, 2014). Critically, task importance is determined by the subjective value that the participant assigns to the task based on the perceived gains/losses resulting from task completion/non-completion (Walter & Meier, 2014). Improved memory for the cell phone compared to the tracker can likely contributed to the personal relevance of the task.

The habitual nature of the task, with remembering one's phone being a habitual task but not the tracker, also may have contributed to the differences in forgetting rates (Rose et al., 2010). As it relates to the forgotten baby syndrome, this fatal error occurs more often when the caregiver who is typically responsible for dropping the baby at daycare, for example, has a change in their habitual routine (Diamond, 2019).

No Difference in Forgetting for Autonomically vs. Explicitly Encoded Tasks

The lack of a difference between autonomic and explicit encoding conditions is one of the most intriguing results of the study. Logistic regression analysis revealed that there were no statistically significant differences in the distributions of forgetting rates across participants for both the tracker and the cell phone. Moreover, although many participants in the autonomic encoding condition did report making a 'mental note' to remember to retrieve their cell phone (69%) and retrieve the tracker (64%), doing so had little effect on them remembering to do so. We argue that this was because the intentions to retrieve and return the objects of value were 'autonomically' encoded and retained such that, when participants were leaving the lab, the majority of participants had the intentions spontaneously 'pop into mind'. This was especially true for the cell phone (60-70%) compared to the tracker (30-40%).

This finding is consistent with at least two studies. Kvavilashvili et al. (2013) also examined PM for a task involving a personal belonging (wristwatch) that they suggested was "implicitly formed". The authors concluded that "the conscious formation of an intention may not always be necessary for successful remembering as stipulated in the prospective memory literature" (p. 873). More recently, Scullin et al. (2018) probed the thoughts of 680 participants during the encoding of PM intentions in 8 experiments and found that participants frequently reported mind wandering, "hardly thinking about the PM task", or engaging in idiosyncratic, "perfunctory" processes rather than following the experimenter's explicit instructions. The authors summarized their results by concluding that participants often encode PM intentions with little effort, that variability in encoding effort often has little effect on PM remembering, and that PM intentions are often encoded "in passing". For the reasons described above, we propose the term 'autonomic' encoding to capture this unique, understudied form of PM intention formation. As it relates to the forgotten baby syndrome, we suspect that autonomic encoding is the default method by which caregivers form the intention to retrieve and bring their baby with them, and this method is typically sufficient. However, errors occur when there is a constellation of other contextual factors, e.g., divergence from habitual routine, sleep deprivation, stress, distraction. The implications for this type of intention formation in terms of the culpability and legal consequences when errors do occur are briefly discussed below.

No Effect of Retention Interval on Forgetting

One finding of the current study that may be surprising, which has important implications for understanding real world PM and the forgotten baby syndrome, is that forgetting rates were unaffected by increasing delays. Although this may be counterintuitive, PM research has shown that forgetting to perform intentions can occur very rapidly (Einstein et al., 2000; Hicks et al., 2000) and be unaffected by delays between intention formation and performance. In one example, PM forgetting was as frequent when the interval between intention formation and retrieval was 10 weeks, 2 days, or even 10 minutes (Nigro & Cicogna, 2000). As it relates to forgotten baby syndrome, it may seem sensible to assume that that caregivers would be more likely to forget a child in their car after a long vs. a short drive, but our data and other empirical evidence contradict this line of thinking. Therefore, judges, lawyers, and jurors

examining potential cases of the forgotten baby syndrome should disregard the amount of time between intention formation and failed retrieval.

Implications for PM Theory: The Role of Monitoring and Spontaneous Retrieval in Autonomic PM

As discussed above, PM research typically involves explicitly instructing participants to perform abstract intentions with little-to-no personal relevance during unnatural scenarios (Phillips et al., 2008). A novel aspect of the current study is that we formulated and attempted to address hypotheses about *autonomic PM.* The standard paradigm has benefitted PM theory development by imposing experimental control to isolate hypothesized cognitive processes of interest. However, no model to date has incorporated a role of autonomically encoded intentions (Kvavilashvili, 2021, personal communication). Because most daily PM tasks likely fall under this category, this is an important area of theory development to address in future PM research.

An analogy may be seen in the working memory literature. Although working memory has long been defined as the active maintenance of information in conscious awareness, recent behavioral, neuroimaging, neurostimulation and computational modeling research provides evidence for mechanisms that support the retention of *latent* information in working memory outside of conscious awareness (Rose et al., 2016; Rose, 2020; Soto et al., 2011). An analogous phenomenon is also seen in visual attention research in which environmental cues associated with unconsciously retained goals can capture attention via “pop-out” like effects (Hsieh et al., 2011). There are many overlapping cognitive and neural mechanisms that support attention, working memory, and PM, so these hypotheses should also be investigated to help advance PM theory. Most importantly, based on the lack of a difference between the autonomic and explicit encoding conditions, we propose that intentions to recover objects of intrinsic value can be autonomically encoded, retained, and initially cued for retrieval outside of conscious awareness. Based on what is known about the neural substrates of goal maintenance and the coding of subjective value (Cona et al., 2015; Mansouri et al., 2017; Zhou et al., 2021), we can even speculate that such signals are represented via frontal-striatal circuitry, and would be sensitive to drugs or damage that affect this circuitry. We believe this is an exciting hypothesis to address in future research.

Implications for the Forgotten Baby Syndrome

According to an excellent review in the *Berkeley Journal of Criminal Law*, if a caregiver who has forgotten their child did not possess a “mens rea”–that is, the knowledge or intent of wrongdoing at the time of their inaction–a crime has not occurred, and the caregiver should not be prosecuted for criminal culpability or criminal negligence (Breitfeld, 2020). As Gene Weingarten wrote in his 2009 Pulitzer Prize winning article in the Washington Post, “if you’re capable of forgetting your cellphone, you are capable of forgetting your child”. These are failures of memory, not of love.

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Declarations

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Research Disclosure Statements

All dependent variables or measures that were analyzed for this article's target research questions have been reported in the Methods section. All levels of all independent variables or all predictors or manipulations, whether successful or failed, have been reported in the Method section. The total number of excluded observations and the reasons for making those exclusions have been reported in the Method section(s). Data and study materials are available at CurateND, the open access Digital Repository for the University of Notre Dame.

Figures

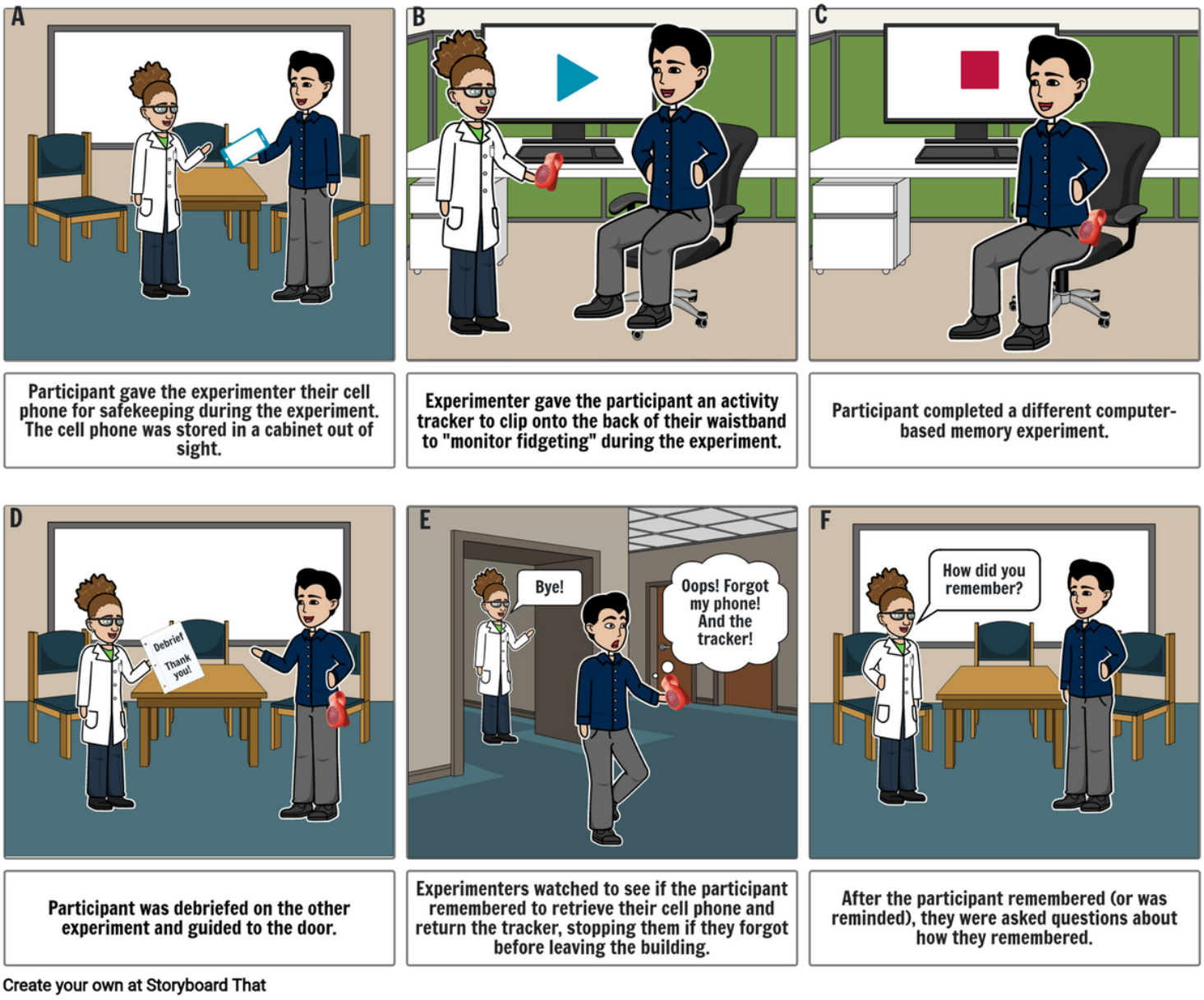

Figure 1

Depiction of the experimental procedure.

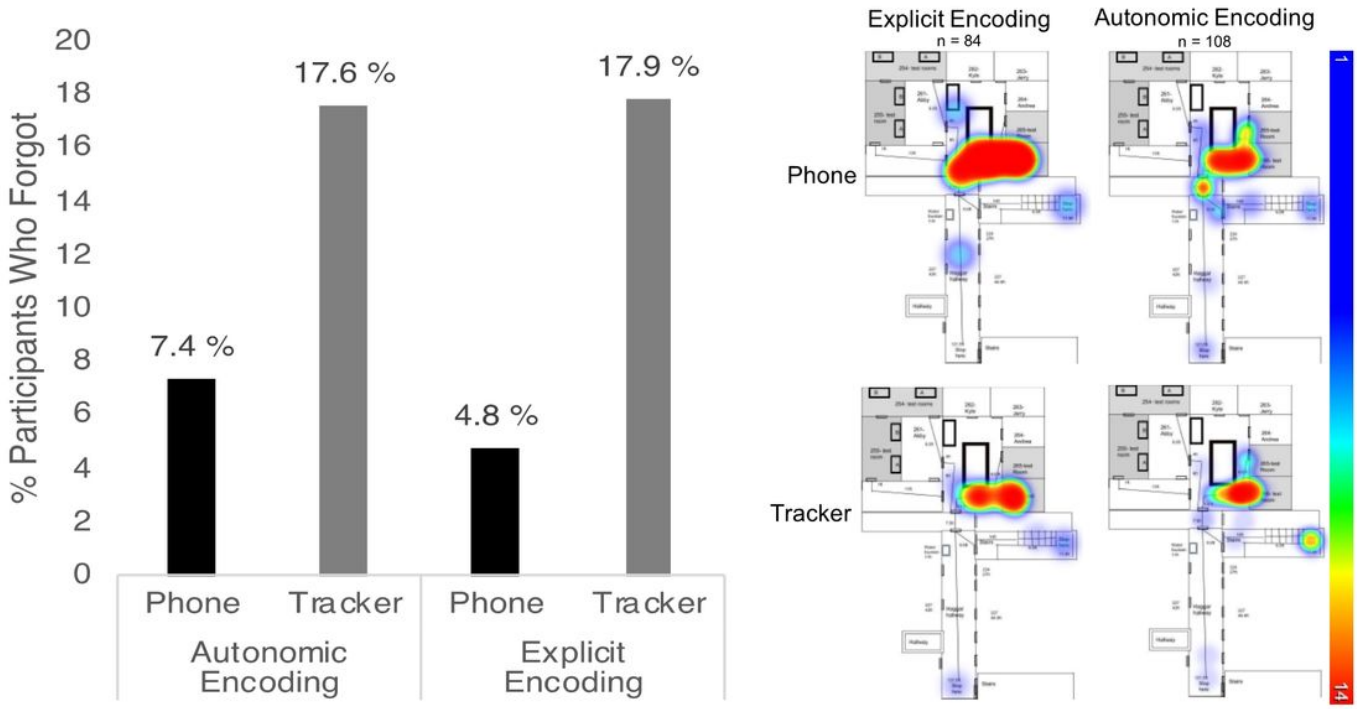

Figure 2

Percent of participants who forgot to retrieve their cell phone or return the activity tracker before leaving to exit the building in the autonomic and explicit encoding conditions (left), and the locations where participants remembered—or were stopped when they forgot (right).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplement.docx