

Table on the Overview of Theory

Citation	Summary of the Article
Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. <i>American Psychologist</i> , 34(10), 906–911. https://doi.org/10.1037/0003-066x.34.10.906	This article explores metacognition and its crucial role in cognitive monitoring, outlining four main components: 1) Metacognitive Knowledge: Understanding oneself, tasks, and effective learning strategies; 2) Metacognitive Experience: The feelings individuals have during cognitive activities (e.g., success or confusion) that influence cognitive processes; 3) Goal Setting and Monitoring: Metacognition aids in setting learning goals and adjusting during task execution. The author notes that children often struggle with self-monitoring, leading to suboptimal learning outcomes, potentially due to inaccurate self-assessments or overconfidence.
Nelson, T. O., & Narens, L. (1990). Metamemory: A theoretical framework and new findings. In G. H. Bower (Ed.), <i>Psychology of learning and motivation</i> (Vol. 26, pp. 125–173). Academic Press. https://doi.org/10.1016/s0079-7421(08)60053-5	The article presents a framework for metamemory based on three principles: 1) Levels of Cognitive Processes: Differentiates meta-level and object-level processes; 2) Dynamic Model: The meta-level regulates learning from a dynamic object-level model; 3) Dominance Relations: Control modifies the object-level, while monitoring informs the meta-level. The authors emphasize individuals can accurately assess their memory states even during retrieval failures.
Schraw, G., & Moshman, D. (1995). Metacognitive theories. <i>Educational Psychology Review</i> , 7(4), 351–371. https://doi.org/10.1007/BF02212307	This paper presents a framework for metacognitive theories, defined as systematic frameworks individuals use to guide their cognitive processes. It distinguishes between tacit, informal, and formal metacognitive theories. The authors highlight the integration of metacognitive knowledge (declarative, procedural, and conditional) and the importance of self-regulation. They suggest that metacognitive theories arise from cultural learning and peer interaction.

Citation	Summary of the Article
Kuhn, D. (2000). Metacognitive development. <i>Current Directions in Psychological Science</i>, 9(5), 178–181. https://doi.org/10.1111/1467-8721.00088	The author outlines how metacognition originates from early childhood awareness of mental functions, progressing through various developmental stages that culminate in sophisticated metacognitive skills often not mastered by adults. Kuhn distinguishes between different kinds of metacognition, highlighting the importance of metastrategic awareness (knowledge about strategies) and its role in cognitive control.
Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. <i>Educational Psychology Review</i>, 16(4), 385–407. https://doi.org/10.1007/s10648-004-0006-x	This article presents a framework for understanding and assessing motivation and self-regulated learning (SRL) among college students. The framework emphasizes four key assumptions: active learner participation, the potential for self-control, the necessity of goals or standards, and the mediational role of self-regulatory activities. Pintrich outlines a four-phase SRL process: planning, monitoring, control, and reflection, highlighting its occurrence across cognitive, motivational, behavioral, and contextual domains.
Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. <i>Metacognition and Learning</i>, 1(1), 3–14. https://doi.org/10.1007/s11409-006-6893-0	The article define metacognition as the awareness and regulation of cognitive activities during learning. Authors identify key components of metacognition, including metacognitive knowledge (awareness of one's cognitive processes) and metacognitive skills (strategies for managing those processes). The article advocates for a multi-method approach to effectively capture the complexities of metacognitive processes. Additionally, they emphasize the importance of effective instructional strategies to foster metacognitive skills in learners.

Citation	Summary of the Article
Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. <i>Educational Psychology Review</i>, 20(4), 391–409. https://doi.org/10.1007/s10648-008-9083-6	This review article seeks to clarify the conceptual boundaries among metacognition, self-regulation, and self-regulated learning (SRL) within educational psychology. The authors analyze 255 studies to investigate definitions, measurement techniques, and the context in which these constructs are used. The authors outline how metacognition is primarily cognitive, while self-regulation incorporates behavioral and motivational elements, often influenced by environmental factors.
Kornell, N. (2009). Metacognition in humans and animals. <i>Current Directions in Psychological Science</i>, 18(1), 11–15. https://doi.org/10.1111/j.1467-8721.2009.01597.x	This article challenges the notion that metacognition is uniquely human, presenting evidence of metacognitive abilities in non-human animals like rhesus monkeys and dolphins. Kornell highlights studies showing these animals can monitor their knowledge, opting out of challenging tasks when uncertain, which leads to better performance.
Yeung, N., & Summerfield, C. (2012). Metacognition in human decision-making: Confidence and error monitoring. <i>Philosophical Transactions of the Royal Society B: Biological Sciences</i>, 367(1594), 1310–1321. https://doi.org/10.1098/rstb.2011.0416	This article explores the role of metacognition in human decision-making, particularly how confidence and error monitoring affect decision evaluations. The authors note that individuals possess an intrinsic awareness of their decisions and mistakes, which aids in avoiding repeated errors. Research into two areas: confidence in perceptual choices and error monitoring, arguing that both rely on post-decisional processing. They assert that confidence is shaped by evaluations after a decision, not just during the decision-making process.
Bjork, R. A., Dunlosky, J., & Kornell, N. (2013). Self-	The authors delineate key constructs of SRL, including goal setting, self-monitoring, and self-

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regulated learning: Beliefs, techniques, and illusions. <i>Annual Review of Psychology</i>, 64, 417– 444. https://doi.org/10.1146/annurev-psych-113011-143823	reflection. They explore how students' beliefs about their abilities and the effectiveness of learning strategies can significantly influence academic outcomes. The article introduces various techniques that can enhance self-regulation, such as self-instruction. Furthermore, the authors address common cognitive illusions—misjudgments about one's abilities and learning processes—that can hinder self-regulation.
Fleming, S. M., & Frith, C. D. (2014). Metacognitive neuroscience: An introduction. In <i>The cognitive neuroscience of metacognition</i> (pp. 1–6). Springer. https://doi.org/10.1007/978-3-642-45190-4_1	Emphasize the neural mechanisms that underlie metacognitive processes. They highlight the relevance of metacognition in cognitive and decision-making, noting that metacognitive judgments are closely tied to brain activity. The authors review key neuroimaging studies that identify specific brain regions associated with metacognitive awareness, including the prefrontal cortex, which plays a crucial role in decision-making and self-reflection, and the parietal regions, implicated in processing confidence and error awareness.
Fleming, S. M., & Lau, H. C. (2014). How to measure metacognition. <i>Frontiers in Human Neuroscience</i>, 8, 443. https://doi.org/10.3389/fnhum.2014.00443	This article reviews methods for quantitatively measuring metacognitive abilities, distinguishing between metacognitive sensitivity and bias in self-assessment of performance. The authors criticize traditional methods like Pearson's r for bias susceptibility and advocate for measures derived from signal detection theory, proposing tools like the type 2 d' and meta-d' measures to enhance the accuracy of metacognitive efficiency assessments.

Citation	Summary of the Article
Geurten, M., & Willems, S. (2016). Metacognition in early childhood: Fertile ground to understand memory development? <i>Child Development Perspectives</i>, 10(4), 263–268. https://doi.org/10.1111/cdep.12201	This article explores the early emergence of metacognitive abilities in children and their significant influence on memory development. The authors present evidence that even 3-year-olds can utilize basic metacognitive monitoring to evaluate and adjust their memory performance, challenging the idea that such skills only develop after age 7. They call for further research on how these early metacognitive skills evolve and impact memory.
Perry, J., Lundie, D., & Golder, G. (2018). Metacognition in schools: What does the literature suggest about the effectiveness of teaching metacognition in schools? <i>Educational Review</i>, 71(4), 483–500. https://doi.org/10.1080/00131911.2018.1441127	This paper reviews over 50 studies on the effectiveness of teaching metacognitive strategies, finding significant benefits for students' academic performance and wellbeing. Despite evidence supporting metacognition's positive impact on learning, the authors criticize its limited implementation in English schools and advocate for its integration into educational policy. They call for further research into metacognitive instruction's benefits across diverse student populations to improve overall educational outcomes.
Fleur, D. S., Bredeweg, B., & van den Bos, W. (2021). Metacognition: Ideas and insights from neuro- and educational sciences. <i>NPJ Science of Learning</i>, 6(1), 13. https://doi.org/10.1038/s41539-021-00089-5	This article explores metacognition from neuro- and educational perspectives, emphasizing the connection between metacognitive knowledge and control, and its correlation with academic success. Authors advocates for a cross-disciplinary approach to enhance understanding and application of metacognitive strategies. They suggest that training in offline metacognitive skills could significantly improve learning outcomes.

Citation	Summary of the Article
Kim, Y.-E., Zepeda, C. D., & Butler, A. C. (2023). An interdisciplinary review of self-regulation of learning: Bridging cognitive and educational psychology perspectives. <i>Educational Psychology Review</i>, 35(3), 92. https://doi.org/10.1007/s10648-023-09800-x	This review examines self-regulation of learning (SRL) and highlights the divergent approaches of cognitive and educational psychology, noting how their siloed understanding hinders scientific progress. The authors propose integrating these perspectives through improved awareness, innovative research methods, and collaboration to overcome barriers. They conclude that a synergistic approach could enhance both research and practical outcomes.
Mazancieux, A., Pereira, M., Faivre, N., Mamassian, P., Moulin, C. J. A., & Souchay, C. (2023). Towards a common conceptual space for metacognition in perception and memory. <i>Nature Reviews Psychology</i>, 2(12), 751–766. https://doi.org/10.1038/s44159-023-00245-1	This article focus on how metacognitive judgments about memory (metamemory) and perception (metaperception) intersect. The authors propose a conceptual framework that facilitates comparisons between these two domains. They distinguish between two categories of metacognitive evaluation: decisional (evaluating during decision-making) and addecisional (evaluating without the influence of a specific decision). Evidence suggests that while there may be some commonalities in metacognitive operations across memory and perception, a strong domain-general architecture is not fully supported.
Fleming, S. M. (2024). Metacognition and confidence: A review and synthesis. <i>Annual Review of Psychology</i>, 75(1), 241–268. https://doi.org/10.1146/annurev-psych-022423-032425	This review explores the relationship between metacognition and confidence, delineates the distinction between subpersonal representations of confidence—controlled sensory tasks—and the broader, personal-level beliefs such as error awareness and success prediction; Introduce the concept of propositional confidence, which refers to confidence in one's hypothetical decisions or actions. He emphasizes that metacognitive judgments often depend on self-models. The review suggests confidence is not merely an outcome of cognitive performance but also a dynamic process influenced by various biases, including the positive evidence bias, which results in overconfidence.

Citation	Summary of the Article
Risko, E. F., & Gilbert, S. J. (2016). <i>Cognitive offloading</i>. <i>Trends in Cognitive Sciences</i>, 20(9), 676-688. https://doi.org/10.1016/j.tics.2016.07.002	This article explores cognitive offloading, which is the use of physical actions to reduce cognitive demands during tasks, such as using external tools or gestures to aid memory and thinking processes. The authors discuss the mechanisms that trigger cognitive offloading and the cognitive consequences associated with this behavior. They present a metacognitive framework for understanding how individuals decide to offload cognition, emphasizing the role of metacognitive evaluations and subjective perceptions of cognitive demands.
Dawson, P. (2020). Cognitive offloading and assessment. In M. Bearman, P. Dawson, R. Ajjawi, J. Tai, & D. Boud (Eds.), <i>Re-imagining university assessment in a digital world</i> (pp. 37–48). Springer. https://doi.org/10.1007/978-3-030-41956-1_4	This chapter discusses cognitive offloading as the use of tools (like notes and calculators) to reduce cognitive load during tasks. It notes that assessment practices have inconsistently addressed cognitive offloading, especially in exams versus authentic open-ended tasks. The chapter proposes principles for incorporating cognitive offloading into assessments, emphasizing transparency, programmatic assessment, evaluative judgement, and authentic assessment. It highlights the need for assessments to adapt to a digital context, considering both the benefits and challenges of cognitive offloading technologies.
Risko, E. F., & Kelly, M. O. (2023). <i>Thinking in the digital age: Everyday cognition and the dawn of a new age of metacognition research</i>. <i>Applied Cognitive Psychology</i>, 37(4), 785–788. https://doi.org/10.1002/acp.4102	This commentary discusses the implications of technology on everyday cognition and metacognition. The authors underscore the shift from basic cognitive tasks to managing both internal and external cognitive resources, highlighting that this transition raises metacognitive challenges—primarily in monitoring and controlling how we use these resources. The commentary further emphasizes the need to explore the consequences of cognitive offloading on metacognitive processes, stressing that while technology can reduce cognitive load, it increases demands on metacognitive monitoring and control as individuals must evaluate the reliability and costs of external memory stores.

Citation	Summary of the Article
Gilbert, S. J., Boldt, A., Sachdeva, C., Scarampi, C., & Tsai, P.-C. (2023). <i>Outsourcing Memory to External Tools: A Review of 'Intention Offloading'</i>. <i>Psychonomic Bulletin & Review</i>, 30(1), 60–76. https://doi.org/10.3758/s13423-022-02139-4	This review article examines intention offloading, defined as the use of external tools such as calendars and reminders to aid in remembering delayed intentions. The authors discuss how this cognitive strategy enhances traditional memory functions and highlight that its effectiveness is shaped by metacognitive processes, which inform how individuals monitor and control their cognitive abilities. They emphasize the developmental trajectory of intention offloading, noting that its usage changes over the lifespan, and neural mechanisms. Findings indicate that while most individuals can effectively offload their intentions, metacognitive biases may lead to systematic patterns in reminder-setting behaviors.
Skulmowski, A. (2023). <i>The cognitive architecture of digital externalization</i>. <i>Educational Psychology Review</i>, 35, 101. https://doi.org/10.1007/s10648-023-09818-1	This review synthesizes findings on cognitive offloading, particularly in digital contexts, where learners use technology to reduce cognitive loads. The author develops a model focusing on cognitive load, emphasizing how high intrinsic load (difficult tasks), high extraneous load (unnecessary complexity), and low perceived working memory capacity lead learners to offload information. The model posits that extraneous cognitive load acts as a barrier to entering working memory and being stored in long-term memory, resulting in the retention of only the gist of information.
Gilbert, S. J. (2024). <i>Memory augmentation, cognitive offloading, and digital technology</i>. <i>Psychological Inquiry</i>, 35(2), 110–112. https://doi.org/10.1080/1047840X.2024.2384129	In this commentary, the author explores the impact of technology on memory through two key perspectives: the difference between digital substitutes and innovative tools, and their implications for memory augmentation and cognitive offloading. He notes that while digital substitution (like using apps for note-taking) replaces traditional tools, innovative technologies (such as social media) foster new forms of memory engagement that differ from conventional recollection. The commentary also highlights the importance of metadata in digital photography for memory retrieval, raising concerns about accessibility and recall when individuals struggle to locate specific memories without assistance.

Citation	Summary of the Article
Richmond, L. L., & Taylor, R. G. (2025). <i>The benefits and potential costs of cognitive offloading for retrospective information</i>. <i>Nature Reviews Psychology</i>, 4, 312–321. https://doi.org/10.1038/s44159-025-00432-2	This review defines cognitive offloading as the practice of utilizing physical actions to lessen internal memory demands. Existing literatures demonstrate that while cognitive offloading can enhance task performance in laboratory settings, it also carries certain risks. The review examines various factors that may impact how and when cognitive offloading is beneficial, such as individual differences in working memory capacity and age. Notably, older adults, who often struggle with certain aspects of retrospective memory compared to younger adults, may find cognitive offloading particularly advantageous in everyday situations.
Burnett, L. K., & Richmond, L. L. (2025). <i>Meta-analytic investigations of the effect of cognitive offloading on memory-based task performance and interindividual variability</i>. <i>Memory & Cognition</i>. https://doi.org/10.3758/s13421-025-01743-8	The authors conducted two meta-analyses: one assessing mean differences in performance between offloading and non-offloading conditions, and another analyzing the variability of performance across individuals. Results indicate that cognitive offloading significantly improves task performance, particularly in forced-offloading conditions compared to choice-offloading ones, with a greater mean benefit observed in adults than in children. Notably, cognitive offloading also reduced interindividual variability in performance, suggesting it could help equalize performance differences among individuals with varying internal memory capabilities. The analysis found that the benefits were especially pronounced in prospective memory tasks.
Armitage, K. L., & Gilbert, S. J. (2025). <i>The nature and development of cognitive offloading in children</i>. <i>Child Development Perspectives</i>, 19, 108–115. https://doi.org/10.1111/cdep.12532	This article explores cognitive offloading in children, highlighting how they utilize external tools to enhance cognitive tasks. They note that even very young children engage in offloading strategies, such as setting reminders and organizing information to aid memory. Research illustrates that children as young as four can effectively apply offloading strategies, often mirroring adult practices, such as relying more on external aids when tasks become cognitively demanding. However, younger children demonstrate biases, like excessive reliance on offloading and lack of self-initiation, which may stem from overconfidence in their own abilities.

Table on the Key Empirical Research

Citation	Summary of the Article
Gilbert, S. J. (2015). Strategic offloading of delayed intentions into the external environment. <i>Quarterly Journal of Experimental Psychology</i>, 68(5), 971–992. https://doi.org/10.1080/17470218.2014.972963	This study investigates how cognitive load and interference affect strategic offloading of delayed intentions into the external environment. Two experiments reveal that participants are more likely to create external reminders under high cognitive load, significantly improving their goal completion rates. Notably, older adults use this strategy more frequently. The findings suggest that externalizing intentions enhances the fulfillment of delayed goals and may indicate an underestimation of participants' capacities in traditional testing contexts.
Risko, E. F., & Dunn, T. L. (2015). <i>Storing information in-the-world: Metacognition and cognitive offloading in a short-term memory task. Consciousness and Cognition</i>, 36, 61–74. https://doi.org/10.1016/j.concog.2015.05.014	This study investigates the factors influencing the choice to store information externally (e.g., writing it down) versus recalling it from memory in a short-term memory task. In Experiments 1a and 1b, participants had to remember items either by relying solely on their memory or by writing them down. Experiments 2a and 2b involved the same stimuli, with participants making metacognitive judgments regarding their predicted performance and effort. Results indicated that the spontaneous use of external storage correlated with both the number of items and individuals' actual and perceived short-term memory capacity. Notably, many participants opted for external storage even when it did not confer observable benefits.
Dunn, T. L., & Risko, E. F. (2016). <i>Toward a metacognitive account of cognitive offloading. Cognitive Science</i>, 40(5), 1080–1127. https://doi.org/10.1111/cogs.12273	This study investigates how individuals utilize body and environment to offload cognitive tasks, particularly focusing on spontaneous physical rotations in response to rotated objects. The authors manipulated the performance costs associated with word rotation and array frame rotation. Contrary to expectations, the findings revealed that participants' spontaneous physical rotations did not correlate with the perceived performance costs or benefits of being rotated. Instead, subjective ratings of perceived benefits aligned closely with the patterns of physical rotations, indicating that metacognitive beliefs about expected performance and the effort required for each strategy (internal versus a combination of internal and external resources) play a crucial role in decision-making.

Citation	Summary of the Article
Weis, P. P., & Wiese, E. (2019). <i>Using tools to help us think: Actual but also believed reliability modulates cognitive offloading</i>. <i>Human Factors</i>, 61(2), 243–254. https://doi.org/10.1177/0018720818797553	This study using an adaptation of the mental rotation paradigm, participants could rotate stimuli either internally or with a rotation knob that allowed for external manipulation on a screen. The research manipulated two key factors: the knob's actual reliability (AR) and participants' beliefs about the knob's reliability (believed reliability; BR). Results showed that participants rapidly and flexibly adjusted their cognitive offloading and perceived utility of the knob based on its actual reliability. However, when instructed that the knob's reliability was lower than it was, participants significantly reduced their cognitive offloading. This indicates that cognitive offloading decisions are influenced not just by utility maximization but also by potentially erroneous preexisting beliefs.
Boldt, A., & Gilbert, S. J. (2019). <i>Confidence guides spontaneous cognitive offloading</i>. <i>Cognitive Research: Principles and Implications</i>, 4, 45. https://doi.org/10.1186/s41235-019-0195-y	This study investigates how metacognitive evaluations influence spontaneous cognitive offloading during a computer-based task on remembering delayed intentions. Participants were divided into two groups: one received explicit instructions to set external reminders, while the other did not. Results showed that the uninstructed group set reminders less frequently but still enhanced performance through offloading. Importantly, participants were more likely to set reminders when they felt less confident in their memory, indicating that metacognitive assessments impact offloading decisions even in spontaneous contexts.
Hu, X., Luo, L., & Fleming, S. M. (2019). <i>A role for metamemory in cognitive offloading</i>. <i>Cognition</i>, 193, 104012. https://doi.org/10.1016/j.cognition.2019.104012	This study explores the role of metamemory, specifically participants' confidence in their future memory performance, in cognitive offloading. Participants learned word pairs and could opt to save some for later use during memory tests. The results revealed that those with higher confidence in their memory were more likely to use saved information to enhance their performance. Overall, the findings indicate a strong connection between metamemory and cognitive offloading, highlighting that confidence in memory significantly influences the strategic use of external aids.

Citation	Summary of the Article
Weis, P. P., & Wiese, E. (2019). <i>Problem Solvers Adjust Cognitive Offloading Based on Performance Goals</i>. <i>Cognitive Science</i>, 43(1), e12802. https://doi.org/10.1111/cogs.12802	This study investigates how individuals adapt their offloading strategies based on differing performance goals, focusing on speed (SPD) versus accuracy (ACC). In two experiments, participants offloaded less frequently in the SPD condition than in the ACC condition, and adaptive offloading behaviors were linked to improved goal-related performance. Participants provided faster answers in the SPD condition and more accurate ones in the ACC condition; however, these adaptations compromised overall performance. The findings suggest that humans strategically adjust their use of external resources to meet immediate cognitive objectives, with implications for future research in environments with high cognitive loads or lacking feedback.
Bulley, A., McCarthy, T., Gilbert, S. J., Suddendorf, T., & Redshaw, J. (2020). Children devise and selectively use tools to offload cognition. <i>Current Biology</i>, 30(17), 3457–3464.e3. https://doi.org/10.1016/j.cub.2020.06.035	This study explores the developmental origins of cognitive offloading in children aged 4 to 11 years through memory tasks involving hidden targets. Even at 4 years old, children readily adopted an external offloading strategy when prompted, particularly on more challenging tasks, indicating a nascent metacognitive understanding. While younger children frequently struggled to devise their own strategies, almost all children aged 10 and 11 successfully created them, suggesting that awareness of cognitive challenges and offloading strategies emerges early and can be fostered with simple prompts.
Sachdeva, C., & Gilbert, S. J. (2020). <i>Excessive use of reminders: Metacognition and effort-minimisation in cognitive offloading</i>. <i>Consciousness and Cognition</i>, 86. https://doi.org/10.1016/j.concog.2020.103024	This article explores the phenomenon of cognitive offloading through the use of external reminders to manage delayed intentions. While individuals often utilize reminders, this behavior can exceed optimal levels. The authors propose that a tendency to avoid cognitive effort in remembering tasks may also contribute to this excessive offloading. To investigate this hypothesis, where one group of participants was rewarded based on performance (expected to encourage more cognitive effort and reduce offloading bias) and another group received a flat payment for participation. Results indicated that the offloading bias was significantly diminished in the performance-rewarded group, implying that individuals might offload reminders not only due to underconfidence but also to minimize cognitive effort.

Citation	Summary of the Article
Gilbert, S. J., Bird, A., Carpenter, J. M., Fleming, S. M., Sachdeva, C., & Tsai, P.-C. (2020). <i>Optimal use of reminders: Metacognition, effort, and cognitive offloading</i>. <i>Journal of Experimental Psychology: General</i>, 149(3), 501–517. https://doi.org/10.1037/xge0000652	This study investigates how individuals decide between relying on unaided memory and using external reminders through three experiments involving memory tasks. Participants showed a consistent bias towards external reminders, even when financial incentives favored optimal memory strategies, and this bias correlated with inaccurate metacognitive assessments of their abilities. Notably, providing metacognitive guidance effectively mitigated this bias, demonstrating that interventions like feedback adjustments and trial difficulty modifications can shift reminder preferences by influencing confidence levels.
Engeler, N. C., & Gilbert, S. J. (2020). <i>The effect of metacognitive training on confidence and strategic reminder setting</i>. <i>PLOS ONE</i>. https://doi.org/10.1371/journal.pone.0240858	Previous research indicated that individuals tend to set more reminders than optimal, often influenced by metacognitive underconfidence in their memory. The current investigation aimed to determine if metacognitive training— involving performance predictions and feedback on judgment accuracy—could enhance metacognitive assessments and reduce excessive reminder-setting bias. Results showed that while metacognitive training significantly improved judgment accuracy, eliminating the underconfidence seen in the control group, both groups still exhibited a strong bias toward setting reminders, showing no significant differences between them. This implies that metacognitive bias alone does not fully account for the tendency to set reminders.
Grinschgl, S., Meyerhoff, H. S., Schwan, S., & Papenmeier, F. (2021). From metacognitive beliefs to strategy selection: does fake performance feedback influence cognitive offloading?. <i>Psychological research</i>, 85(7), 2654–2666. https://doi.org/10.1007/s00426-020-01435-9	This research examines the impact of metacognitive beliefs, shaped by performance feedback, on cognitive offloading behavior. By providing participants with manipulated fake performance feedback, the study found that those receiving below-average feedback rated their memory abilities lower. However, this change in metacognitive evaluations did not lead to significant differences in actual offloading behavior during a pattern copying task, indicating that while metacognitive beliefs may shift, they do not always influence strategy selection or cognitive offloading in practice.

Citation	Summary of the Article
Grinschgl, S., Papenmeier, F., & Meyerhoff, H. S. (2021). Consequences of cognitive offloading: Boosting performance but diminishing memory. <i>Quarterly Journal of Experimental Psychology</i>, 74(9), 1477-1496. https://doi.org/10.1177/17470218211008060	This study examines how cognitive offloading—using external tools for working memory—affects both immediate performance and long-term memory retention. Experiment 1 found that higher costs associated with offloading decreased its use, leading to lower immediate performance but better retention on a later unexpected test. While Experiment 2 showed that offloading negatively impacted memory regardless of awareness of an upcoming test, Experiment 3 indicated that when participants had to offload significantly and were informed about the test, they could counteract the adverse memory effects. Overall, the findings underscore the importance of explicit memory goals in optimizing the use of external tools for cognitive tasks.
Kelly, M. O., & Risko, E. F. (2022). <i>Study effort and the memory cost of external store availability</i>. <i>Cognition</i>, 224, 105228. https://doi.org/10.1016/j.cognition.2022.105228	This study examines how the expectation of access to external memory aids influences learning and recall performance. The researchers found that when individuals anticipate using an external store during a test, they tend to invest less effort in encoding the information, leading to reduced recall. Two experiments confirmed that this expectation affected both the time spent studying and the strategies employed, which mediated the relationship between external aid availability and recall performance. Interestingly, even after controlling for study effort, a significant memory cost remained.
Chiu, G., & Gilbert, S. J. (2023). Influence of the physical effort of reminder-setting on strategic offloading of delayed intentions. <i>Quarterly Journal of Experimental Psychology</i>, 77(6), 1295-1311. https://doi.org/10.1177/17470218231199977	This study explores how the physical effort required to set reminders impacts intention offloading, which involves using tools like to-do lists to manage delayed intentions. Two experiments showed that higher physical effort led to fewer reminders being set across varying memory loads, with low-effort scenarios enhancing task performance accuracy but diminishing at higher effort levels. Interestingly, the greatest impact of physical effort was found at intermediate memory loads, suggesting that physical effort significantly influences strategy decision-making, particularly when participants are uncertain about their best approach. This highlights the importance of considering physical effort in the cost-benefit analysis of cognitive offloading strategies.

Citation	Summary of the Article
Gilbert S. J. (2024). Cognitive offloading is value-based decision making: Modelling cognitive effort and the expected value of memory. <i>Cognition</i>, 247, 105783. https://doi.org/10.1016/j.cognition.2024.105783	This article explores how individuals decide whether to retain information in short-term memory or to offload it to external reminders, and how these decisions impact subsequent memory performance. The author proposes a computational model grounded in two principles: (A) items held in brain-based memory utilize limited capacity, leading to an opportunity cost, and (B) while reminders involve a small physical action cost, the capacity for using them is effectively unlimited. The simulation results of the model are consistent with many empirical findings: 1) a tendency to offload high-value items preferentially, 2) increased offloading at higher loads, 3) instances of unintentional forgetting for offloaded items ("Google effect") alongside improved memory for non-offloaded items ("saving-enhanced memory" effect), 4) a diminished saving-enhanced memory effect with unreliable reminders, 5) a preference for offloading more valuable items while retaining less valuable ones in memory, 6) greater sensitivity to the effort required for reminder-setting at intermediate task difficulty levels, and 7) increased offloading by individuals with poorer memory abilities.
Ball, B. H., & Peper, P. (2025). Cost avoidance underlies decisions to use prospective memory reminders. <i>Memory & Cognition</i>, 53, 1785–1802. https://doi.org/10.3758/s13421-025-01683-3	This study explores how individuals manage prospective memory demands by offloading tasks to external reminders. The experiment involved participants planning to respond to either one (low load) or four (high load) prospective memory targets, with the option to use a "lookup table" for reminders. Results indicated that participants relied on reminders more frequently in high-load situations but decreased their usage when associated costs, such as time penalties or the number of distractors, increased. Interestingly, individual confidence in memory ability did not correlate with how often reminders were checked. Overall, the findings suggest that the decision to use reminders is primarily driven by the desire to minimize time and effort, highlighting cost avoidance as a crucial factor in the use of prospective memory aids.