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Review Paper

Cognitive Offloading: A Review

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ABSTRACT

The memory capacity of humans, particularly that of short-term memory, is limited (Schacter, 2001; Shenhav etal., 2017). According to the extended mind theory, cognition functions as a cohesive system made up of interactions between internal processes and the external environment to support cognitive tasks (Clark & Chalmers, 1998). Hence to improve performance we use various methods. We are frequently warned about depending too much on the external tools rather than our own internal cognitive capacities in the Internet and smartphone era (e.g., Carr, 2020). Cognitive offloading is such a strategy used to reduce cognitive load. There are instances when physical activity is utilised to lessen a task's cognitive demands. We call this cognitive offloading. The mechanisms that lead to cognitive offloading and the cognitive effects of this behaviour are being studied in recent times. Generally speaking, cognitive offloading can be categorised as behaviours that transfer cognitive demands on to the body and the environment. Using the environment as a storehouse for representational information, we are able to import cognitive processes into the world and do away with the necessity for internal representations. To record knowledge that has to be recalled, people could, for instance, write down, enter into a computer, sketch, or take other actions that modify the surroundings (Gilbert & Risko 2016). The aim of study is to conduct a review of the phenomenon of cognitive offloading. For that using the keywords of cognitive offloading, psychology and meta cognition searches on Web of science, Google scholar, and Scopus were carried out. Out of the available full articles, only 49 were selected that matched the aim of the study. All papers were analysed and review paper was organised into three sections: studies that showed advantages of cognitive off loading, studies on dis advantages and studies that shows relation with metacognitive evaluations. Conclusions were made accordingly. In this age of technological advancements where chips are being inserted to human brains for tackling various daily tasks, cognitive offloading or the use of physical action to reduce the cognitive demands of a task remains relevant. There are Various studies that suggest the potential advantages of this task like improving performance, enhancing prospective task and intentional offloading, reducing errors and cognitive loads etc. at the same time various studies suggest how employing cognitive offloading tasks result in creating false memories, affecting inherent memory abilities, making humans passive or lazy thinkers etc. Meta cognitive evaluations play a crucial role in the decision to use or not use cognitive offloading tasks.

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The memory capacity of humans, particularly that of short-term memory, is limited (Schacter, 2001; Shenhav etal., 2017). According to the extended mind theory, cognition functions as a cohesive system made up of interactions between internal processes and the external environment to support cognitive tasks (Clark & Chalmers, 1998). Humans frequently face hard restrictions when depending solely on internal processes: we have limited memory storage (Loftus, 2005), severe attentional constraints (Jensen et al., 2011, Simons & Rensink, 2005), and aging-related perceptual impairments. Numerous animals that are not human exhibit behaviours that suggest they are sensitive to the difficulty of cognitive tasks [(Perry & Barron, 2013, Smith et al., 1995), and some even modify their surroundings in ways that seem to improve cognitive processing (Zahavi, 2009; Farina, 2011).Among invertebrates, for example, bumblebees leave scent marks on flowers during flower-foraging, and they later use these marks (or those left by a conspecific) as indicators that a particular flower is unlikely to contain a reward (Ayasse & Jarau, 2014; Goulson et al., 1998); orb-weaver spiders increase the tension of their webs when they are hungry, so they are more likely than usual to perceive and respond to catches of small prey (Japyassë & Laland, 2017; Watanabe, 2000); ; and social insects like ants build intricate pheromone trails that serve to preserve navigational data in the surrounding area, frequently for the good of the entire colony (Czaczkes et al., 2015; Lebedev & Ossadtchi, 2018).

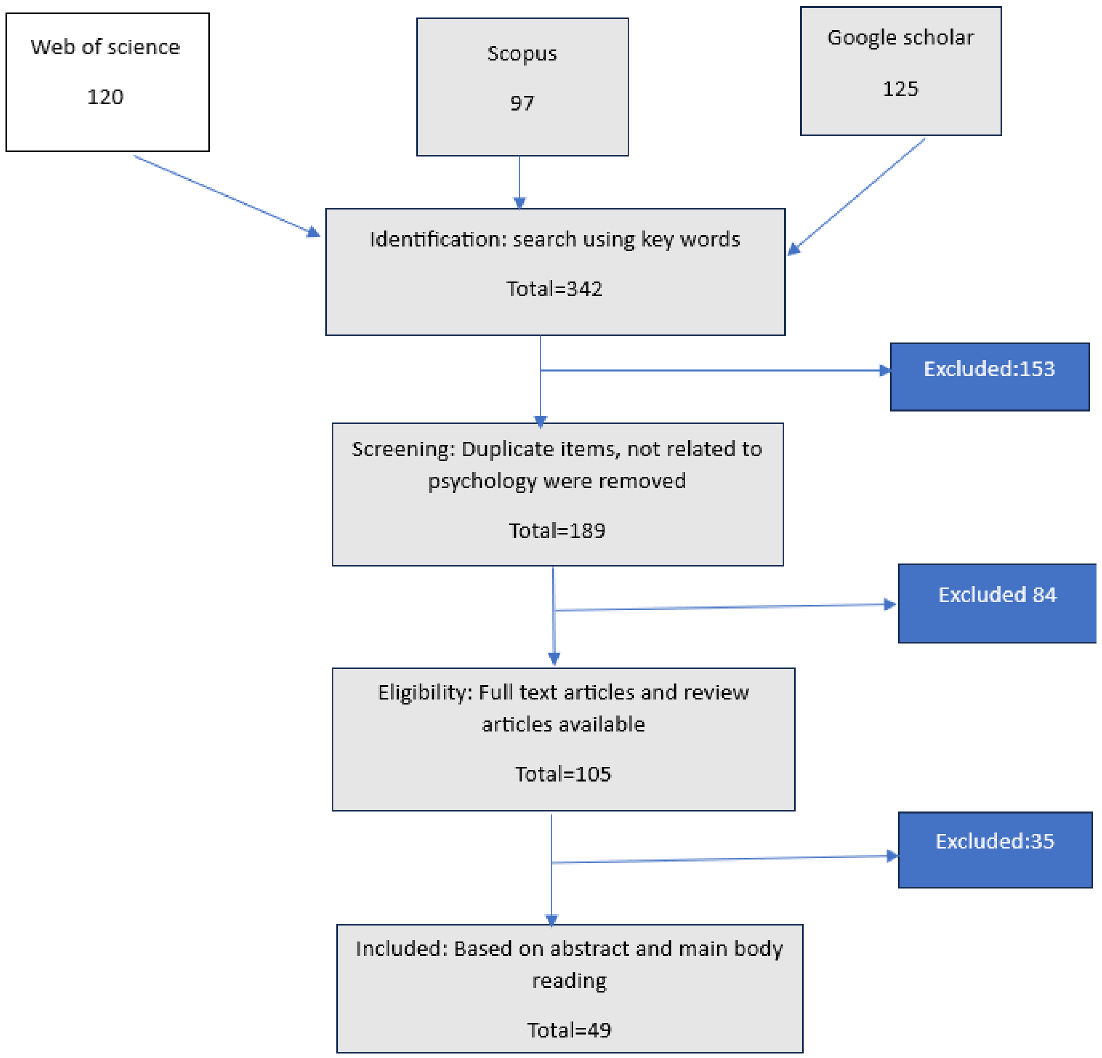
It has recently been suggested that territorial scent-marking in mammals may be essential to the creation and application of cognitive maps, improving the effectiveness of navigation [(Lebedev et al., 2018)However, these actions may be attributed to instincts (Sevincer & Oettingen, 2021) or associative learning (Perry & Barron, 2013; Le Pelley, 2012:Redshaw & Suddendorf, 2020) rather than metacognitive knowledge of cognitive difficulty (Smith, 2009).On the other hand, adult humans are able to use their acute awareness of cognitive challenges and their ability to use metacognitive awareness to shift the burden of cognitive demands onto their surroundings (Risko & Gilbert, 2016; Dunn & Risko, 2015; Gilbert et al., 2020).In fact, the reason that only humans seem to be able to produce and utilise external "thinking tools" like maps, calculators, and written text (Weis & Wiese, 2018) may be explained by our evolved capacity to reflect on our own cognitive boundaries (Bulley etal, 2020). Hence to improve performance we use various methods. We are frequently warned about depending too much on the external tools rather than our own internal cognitive capacities in the Internet and smartphone era (e.g., Carr, 2020). Cognitive offloading is such a strategy used to reduce cognitive load. There are instances when physical activity is utilised to lessen a task's cognitive demands. We call this cognitive offloading. The mechanisms that lead to cognitive offloading and the cognitive effects of this behaviour are being studied in recent times. The internal cognitive demands that would otherwise be required have an impact on the propensity to impede cognitive processes (Gilbert & Risko 2016)

Types of Cognitive offloading

Generally speaking, cognitive offloading can be categorised as behaviours that transfer cognitive demands on to the body and the environment. An easy way to visualise this kind of cognitive offloading is through external normalisation. For instance, people frequently physically tilt their heads to normalise the orientation of rotational stimuli, such as a book that is slanted, when they come across them. This conduct exemplifies the process of externalisation and can be viewed as a way to initiate internalisation. This is an internal change—in this case, mental rotation—that brings a stimulus's representation into line with a memory's representation. Similar to offloading cognitive processes onto our bodies, outputting cognitive processes into the world is a common occurrence in our daily cognitive experiences. Using the environment as a storehouse for representational information, we are able to import cognitive processes into the world and do away with the necessity for internal representations. To record knowledge that has to be recalled, people could, for instance, write down, enter into a computer, sketch, or take other actions that modify the surroundings (Gilbert & Risko 2016)

METHOD

We searched the following academic databases: Web of Science, Scopus and Google Scholar. Our search terms included combinations of keywords like "Cognitive offloading," "meta cognitive evaluations," and "origins of cognitive offloading." We limited our search to articles published only included studies published after 2016 in peer-reviewed journals. After removing duplicates, we screened titles and abstracts to identify potentially relevant studies.



Studies that show advantages of cognitive offloading

Researchers believe that offloading relieves users of the need to keep offloaded goods maintained. After that, acquired resources can be used to more cognitively demanding tasks. memory offloading can effectively allocate our limited cognitive resources to the most pertinent activities at hand while securely storing currently irrelevant information outside of our own memory. It can assist reduce the amount of information that needs to be processed at any given time (Runge et al., 2019)

The current findings offer empirical support for the idea that cognitive offloading can help older persons with their performance on tasks requiring retrospective memory and make up for age-related memory loss. At high memory loads, the decision to utilise the offloading technique was consistent across age groups, and both young and older individuals performed better when using the offloading strategy. These findings imply that cognitive offloading can be used successfully by older adults to improve performance on memory-based tasks. They also encourage further study into the advantages of cognitive offloading for older adults in other, more complex tasks where age-related memory impairment is anticipated to be more pronounced (Burnett & Richmond, 2023)

Beyond encoding and retrieving more information, offloading learned data onto a computer improves subsequent cognitive function. These findings shed light on human cognition and the management of cognitive resources. They also highlight the advantages of using external memory storage for everyday information management (Runge et al., 2019)

Although it is well established that offloading information that needs to be remembered impairs our capacity to recall from internal memory (Eskritt & Ma, 2014; Sparrow et al., 2011), offloading may have a greater impact on some components of memory than others. The results indicate that the advantage of semantic categorization for memory was not diminished when participants were allowed to reload. This implies that the capacity to comprehend the essence of a list is mostly maintained even in situations when we can depend on outside resources to do the cognitive labour of "remembering" for us. (Lu et al., 2022)

In a study conducted, for each cognitive task, participants were given distinct objectives, such as maximising speed (SPD) or accuracy (ACC), and we recorded the frequency (Experiment 1) and level of proficiency (Experiment 2) with which they resorted to a novel external resource to aid in their cognitive processing. Experiment 1 demonstrated how participants' offloading behaviour changed depending on their goals; in the SPD condition, offloading was lower than in the ACC condition. Experiment 2 demonstrated the correlation between high goal-related performance and this differential offloading behaviour. Compared to the ACC condition, participants offloaded less in the SPD condition. Experiment 2 demonstrated that good goal-related performance—quick answers in the SPD condition and accurate answers in the ACC condition—was linked to this unequal offloading behaviour. Goal-unrelated performance was compromised at the same time: sluggish responses in the ACC condition and erroneous replies in the SPD condition. According to the findings, humans are shrewd offloaders who can successfully integrate their surroundings to achieve their present cognitive objectives (Weis & Wiese, 2019).

In two blocked circumstances, 94 participants—62 young people and 32 older individuals—were assessed on a retrospective audiovisual short-term memory task. In the offloading choice condition, offloading was allowed; in the internal memory condition, it was not.

When compared to the internal memory condition, both age groups performed better in the offloading choice condition. Furthermore, at high memory loads, age groups made similar decisions about using the offloading technique, and both young and older adults performed better when using the offloading strategy. These findings imply that cognitive offloading can be used successfully by older adults to improve performance on memory-based tasks. They also encourage further study into the advantages of cognitive offloading for older adults in other, more complex tasks where age-related memory impairment is anticipated to be more pronounced (Burnett & Richmond, 2023b)

In a study Investigating the relation between the development of reactive and cognitive capabilities researchers explored whether the development of reactive capabilities prevents or promotes the development of cognitive capabilities in a population of evolving robots that have to solve a time-delay navigation task in a double T-Maze environment. Analysis of the experiments reveals that the evolving robots always select reactive strategies that rely on cognitive offloading, i.e., the possibility of acting so as to encode onto the relation between the agent and the environment the states that can be used later to regulate the agent's behavior. The discovery of these strategies does not prevent, but rather facilitates, the development of cognitive strategies that also rely on the extraction and use of internal states. Detailed analysis of the results obtained in the different experimental conditions provides evidence that helps clarify why, contrary to expectations, reactive (Carvalho & Nolfi, 2016)
"The cognitive overloading argument," which argues that, from the perspective of the idea of virtue responsibilism, excessive cognitive overloading of the kind encouraged by a technology like neuromedia threatens to impede intellectual virtue development. Next, I analyse the cognitive overloading argument in relation to the quality of intellectual persistence, contending that exposure to neuro-media could potentially enhance cognitive efficiency at the expense of intellectual persistence. However, when applied with epistemic responsibility, cognitive loading devices might not weaken intellectual perseverance, but rather relieve people from various forms of low-value intellectual labour, enabling them to persevere towards intellectual goals they find more worthwhile (Turner, 2022).

The primary takeaways from a research are as follows: (1) the requirement to complete a secondary task enhanced offloading behaviour, indicating that the auditory N-back task and the visual pattern copy task revert to the same working memory resources; and (2) more offloading (because there are no temporal costs) in the pattern copy task enhanced concurrent N-back performance. This result emphasises the notion that cognitive offloading improves task performance even in extremely demanding circumstances and supports the flexible resource model of working memory. (3) Participants' perceived workload decreased as a result of cognitive offloading, indicating that offloading need not need extra labour if cognitive load is already high as a result of completing two activities at once (Grinschgl et al., 2023)

In a study, offloading behavior is investigated in a short-term memory task requiring memory for letters. The present study is a replication and extension of a previous study conducted by Risko and Dunn, and tests the new prediction that individuals with lower working memory capacity will be more likely to offload. Here, we find that offloading information confers a performance advantage over relying on internal memory stores, particularly at higher memory loads. However, we fail to observe that those with poorer memory abilities have a greater propensity for offloading or benefit more from it. Instead, our findings suggest that cognitive offloading may be a valid compensatory strategy to improve performance of memory-based tasks for individuals with a wide range of memory ability. This study examines offloading behaviour in a short-term memory test that involves letter memorization. This study examines a new hypothesis that people with lesser working memory capacity will offload more frequently. It is a replication and expansion of a prior study by Risko and Dunn. In this case, we discover that offloading data offers a speed benefit over using internal memory stores, especially when memory loads are higher. We neglect to notice, meanwhile, that people with worse memory are more likely to unload or gain more from it. Rather, our results imply that cognitive offloading could be a legitimate compensatory technique to enhance memory-based task performance for people with varying degrees of memory capacity (Morrison & Richmond, 2020)

Another study on between-subjects experiments where participants were trained to categorise one pair of dog breeds, but were then required to categorise another pair of highly confusable breeds. Participants in the treatment group were divided into dyads and permitted to communicate with one another using the labels of these four dog breeds. Novices often used labels to refer to breeds they were unable to identify while asking questions of trained "experts." The rates of inquiring for the two members of a dyad were strongly connected, and experts were very responsive to the questions of their partnered novices. Novices' asking increases when independent categorization fails and offloading categorization succeeds, suggesting adaptive usage of offloading. Experts in a dyad reported knowing more about their breed on their own than did experts working alone (Andrade-Lotero et al., 2023)

In the current investigation, we investigated if this aversion manifests itself in human behaviour under conditions of high cognitive load. A multiple object tracking (MOT) task was administered to the participants, which asked them to focus their attention while tracking a subset of moving targets among distractions on a computer screen. After completing the MOT task by themselves (Solo condition), participants might choose to assign any number of targets to a computer partner (Joint condition). We discovered that individuals greatly increased the accuracy of their individual tracking by offloading some (but not all) targets to the computer partner (Experiment 1). In Experiment 2, participants who were told in advance that the computer partner's tracking accuracy was perfect showed a similar tendency to unload. The current research demonstrates that in order to lessen their own cognitive burden, humans are willing to (partially) delegate task demands to an algorithm. We argue that one crucial consideration for assessing human tendencies to dump cognition onto artificial systems is the cognitive load of a task. (Wahn et al., 2023)

The majority of the research that has already been done in this area has been on laboratory-based tasks that involve letter strings, word lists, or numerical stimuli. As a result, it has not dealt much with real-world situations where cognitive offloading may occur. Consequently, offloading choice behaviour and the possible advantages of offloading health-related data are examined in the current work. In Experiment 1, the effectiveness of internal memory for various missing drug interaction details is tested. In Experiment 2, offloading under complete and partial offloading instructions for relatively mild interaction results (sweating, for example) is tested along with internal memory. Experiment 3 builds on Experiment 2 by examining offloading behaviour and benefit in interaction outcomes of low, medium, and high severity (e.g., backache, heart attack). Here, we sought to clarify the possible advantages of partial offloading and investigate whether there seems to be a preference for offloading (i) information from more severe interaction outcomes and (ii) information from hard-to-remember outcomes across outcomes that vary in severity. The findings indicate that performance is improved by partial offloading as opposed to depending just on internal memory, although full offloading improves performance more than partial offloading (Richmond et al., 2023)

Studies that show Disadvantages of cognitive offloading

A study concluded that earlier cognitive offloading had little effect upon individuals' subsequent unaided ability, leading to a small and nonsignificant drop in subsequent performance. However, there was a strong effect on participants' subsequent likelihood of setting reminders. These findings suggest that the short-term impact of cognitive offloading is more likely to be seen on individuals' strategy choices rather than basic memory processes (Scarampi & Gilbert, 2020)

According to another study, early cognitive offloading caused a minor and insignificant decline in subsequent performance but had no effect on people's capacity to function independently later on. Nonetheless, there was a significant impact on the participants' propensity to set reminders in the future. These results imply that rather than affecting fundamental memory functions, the short-term effects of cognitive overloading are more likely to be observed in people's strategy decisions (Scarampi & Gilbert, 2020).

Individuals frequently shift the burden of memory demands onto external objects, such as smartphones. Although this technique enables us to overcome the constraints of our biological memory, external memory storage leaves memories vulnerable to manipulation. Three experiments, two of which were pre-registered, are reported to investigate the effects of such alteration. Participants completed a memory exercise in which they may transfer information they needed to recall to an external storage. During a crucial trial, we covertly altered the data in that store. The findings showed that people seldom ever recognised this modification. Furthermore, people frequently encoded information that was implanted into their biological memory when it was placed into their external memory storage, which resulted in the generation of false memories. The published findings emphasise one of the negative effects of memory dumping on cognition to external world (Risko et al., 2019)

A study was conducted in 2021 to throw light upon the relationship between cognitive offloading and subsequent memory for the offloaded information as well as the interplay of this relationship with the goal to acquire new memory representations. participants solved the Pattern Copy Task, in which experimenter manipulated the costs of cognitive offloading and the awareness of a subsequent memory test. In Experiment 1 (N = 172), showed that increasing the costs for offloading induces reduced offloading behaviour. This reduction in offloading came along with lower immediate task performance but more accurate memory in an unexpected test. In Experiment 2 (N = 172), confirmed these findings and observed that offloading behaviour remained detrimental for subsequent memory performance when participants were aware of the upcoming memory test. Interestingly, experiment 3 (N = 172) showed that cognitive offloading is not detrimental for long-term memory formation under all circumstances. Those participants who were forced to offload maximally but were aware of the memory test could almost completely counteract the negative impact of offloading on memory. These experiments highlight the importance of the explicit goal to acquire new memory representations when relying on technical tools as offloading did have detrimental effects on memory without such a goal.(Grinschgl, Papenmeier, et al., 2021)

In this study, we investigate the effects of unloading on both true and false recollection. Participants in three tests looked at and noted word lists that were all closely linked to an unidentified critical word. The participants' recollection in the Offloading condition—where they were informed that they would have access to their written lists during recall—was compared to the No-Offloading condition, where they were informed that they would not. Offloading, it turned out, increased false recollection for crucial words that were not delivered but decreased real recall for terms that were. The results are explored in terms of how various offloading influences the creation of verbatim traces and gist during encoding. (Lu et al., 2020)

Relation with metacognitive beliefs

Generally speaking, people discard things they are unsure they will remember later. One's confidence level, which can be lowered by item difficulty, is a determining factor in the metacognitive judgement of task performance (Boldt & Gilbert, 2019). Individuals offload items that they are not confident they can recall in the future. The metacognitive evaluation of task performance partially relies on one's confidence level, which can be decreased by item difficulty (Boldt & Gilbert, 2019). Metacognitive assessments of our cognitive capacities also have an impact on it. These metacognitive assessments have the potential to be inaccurate, which could result in undesirable offloading behaviour (Gilbert & Risko 2016)

A research conclude that while fake performance feedback strongly influenced metacognitive beliefs, this did not transfer into a change of strategy selection, thus not influencing offloading behavior. Thus, it proposes to consider not only metacognitive beliefs but also metacognitive experiences as potential determinants of cognitive offloading.(Grinschgl, Meyerhoff, et al., 2021)

Another study come to the conclusion that fake performance feedback had a significant impact on metacognitive beliefs, it had no effect on offloading behaviour since it did not lead to a shift in strategy choice. This suggest that metacognitive experiences as well as beliefs should be taken into account as possible factors influencing cognitive offloading. (Meyerhoff, Gryphon, et al., 2021).

Uninformed humans who solve problems have mental models that include assumptions about the task-specific knowledge of human and robot agents. The degree to which human problem solvers are willing to employ such entities to assist them in completing particular cognitive tasks is indicative of these preexisting mental models. Therefore, people are unsure about which of two novel and similar cognitive tools—such as smartphone apps—to utilise. Still, but all it takes to update the mental model and produce as much behavioural relevance as the robust pre-existing mental models that are in place for human and robotic agents is to provide a paragraph outlining each app's task-specific capabilities. We contend that altering offloading preferences and, consequently, enhancing the interactions between human problem solvers in cognitive settings can be achieved simply and effectively by developing or improving mental models, particularly beliefs about competence (Mental Modals and Offloading Preferences Topic: Cognition, n.d.).

In an experimental study (N ¼= 172), that investigated two determinants of participants' decision to offload working memory processes when using mobile devices. These determinants, interface design (i.e. responsivity in terms of temporal delay) and interaction design (touch- based vs. mouse-based control) of the involved mobile devices altered offloading behavior in a Pattern Copy Task.it was observed that participants performing the task with a highly responsive device (i.e. no delay when accessing relevant information) offloaded more working memory processes than participants handling the same device at a lower responsivity (i.e. temporal delay). Further, participants using the device's touch function also offloaded more working memory processes than participants using a computer mouse. These findings were further supported by subjective measures about the easiness, naturalness, and intuitivity when using the device. Thus, our study showed that both interface and interaction design influence metacognitive evaluations of the use of mobile devices and offloading behavior.(Grinschgl et al., 2020)

A research that examined younger and older adults' (N = 88) performance on a memory task where they chose between remembering delayed intentions with internal memory (earning maximum reward per item) or external reminders (earning a reduced reward). This allowed to distinguish (a) the absolute number of reminders used versus (b) the proreminder or ant reminder bias, compared with each individual's optimal strategy. Older adults used more reminders overall, as might be expected, because they also had poorer memory performance. However, when compared against the optimal strategy weighing the costs versus benefits of reminders, it was only the younger adults who had a pro reminder bias. Younger adults overestimated the benefit of reminders, whereas older adults underestimated it. Therefore, even when aging is associated with increased use of external memory aids overall, it can also be associated with reduced preference for external memory support, relative to the objective need for such support. This age-related difference may be driven at least in part by metacognitive processes, suggesting that metacognitive interventions could lead to improved use of cognitive tools.(Tsai et al., 2023)

Researcher has found that both the device's actual reliability and erroneous beliefs about the device's reliability influence cognitive offloading. These results emphasize the relevance of factors beyond feedback-related performance optimization when offloading cognition.(Weis et al., n.d.)

Another research that examined individual differences in offloading behaviour across two well-known offloading paradigms: the pattern copy task, which addresses continuous short-term memory load, and the intention offloading task, which addresses memory for intentions. This study looked at the relationships between individual differences in two popular paradigms that study cognitive offloading, and the findings were rather clear-cut. The intention offloading task and the pattern copy task both demonstrated good-to-excellent reliability for examining individual differences in offloading behaviour; however, there was no correlation found between the individual differences across the tasks. However, in both tasks, individual differences in offloading behaviour were connected with short-term memory ability. These findings demonstrate that offloading behaviour is not easily accounted for by a single factor affecting two distinct tasks (even when those activities are related to short-term memory processes (Grinschgl et al., 2023)

In two studies, children aged 4–11 years (n = 258) were given an opportunity to manually rotate a turntable to eliminate the internal demands of mental rotation—to solve the problem in the world rather than in their heads. In study 1, even the youngest children showed a linear relationship between mental rotation demand and likelihood of using the external strategy, paralleling the classic relationship between angle of mental rotation and reaction time. In study 2, children were introduced to a version of the task where manually rotating inverted stimuli was some- times beneficial to performance and other times redundant. With increasing age, children were significantly more likely to manually rotate the turntable only when it would benefit them. These results show how humans gradually calibrate their cognitive offloading strategies throughout childhood and thereby uncover the developmental origins of this central facet of intelligence. By examining the effects of item difficulty and value on cognitive offloading and illuminating the developmental features and mechanisms of cognitive offloading during cue utilisation, the current study built on earlier research on the development of cognitive offloading during challenging tasks (Armitage et al., 2020; Redshaw et al., 2018).

Intention offloading is highly effective, experimentally tractable, and guided by metacognitive processes. Individuals have systematic biases in their offloading strategies that are stable over time. Evidence also suggests that individual differences and developmental changes in offloading strategies are driven at least in part by metacognitive processes. Therefore, metacognitive interventions could play an important role in promoting individuals' adaptive use of cognitive tools(Gilbert et al., 2023)

In another study that Investigated an application of cognitive offloading with children, in particular children with poor working memory. Participants were required to remember and recall sequences of colors by placing colored blocks in the correct serial order. In one condition the blocks were arranged to facilitate cognitive offloading (i.e., grouped by color), whereas in the other condition they were arranged randomly. Across two experiments (total N = 166) the ordered condition improved task performance for children with low working memory ability. In addition, participants in Experiment 2 rated the difficulty of the two arrangements, and performed a further condition in which they were given an opportunity to freely arrange the blocks before completing the task. Despite performing better in the ordered condition, children with low working memory ability did not rate the ordered arrangement as easier, nor did they choose an ordered arrangement when given the opportunity to do so(Berry et al., 2019)

In a four experimental study conducted, participants were asked to learn word pairs and decide whether to offload some of the pairs by "saving" them on a computer. In the memory test, they had the opportunity to use this saved information on half of trials. Participants adaptively saved the most difficult items and used this offloaded information to boost their memory performance. Crucially, participants' confidence judgments about their memory predicted their decisions to use the saved information, indicating that cognitive offloading is associated with metacognitive evaluation about memory performance. These findings were accommodated by a Bayesian computational model in which beliefs about the performance boost gained from using offloaded information are negatively coupled to an evaluation of memory ability. Together our findings highlight a close link between metamemory and cognitive offloading.(Hu et al., 2019)

External cues are frequently used by people to assist them remember postponed intentions. One type of "cognitive offloading" is this. Sometimes people offload more frequently than is ideal (Gilbert et al., 2020). Participants' false metacognitive under confidence in their memory skills has been connected to this bias. Under confidence, meanwhile, is unlikely to account for all of the bias. An additional, as-yet-untested aspect that could be involved in the offloading bias is a propensity to minimise the mental strain of internal memory recall. The current study looked at supporting data for this theory. One group of participants received payment based on how well they completed the task, which was supposed to boost cognitive effort and lessen the bias towards offloading; the other group, which had also participated in the preceding experiment, received a flat payment. In the rewarded group, the offloading tendency was greatly decreased (but not eliminated), indicating that cognitive offloading is influenced by a preference to avoid cognitive work. (Sachdeva & Gilbert, n.d.)

CONCLUSION

Cognitive offloading, or the use of physical activity to lessen the cognitive demands of a work, is still relevant in this era of technological developments where chips are being put into human brains to handle numerous daily chores. Numerous research point to the possible benefits of this activity, including increased performance, bettering planned task and purposeful unloading, less cognitive burdens and errors, etc. However, a number of research indicate that doing cognitive offloading activities might lead to the formation of false memories, impair innate memory functions, and turn people into passive or lazy thinkers, among other effects.

Meta cognitive evaluations play a crucial role in the decision to use or not use cognitive offloading tasks. According to the study's findings, cognitive offloading has advantages and disadvantages and affects our daily lives significantly. In all circumstances, the decision to unload or not is made by the metacognitive judgments.

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