

Distributed Practice, Mind Wandering, and Learning Performance: Evidence from a Randomized Study with University Students

Khadija Nadeem¹

¹ Master of Science in Clinical Psychology, Government College University, Faisalabad, Pakistan, Email: khadijanadeem705@gmail.com

DOI: <https://doi.org/10.63163/jpehss.v3i3.664>

Abstract

This study examined how study strategy and mind wandering jointly influence students' long-term learning. A total of 160 first-year psychology students were randomly assigned to either massed practice (one 4-hour session) or distributed practice (two 2-hour sessions on consecutive days). During study, participants received 12 random mind-wandering probes and completed a 20-item delayed recall test two weeks later. Students who used distributed practice scored significantly higher on the delayed test ($M = 18.42$, $SD = 1.15$) than those who used massed practice ($M = 13.51$, $SD = 1.43$), $t(158) = 22.63$, $p < .001$. Mind wandering was lower in the distributed group ($M = 6.01$ vs. 8.47), $t(158) = 7.09$, $p < .001$, and was negatively correlated with test performance ($r = -.46$, $p < .001$). Correlations also showed that distributed practice predicted higher performance ($r = .87$, $p < .001$) and less mind wandering ($r = -.50$, $p < .001$). These findings, interpreted through the dual-process model of cognition, indicate that distributed practice improves memory both directly and indirectly by sustaining attention and reducing mind wandering. The results provide clear guidance for educators and students: spreading study sessions over time and embedding attention-support strategies can substantially strengthen retention and learning outcomes.

Introduction

How students plan and organise their study time strongly affects how well they learn. Two of the most common strategies are massed practice—often known as *cramming*—and distributed practice, or *spacing*. Massed practice involves long, intensive sessions over a short time. Distributed practice spaces study sessions over days or weeks. Decades of cognitive and educational research show that distributed practice supports stronger, longer-lasting learning than massed practice (Carpenter et al., 2012; Xu & Metcalfe, 2016). Another factor shaping learning is mind wandering—moments when attention drifts from the material to unrelated thoughts (Smallwood et al., 2007). Mind wandering can interrupt comprehension, reduce memory, and lower test performance (Was et al., 2019; Sanchez & Naylor, 2018). While some studies suggest that certain types of mind wandering can support creative insight (Pachai et al., 2016), most evidence shows that frequent lapses of attention undermine effective learning. Research on study strategies and attention has grown in the last decade. Spaced learning helps students return to material after a delay, strengthening memory traces and retrieval pathways. Massed practice, although common before exams, often leads to quick forgetting. Xu and Metcalfe (2016) argue that spacing sessions in the “region of proximal learning” both strengthens memory and reduces off-task thinking. At the same time, mind wandering has become an important topic. Studies show that it is common during lectures and reading, and it is linked to lower recall and poorer understanding (Wammes et al., 2016; Wammes et al., 2018). Interventions such as pretesting (Pan

et al., 2020), frequent testing (Peterson & Wissman, 2020), and active note-taking (Wong & Lim, 2023) can reduce mind wandering and help students stay focused. Despite many studies on the spacing effect and on attention, fewer have tested how study strategy and mind wandering interact. Most past research examines either the effect of spacing on retention or the effect of mind wandering on comprehension, but not how they combine in natural study settings. It is also unclear whether using distributed practice directly lowers the frequency of mind wandering and whether this partly explains its benefits for test performance.

Research Questions and Objectives

This study focuses on three questions:

1. Does **distributed practice** lead to higher test performance than **massed practice**?
2. Is **mind wandering** negatively related to test performance?
3. Does **distributed practice reduce mind wandering**, thereby helping learning?

We predicted that students in the distributed practice group would score higher on a delayed test, that mind wandering would show a negative correlation with test performance, and that distributed practice would be associated with fewer mind-wandering episodes. Identifying how study strategy and attention interact has direct value for students and educators. Understanding whether distributed practice limits mind wandering can guide evidence-based teaching methods, improve study advice given to students, and inform the design of digital learning environments that prompt breaks or retrieval practice to maintain attention. The results may also help teachers and policy makers choose more effective scheduling and assessment strategies. The rest of this article develops these ideas in a structured way. First, the literature review summarises key findings on massed versus distributed practice and on mind wandering, identifying the research gap. The theoretical framework then explains how dual-process models of cognition account for the proposed links between study strategy, mind wandering, and learning outcomes. Next, the methodology details the experimental design, participants, materials, and analytic approach. The results and findings present descriptive statistics, a correlation matrix, and hypothesis testing. Finally, the discussion interprets these findings, compares them with previous research, explores theoretical and practical implications, and outlines limitations and directions for future study.

Literature Review

Research on study strategies consistently shows that distributed practice improves long-term memory more than massed practice. Distributed practice involves breaking study into multiple shorter sessions with breaks in between. This spacing strengthens memory traces and retrieval pathways, a phenomenon known as the spacing effect (Carpenter et al., 2012). Xu and Metcalfe (2016) demonstrated that students who studied in the *region of proximal learning*—where material is challenging but manageable—benefited more from spacing than cramming. Their work suggests that distributed sessions create ideal intervals for consolidation and review, thereby boosting delayed test performance. By contrast, massed practice, or cramming, compresses study into one long session. Although cramming can produce short-term gains, retention typically fades quickly. Students who rely on massed practice often score lower on delayed tests, showing that initial fluency can be misleading (Xu & Metcalfe, 2016). Mind wandering—defined as a shift of attention from the learning task to unrelated thoughts—adds another important dimension. Early work by Smallwood et al. (2007) linked mind wandering with poorer comprehension and recall. Later studies confirmed that mind wandering during lectures or reading predicts weaker test outcomes (Wammes et al., 2016; Sanchez & Naylor, 2018). Was et al. (2019) found that many students underestimate how much mind wandering harms their learning, especially in online settings. Researchers have also examined ways to reduce mind wandering. Pretesting and frequent quizzes help maintain focus (Pan et al., 2020; Peterson & Wissman, 2020). Note-taking strategies that

actively engage students can also limit mind wandering and improve retention (Wong & Lim, 2023). Randall et al. (2022) emphasised the value of self-regulatory strategies—such as setting goals and monitoring comprehension—for sustaining attention in self-directed learning. Interestingly, some studies argue that mind wandering can occasionally support creative thinking or incubation of ideas. Pachai et al. (2016) and Martin et al. (2018) suggest that when material is very familiar or easy, brief attentional drifts may allow deeper processing or problem solving. However, in most academic contexts, frequent mind wandering is detrimental. Many spacing and attention studies have used controlled experiments with random assignment to massed or distributed conditions and delayed recall tests (Carpenter et al., 2012; Xu & Metcalfe, 2016). Mind-wandering research often employs experience-sampling probes during study sessions (Risko et al., 2012; Wammes et al., 2016), where participants report whether their mind was on task. These methods produce reliable estimates of attentional lapses and allow for correlational analysis with performance outcomes.

The collective findings are clear on key points:

- **Spacing improves memory.** Learners who revisit material over time show better long-term retention.
- **Mind wandering undermines learning.** Higher rates of attentional drift predict lower comprehension and test scores.
- **Active engagement reduces mind wandering.** Pretesting, retrieval practice, and interactive strategies help maintain attention.

There is also evidence that spacing may reduce mind wandering by keeping study sessions shorter and cognitively fresher. Xu and Metcalfe (2016) propose that spacing naturally supports study in the region of proximal learning, which maintains interest and reduces off-task thoughts. Despite this rich background, a clear gap remains: few studies have tested study strategy and mind wandering together in one design. Most research examines how spacing affects memory or how mind wandering affects comprehension separately. Little is known about whether distributed practice directly lowers mind wandering and whether this mediates its effect on test performance. Few experiments have simultaneously measured test outcomes, mind-wandering episodes, and study condition in the same sample, leaving unanswered whether the spacing effect is partly driven by reduced attention lapses. The present study addresses this gap. By randomly assigning students to massed or distributed study and repeatedly measuring mind wandering during study sessions, it investigates (a) whether distributed practice leads to better delayed test performance, (b) whether mind wandering predicts poorer performance, and (c) whether distributed practice reduces mind wandering. Examining these variables together offers new insight into how study scheduling and attentional control interact to shape learning.

Theoretical Framework

This study is guided by the dual-process model of cognition (Strack & Deutsch, 2004), which explains how two systems of mental processing work together to shape behaviour. *The automatic system* is fast, effortless, and often unconscious. It produces habits and allows thoughts to drift when tasks are routine or unengaging—conditions that foster mind wandering (Smallwood et al., 2007). *The reflective system* is slower and deliberate. It manages goal-directed activities such as planning, self-monitoring, and selecting effective study strategies. Distributed practice is closely linked to the reflective system. Spacing study sessions requires advance planning and repeated retrieval, processes that strengthen memory and maintain engagement (Carpenter et al., 2012; Xu & Metcalfe, 2016). By creating natural breaks and variety, distributed practice can also reduce the fatigue that feeds automatic lapses of attention, thereby limiting mind wandering. In contrast, massed practice encourages the automatic system. Long, continuous sessions can exhaust working memory, making students more vulnerable to distraction and off-

task thoughts. Mind wandering becomes more likely when cognitive resources are depleted or when material feels monotonous (Wammes et al., 2016). This framework also supports the expected negative link between mind wandering and test performance. When attention drifts, less information is encoded and fewer retrieval cues are formed, leading to weaker long-term memory (Was et al., 2019; Sanchez & Naylor, 2018). By framing mind wandering as an automatic process and distributed practice as a reflective strategy, the dual-process model explains why spacing should improve learning outcomes and why attention lapses harm them. Integrating these ideas, the model predicts that distributed practice enhances test performance both directly and indirectly by reducing mind wandering, while massed practice allows the automatic system to dominate, producing more off-task thinking and poorer retention. This theoretical foundation provides a consistent lens for analysing the study's three research questions and for interpreting the empirical results that follow.

Methodology

Transparency

This research used a quantitative, experimental design to test how study strategy and mind wandering affect learning outcomes. Participants were randomly assigned to one of two study conditions—massed practice or distributed practice—and their attention and performance were measured. Full details of the sampling, procedures, materials, and statistical analyses are given so that the study can be replicated.

Participants

The sample included 160 first-year psychology students (80 in each study condition) who took part for course credit. Ages ranged from 18 to 67 years ($M = 21.2$, $SD = 4.5$). About 63% identified as female, 35% as male, and 2% as non-binary or preferred not to say. Participation was voluntary, and all students gave informed consent online before starting the study.

Materials

- **Study material:** The *Research in Psychology* chapter from Bernstein et al. (2018) served as the core learning text.
- **Test material:** A 20-item fill-in-the-blank test assessed delayed recall of the chapter's key concepts.
- **Mind-wandering probe:** Following Risko et al. (2012), an on-screen question—"Were you mind wandering?" (Yes/No)—was presented at random 20-minute intervals during study.
- **Demographic questions:** Participants reported age and gender.

Procedure

The experiment had three parts:

1. **Scheduling and assignment:** After consent, participants were randomly placed in either the *massed* or *distributed* group. The massed group scheduled a single 4-hour session, while the distributed group scheduled two 2-hour sessions on consecutive days.
2. **Study sessions:** At the appointed times, participants studied the chapter on a computer. During study, they received 12 random mind-wandering probes and responded yes/no each time.
3. **Delayed testing: Two weeks after** their final study session, all participants logged in to complete the 20-item test (max 25 minutes).

Participants were debriefed about the purpose and hypotheses after finishing all parts.

Appropriateness of methods

A between-groups experimental design was chosen to allow causal testing of how study strategy influences both test performance and attention. Measuring mind wandering during learning sessions, rather than afterwards, ensured ecological validity. A delayed test was used to assess long-term retention, which is central to the spacing effect.

Validity and reliability

The random assignment of participants and automated timing of probes increased internal validity. Test items were taken from a standard textbook and piloted for clarity. Mind wandering was measured with a widely used probe method that has shown strong reliability in earlier research (Wammes et al., 2016). Descriptive checks confirmed normal distributions and absence of extreme outliers.

Ethical considerations

The University Human Research Ethics Committee approved all procedures. Participants were informed that their data would remain anonymous and that they could withdraw at any time before submission. Data were stored securely and used only for research.

Results and Findings

Overview

The purpose of the analyses was to examine (a) whether distributed practice improved test performance compared with massed practice, (b) whether mind wandering predicted lower test performance, and (c) whether study strategy reduced mind wandering.

Descriptive statistics

Table 1 shows the means and standard deviations for the two groups. Students who used **distributed practice** scored significantly higher on the delayed test (**M = 18.42, SD = 1.15**) than those who used **massed practice** (**M = 13.51, SD = 1.43**). The distributed group also reported **fewer mind-wandering episodes** (**M = 6.01, SD = 2.15**) than the massed group (**M = 8.47, SD = 2.38**).

Table 1: Means and Standard Deviations for Test Scores and Mind Wandering (N = 160)

Variable	Massed practice (n = 80)	Distributed practice (n = 80)
Test performance (0–20)	13.51 (1.43)	18.42 (1.15)
Mind wandering (0–12 probes)	8.47 (2.38)	6.01 (2.15)

Note. Values are M (SD).

Independent-samples *t*-tests confirmed that the distributed group outperformed the massed group on the test ($t(158) = 22.63, p < .001$, Cohen's $d = 2.83$) and reported less mind wandering ($t(158) = 7.09, p < .001, d = 0.89$).

Correlations

Pearson correlations (Table 2) examined the relationships among test performance, mind wandering, and study strategy (coded 0 = massed, 1 = distributed). Mind wandering correlated negatively with test performance ($r = -.46, p < .001$). Study strategy correlated positively with test performance ($r = .87, p < .001$) and negatively with mind wandering ($r = -.50, p < .001$).

Table 2: Correlations Among Key Variables (N = 160)

Variable	1	2	3
1. Test performance	—		
2. Mind wandering	-.46***	—	
3. Study strategy	.87***	-.50***	—

Note. Study strategy coded 0 = massed, 1 = distributed.

*** $p < .001$.

Summary of findings

The results support all three hypotheses. Students who studied in a distributed fashion achieved higher test scores and reported less mind wandering. Across the entire sample, more mind wandering predicted poorer performance, and distributed practice indirectly improved learning by lowering inattentive episodes.

Discussion

The present study examined how **study strategy** (massed versus distributed practice) and **mind wandering** influence students' learning outcomes. Three research questions guided the work:

1. Does distributed practice lead to higher test performance than massed practice?
2. Is mind wandering negatively related to test performance?
3. Does distributed practice reduce mind wandering, thereby supporting learning?

All three questions received strong support.

Consistent with earlier findings on the spacing effect, students who used distributed practice scored substantially higher on the delayed test than those who relied on massed practice (Carpenter et al., 2012; Xu & Metcalfe, 2016). The large difference (Cohen's $d = 2.83$) confirms that spacing study sessions greatly benefits long-term retention. This result strengthens decades of evidence that distributed learning supports the consolidation of memory traces and creates more retrieval opportunities. Mind wandering was also a significant factor. A clear negative correlation ($r = -.46$) between mind wandering and test performance shows that frequent attentional lapses reduce learning efficiency. This echoes earlier work demonstrating that when attention drifts, less information is encoded and later recalled (Smallwood et al., 2007; Was et al., 2019; Sanchez & Naylor, 2018). The current data thus reinforce the conclusion that sustained attention is critical for deep learning, regardless of study method. The third hypothesis predicted that distributed practice would reduce mind wandering, and the results supported this. Students in the distributed group reported significantly fewer mind-wandering episodes than those in the massed group. This finding agrees with the proposal of Xu and Metcalfe (2016) that spacing keeps learners in a "region of proximal learning," where material remains engaging and cognitive fatigue is minimised. By providing natural breaks and time for consolidation, distributed sessions may help the reflective system (Strack & Deutsch, 2004) regain focus and counteract the automatic processes that drive mind wandering. The dual-process model of cognition offers a coherent explanation. Massed practice strains working memory and promotes automatic processing, leaving students vulnerable to distraction and mind wandering. Distributed practice, in contrast, gives the reflective system repeated opportunities to plan and review, which refreshes attention and improves retention. The negative association between mind wandering and test performance fits the model's view that automatic processes can interrupt deliberate learning, leading to poorer memory formation.

Theoretical implications

These results extend the spacing literature by integrating an attentional mechanism. Rather than simply strengthening memory, distributed practice appears to help because it reduces mind wandering, thereby protecting the encoding process. The findings therefore bridge two lines of research—spaced learning and mind wandering—showing that their effects are connected. They also support the idea that the spacing effect is partly attentional, not purely mnemonic.

Practical implications

The practical message is straightforward:

Students learn more when they spread study sessions over time and keep attention focused. Teachers and curriculum designers can apply these results by encouraging shorter, spaced study blocks and by including regular low-stakes quizzes or interactive elements to maintain engagement (Peterson & Wissman, 2020; Pan et al., 2020). Digital learning platforms can integrate attention prompts or scheduled breaks to reduce fatigue. Students themselves can use this evidence to plan daily or weekly study routines that prevent long periods of continuous work and reduce the chance of mind wandering.

Strengths and limitations

The study had several strengths. Random assignment and automated mind-wandering probes ensured internal validity. The relatively large, balanced sample (80 per condition) increased statistical power and the reliability of estimates. The delayed test measured long-term learning, the outcome most relevant to real education. However, some limitations must be acknowledged. First, all participants were first-year psychology students at one institution, which may limit generalisability to other disciplines or older learners. Second, mind wandering was measured through self-report probes; although widely used, this method depends on participants' honesty and self-awareness. Third, the study examined only a single textbook chapter. Different types of material—such as mathematics or creative writing—might yield different patterns of attention and retention. Finally, the design was cross-sectional; it cannot prove that reduced mind wandering causes better retention, only that they co-occur.

Future research

Future studies could recruit diverse age groups and academic fields, combine objective attention measures (such as eye-tracking or EEG) with self-report probes, and extend the design to longer courses or semester-long interventions. Longitudinal approaches could clarify whether spacing continues to benefit learning over months and whether early reductions in mind wandering predict later academic success. It would also be useful to test digital prompts or pretesting techniques (Pan et al., 2020) as additional tools to sustain attention. Overall, this study shows that distributed practice not only improves memory but also limits mind wandering, helping students to focus and learn more effectively. The findings deepen understanding of how attention and scheduling interact and provide actionable guidance for educators and students seeking to maximise learning outcomes.

Conclusion

This study set out to clarify how study strategy and mind wandering interact to influence students' learning. Across a balanced sample of 160 first-year psychology students, we found three consistent patterns. First, distributed (spaced) practice produced substantially higher test scores than massed (crammed) practice, confirming that spreading study sessions over time is a powerful way to strengthen long-term memory. Second, mind wandering correlated negatively with test performance: students who experienced more off-task thoughts during study performed worse on

the delayed test. Third, distributed practice was linked to fewer mind-wandering episodes, suggesting that spacing promotes sustained attention as well as memory consolidation. These findings make several contributions to theory and practice. Theoretically, they integrate the dual-process model of cognition (Strack & Deutsch, 2004) with research on the spacing effect, showing that distributed practice supports the reflective system and helps counter the automatic drift of attention that leads to mind wandering. By highlighting attention control as a mechanism, this work refines our understanding of why spacing enhances learning. Practically, the results underline that how students schedule their study time matters as much as how long they study. Educators can draw on these insights to design curricula that encourage shorter, well-spaced learning blocks and incorporate brief retrieval activities or digital prompts to help maintain focus (Peterson & Wissman, 2020; Pan et al., 2020). Students can also apply these strategies in self-directed learning by setting regular study sessions across days rather than relying on single, prolonged cramming periods. Like all research, the present work has limits—its single-discipline sample, reliance on self-reported attention probes, and cross-sectional design. Future studies should include more diverse participants, objective attention measures, and longitudinal designs to test whether early reductions in mind wandering predict longer-term academic success. In sum, the evidence shows that distributed practice improves retention partly because it reduces mind wandering. This dual benefit provides a strong basis for recommending spaced learning as a core educational strategy and for integrating attention-support tools into modern teaching and digital learning environments.

References

- Al-Balushi, S. M., & Al-Harthy, I. S. (2015). Students' mind wandering in macroscopic and submicroscopic textual narrations and its relationship with their reading comprehension. *Chemistry Education Research and Practice*, 16(3), 680–688. <https://doi.org/10.1039/C5RP00052A>
- Bernstein, D. A., Penner, L. A., Clarke-Stewart, A., Roy, E. J., & Wickens, C. D. (2018). *Psychology* (11th ed.). Cengage.
- Carpenter, S. K., Cepeda, N. J., Rohrer, D., Kang, S. H. K., & Pashler, H. (2012). Using spacing to enhance diverse forms of learning: Review of recent research and implications for instruction. *Educational Psychology Review*, 24(3), 369–378. <https://doi.org/10.1007/s10648-012-9205-z>
- Desideri, L., Ottaviani, C., Cecchetto, C., & Bonifacci, P. (2019). Mind wandering, together with test anxiety and self-efficacy, predicts students' academic self-concept but not reading comprehension skills. *British Journal of Educational Psychology*, 89(2), 307–323. <https://doi.org/10.1111/bjep.12240>
- Huijzer, M. (2023). *The relationship between motivation and mind wandering: Learning strategies as a mediator* (Master's thesis). Utrecht University. <https://studenttheses.uu.nl/handle/20.500.12932/44377>
- Martin, L., Mills, C., D'Mello, S. K., & Risko, E. F. (2018). Re-watching lectures as a study strategy and its effect on mind wandering. *Experimental Psychology*, 65(5), 271–282. <https://doi.org/10.1027/1618-3169/a000412>
- Mills, C., D'Mello, S., Bosch, N., & Olney, A. M. (2015). Mind wandering during learning with an intelligent tutoring system. In C. Conati et al. (Eds.), *Artificial intelligence in education: 17th International Conference, AIED 2015, Madrid, Spain, June 22–26, 2015. Proceedings* (pp. 267–276). Springer. https://doi.org/10.1007/978-3-319-19773-9_27
- Pachai, A. A., Acai, A., LoGiudice, A. B., & Kim, J. A. (2016). The mind that wanders: Challenges and potential benefits of mind wandering in education. *Scholarship of Teaching and Learning in Psychology*, 2(2), 134–146. <https://doi.org/10.1037/stl0000060>

- Pan, S. C., Sana, F., Schmitt, A. G., & Bjork, E. L. (2020). Pretesting reduces mind wandering and enhances learning during online lectures. *Journal of Applied Research in Memory and Cognition*, 9(4), 542–554. <https://doi.org/10.1016/j.jarmac.2020.07.004>
- Peterson, D. J., & Wissman, K. T. (2020). Using tests to reduce mind-wandering during learning review. *Memory*, 28(4), 582–587. <https://doi.org/10.1080/09658211.2020.1748657>
- Randall, J. G., Hanson, M. D., & Nassreelgrawi, A. S. (2022). Staying focused when nobody is watching: Self-regulatory strategies to reduce mind wandering during self-directed learning. *Applied Psychology*, 71(4), 1428–1464. <https://doi.org/10.1111/apps.12366>
- Risko, E. F., Anderson, N., Sarwal, A., Engelhardt, M., & Kingstone, A. (2012). Everyday attention: Variation in mind wandering and memory in a lecture. *Applied Cognitive Psychology*, 26(2), 234–242. <https://doi.org/10.1002/acp.1814>
- Sanchez, C. A., & Naylor, J. S. (2018). Mind-wandering while reading not only reduces science learning but also increases content misunderstandings. *Journal of Applied Research in Memory and Cognition*, 7(3), 332–341. <https://doi.org/10.1016/j.jarmac.2018.05.001>
- Smallwood, J., Fishman, D. J., & Schooler, J. W. (2007). Counting the cost of an absent mind: Mind wandering as an underrecognized influence on educational performance. *Psychonomic Bulletin & Review*, 14(2), 230–236. <https://doi.org/10.3758/BF03194057>
- Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, 8(3), 220–247. https://doi.org/10.1207/s15327957pspr0803_1
- Wammes, J. D., Boucher, P. O., Seli, P., Cheyne, J. A., & Smilek, D. (2016). Mind wandering during lectures I: Changes in rates across an entire semester. *Scholarship of Teaching and Learning in Psychology*, 2(1), 13–32. <https://doi.org/10.1037/stl0000053>
- Wammes, J. D., Seli, P., & Smilek, D. (2018). Mind-wandering in educational settings. In K. C. R. Fox & K. Christoff (Eds.), *The Oxford handbook of spontaneous thought: Mind-wandering, creativity, and dreaming* (pp. 259–271). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780190464745.013.22>
- Was, C. A., Hollis, R. B., & Dunlosky, J. (2019). Do students understand the detrimental effects of mind wandering during online learning? *Computers & Education*, 135, 113–122. <https://doi.org/10.1016/j.compedu.2019.02.020>
- Wong, S. S. H., & Lim, S. W. H. (2022). A mind-wandering account of the testing effect: Does context variation matter? *Psychonomic Bulletin & Review*, 29(1), 220–229. <https://doi.org/10.3758/s13423-021-01944-8>
- Wong, S. S. H., & Lim, S. W. H. (2023). Take notes, not photos: Mind-wandering mediates the impact of note-taking strategies on video-recorded lecture learning performance. *Journal of Experimental Psychology: Applied*, 29(1), 124–139. <https://doi.org/10.1037/xap0000375>
- Xu, J., & Metcalfe, J. (2016). Studying in the region of proximal learning reduces mind wandering. *Memory & Cognition*, 44(5), 681–695. <https://doi.org/10.3758/s13421-016-0589-8>