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GADGETS, INFORMATION OVERLOAD AND HUMAN ATTENTION: A NARRATIVE REVIEW OF THE PSYCHOLOGICAL EVIDENCE

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Abstract. Notifications, feeds and constant connectivity are widely said to fragment attention, impair memory and mood, and even change brain structure. Some of these claims are well supported, others rest on single studies or on correlations. This narrative review examines experimental studies, meta-analyses, registered replications and key neuroimaging and sleep studies. Each claim in an earlier draft was traced to its primary source and graded by the strength of the evidence behind it. The best-supported findings are that notifications and interruptions disrupt ongoing tasks, that returning to interrupted work takes long (about 23 to 25 minutes in one field study, although that interval includes time spent on other work), and that reading informational text on screen yields a small comprehension disadvantage ($g = -0.21$). Evidence is mixed for the effects of heavy media multitasking and of a phone's mere presence, and weak for brain-structure and adolescent well-being claims (at most 0.4% of variance in well-being). Mindfulness training shows small to moderate cognitive benefits, digital detox results are inconsistent. Attentional fragmentation is a real but narrower problem than popular accounts suggest. Practical advice should rest on interruption control and sleep protection rather than on claims of neural decline.

Keywords: attention, digital distraction, interruptions, media multitasking, cognitive control, mindfulness, digital detox

Attention is limited. Kahneman (1973) described it as a pool of capacity that has to be divided among competing demands, and later work separates attentional control into selective, sustained and executive components. Neuroimaging research links stimulus-driven capture of attention mainly to a ventral frontoparietal network and goal-directed attention to a dorsal one (Corbetta & Shulman, 2002). A device that sends alerts at unpredictable moments therefore acts on a system with a hard capacity limit.

Phones, tablets and wearables now deliver alerts and content feeds across the whole day. A common claim, repeated in popular and some academic writing, is that this stream fragments attention, harms memory and mood, and reshapes the brain. Some of these claims come from solid experiments. Others come from single studies, from correlations that cannot show direction, or from effects that have since failed to replicate. A reader cannot tell which is which without checking the sources. This review sorts the evidence by strength. It asks three questions. First, do notifications, interruptions and media multitasking impair attention and task performance? Second, does the evidence extend to reading, sleep and well-being? Third, which interventions have been tested, and what do the trials show?

Methods

This is a narrative review, not a systematic review or a meta-analysis. No protocol was registered and no effect sizes were pooled. The purpose was to verify and grade the claims made

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in an earlier draft article on the same topic and to rebuild the argument on sources that could be checked.

The earlier draft contained roughly thirty empirical claims. For each, the cited study (or the study the claim appeared to derive from) was located through targeted searches that returned journal pages, PubMed and PubMed Central records and publisher abstracts. A claim was kept only if the primary record supported it. Where a claim was only partly supported, it was restated at the level the record allows. Where no supporting record was found, the claim was removed. Bibliographic details were corrected against the records. Meta-analyses, preregistered replications and experimental or randomized designs were given priority. Cross-sectional correlational and imaging studies were retained but flagged, because they cannot show whether device use changes attention or whether people with weaker attentional control use devices differently. Each finding was graded as strong, moderate, mixed or weak on four questions. Whether independent studies agree, whether the finding has been replicated, whether the design supports a causal reading, and how large the effect is.

Limitations of the method

A single reviewer carried out the searches and grading, the searches were not exhaustive, and only English-language sources were consulted. The grades are judgments and should be read as such.

Results

In a field study of information workers, Mark et al. (2005) found that work was highly fragmented and that interrupted tasks were often resumed only after considerable delay. The mean delay for tasks resumed on the same day was 25 minutes 26 seconds; the figure of 23 minutes 15 seconds, widely quoted in popular sources, comes from the same research programme. This interval is not idle recovery time. It includes the work people did on other tasks before they returned. A later experiment found that interrupted people worked faster but reported more stress, frustration, time pressure and effort (Mark et al., 2008). Notifications alone can be disruptive. Stothart et al. (2015) randomly assigned students to receive a call, a text message, or nothing while they did an attention-demanding task. Those who received a notification performed worse even though they did not look at or answer their phones, and the size of the drop was comparable to that seen when people actively used a phone. Ward et al. (2017) reported that participants whose own phone sat on the desk, rather than in another room, had less available cognitive capacity. This result has not held up consistently. A preregistered direct replication of the second experiment found no difference between phone-location conditions on either the operation-span task or the go/no-go task (Ruiz Pardo & Minda, 2022). A meta-analysis reports an overall negative effect of smartphone use and presence on cognitive performance, but the effect varies by cognitive domain and the authors call for further research (Böttger et al., 2023). The presence effect should be treated as unsettled. Ophir et al. (2009) found that heavy media multitaskers performed worse than light multitaskers on tests of filtering irrelevant information and task switching. A later review concluded that the balance of evidence points to poorer performance in several cognitive domains among heavy multitaskers, but also noted that many studies find no group differences (Uncapher & Wagner, 2018). In roughly half of the studies reviewed, heavy multitaskers underperformed on working memory and sustained attention tasks. Nearly all of this work is cross-sectional, so the direction of causality is unknown (Uncapher et al., 2017).

Loh and Kanai (2014) reported that higher media-multitasking scores were associated with smaller gray-matter density in the anterior cingulate cortex, and with weaker functional connectivity between that region and the precuneus. The authors themselves state that the cross-sectional design does not allow conclusions about direction. Sanbonmatsu et al. (2013) studied

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310 undergraduates and found that frequent multitaskers scored lower on an objective multitasking measure while rating their own ability as inflated. Impulsivity and sensation seeking were associated with more multitasking, and the best performers were the least likely to multitask.

A meta-analysis of 54 studies published between 2000 and 2017 found that reading comprehension was better on paper than on screen (Hedges' g = −0.21). The paper advantage was larger when reading time was limited and for informational texts, and it was not found in studies that used only narrative texts (Delgado et al., 2018).

In a crossover laboratory study, 12 young adults read either on a light-emitting tablet or from a printed book in the evening for five consecutive days. Tablet reading was followed by longer sleep onset (about 10 minutes), lower melatonin, later circadian timing, less REM sleep and lower alertness the next morning (Chang et al., 2015). Separately, one night of sleep deprivation amplified amygdala responses to negative images and weakened amygdala–prefrontal connectivity (Yoo et al., 2007). Putting these together suggests a route from late-night device use to emotional reactivity, but this chain has not been tested end to end.

The direct evidence linking technology use to adolescent well-being is weaker than public debate suggests. Across three large datasets (N = 355,358), the association between digital technology use and well-being was negative but small, explaining at most 0.4% of the variation in well-being (Orben & Przybylski, 2019).

A systematic review of digital detox interventions (21 studies, N = 3,625, of which 12 were randomized controlled trials) found effects that varied across studies and outcomes: some reported benefits, others no effect or even negative effects on well-being (Radtke et al., 2022). For mindfulness training, a meta-analysis of 111 randomized trials (n = 9,538) found small to moderate effects on executive attention, working memory accuracy, inhibition accuracy, shifting accuracy and sustained attention, with effect sizes of g = 0.257 to 0.643 depending on the outcome and comparison group (Zainal & Newman, 2024). These trials did not select participants for device-related distraction, so they show that mindfulness can improve attention measures, not that it repairs device-induced fragmentation.

Table 1. Strength of evidence for key claims

Claim	Evidence base	Grade
Notifications and interruptions disrupt ongoing tasks	Field study (Mark et al., 2005); randomized experiment (Stothart et al., 2015)	Moderate to strong
Returning to interrupted work takes a long time	Field study; interval includes other work	Moderate (often misquoted)
A phone's mere presence lowers cognitive performance	One original study; failed preregistered replication; meta-analysis reports overall negative effect	Mixed
Heavy media multitasking goes with poorer attention and working memory	Review; about half of studies; cross-sectional	Mixed
Heavy media multitasking goes with smaller ACC gray-matter density	One cross-sectional imaging study	Weak (direction unknown)

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Claim	Evidence base	Grade
Screen reading lowers comprehension of informational text	Meta-analysis, 54 studies, g = −0.21	Moderate (small effect)
Evening light-emitting devices delay circadian timing and reduce melatonin	Crossover laboratory study, N = 12	Moderate (small sample)
Technology use strongly harms adolescent well-being	Specification-curve analysis, at most 0.4% of variance	Weak
Mindfulness training improves attention outcomes	Meta-analysis of 111 RCTs	Moderate (not device-specific)
Digital detox improves outcomes	Systematic review, 21 studies, inconsistent	Mixed

Note. Grades reflect the reviewer's judgment using the criteria in Section 2.3.

Discussion

The strongest conclusions are the most immediate ones. Interruptions and even unanswered notifications degrade performance on the task at hand, and recovering from interruptions in real workplaces is slow, partly because people drift into other work first. Reading informational text on screen carries a small comprehension cost, especially under time pressure. Evening use of light-emitting screens can delay the body clock in a controlled setting. These findings are consistent with a limited-capacity view of attention and are specific enough to act on. Three popular claims need caution. First, the idea that a silent phone drains cognitive capacity has a failed preregistered replication behind it and an inconclusive meta-analysis. Second, the brain-structure findings for heavy multitaskers come from a cross-sectional study whose authors cannot say which came first. People who are impulsive or high in sensation seeking multitask more (Sanbonmatsu et al., 2013), so pre-existing differences are a plausible alternative to damage caused by devices. Third, the link with adolescent well-being is small. It is often said that notifications work like variable-ratio reward schedules, which are known to sustain high rates of responding and resistance to extinction (Ferster & Skinner, 1957). That analogy is reasonable, but none of the sources checked here measured dopamine release in response to notifications, so the neurochemical account is a hypothesis, not a finding. Another common explanation holds that resisting the urge to check a phone depletes a limited self-control resource. That rests on the strength model of self-control (Baumeister et al., 1998), yet a multi-laboratory preregistered replication (23 labs, N = 2,141) found an effect close to zero (d = 0.04, 95% CI [−0.07, 0.15]; Hagger et al., 2016). Explanations built on depletion should be avoided until better evidence appears. Reducing the number of interruptions follows directly from the experimental work, because notifications alone impair performance. Mindfulness training has reasonable support for improving attention measures in general. Digital detox has been studied far less consistently and its benefits cannot be assumed. Individual differences matter, if impulsivity and sensation seeking drive heavy multitasking, then strategies that work through environmental design may help more than strategies that rely on willpower. This remains to be tested. The conclusions are limited by the narrow base of the review, one reviewer, non-exhaustive searches, English-language sources, and graded judgments. Many of the studies are short laboratory experiments on students, which limits generalization to everyday life. Future work should use longitudinal and preregistered

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designs, measure real-world device use objectively, and test whether notification control or mindfulness training reduces fragmentation in people who report it.

Conclusion

The evidence supports a measured claim that devices that interrupt people impair what they are doing, slow their return to work and, when used late at night, can disturb sleep. It does not yet support strong claims that device use damages brain structure, erodes metacognition across the population or causes large declines in adolescent well-being. Advice for individuals and institutions should focus on controlling interruptions, protecting sleep and choosing the right medium for demanding reading, and should treat claims about permanent neural change with caution until longitudinal evidence is available.

Appendix (not part of the article): verification log for the original draft

Original claim	What the sources show	Action taken
Uncapher & Wagner (2018) is a systematic review in Current Directions in Psychological Science, 27(3), 176–184	The paper is "Minds and brains of media multitaskers" in PNAS, 115(40), 9889–9896. It is a review that notes many null results	Citation corrected; conclusions qualified
Resumption after an interruption averages about 23 minutes (Mark et al., 2008)	The figure comes from Mark et al. (2005); that paper reports 25 min 26 s, and 23 min 15 s appears in later interviews. The interval includes other work. The 2008 paper is about speed and stress	Re-attributed and explained
Silent phone presence reduces performance, shown with EEG and pupillometry	The original study used behavioral tasks. A preregistered replication found no effect; a meta-analysis is mixed	Rewritten as unsettled
Strength model of self-control supports prefrontal depletion by resisting the phone (Baumeister et al., 1998)	Multi-lab replication: d = 0.04, CI includes zero. The draft's reference list also listed a different Baumeister book (2011)	Flagged as contested; correct 1998 paper listed
Every notification triggers phasic dopamine release	No source checked measured this. Variable-ratio schedules are documented in Ferster & Skinner (1957); Skinner (1938) was cited but not listed	Reframed as a hypothesis
Smartphones are checked 150+ times a day	No primary source found	Removed
Heavy multitaskers are worse on sustained attention, working memory span and filtering (Ophir et al., 2009)	Ophir et al. reported filtering and task-switching deficits; other domains are mixed across studies	Qualified

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Original claim	What the sources show	Action taken
Reduced gray-matter density in ACC and reduced DMN–task-positive connectivity	Loh & Kanai report ACC density and ACC–precuneus connectivity, cross-sectional, direction unknown. The DMN claim was not found	Qualified; DMN claim removed
Digital readers show more backtracking, shorter fixations and fewer regressions	The statement is internally inconsistent and was not traced to a source	Replaced by the meta-analysis (g = −0.21)
Screen reading activates right TPJ less; print engages angular gyrus more	Not verified	Removed
Blue light cuts REM; depression cascade in adolescents	Chang et al. (N = 12) support delay and melatonin effects. Large datasets show at most 0.4% of variance in well-being	Qualified and corrected
FoMO linked to blunted diurnal cortisol; 48-hour detox improves divergent thinking	No source found; detox trials are inconsistent (Radtke et al., 2022)	Removed
Adolescent DLPFC cortical thinning; weakened mPFC/STS development; ERN attenuation in multitaskers	Not verified	Removed
Terms “attentional atrophy” and “cognitive patience depletion”	Not established constructs with evidence	Removed
References: Small et al. (2009), Baumeister & Tierney (2011), Gazzaley & Rosen (2016)	Not used in the text; Small et al. reported increased activation in a 24-person study, not impairment	Dropped; new verified references added

Please open each reference once before submission to confirm page numbers and DOIs for your institution’s format.

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