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Self-reported strategy use and prospective memory: The roles of cue focality and task importance

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Abstract

Interest in the metacognitive aspects of prospective memory (PM) is growing. Yet, the interplay between participants' metacognitive awareness of PM task demands and features that contribute to successful PM require further attention. To this aim, participants in the current study completed laboratory-based PM tasks of varying difficulty (cue focality: focal, nonfocal-category, or nonfocal-syllable) and reported their strategy use and perceptions of PM task importance. Most participants reported using a strategy regardless of cue focality. However, only under the most challenging condition (i.e., nonfocal-syllable) did participants who reported using a strategy exhibit better PM performance compared to those who did not use a strategy. Additionally, strategy use and cue focality were independently associated with greater costs to ongoing task performance: strategy users exhibited greater slowing relative to individuals who did not use a strategy, and the extent of slowing was greater as the task difficulty increased across cue focality. Finally, perceived task importance appeared to play an important role in the interactive link between cue focality and strategy use on PM performance for the more challenging, nonfocal PM tasks. Specifically, moderation analyses suggested that greater perceived task importance alone may improve the likelihood of PM success for moderately challenging PM tasks (i.e., nonfocal-category), but for the most challenging PM tasks (i.e., nonfocal-syllable), individuals' strategy use was still associated with better PM performance. The present study expands our understanding of metacognition's role in PM performance and has implications for everyday PM performance.

Keywords Prospective memory · Metacognition · Importance perceptions · Focality · Strategy use

Introduction

In everyday life people employ a variety of strategies to remember to carry out their intentions. Whether setting reminders on smartphones, asking family members to remind us, or placing items to be returned in prominent locations, we use an array of methods to support everyday prospective memory (PM) performance. In their early investigation of PM, Einstein and McDaniel (1990) documented superior laboratory PM performance among participants who used a memory aid compared to those who did not. Studying strategy in the laboratory can provide insight into metacognitive aspects of PM, inform PM theory, and has the potential to shed light on strategy use in naturalistic settings. Kuhlmann (2019) provided an overview of the metacognitive components of PM, identifying *monitoring* and *control* processes that appear to be at play in the successful completion of PM tasks. In terms of monitoring, in the classic Nelson and Narens (1990) sense, an individual must consider a variety of factors to effectively accomplish a task, such as task demands, knowledge of available strategies, and task importance. Decisions regarding monitoring-related factors are likely to impact control processes, or actions that are meant to regulate cognitive behaviors, such as *whether* a strategy is needed, *when* it may be needed, and *what* strategy (or strategies) to implement. A considerable amount of episodic memory research has examined monitoring and control processes, but until recently, relatively little attention has been dedicated to understanding metacognition in PM and how it relates to strategy implementation.

One defining feature of PM task demands that can affect the extent to which a strategy is needed for successful PM is cue focality. Cue focality is often defined as the

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correspondence between the processing required to successfully recognize a PM target (i.e., PM cue) and the ongoing task (Einstein et al., 2005; Maylor, 1996; McDaniel & Einstein, 2000; Scullin, McDaniel, Shelton et al., 2010b). If there is high overlap between the processing required for identifying a PM cue and for completing the ongoing task, then the PM task is considered a *focal* task. In laboratory settings this is often achieved by asking participants to make a PM response any time a specific word (e.g., *tortoise*) appears on the screen during an ongoing lexical decision task (LDT; e.g., Einstein et al., 2005; Einstein & McDaniel, 1990), as both tasks rely on processing semantic attributes. Alternatively, if identifying the PM cue is not stimulated by the processing required of the ongoing task, then this is considered a *nonfocal* PM task. Nonfocal PM tasks often require participants to respond to syllable PM cues (e.g., any word that includes the syllable *tor*; Ball & Bugg, 2018; Einstein et al., 2005; Scullin, McDaniel, Einstein et al. 2010a, Scullin, McDaniel, Shelton et al. 2010b), or by asking participants to make a PM response to a general category of words (e.g., *animal* or *fruit* words) during a word judgment task (e.g., Kominsky & Reese-Melancon, 2017; Lourenço et al., 2015; Reese-Melancon et al., 2019).

PM performance is typically better under focal conditions than under nonfocal ones (Einstein et al., 2005; Rendell et al., 2007), which has been attributed to the differences in the strategic processing requirements of the two types of tasks. Specifically, focal PM tasks benefit from more automatic, bottom-up processing, whereas nonfocal tasks typically require effortful, top-down processing (Ball & Bugg, 2018; Cona et al., 2016; Einstein et al., 2005; McDaniel & Einstein, 2000). Thus, nonfocal tasks tend to be more difficult than focal tasks, and therefore benefit more from monitoring and other mnemonic aids to meet task demands and successfully complete PM intentions relative to focal tasks (Ball & Bugg, 2018).

A prevailing theme within the metacognitive PM literature is whether individuals possess the metacognitive awareness to know when using a strategy would be most helpful. Within laboratory settings, manipulating PM cue focality has been an effective method used to test the extent to which participants utilize various strategies. Foundational research on the differences between focal and nonfocal PM performance was initially developed to examine differences in monitoring as a strategic process necessary to support PM on nonfocal tasks (Einstein et al., 2005; McDaniel & Einstein, 2000). Researchers have since expanded upon initial investigations of PM monitoring (e.g., Meier et al., 2006; Reese & Cherry, 2002; Scullin, McDaniel, Einstein et al. 2010a, Scullin, McDaniel, Shelton et al. 2010b) to examine the influence of other strategies on PM performance, including implementation intentions (McDaniel & Scullin, 2010; Meeks & Marsh, 2010; Smith et al., 2014), offloading intentions onto external sources (Gilbert et al., 2023; Peper et al., 2023), or delaying responding to provide additional time for decision making (Heathcote et al., 2015). Much of the research in this area has focused on the implementation of specific strategies with fewer examinations of strategies that participants naturally select themselves. As such, our understanding of whether individuals recognize different task demands and how they accordingly respond to support their memory intentions remains limited.

Rather than strategies assigned by an experimenter, Reese-Melancon and colleagues (Reese-Melancon et al., 2019) investigated the relationship between self-reported strategy use and PM performance across two conditions that varied in focality. Participants completed either a focal (e.g., PM cue: *goat*) or nonfocal (e.g., PM cue: *animal* words) PM task that was embedded in an ongoing LDT and were later asked whether they had done anything to help themselves remember to complete the PM task. Overall, about half of the participants reported using a strategy, but unexpectedly, strategy use was more commonly reported among participants in the focal condition than among those in the nonfocal condition. Participants' strategy use was associated with better PM performance, but it was more strongly associated with successful PM in the nonfocal condition than it was in the focal condition. This PM performance benefit appeared to come at a cost to ongoing task performance among those in the nonfocal condition, however. Specifically, participants in the nonfocal condition who reported using a strategy exhibited significantly slower response times on the LDT compared to those in the nonfocal condition who did not use a strategy and those in the focal condition, regardless of strategy use. Further, given the near ceiling performance of those who completed the focal task, some participants may have used a strategy when not necessary (see also, Smith et al., 2007). Comparatively, PM performance in the nonfocal condition was superior among those who used a strategy compared to those who did not; thus, many of the participants completing the more challenging nonfocal task may not have realized that using a strategy would support their PM. These findings provide initial insight into participants' awareness of task demands that accompany PM cue focality in relation to strategy use but also highlight the cost tradeoff that can come with strategy use (see also, Ball & Bugg, 2018; Einstein et al., 2005).

It is important to acknowledge, however, that focality exists on a continuum with certain nonfocal tasks being more challenging than others (Scullin, McDaniel, Shelton et al. 2010b). Work by Meeks and Marsh (2010) suggested that experimenter-assigned strategies (i.e., implementation intentions and imagery) can improve PM performance in nonfocal-category (e.g., animal cue words) and nonfocal-syllable tasks (e.g., syllable cue words), but the study was underpowered to determine whether assigned strategy efficacy differed between conditions. Whether self-initiated strategy use varies based on degree of focality requires further exploration. Given that PM task difficulty can be influenced by the relationship between the PM cue and the ongoing task (i.e., cue focality; Einstein et al., 2005; Maylor, 1996; McDaniel & Einstein, 2000; Scullin, McDaniel, Shelton et al. 2010b), as well as cue salience (e.g., Meeks & Marsh, 2010; McDaniel & Einstein, 2000), strategy use should be more beneficial for particularly challenging PM tasks. For example, identifying a syllable within a word (i.e., nonfocal-syllable task) is likely more difficult than identifying a whole word from a well-known semantic category (i.e., nonfocal-category task). Demonstrating whether PM performance and associated self-initiated strategy use differs between nonfocal-category and -syllable conditions will enhance our understanding of whether individuals recognize PM task demands and support their PM performance in accordance with those demands. Such work will advance PM theory by providing evidence for the metacognitive components associated with successful PM, as well as the circumstances that may accompany these supportive behaviors.

Beyond task demands, another monitoring process that contributes to an individual's decision to employ a strategy for a PM task is task importance (Kuhlmann, 2019). In laboratory settings, researchers have identified benefits to performance when a PM task is considered more important (for review, see Walter & Meier, 2014). This is often achieved by researchers emphasizing the importance of a PM task over the ongoing task (Guo et al., 2023; Hering et al., 2013; Kliegel et al., 2001, 2004). Furthermore, perceived PM task importance appears to relate to increased memory strategy use. Much of the support for this notion comes from studies examining naturalistic PM (e.g., Ihle et al., 2012; Jeong & Cranney, 2009; Meacham & Singer, 1977; Penningroth & Scott, 2013). Several studies suggest that individuals are more likely to report using reminders or other memory cues for both hypothetical (Penningroth & Scott, 2013) and actual naturalistic PM tasks (Ihle et al., 2012; Jeong & Cranney, 2009) considered to be more important.

Yet, investigations into task importance and strategy use in laboratory settings remain limited. Additional research in this area would improve our understanding of the interplay between task importance and strategy use for PM tasks that vary in difficulty, as well as potentially associated performance benefits for these types of PM tasks. Interestingly, emphasizing PM task importance appears to be most beneficial under task conditions that require a greater allocation of attentional resources for successful PM performance (e.g., Kliegel et al., 2001, 2004). As such, individuals who perceive a nonfocal PM task to be important may be motivated to use memory strategies, and thus improve their PM performance, more so than someone completing an easier focal task. It is also possible that this hypothesized effect is greater as the extent of task difficulty (or the task demands associated with cue focality) increases. Empirical examination of cue focality, task importance, and strategy use is necessary to address these gaps in the literature.

To our knowledge, no study has examined the relationship between strategy use and perceptions of laboratory PM importance on PM performance when participants have not specifically been told to prioritize the PM task. Perceived importance may be a key individual difference that not only aids in a participant's decision to use a strategy but may also help individuals meet the task demands of more challenging nonfocal PM tasks. By examining interactions between strategy use and perceived importance, we will better understand motivational underpinnings for strategy use and whether the combination of perceived importance and strategy use can improve individuals' PM performance in the face of challenging nonfocal PM tasks.

Current study

The current research extends existing literature by examining self-reported strategy use for a laboratory-based PM task with varying degrees of cue focality, as well as how perceptions of importance relate to strategy use and PM performance. Our first aim assesses strategy use across the PM focality continuum. Specifically, we examine whether self-reported strategy differs between participants who complete a laboratory PM task with either a focal, nonfocal-categorical, or nonfocal-syllable PM cue. Examining self-reported PM strategy use within a controlled laboratory setting can improve our understanding of the factors that influence decisions regarding strategy implementation (e.g., Gilbert, 2015a, 2015b; Scarampi & Gilbert, 2020). If participants understand the demands of the PM task presented to them, then greater strategy use should be observed under more challenging nonfocal compared to focal conditions. Furthermore, as the nonfocal-syllable condition is expected to be the most challenging PM task, participants in this condition should report greater strategy use than participants in the nonfocal-categorical and focal conditions. However, participants do not always recognize task demands and implement strategies when doing so would be beneficial (Reese-Melancon et al., 2019), so it is possible that we will not observe differences in reported strategy use by focality.

Our second aim investigates the interplay between focality and strategy use for both PM and ongoing task performance. Consistent with previous research that indicates PM performance under resource-demanding conditions often benefits from mnemonic support (Ball & Bugg, 2018; Reese-Melancon et al., 2019), reporting strategy use under nonfocal conditions is hypothesized to be associated with better PM performance. This should be especially evident in the more challenging nonfocal-syllable condition relative to the nonfocal-categorical condition. In comparison, focal PM cues are often supported by spontaneous retrieval processes (McDaniel & Einstein, 2000; Scullin, McDaniel, Einstein et al. 2010a), and thus performance is not expected to differ in relation to strategy use. In terms of ongoing task performance, reported strategy use is expected to be associated with slower response times as the implementation of various strategies likely requires the expenditure of additional attentional resources (Einstein et al., 2005; Reese-Melancon et al., 2019). Again, we expect to see greater performance costs (i.e., slower response times) among participants in the nonfocal conditions given the processing requirements of these more challenging tasks (Scullin, McDaniel, Shelton et al. 2010b).

Our final aim addresses the relationship between strategy use and task importance across PM tasks with varying degrees of focality. In line with previous recommendations (Walter & Meier, 2014), the present work examines participants' self-determined PM task importance in relation to strategy use and PM performance rather than task importance assigned by the experimenter. Past work suggests that PM task demands, or attentional requirements, can influence perceptions of task importance (e.g., Kliegel et al., 2001, 2004), and, similarly, task instructions that emphasize PM importance increase the likelihood of PM strategy use (Guo et al., 2023; Jeong & Cranney, 2009; Meacham & Singer, 1977). Extending previous research, we examine whether self-determined perceptions of task importance differ by cue focality and strategy use. We expect that participants who complete nonfocal PM tasks and report using a strategy will perceive the PM task to be more important than those who do not report using a strategy. This pattern of findings would suggest that perceptions of task importance underlie strategy use for more challenging PM conditions.

To further consider the possibility that importance underlies PM strategy use, the present research also explores whether the hypothesized links between focality and strategy use on PM performance remain after controlling for perceived task importance. If the hypothesized links are robust to the influence of perceived task importance, it would suggest that task importance plays a role in PM performance, but that strategy use is largely responsible for performance differences between those who do and do not report using strategies. However, if the hypothesized effects are no longer present when perceived task importance is included in the model, then findings may suggest that perceived task importance alone can improve PM performance under more attention demanding conditions, without the need for strategy implementation. Taken together, the present work advances our theoretical understanding of the metacognitive components of PM and has implications for everyday PM performance.

Method

Participants

A total of 198 participants completed the study[1] and were sequentially assigned to one of the three PM cue focality conditions upon arrival to the laboratory. Participants were removed from the analytical sample for the following reasons: computer errors that occurred during the testing session ($n = 5$), exhibiting LDT response times greater than 2.5 standard deviations above the sample mean ($n = 6$), indicating English as a second language ($n = 9$), or interruptions or behavioral issues that occurred during the testing session ($n = 10$).

Thus, the analytical sample included 167 undergraduate participants (125 female; age 18–39 years, $M_{age} = 19.52$ years, $SD_{age} = 2.51$ years) from Oklahoma State University who identified as Caucasian/White (70.1%), Black/African American (6.0%), Native American/Alaskan Native (5.4%), Hispanic/Latino (3.6%), Other (0.6%), or checked multiple ethnicities (14.3%). Participants volunteered through the Department of Psychology's online recruiting system and received course credit in exchange for their participation.

Materials

Ongoing (lexical decision) and prospective memory tasks

The ongoing task was a lexical decision task (LDT) in which half of the trials were valid English words and half were pronounceable nonwords. Items were selected from the English Lexicon Project Database (Balota et al., 2007) and were randomly assigned to trial position. Participants were asked to indicate whether each item was a word by pressing keys labelled as "YES" or "NO" on the keyboard. For each trial, a fixation point (+) was presented to the participant for 500 ms followed by the presentation of a

[1] A power analysis was not conducted prior to data collection. Rather, we sought to collect 50 participants per condition to replicate sample sizes within previous work (e.g., Meeks & Marsh, 2010) with some planned oversampling to account for participants who would have to be removed for reasons related to the testing environment at the time (e.g., earthquakes, construction, etc.). To address power within the current study, post hoc power analyses were conducted using G*Power based on the observed effect sizes for the highest order effects (partial omega-squared values were transformed into partial eta-squared to be compatible with G*Power). These analyses revealed that we were sufficiently powered to detect an interaction of strategy use and focality on PM performance and PM importance ratings, respectively (observed power values = 1.00). However, the post hoc analysis revealed that we were underpowered to detect a significant interaction on ongoing response time (power = 0.58) yet were sufficiently powered to address main effects of strategy use and focality (power values > 0.85).

letter string for a maximum of 3,000 ms. After each lexical decision was made, the screen went blank until the next trial began.

The PM task was embedded in the LDT and required participants to press the "F6" key on the keyboard instead of making a lexical decision whenever a PM target word appeared on the screen. In the focal condition, participants were told to make a PM response any time they saw the word *hamster*. In the nonfocal-category condition, participants were instructed to make a PM response whenever they saw a word representing the semantic categories of *insect* or *animal*, whereas in the nonfocal-syllable condition, participants were instructed to make a PM response whenever they saw a word that contained the syllable *TER*. The PM response words were the same across both nonfocal conditions (i.e., *anteater, butterfly, hamster, lobster, otter, rooster, termite, terrier*), the only difference between the two conditions was the task instructions. In total, eight PM target opportunities occurred across all conditions. PM performance was calculated as the proportion of eight target items for which the participant pressed the F6 key either during the PM target trial or the following three trials.

Strategy report

The current study employed an open-ended strategy measure originally used in Reese-Melancon et al. (2019). For this measure, the experimenter asked the participant the following question: "*Was there anything you did during the course of today's experiment to help you remember to press 'F6' when you saw [the target word(s)]?"* The experimenter recorded the participant's response. If the participant responded no, the experimenter asked the follow-up question: "*How do you think you remembered to press 'F6' when you saw [the target word(s)]?"* and recorded the participant's response.

PM task importance

As a measure of perceived importance of the PM task, participants were instructed to "*rate the importance that you placed on remembering to press the F6 key in response to the target words"* using a 7-point Likert-type scale (1 = *very little importance*, 7 = *a great deal of importance*).

Procedure

Participants completed individual testing sessions in a laboratory setting that lasted approximately 45 min to 1 h. They were first introduced to the LDT and instructed to make yes/no responses as quickly and accurately as possible. Participants completed ten practice LDT trials before starting a first baseline block that consisted of 105 trials. They then received the condition specific PM instructions to press the PM response key when they encountered a PM target item instead of making the LDT response and were asked to repeat the PM instructions aloud to the experimenter to confirm they understood the task. Next, participants completed distractor tasks at a second laboratory computer for approximately 10 min before they returned to the original computer and began the PM-embedded LDT block that consisted of 210 trials. They were not reminded of the PM task prior to starting the PM block of the LDT. Once the PM block finished, participants were asked a series of questions, including an assessment of whether they remembered receiving the PM task instructions, their perceptions of PM task importance, and their self-reported strategy use. Finally, participants completed another baseline block of 105 LDT trials after being told they no longer needed to look for or respond to the target words. The experiment concluded with debriefing.

Analytical procedure

Strategy coding

Prior to analyses, research assistants electronically removed instructions from the strategy reports so that raters (the authors) could categorize responses without knowing whether the response came from a participant in a focal or nonfocal condition. A modified coding scheme from Reese-Melancon et al. (2019) was employed to categorize participants' responses (see Online Supplemental Material (OSM)). The coding scheme was updated to include a Timing category meant to reflect recent theories that would capture participants who reported "slowing down" or "taking time to make a decision" as a strategy (delay theory – Heathcote et al., 2015; Prospective Memory Decision Control – Strickland et al., 2018). Similarly, an Attention category was added to capture participants' reports of "paying close attention," "focusing," or other behaviors that implied a deliberate reallocation of attentional resources. The raters practiced categorizing sets of practice data until they were able to consistently categorize responses. Interrater reliability was calculated as the number of agreements among the two initial raters divided by the total number of agreements plus disagreements and was acceptable at 91.62% (Nunnally & Bernstein, 1994). When the initial raters disagreed on which category was most appropriate, a third rater (the third author) provided a rating. For all but two disagreements, the third rater's opinion matched one of the initial codes, and thus was used as the final code. The remaining two were coded based on consensus following discussion.

Ongoing task cleaning

Response times (RTs) on the LDT were recorded as the length of time it took for participants to correctly press the "YES" key on the keyboard when a word was presented on the screen (Hicks et al., 2005; Rummel et al., 2013). PM target trials and the three trials following each PM target were trimmed to control for task switching costs (Rummel et al., 2013; Smith & Bayen, 2004). Word trials with RTs of less than 300 ms or more than 2.5 standard deviations from an individual's mean RT were trimmed. This resulted in the exclusion of less than 3% of trials. Next, RTs were averaged across the two baseline blocks to create one composite baseline RT score. Finally, RT difference scores were calculated by subtracting each participant's average baseline RT from their average PM block RT. Participants' RT difference scores were used as an indicator of RT slowing from the baseline to the PM block for the following analyses. We also examined ongoing task accuracy. For brevity, information on ongoing task accuracy cleaning and analyses are included within the OSM.

Statistical procedures

Analyses were primarily conducted using IBM/SPSS Statistics 27.0. For analytic purposes, we set the statistical significance threshold at $\alpha = .05$, unless otherwise stated. To assess distribution of self-reported strategy use among our sample, we first conducted a chi-square goodness of fit test to determine whether the number of participants who reported using a strategy within the study differed from the number of those who did not report using a strategy. We then conducted a chi-square test of independence to determine whether this proportion differed by focality condition.

Most of our aims were initially tested with mixed factorial ANOVAs and were followed up with Bonferroni-corrected tests of simple effects. However, some analyses (i.e., on PM performance, ongoing task RTs, and PM importance ratings) indicated that our data violated the assumption of homogeneity of variance. When this violation occurred, data were analyzed using a Robust ANOVA in R-statistical software (Kloke & McKean, 2012, 2014) and were followed up with individual nonparametric Mann-Whitney and Dunn's tests. Finally, we conducted a set of exploratory regression analyses using the PROCESS macro in SPSS (Hayes, 2018; Model 1) to re-examine the relationship between focality and strategy use on PM performance with PM importance excluded (Model A) and included (Model B) as a covariate. Focality was entered as a multicategory term with the focal condition serving as the reference group, which allowed us to make comparisons between participants in the focal condition to those in the nonfocal-category and nonfocal-syllable conditions, respectively. Strategy use was dummy coded with "no strategy" as the reference group (0 = no strategy, 1 = reported using a strategy). In Model B, PM importance was included as a covariate to identify whether any of the pathways from Model A were affected by the inclusion of PM importance. All terms were estimated with 5,000 bootstrapped iterations to compute a bias corrected 95% confidence interval.

Results

Strategy use

Self-reported strategy use frequencies are depicted in Table 1. Overall, more than half of participants reported using a strategy to accomplish the PM task (55.09%), which was not significantly different from the number of participants who did not report a strategy (44.91%; $\chi^2(1) = 1.73$, $p = .188$). In contrast, the frequency of reported strategy use across the focality conditions did differ ($\chi^2(2) = 8.47$, $p = .014$). Examination of the adjusted residuals revealed that this significant effect was largely due to the nonfocal-category condition. Specifically, there were significantly more participants who did not report using a strategy and significantly fewer participants who reported using a strategy in the nonfocal-category condition than could be expected by chance ($ps < .05$).

Among those who reported using a strategy, Monitoring/Maintenance Rehearsal was most frequently reported across all conditions. The next most frequently reported strategy among those in the focal condition was Physical Behaviors, whereas Timing was the second most frequently reported strategy among those in the nonfocal conditions. Other strategies, or idiosyncratic yet seemingly effortful strategies that did not fit into our coding scheme (see OSM for examples), were tied for the second most common strategy category reported among those in the nonfocal-syllable condition. Some participants in each of the conditions reported using Attentional strategies and few participants in the focal condition reported using Imagery and Association strategies; however, no participants in either of the nonfocal conditions reported that they implemented these strategies. Finally, no participants in the current study reported using elaborative strategies.

We also observed that several participants across the three conditions reported what we considered to be a non-effortful behavior in which they noticed the PM target appear on the screen and realized that they needed to make a PM response. We considered these reports to be non-strategic but noted that

Table 1 Percentage of self-reported strategy use and strategy repertoire by focality condition

	Focal (n = 57)	Nonfocal-category (n = 54)	Nonfocal-syllable (n = 56)	Total (n = 167)
No strategy	21 (36.84%)	33 (61.11%)	21 (37.50%)	75 (44.91%)
Strategy	36 (63.16%)	21 (38.89%)	35 (62.50%)	92 (55.09%)
Monitoring/ Maintenance rehearsal	25 (69.44%)	12 (57.14%)	27 (77.14%)	64 (69.57%)
Physical	8 (22.22%)	3 (14.29%)	1 (2.86%)	12 (13.04%)
Association	1 (2.78%)	0 (0.00%)	0 (0.00%)	1 (1.09%)
Imagery	1 (2.78%)	0 (0.00%)	0 (0.00%)	1 (1.09%)
Elaboration	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Timing	2 (5.56%)	4 (19.05%)	3 (8.57%)	9 (9.78%)
Attention	1 (2.78%)	2 (9.52%)	1 (2.86%)	4 (4.35%)
Other	2 (5.56%)	1 (4.76%)	3 (8.57%)	6 (6.52%)
Noticing	6 (10.53%)	4 (7.41%)	2 (3.57%)	12 (7.19%)

Note. Values represent n (%). Type of strategy is based on participants who reported using at least one strategy. Percentages sum to over 100% because some participants (n = 5) reported using two strategies

this occurrence was most commonly reported in the focal condition with fewer participants in the nonfocal-category and nonfocal-syllable conditions describing this type of behavior.

Prospective memory performance

We were interested in whether PM performance differed based on focality condition and reported strategy use (see Fig. 1 for mean PM performance across focality and by strategy use). The assumption of homogeneity of variance was violated (Levene's $F(5, 161) = 25.42$, $p < .001$); therefore, PM data were analyzed using a 2 (Strategy: strategy, no strategy) × 3 (Focality: focal, nonfocal-category, nonfocal-syllable) between-subjects Robust ANOVA. Significant main effects for Strategy ($F(1, 161) = 32.82$, $p < .001$, $\omega^2_{Rp} = .16$) and Focality were observed ($F(2, 161) = 57.62$, $p < .001$, $\omega^2_{Rp} = .40$), but were subsumed by a significant interaction effect ($F(2, 161) = 17.95$, $p < .001$, $\omega^2_{Rp} = .17$). To probe the interaction, individual Mann-Whitney tests were conducted to examine PM performance between strategy and non-strategy users under each of the focality conditions (p set to .017 to correct for multiple comparisons). Analyses indicated that participants performed equally well on the PM task regardless of strategy use in the focal ($p = .182$) and nonfocal-category conditions ($p = .129$). However, participants in the nonfocal-syllable condition who reported using a strategy had significantly better PM performance than those who did not report using a strategy ($p < .001$).

Ongoing task response times (RTs)

Next, RT difference scores were examined to determine whether participants exhibited slowing during the PM block of the LDT based on focality and reported strategy use (see Fig. 2). The assumption of homogeneity of variance was violated (Levene's $F(5, 161) = 5.79$, $p < .001$), and thus a 2 (Strategy: strategy, no strategy) × 3 (Focality: focal, nonfocal-category, nonfocal-syllable) Robust ANOVA on participants' RT difference scores was conducted. A significant main effect of Strategy was observed ($F(1, 161) = 8.58$, $p = .004$, $\omega^2_{Rp} = .04$). A follow-up Mann-Whitney test revealed that participants who reported using a strategy exhibited greater slowing than participants who did not report using a strategy ($p = .011$). The main effect of Focality was also significant ($F(2, 161) = 22.17$, $p < .001$, $\omega^2_{Rp} = .20$). Follow-up nonparametric Dunn's tests (Dunn, 1964) for multiple comparisons (Bonferroni-corrected) revealed that there was significantly less slowing in the focal condition compared to the nonfocal-category ($p = .006$) and nonfocal-syllable conditions ($p < .001$). Additionally, the nonfocal-category condition exhibited significantly less slowing than the nonfocal-syllable condition ($p < .001$). The interaction between Focality and Strategy did not reach statistical significance ($F(2, 161) = 2.93$, $p = .056$, $\omega^2_{Rp} = .02$).

Prospective memory importance

Finally, analyses examined focality and reported strategy use in relation to participants' PM task importance ratings (see Fig. 3). The assumption of homogeneity of variance was violated (Levene's $F(5, 161) = 8.37$, $p < .001$); therefore, participants' importance ratings were analyzed using a 2 (Strategy: strategy, no strategy) × 3 (Focality: focal, nonfocal-category, nonfocal-syllable) between-subjects Robust ANOVA. Significant main effects for Strategy ($F(1, 161) = 68.75$, $p < .001$, $\omega^2_{Rp} = .29$)

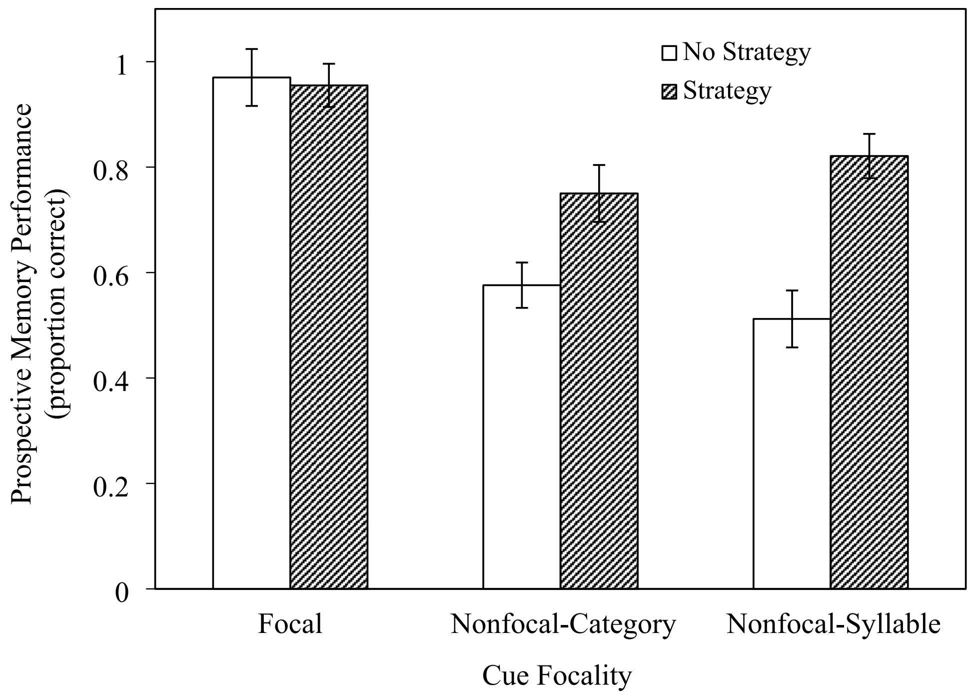

Fig. 1 Prospective memory performance by cue focality and strategy use

and Focality were observed ($F(2, 161) = 40.18$, $p < .001$, $\omega^2_{Rp} = .32$). However, a significant interaction between Strategy and Focality subsumed these effects ($F(2, 161) = 30.26$, $p < .001$, $\omega^2_{Rp} = .26$). To probe the interaction, individual Mann-Whitney tests were conducted to examine importance ratings of the PM task by strategy use under each of the focality conditions (p set to .017 to correct for multiple comparisons). Analyses indicated that participants in the focal ($p = .513$) and nonfocal-category conditions ($p = .034$) perceived the PM task to be equally important regardless of strategy use. In contrast, participants who used a strategy in the nonfocal-syllable condition reported higher PM importance ratings than those who did not report using a strategy ($p = .004$).

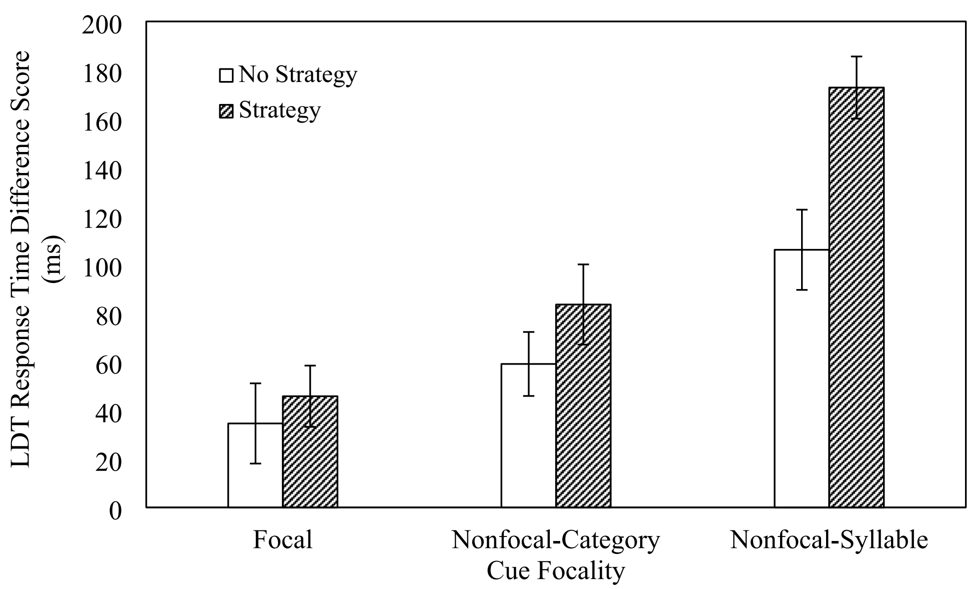

Fig. 2 Mean difference scores for lexical decision response latency by cue focality and strategy use

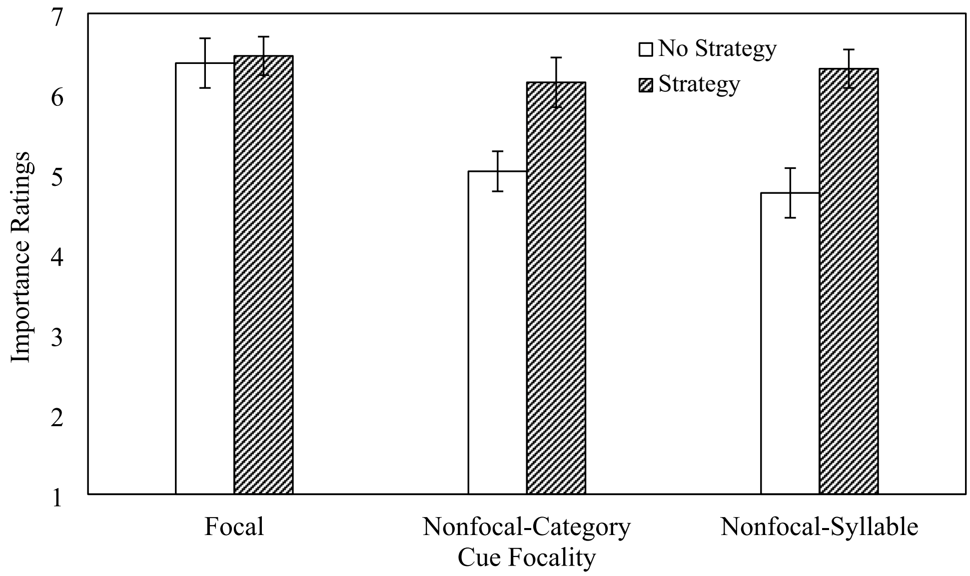

Fig. 3 Prospective memory importance ratings by cue focality and strategy use

Table 2 Moderation analyses examining the predictive power of strategy use, focality, and importance on prospective memory performance

Effect	Model A				Model B			
	b	*SE*	95% CI		*b*	*SE*	95% CI	
			LL	*UL*			*LL*	*UL*
X: Strategy Use	-0.02	0.07	-0.15	0.12	-0.03	0.05	-0.13	0.08
W1: Nonfocal-Category	-0.39***	0.07	-0.53	-0.26	-0.25***	0.06	-0.35	-0.14
W2: Nonfocal-Syllable	-0.46***	0.08	-0.61	-0.31	-0.28***	0.06	-0.40	-0.16
Strategy Use X Nonfocal-Category	0.19	0.10	-0.00	0.38	0.08	0.08	-0.07	0.23
Strategy Use X Nonfocal-Syllable	0.32***	0.10	0.14	0.51	0.16*	0.08	0.01	0.31
C: Importance					0.11***	0.01	0.09	0.13
	$R^2 = .330$ $F(5, 161) = 15.85, p < .001$				$R^2 = .603$ $F(6, 160) = 40.46, p < .001$			

Note. *$p < .05$; ***$p < .001$. CI = confidence interval; *LL* = lower limit; *UL* = upper limit. Focality was entered as a multicategory term (i.e., Focal = 0, Nonfocal-Category = 1, Nonfocal-Syllable = 2). Importance was mean centered and entered as a covariate in Model B

To understand the role that importance may play in the interactive effects of focality and reported strategy use on PM performance, we conducted two exploratory regression analyses to examine focality and reported strategy use on PM performance with PM importance excluded (Model A) and included (Model B) as a covariate (see Table 2 for model statistics). In Model A, we observed a trending interaction between reported strategy use and focality in the nonfocal-category condition ($b = 0.05$, $SE = .10$, $p = .051$) and a significant interaction in the nonfocal-syllable condition ($b = 0.32$, $SE = .10$, $p < .001$) compared to the focal condition. Tests of conditional effects indicated that self-reported strategy use was significantly associated with better PM performance in both the nonfocal-category ($b = 0.17$, $SE = .07$, $p = .012$) and nonfocal-syllable conditions ($b = 0.31$, $SE = .07$, $p < .001$), but not within the focal condition ($b = -0.02$, $SE = .07$, $p = .821$).

Interestingly, when PM importance was included as a covariate in Model B, the trending interaction between focality and reported strategy use among those in the nonfocal-category condition relative to the focal condition was no longer present ($b = 0.08$, $SE = 0.08$, $p = .307$). Yet, the interaction between focality and reported strategy use remained among participants in the nonfocal-syllable condition ($b = 0.16$, $SE = 0.08$, $p = .032$) relative to the focal condition, although the effect was somewhat smaller. Tests of conditional effects revealed that using a strategy was significantly associated with greater PM performance within the nonfocal-syllable condition ($b = 0.14$, $SE = .06$, $p = .013$), whereas strategy use was not associated with changes in PM performance among those in the focal (b = -0.03, SE = .05, p = .628) or nonfocal-category conditions (b = 0.05, SE = .05, p = .343). Thus, it appears that perceived importance of the PM task was associated with better PM performance among both nonfocal conditions; however, perceived importance does not completely explain the relationship between using a strategy and PM performance in the nonfocal-syllable condition.

Discussion

The goals of the current study were to determine how strategy use varies across laboratory PM tasks that differ in cue focality and whether perceptions of task importance are related to strategy use under these varying conditions. Key findings extend earlier work documenting that self-reported strategy use is associated with better performance under the most demanding PM conditions, though its use comes at a cost to ongoing activities. The results also reveal new information regarding the role of perceived task importance for strategy use and performance. PM performance results relate to existing PM theory, add to what is known about the contributions of metacognition to PM performance, and have potential relevance to how people approach PM tasks in everyday life.

The first aim of the current study was to extend previous investigations into the metacognitive components of PM, particularly with regard to participants' understanding of task demands as reflected by the control process of strategy use. Most participants reported employing a strategy to help them complete the PM task. Importantly, this tendency to use a strategy was true whether participants were in a focal condition, where a strategy may be unnecessary, or in one of the two nonfocal conditions, where a strategy is likely to be beneficial. Further, the types of strategies reported were similar across the three conditions, with most participants reporting that they monitored for the opportunity to fulfill the PM intention during the LDT task. The second most commonly reported strategy was a physical one that often involved trying to keep a finger near the PM response key. Although the use of external strategies was restricted in this study, as is common in laboratory PM studies, this physical strategy could be viewed as a form of cognitive offloading, similar to tilting one's head to help with a mental rotation task (Risko & Gilbert, 2016). Participants also made remarks that appear to represent a delay or slowing strategy (Heathcote et al., 2015; Strickland et al., 2018), such as one who said, "I went slow and tried to process the words before I made a decision." Comments like this are in line with the Prospective Memory Decision Control theory (Strickland et al., 2018), and suggest that participants may intentionally slow down to aid in PM execution. A strategy not captured in prior self-report work relates to attention allocation and is reflected by participant comments, such as "I tried to stay focused" or "I concentrated harder." These delay and attention approaches were not strongly represented among the strategies reported, but on the face of it, they appear to be used more under nonfocal conditions than under focal ones. Very few participants reported imagery, elaboration, or association strategies. Overall, these findings replicate and extend those of Reese-Melancon and colleagues (Reese-Melancon et al., 2019), and reaffirm the conclusion that laboratory participants often employ strategies even under circumstances where they may not be needed for successful performance and where they could come at a cost to ongoing activities.

The PM performance data further support the assertion that laboratory participants appear to employ strategies even when the circumstances do not necessitate their use; participants in the focal condition performed equally well regardless of whether they reported using a strategy, possibly due to the near ceiling performance exhibited by this group (for similar findings, see Meeks & Marsh, 2010; Reese-Melancon et al., 2019). Surprisingly, participants in the nonfocal-category condition also performed equally well regardless of reported strategy use; specifically, those who employed a strategy performed slightly, but not statistically, better than those who did not report using a strategy, as can be seen in Fig. 1. In the more demanding nonfocal-syllable condition, however, there was a clear advantage for those who reported using a strategy. The PM performance results support the view that PM demands differ between focal and nonfocal cues (Cona et al., 2016; Scullin, McDaniel, Shelton et al. 2010b) and that strategies are most likely to be helpful when cues are less salient. Consistent with the Multiprocess Framework (McDaniel & Einstein, 2007), the present work indicates that individuals completing nonfocal PM tasks, particularly ones with higher attentional demands, stand to benefit from strategy use that promotes cue detection, but that spontaneous retrieval will suffice for less demanding tasks like focal ones.

Also of particular interest was whether strategy was associated with cost to the ongoing task and whether those costs would vary by focality. Participants who reported using a strategy were generally slower than those who did not, and participants in the nonfocal-syllable condition were the slowest of all. Figure 2 reveals a stark contrast in the slowing of those in the nonfocal-syllable condition who reported using a strategy compared to those who did not. However, this effect was not statistically significant in the Bonferroni-corrected model. While interpretive caution is warranted, our findings suggest that more challenging PM tasks likely benefit from strategy use, but these are also the circumstances for which strategy use comes at a cost to one's ongoing work. Rather than relying on internal strategies, like most of the strategies reported by participants in the current study, more challenging naturalistic PM tasks may benefit from external strategies in which demands can be offloaded (Gilbert et al., 2023), such as setting a reminder on your phone to remember to attend an appointment (Harrington et al., 2023). Doing so will reduce the amount of cognitive resources dedicated to employing an internal strategy that may divert from the ongoing task, and should allow the person to fully focus on the task at hand.

The final aim addressed the relationships among perceived PM task importance, self-reported strategy use, and focality to understand motivational influences of strategy implementation and associated PM performance benefits. Past research documents the tendency to utilize strategies for more important PM tasks (e.g., Jeong & Cranney, 2009; Meacham & Singer, 1977; Penningroth & Scott, 2013). Yet, limited work has addressed participants' self-reported strategy use within the context of perceptions of laboratory-based PM task importance. Our initial analyses indicated that in the most challenging condition (i.e., nonfocal-syllable) strategy users perceived the PM task to be more important than did non-strategy users. In comparison, strategy and non-strategy users viewed the PM task as equally important for easier (i.e., focal) or moderately challenging (i.e., nonfocal-category) tasks. This pattern of findings suggests that participants are more likely to implement a strategy to help with the most challenging PM tasks when they perceive the PM task to be important.

Given the observed differences in PM importance ratings within the nonfocal-syllable condition, we explored whether differences in perceived importance related to PM performance benefits experienced among nonfocal-syllable strategy users. When PM importance was included as a covariate, the strategy users' PM performance no longer differed from those who did not use a strategy in the nonfocal-category condition and the effect in the nonfocal-syllable condition diminished but remained significant. Taken together, perceived task importance appears to play an important role in the relationship between strategy use and PM performance for challenging, nonfocal tasks (Walter & Meier, 2014). However, the magnitude of the effect was stronger in the nonfocal-category condition compared to the nonfocal-syllable condition. It is possible that greater perceived task importance alone can increase the likelihood of successful PM execution for moderately difficult PM tasks (i.e., nonfocal-category). In comparison, using a strategy appears to still be beneficial to support PM performance for the most challenging PM tasks (e.g., nonfocal-syllable), even if individuals perceive the task to be important. Additional factors that relate to motivation and strategy use may be more influential when completing more challenging PM tasks, such as metacognitive knowledge about strategy efficacy (e.g., Borkowski et al., 1987; Kuhlmann, 2019), confidence in one's PM abilities (e.g., Gilbert, 2015b; Meeks & Marsh, 2010), and planning or other types of encoding efforts that might not have been captured by the current study (e.g., Niedźwieńska et al., 2013; Penningroth & Scott, 2013). Further work is required to examine additional factors that may influence PM strategy use and subsequent performance across the focality continuum.

The present study focused on self-reported strategy use as a method of examining participants' strategy use for laboratory PM tasks. This method builds on previous work (Reese-Melancon et al., 2019) and allows for an impartial assessment of how participants believe they completed the PM task they were given. Open-ended questioning was chosen because it affords more freedom for response (Vinten, 1995) and can also allow for more description of motivation (Dohrenwend, 2008). However, participants responding to an open-ended question may leave out information they determine is not relevant or that they think of as obvious (Schwarz, 1999), and participants' open-ended descriptions may not accurately reflect their process for completing the PM task. For instance, participants may have reported using a monitoring-like behavior (e.g., active search, or "looking" for a cue) when they just happened to notice the target word. Finally, the limited interval between completing the task and providing metacognitive self-reports may have restricted participants' opportunities for reflection on possible strategies they implemented to help them complete the PM task. Future work could consider closed-ended questioning of strategy use to confirm the present findings and to provide some scaffolding for participant understanding of what constitutes a strategy.

Future research may also consider examining strategy use among focal conditions that vary in cognitive load. Within the current study, participants in the focal condition only needed to respond to one specific PM cue word. Despite being a common focal manipulation (e.g., Einstein et al., 2005; Einstein & McDaniel, 1990; Reese-Melancon et al., 2019; Rummel et al. 2013), the difference in PM cue words between the focal and nonfocal PM conditions could be seen as a limitation, as this may have resulted in differences in target monitoring or noticing behaviors between the conditions. Some studies provide focal PM instructions to memorize a list of words (e.g., Einstein et al., 1992; Meeks & Marsh, 2010; Meier & Zimmermann, 2015), which can enable all participants to see the same PM targets but may subsequently tax focal participants' cognitive load as they try to keep all target words in mind during the PM task. It appears that the present focal condition manipulation was an easy task, regardless of strategy use. However, strategy use may be beneficial when completing cognitively taxing focal PM tasks (e.g., memorize and respond to a list of PM cue words; Einstein et al., 1992; Meeks & Marsh, 2010; Meier & Zimmermann, 2015).

Building from the current work, future studies may examine whether self-reported strategy use relates to performance for focal tasks with varying loads.

An additional consideration for the observed findings is the timing of the importance ratings. Specifically, the experimenter asked participants to recall the PM target and response prior to rating the importance of the PM task. This may have led some participants to either overestimate or underestimate the importance they ascribed to the task. For example, if a participant realized that they did not remember the PM intention, they may have adjusted their perceptions of importance ("*I did not remember to do that so I must not have thought it was important*."). As such, we are unable to address possible reverse causality, wherein performance may have influenced importance perceptions. However, future research could address this concern by measuring importance ratings at multiple time points rather than only at the end of the PM task.

The present research extends past laboratory-based examinations of PM and cue focality and documents the supportive roles that strategy use and task importance play across PM tasks with varying degrees of difficulty. Findings not only extend PM theory but can also inform the way we think about our everyday PM intentions. For instance, one of the most extreme examples of PM failure in everyday life is that of a parent leaving a child in a car on a hot day when they had intended to take them to childcare. There are many circumstances that come into play when these tragedies occur, but two relate to the present study. Getting the child safely to daycare is incredibly important to the parent, and remembering to drop the child off is a nonfocal task when the child is silent in the backseat and the ongoing task is driving with the ultimate goal of arriving at work. Our findings suggest that importance alone may not be enough here, and that a strategy is very likely needed to make sure the child is taken to childcare. This is likely why some vehicles now have dashboard alarms that remind the driver to check the back seat if a back door is opened during vehicle loading. The alarm is a strategy, one that is needed despite the indisputable importance of the child's safety. More work is warranted to understand the interplay between important, but very difficult, PM tasks and strategy, especially in naturalistic settings that would better illuminate these relationships in the real world.

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Data availability Data and materials can be viewed through the Open Science Framework (OSF) using the following link or by contacting the corresponding author.

Code availability Analytical code can be made available upon reasonable request to the corresponding author.

Declarations

Ethics approval Approval was obtained from the Institutional Review Board at Oklahoma State University. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent to participate Informed consent was obtained from all individuals prior to participation in the current study.

Conflicts of interest The authors have no competing interests to declare.

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