

## **Prospective Memory: The Effect of Divided Attention While Encoding Intention on Spontaneous Retrieval**

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### **ABSTRACT**

Prospective memory (PM) refers to the ability to remember to perform intended actions in the future. Failures in PM, such as forgetting to carry out planned activities, can lead to serious consequences in daily life. Although PM failures have been extensively studied, the role of divided attention during intention formation remains underexplored. This study investigates the effect of divided attention during intention formation on spontaneous retrieval among undergraduates at Universiti Pendidikan Sultan Idris (UPSI). 11 female psychology undergraduates participated in this experimental, between-subjects study. Participants were assigned to either a divided attention or a non-divided attention condition during the formation of an intention, followed by a prospective memory task. Spontaneous retrieval was measured by using the PM task performance, which used a binary scoring system, where successful retrieval was coded as 1 and failure as 0. Although the hypothesis—that divided attention would impair spontaneous retrieval—was not statistically supported, the observed trend aligned with theoretical expectations. Due to the need for refinement in the methodology, findings remain inconclusive but offer a valuable foundation for future research.

**Keywords:** divided attention, Fisher's Exact test, intention encoding, prospective memory, spontaneous retrieval

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### **Introduction**

Prospective memory (PM) involves remembering to perform an intended action after a delay between the formation of the intention and the opportunity to execute it (Smith, 2016). This interval is known as the PM delay, and a failure to recall the intention after this delay is termed a PM failure. The multi-process framework divides PM retrieval into two main processes: intentional retrieval and spontaneous retrieval (McDaniel & Einstein, 2000). Intentional retrieval requires active monitoring of the intention, demanding attentional resources along the process. In contrast, spontaneous retrieval occurs automatically when an environmental cue triggers the intention without deliberate monitoring (Eysenck, 2020).

Current research focuses specifically on spontaneous retrieval, as there are times when individuals do not have the opportunity to monitor their intentions. In spontaneous retrieval, two aspects are critical. First, the absence of intention monitoring during the PM delay, and second, the presence of a cue that is associated with the intended action. Such cues can vary in their level of salience. High-salience cues—such as distinctive words, visual symbols, or environmental signals—are more effective in triggering spontaneous retrieval (Anderson & McDaniel, 2019). However, when individuals' attentional resources are highly taxed or divided, even salient cues may fail to activate the intended memory, resulting in spontaneous retrieval failure (Harrison et al., 2014).

Interestingly, age appears to influence the likelihood of prospective memory (PM) failures. Unlike retrospective memory (RM), which involves recalling past information and is more prone to failure among middle-aged and older adults, PM failures tend to occur more frequently in young adults. This may be because young adults have not yet established stable habits for remembering to execute intentions, whereas older adults are more likely to have developed such routines (Niedźwieńska et al., 2020). In Malaysia, young adults are typically undergraduate students who manage multiple responsibilities beyond academics, including co-curricular activities, part-time employment, and personal commitments. These simultaneous demands often divide their attention across tasks, potentially limiting their ability to fully focus on encoding future intentions.

The study by Harrison et al. (2014) on undergraduates shows that even with salient cues, PM performance can still be disrupted when attention is divided, indicating that attentional demands influence PM processes. Previous research has similarly demonstrated that attentional resources matter across different stages of prospective memory, including during intention encoding, maintenance, and retrieval (McDaniel et al., 2008; Harrison et al., 2014; Guo et al., 2024; Chen et al., 2022). However, the current study focused specifically on the encoding phase, where the intention is formed, with the aim of examining whether attentional resources allocated during this phase influence PM retrieval—specifically the spontaneous retrieval process.

While previous studies have demonstrated that divided attention impairs prospective memory (PM) performance, most research has focused on the effects of attention division during the PM delay or retrieval phase. However, little is known about how divided attention during intention formation—when individuals initially encode their future plans—might influence spontaneous PM retrieval. Addressing this gap is particularly important for understanding everyday PM failures among undergraduates, who often juggle multiple academic and personal responsibilities. To examine this issue, the present study formulated two research questions: (1) Does embedding a PM task affect ongoing task performance, specifically in terms of accuracy and reaction time, and (2) Does dividing attention during intention encoding influence spontaneous PM retrieval? These questions aim to clarify the variable of spontaneous retrieval and to identify the role of attentional resources during the encoding phase on spontaneous retrieval.

## **Methods**

### **Operationalisation**

#### ***Divided Attention During Encoding Intention***

Divided attention during encoding intention was operationalised with two levels: (a) divided attention and (b) non-divided attention. In the *divided attention condition*, participants received the PM instruction (i.e. encoding intention) while simultaneously performing a lexical decision task (LDT). The LDT required pressing ‘Y’ for real words and ‘N’ for nonsense syllables. At the same time, participants listened to the PM instruction audio through a headphone (i.e. encoding intention process), which directed them to press ‘O’ when a target word (*issue* or *level*) appeared on the screen (i.e. the intention). Participants then verbally repeated the PM instruction to the experimenter while continuing the LDT to

confirm the intention is encoded correctly. In the *non-divided attention condition*, participants listened to and verbally explained the PM instruction without performing any concurrent task.

### ***Spontaneous Retrieval***

Spontaneous retrieval was operationalised as prospective memory (PM) task performance, recorded using a binary score (1 = PM task performed; 0 = not performed). The PM task was implanted within a high-load ongoing task designed to meet the two defining characteristics of spontaneous retrieval: (a) the presence of a cue and (b) the absence of active monitoring. The ongoing task is designed to consist of a simultaneous LDT and digit detection task (DDT). In the LDT, participants pressed 'Y' for real words and 'N' for nonsense syllables. Concurrently, in the DDT, participants heard pairs of digits every 2–3 seconds and pressed Enter only when both digits were odd. The PM cue—the target word (*issue* or *level*)—appeared within the LDT, and participants were required to press 'O' button upon its appearance. This PM task is embedded within this dual-task environment, ensuring cue presence—the presence of the target word on screen—and minimising monitoring, consistent with evidence from Harrison et al. (2014), who showed that this dual-task reduces strategic monitoring during PM delays. Participants received a score of 1 for correctly pressing 'O' (i.e. successfully retrieving intention), and 0 when another key was pressed.

### **Participants and Sampling**

The target population comprised undergraduate students enrolled at Universiti Pendidikan Sultan Idris (UPSI), Malaysia. A purposive sampling technique was employed based on inclusion and exclusion criteria. Eligible participants were required to be current UPSI undergraduates and have achieved at least Band 3 in the Malaysian University English Test (MUET), ensuring adequate comprehension of English task materials. Exclusion criteria included individuals with diagnosed memory disorders, learning disabilities, or visual and auditory impairments, as well as those experiencing sleep deprivation on the day of testing, as these factors could become confounding factors of prospective memory performance.

Participant recruitment was conducted through word-of-mouth and digital flyers distributed via WhatsApp. A total of 19 students registered, and each was randomly assigned to one of two conditions—experimental (divided attention) or control (non-divided attention)—using the online randomisation tool Research Randomizer (Jhangiani, 2019). The prospective memory target word (“issue” or “level”) was alternated across participants within each condition to counterbalance target effects. Ultimately, 14 participants completed the study: six in the experimental group and eight in the control group. All experimental sessions were conducted between 23 January 2025 and 14 February 2025 in a quiet experimental laboratory at the Faculty of Human Development, Universiti Pendidikan Sultan Idris (UPSI), Malaysia. Each session lasted approximately 45 to 60 minutes and was conducted individually.

### **Apparatus**

The experimental tasks were programmed and presented using PsychoPy software (version 2020.2.4) on a Windows 10 Pro operating system (64-bit) running on an Intel® Core™ i5-7300U CPU @ 2.60 GHz (2.71 GHz). Auditory stimuli were delivered through Edifier WH700NB headphones, which include ambient noise cancellation to reduce

environmental distractions and ensure consistent audio clarity across participants. Standardised printed instruction sheets were provided to maintain uniform instructions throughout the study. All testing sessions were conducted under consistent laboratory lighting and ambient noise conditions, with participants seated approximately 50 cm from the laptop screen.

## **Experimental Tasks**

### ***Lexical Decision Task (LDT)***

The LDT consisted of 80 letter strings (40 real English words and 40 non-words) selected randomly from the validated Balota et al. (2007) word pool. The stimuli were divided into three sets: (a) Practice Set, which was used during the practice phase, (b) Instruction Set, which was used while delivering the PM instruction to the experimental group, and (c) Ongoing Set, which was used during the PM delay period. Each stimulus appeared individually on the laptop screen, and participants pressed the “Y” key for real words and the “N” key for non-words. Responses and reaction times were automatically recorded. The target words “issue” or “level” appeared once per participant within the Ongoing Set, counterbalanced across participants.

### ***Prospective Memory Task (PM)***

The PM task was embedded within the LDT. Participants received an audio instruction via headphones, prompting them to press the “O” key when they saw the target word (“issue” or “level”). They were asked to verbally explain the instruction immediately after the instruction ended to ensure the correct intention was encoded. For the experimental group, the PM instruction was presented while participants were actively engaged in the LDT (Instruction Set), creating a divided attention condition during intention formation. For the control group, the same instruction was presented before the LDT began, allowing full attention during intention encoding.

### ***Digit Detection Task (DDT)***

To make sure participants are not monitoring the encoded intention during the PM delay, the DDT and the LDT (using Ongoing Set) were performed simultaneously in this phase (Harrison et al., 2014). This combination of tasks is later called an ongoing task in this paper. The DDT used AI-generated pre-recorded audio presenting random pairs of digits (01–99) every two seconds. Participants were instructed to press “Enter” whenever they heard two consecutive odd digits (e.g., “one, one”; “three, seven”). This task induced cognitive load, preventing PM monitoring (Foster & Lavie, 2008). The DDT response data were recorded but not scored for accuracy, as the task served primarily to manipulate attentional demand.

## **Experimental Procedure**

Prior to data collection, 40 participant identification codes (P001–P040) were pre-generated and randomly assigned to either the experimental or control condition using a random number generator via Research Randomizer (Jhangiani, 2019). Participant recruitment was conducted through digital flyers and personal communication. Upon registration, participants were assigned a pre-generated identification code sequentially based on their order of registration (e.g., the first participant was assigned P001). The condition

information was withheld from participants until debriefing to maintain the single-blind nature of the study. This allocation procedure was adopted due to time constraints in participant recruitment. Upon arrival at the laboratory, participants read and signed a consent form. They were informed that the study examined accuracy and speed in computer-based tasks, while the true focus on prospective memory was concealed to prevent intentional monitoring of the prospective memory task. Participants also completed a demographic questionnaire and reported their MUET scores.

Participants first received printed instructions for the LDT, which they read and verbally summarised to confirm understanding. They completed two practice LDT trials, followed by a combined LDT and DDT practice consisting of three trials. A 30-second break was provided between trials. The practice ensured participants' familiarity with both visual and auditory components. A 2-minute rest was provided after this practice phase. Participants then entered the experimental phase. Both groups read a printed PM task briefing to prepare them for the coming PM task, and then they explained it to the experimenter and asked questions for clarity. The next procedure differed by condition—the experimental group (divided attention condition) and the control group (non-divided attention).

In the experimental group, participants began the experimental phase with the LDT (Instruction Set). Immediately after the first few words of LDT were presented on the screen, the PM instruction audio was played through the headphones while participants continued performing the LDT. They explained the instructions aloud while maintaining engagement in the LDT. Upon completion of their verbal explanation, the experimenter pressed the “1” key to switch to the Ongoing Set and simultaneously start the DDT audio. The target word appeared once within the Ongoing Set. Whilst in the control group, participants received the PM instruction before beginning the LDT. They explained it verbally to the experimenter, then the experimenter pressed the “1” key to start the Ongoing Set of LDT and the audio of DDT was played simultaneously. The target word appeared once within the Ongoing Set.

All participants in both groups completed 80 LDT words in the Ongoing Set while performing the DDT simultaneously. Responses for LDT were recorded automatically. After task completion, participants were debriefed. The true purpose of the study was explained, including the role of divided attention and prospective memory. Participants were allowed to ask questions and were given a small token of appreciation (a sachet of biscuits and a handmade crocheted bracelet).

## **Results**

Although 40 participant identification codes were pre-generated, only 19 participants registered for the study, of whom three were male. Of these 19 participants, 14 completed the experimental session, with only one male participant completing the study. Following data cleaning, only 11 participants were retained for the final analysis, all of whom were female. Three participants were excluded based on predefined data-cleaning criteria. One participant reported insufficient sleep prior to the experimental session, which may have affected cognitive performance. Another participant experienced a technical error during the procedure. The third excluded participant failed to respond appropriately to the prospective memory target, responding with the key (“N”) instead of the “Y” or “O”, implying not knowing the spelling of the target word or not being properly engaged in the procedure.

During the debriefing session, this participant confirmed not noticing the target word, and the experimenter noticed the participant responding in a rushed manner. Although the study did not initially intend to restrict participation by gender, the final sample consisted entirely of female participants due to limited interest from male students. During recruitment, several potential participants reported time constraints and perceived the estimated duration of the experiment (approximately 45 minutes to one hour) as a barrier to participation. Consequently, the participant pool was limited, resulting in a gender-homogeneous final sample.

All 11 participants included in the final analysis were female undergraduate students enrolled in the Bachelor of Psychology with Honours programme. Participants ranged in age from 21 to 25 years ( $M = 23.09$ ,  $SD = 1.14$ ). As for English language proficiency, the majority of participants obtained Malaysian University English Test (MUET) Band 4 ( $n = 9$ ), with one participant each obtaining Band 3 and Band 5. Five participants were assigned to the divided attention (DA) group, and six participants were assigned to the non-divided attention (NDA) group. Demographic characteristics by experimental group are summarised in Table 1.

Table 1. Demographic Characteristics of Participants by Group

Variable	DA (n = 5)		NDA (n = 6)	
	Frequency	Percentage	Frequency	Percentage
Gender				
Male	0	0	0	0
Female	5	100%	6	100%
Age group				
21	0	0%	1	16.7%
22	0	0%	2	33.3%
23	2	40%	2	33.3%
24	2	40%	1	16.7%
25	1	20%	0	0%
MUET band				
Band 3	1	20%	0	0%
Band 4	4	80%	4	66.7%
Band 4.5	0	0%	1	16.7%
Band 5	0	0%	1	16.7%

### Ongoing Task Performance

A two-tailed paired-samples t-test was conducted using SPSS with an alpha level of .05 to examine differences in ongoing task performance, specifically accuracy and reaction time, between the LDT performed without an embedded PM task (data from the final practice phase) and the LDT performed with an embedded PM task (data from the experimental phase). This analysis was conducted to assess the presence of monitoring, operationalised as a decrease in accuracy or an increase in reaction time (i.e. ongoing task costs; Harrison et al., 2014). It was hypothesised that if participants engaged in monitoring for the PM task, ongoing task performance would be impaired, such that LDT accuracy would be significantly reduced and reaction time would be significantly increased when the PM task was embedded. The null hypothesis stated that (1) there would be no significant difference in LDT accuracy between the LDT performed without a PM task and the LDT performed with an embedded

PM task, and (2) there would be no significant difference in LDT reaction time between the LDT performed without a PM task and the LDT performed with an embedded PM task.

Prior to conducting the paired-samples *t*-test, assumptions of normality were assessed using skewness, kurtosis, and the Shapiro–Wilk test. Skewness and kurtosis values for accuracy (skew =  $-0.77$ , kurtosis =  $-0.56$ ) and reaction time (skew =  $-0.51$ , kurtosis =  $0.48$ ) fell within the acceptable range of  $\pm 2$ , indicating approximate normality. The Shapiro–Wilk test was also non-significant for accuracy,  $p = .095$ , and for reaction time,  $p = .916$ , suggesting that both variables did not significantly deviate from normality. Therefore, the assumptions for conducting a paired-samples *t*-test were satisfied.

A two-tailed paired-samples *t*-test revealed that LDT accuracy was significantly higher when the PM task was embedded ( $M = 70.18$ ,  $SD = 8.35$ ) compared to the LDT without a PM task ( $M = 64.09$ ,  $SD = 5.99$ ),  $t(10) = -2.66$ ,  $p = .024$ . A similar pattern was observed for reaction time, such that responses were significantly slower in the LDT with an embedded PM task ( $M = 136.54$ ,  $SD = 20.88$ ) than in the LDT without a PM task ( $M = 120.83$ ,  $SD = 25.73$ ),  $t(10) = -2.30$ ,  $p = .045$ . Hence, the null hypotheses for both accuracy and reaction time were rejected. This pattern shows that embedding a PM task led to slower response times and improved accuracy in the ongoing task, indicating that spontaneous retrieval could not be demonstrated, and that the dependent variable in this study reflects prospective memory retrieval in general rather than specifically spontaneous retrieval.

### Prospective Memory Task Performance

Descriptively, only one out of five participants in the divided attention (DA) group (20%) successfully performed the prospective memory (PM) task ( $M = 0.20$ ,  $SD = 0.45$ ). In contrast, five out of six participants in the non-divided attention (NDA) group (83.3%) successfully performed the PM task ( $M = 0.83$ ,  $SD = 0.41$ ). Overall, six participants successfully retrieved the intention, whereas five participants did not. Table 2 presents the frequency distribution of PM task success across the two experimental groups. The descriptive pattern indicates a higher likelihood of successful PM performance in the NDA group compared to the DA group.

Table 2. Frequency Distribution of PM Task Performance by Attention Condition

Attention condition	PM task performance		Total
	Not success (0)	Success (1)	
Divided attention	4	1	5
Non-divided attention	1	5	6
Total	5	6	11

A one-tailed Fisher’s Exact Test was conducted using R (version 4.4.3) with an alpha level of  $.05$  to test the null hypothesis that there is no difference in PM performance between the divided attention (DA) and non-divided attention (NDA) encoding conditions. The alternative hypothesis specified that divided attention during intention encoding would reduce the likelihood of PM performance. Fisher’s Exact Test was selected due to the categorical nature of the variables and the small sample size ( $N = 11$ ), and as it is appropriate for analysing associations in  $2 \times 2$  contingency tables when expected cell frequencies are low (Agresti, 2019).

The results indicated that the association between attention condition and PM task performance was not statistically significant,  $p = .067$  (one-tailed; Fisher, 1925, as cited in Miller & Ulrich, 2019). Therefore, the null hypothesis was not rejected. This finding suggests that attentional resources during intention encoding do not affect PM performance.

### **Discussions**

The present study aimed to examine whether attentional resources allocated during the intention encoding phase influence spontaneous retrieval. In line with previous research, spontaneous retrieval was operationalised via ongoing task costs, which were defined as reduced accuracy and increased reaction time on the LDT performance (Harrison et al., 2014). Results of the ongoing task performance indicated that embedding a PM intention was associated with slower response times but improved accuracy on the LDT. Contrary to the hypothesis, this pattern does not reflect the typical ongoing task cost profile, which is usually characterised by both slowed responses and reduced accuracy due to divided attentional resources (Harrison et al., 2014; Forster & Lavie, 2008).

One possible explanation for the observed increase in accuracy alongside slower response times is that participants may not have been actively monitoring the PM intention, but instead allocated greater attentional resources to the ongoing task. The LDT without an embedded PM task was framed as a practice phase, during which participants may have had lower motivation and invested less effort. As a result, performance in the practice phase may have been characterized by lower accuracy and faster responses compared to the experimental phase. The possibility of differences in effort could account for the improved accuracy and slower responses observed in the experimental phase, without necessarily indicating active monitoring of the PM task. This is supported by previous research that shown participants' performance is influenced by motivation, particularly in low-stakes conditions. For example, participants achieved higher scores when incentives were provided, suggesting lower effort during low-stakes tasks (Duckworth et al., 2025). Therefore, the pattern of LDT performance may reflect changes in task engagement rather than active monitoring of the PM's intention.

An alternative interpretation is that participants may have engaged in some degree of monitoring during the PM delay phase. Previous research suggests that monitoring costs can manifest as either reduced accuracy or increased reaction time, depending on the demands of the ongoing task (Harrison et al., 2014). Although the current findings are consistent with prior literature in terms of slowed reaction times, the absence of ongoing task accuracy costs weakens the evidence for sustained monitoring during the PM delay phase. Nevertheless, the observed increase in reaction time may still reflect some level of monitoring of the PM intention. However, because the present study did not explicitly operationalize intentional retrieval—which requires participants to actively monitor their PM intention (Eysenck, 2020)—it is not possible to conclude that the dependent variable reflects intentional retrieval. Consequently, the dependent variable in this study is best interpreted as prospective memory retrieval in general, without specifying the type of retrieval. This approach is consistent with a previous PM study that examine PM performance without explicitly distinguishing between spontaneous and intentional retrieval mechanisms (McDaniel & Scullin, 2010).

Although this study initially aimed to examine whether attentional resources allocated during the intention encoding phase influence spontaneous retrieval, the analysis of ongoing

task performance suggested the potential presence of monitoring. Consequently, the existence of spontaneous retrieval processes could not be demonstrated, and the findings are better interpreted as reflecting prospective memory retrieval in general. The descriptive pattern of the categorical data indicated that fewer participants in the divided attention (DA) condition (20%) successfully retrieved the PM intention at the appropriate moment compared to those in the full attention condition (83.3%). To further examine the relationship between attentional resources and PM retrieval, an inferential analysis was conducted using Fisher's Exact Test. The results indicated that dividing attention during encoding did not significantly affect PM retrieval. Although the inferential analysis did not yield a statistically significant effect, the descriptive trend was consistent with the hypothesised direction. However, this pattern should be interpreted as suggestive rather than confirmatory.

One possible explanation is that dividing attentional resources at encoding may have weakened the formation of the intention, thereby lowering the likelihood of retrieval. This interpretation is consistent with cognitive load theory (Forster & Lavie, 2008), which posits that individuals differ in their information processing capacity. Although the descriptive data followed the hypothesised pattern, the lack of a significant effect may be due to unmeasured individual differences in processing capacity. Future research should therefore measure and operationalise processing capacity to clarify its potential role in prospective memory performance under divided attention conditions.

Another possible explanation is that the nature of the ongoing task may have facilitated encoded intention. Specifically, when the ongoing task involves processing that is similar to the PM task, which is called the focal task (Eysenck, 2020). Although these tasks were designed to promote spontaneous retrieval conditions, evidence from this study suggested that participants may not rely purely on spontaneous processes. Instead, the similarity in processing between the ongoing task and the PM task may lead to monitoring of the encoded intention, thereby enhancing its retrieval (Peper & Ball, 2004). As a result, successful PM performance may be less dependent on the quality of encoding during the initial phase and more influenced by processes occurring after encoding. In particular, the presence of monitoring may play a more critical role in triggering retrieval, compensating for any reduced attentional resources during encoding.

The insignificant finding also contrasts with previous research on implementation intentions, which has shown that intentional, effortful, and highly focused encoding enhances PM performance (Chen et al., 2022). One plausible explanation for this discrepancy is the very small sample size used in this study, with only five participants in the DA group and six in the NDA group. Although Fisher's Exact Test is appropriate for small samples (Kim, 2017), a small sample size could increase the risk of Type II errors—failing to detect an actual effect of attentional resources on spontaneous retrieval (Kantowitz et al., 2009)—and make meaningful effects in the data difficult to detect (Agresti, 2019). Notably, PM studies typically employ far larger samples, from 60 to 192 participants (Harrison et al., 2014; Guo et al., 2024; Rose et al., 2024; Smith & Bayen, 2004).

The discrepancy may also be influenced by the timing of data collection, which coincided with the study week, examination period, and semester break. Collecting data across such varied periods may introduce confounding variables such as academic stress, which has been shown to influence prospective memory performance (Diamond, 2019). Future research

should therefore recruit participants during a consistent academic period—to reduce the discrepancy in terms of stress level—and consider screening for stress level using reliable and valid instruments. Conducting the study within a shorter data collection window may also reduce the likelihood of participants sharing information about the task, thereby improving the internal validity of the experiment. This recommendation aligns with methodological literature highlighting the importance of minimising participant communication to avoid contamination in nested designs (Shadish et al., 2002). Additionally, employing research assistants or confederates would enable simultaneous data collection and support larger sample sizes.

A further limitation concerns variability in English language proficiency, despite screening participants at MUET Band 3 and above. Older MUET scores may not accurately reflect participants' current language skills. Some participants also reported perceiving the task as too challenging, suggesting that task difficulty was not uniform across individuals. This is particularly important for PM studies using LDT paradigms, as differences in task difficulty can influence spontaneous retrieval (Harrison et al., 2014). Future research should recruit participants from a narrower MUET band (e.g., Band 4 only) using recent test results or screening for English vocabulary. However, this would limit the generalizability of the findings to populations with that specific proficiency level and would still not address variability among Malay-speaking undergraduates. One of the methodological challenges faced in the current study was the infeasibility of converting the LDT stimuli into Malay due to the lack of validated Malay word and non-word databases. Without standardized Malay lexical norms, constructing a fully Malay-based LDT becomes difficult, as researchers would need to select words manually, which increases the risk of experimenter bias in stimulus selection (Balota et al., 2007).

Another limitation of the present study is the manual administration of auditory stimuli, which may have contributed to the discrepancy in results. Because auditory stimulus presentation was not automated, the timing of auditory cues likely varied across participants, which may introduce unrecognisable variability into the task. Other than that, because the response accuracy and reaction time for the Digit Detection Task could not be recorded automatically, it was not possible to verify whether participants consistently engaged with the DDT, potentially affecting the reliability of the divided attention manipulation. To address these issues, future research should fully automate both stimulus presentation and response collection using experimental software such as PsychoPy or E-Prime, which are designed to deliver stimuli and record responses with millisecond precision (Bridges et al., 2020). Future studies should also evaluate the performance of the experimental software on the specific computer system used (e.g., Windows-based systems) to minimise potential lag or timing delays that could compromise the accuracy of stimulus timing and response recording (Bridges et al., 2020).

### **Conclusion**

The present study investigated whether attentional resources allocated during the intention encoding phase influence prospective memory (PM) retrieval, with a specific focus on spontaneous retrieval processes. However, there was little evidence to support the existence of spontaneous retrieval, resulting in the dependent variable being reinterpreted as PM retrieval in general. Although descriptive patterns suggested lower PM performance

under divided attention, inferential analysis using Fisher's Exact Test did not yield statistically significant results. Methodological factors—including small sample size, variability in English proficiency, manual stimulus administration, and the absence of validated Malay lexical stimuli—likely influenced the findings and limit generalizability. Overall, the results suggest that attentional resources during intention encoding may not reliably predict PM retrieval performance. Nevertheless, the study remains inconclusive due to the need for methodological refinement. Future research should address these limitations to more clearly elucidate the role of attention in prospective memory.

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