The Extended Mind Thesis and Cognitive Offloading

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Introduction

Where does the mind stop and the rest of the world begin? This question, posed by Clark and Chalmers in their foundational 1998 paper, has generated over two decades of philosophical debate about the boundaries of cognition. Their extended mind thesis challenged the intuitive assumption that mental processes are confined to the brain and nervous system, proposing instead that cognitive processes can extend into the physical environment when external resources are appropriately coupled with internal neural processes. The parity principle—the claim that if an external process performs the same functional role as an internal cognitive process, it should count as genuinely cognitive—provided the theoretical foundation for this radical proposal. Yet while philosophers have debated the merits of cognitive extension primarily through thought experiments like Otto's notebook, a parallel empirical tradition has developed largely independently. Cognitive offloading research examines how people actually use external resources to reduce internal cognitive demands, measuring behavioral patterns, metacognitive control mechanisms, and neural substrates of offloading decisions. These two research programs—philosophical extended mind theory and empirical cognitive offloading research—address overlapping phenomena but have been insufficiently integrated.

The relationship between these literatures raises a specific problem: philosophical debates about extended cognition engage primarily with conceptual arguments about constitution versus causation, functionalist commitments, and the coupling-constitution inference, while empirical offloading research focuses on measurable behavioral outcomes and mechanisms. Clark (2008) refined the original thesis by introducing trust, glue, and accessibility conditions as constraints on extension, while critics like Adams and Aizawa (2001) challenged the parity principle by arguing that functional equivalence does not establish constitutional status—external resources may be causally coupled with cognitive processes without being constitutive parts of those processes. Meanwhile, Gilbert and colleagues (2022) have established that offloading decisions in prospective memory tasks are guided by metacognitive monitoring of confidence and systematically biased toward overuse of external reminders, while Sparrow, Liu, and Wegner (2011) documented how internet availability transforms memory strategies from internal storage to metamemory for information location. The question is whether and how each literature informs the other—whether empirical findings about offloading mechanisms speak to philosophical debates about cognitive boundaries, and whether philosophical distinctions can structure empirical research programs.

This integration matters because digital technologies have made cognitive offloading pervasive. Smartphones provide constant access to information, communication networks, and computational tools; internet search engines serve as external memory systems; GPS navigation replaces spatial memory with route-following. If minds genuinely extend into these technologies, then tool design becomes cognitive system design, interface accessibility becomes a matter of cognitive capacity, and disruption of access constitutes cognitive impairment rather than mere inconvenience. But if these technologies merely support cognition without constituting it, then questions about their impacts shift from cognitive architecture to instrumental effectiveness and potential dependency. The empirical stakes are equally significant: Ward and colleagues' (2017) "brain drain" hypothesis suggests that smartphone presence alone may consume cognitive resources, while replication attempts have yielded mixed results. Understanding whether digital offloading represents adaptive cognitive extension or problematic dependence requires integrating philosophical frameworks with empirical evidence.

This review examines the intersection of extended mind theory and cognitive offloading research across four sections. The first section maps the philosophical architecture of extended cognition debates, tracing evolution from parity-based arguments through internalist critiques to integration-based alternatives. The framework establishes conceptual machinery for evaluating when external resources constitute cognitive processes rather than merely supporting them. The second section surveys empirical research on cognitive offloading, focusing on metacognitive mechanisms governing externalization decisions, individual differences in offloading strategies, and developmental trajectories. This section grounds philosophical debates in measurable phenomena and identifies where empirical evidence complicates theoretical accounts. The third section examines smartphones and internet technologies as contemporary test cases where philosophical analysis and empirical findings converge, evaluating evidence about cognitive impacts and assessing whether digital tools satisfy criteria for cognitive extension. The fourth section presents critical perspectives, including alternative frameworks from enactivism and predictive processing, methodological concerns about empirical tractability, and normative questions about cognitive autonomy. Together, these sections establish that the intersection of extended mind theory and cognitive offloading research represents both a productive space for theoretical development and a practically urgent domain given the ubiquity of digital cognitive tools.

Section 1: The Philosophical Architecture of Extended Cognition

The extended mind thesis, introduced by Clark and Chalmers in 1998, proposes that cognitive processes can extend beyond the brain to include aspects of the physical and social environment. This thesis challenges traditional boundaries in cognitive science by arguing that external resources can play constitutive rather than merely causal roles in cognition when coupled with internal processes in appropriate ways. The resulting debate has evolved over more than two decades from initial parity-based arguments through sustained internalist critiques to integration-based alternatives that reconceptualize what cognitive extension involves. Understanding this philosophical architecture is essential for

evaluating whether cognitive offloading—the externalization of cognitive work to environmental resources—constitutes genuine cognitive extension or remains merely instrumental tool use.

Subsection 1.1: Active Externalism and the Parity Principle

Clark and Chalmers (1998) ground their argument in what they call active externalism: the view that the environment can play an active, constitutive role in driving cognitive processes. They distinguish this from content externalism, which concerns only how the environment fixes semantic content. The central argumentative device is the parity principle, which holds that if an external process performs the same functional role as an internal process, location alone should not disqualify it from cognitive status. The famous Otto-Inga thought experiment illustrates this: Otto, who has Alzheimer's disease, relies on a notebook to store and retrieve information in ways functionally equivalent to Inga's biological memory. According to the parity principle, Otto's notebook-based beliefs should count as genuine beliefs just as Inga's neurally-realized beliefs do.

Clark's (2008) book-length development of the thesis responds to early objections by introducing refinements. He proposes that cognitive extension requires not just functional equivalence but also trust, glue, and accessibility: the agent must trust the external resource, it must be reliably available (the "glue" that couples it to the agent), and it must be easily accessible. These conditions constrain which external resources count as cognitive extensions while preserving the core functionalist commitment that what matters is functional role rather than physical location or implementation. Clark emphasizes complementarity between internal and external resources—external tools enhance cognition precisely because they operate differently from biological processes, enabling cognitive transformations impossible with neural resources alone.

Wheeler's (2010, 2011) clarifications address misunderstandings of what the parity principle actually claims. Wheeler argues that parity is not a sufficient condition for cognitive status but rather a methodological burden-shifting argument: if an external process would count as cognitive were it internal, opponents must explain why location matters rather than simply assuming brain-boundedness. This interpretation recasts parity as a challenge to internalist intuitions rather than a positive criterion for cognitive extension. Rowlands (2010) situates the extended mind within the broader embodied cognition program, distinguishing embodied, embedded, enacted, and extended forms of cognition and developing the "amalgamated mind" thesis—that cognitive processes are often hybrids of neural and environmental structures. This systematic taxonomy clarifies how extended cognition relates to other departures from traditional cognitive science.

Subsection 1.2: Internalist Critiques—The Mark of the Cognitive and the Coupling-Constitution Debate

The extended mind thesis faces sustained criticism from internalists who argue that parity-based arguments conflate causal coupling with cognitive constitution. Adams and Aizawa (2001, 2010) develop the most influential critique, charging that extended mind

proponents commit a “coupling-constitution fallacy”: just because external resources are causally coupled to cognitive processes does not mean they constitute parts of those processes. They propose a “mark of the cognitive” based on non-derived content—cognitive processes involve intrinsic intentionality, while external symbols like written words have only derived intentionality that depends on minds for their meaning. A notebook may play a memory-like functional role, but this does not make it part of the memory system any more than derived content makes symbols genuinely cognitive.

Rupert (2004, 2009) offers a systems-based alternative to parity arguments. His Hypothesis of Embedded Cognition (HEC) treats cognitive systems as individuated by dense, persisting causal integration rather than functional equivalence. Rupert argues that internal and external processes differ systematically in portability, reliability, and accessibility—differences that matter for cognitive scientific explanation even if they do not show up in functional profiles. A notebook coupled to Otto may support his memory, but the coupling is less dense and reliable than the integration among neural processes, making the notebook a cognitive tool rather than a cognitive component. Rupert (2013) extends this critique by arguing that cognitive science terms like “memory” pick out natural kinds defined by mechanistic profiles, not mere functional roles. Functional equivalence at some grain level does not establish identity of cognitive kinds.

Sprevak (2009) challenges whether functionalism straightforwardly entails extended cognition, as Clark and Chalmers assume. He argues that functionalists must specify the grain at which functional roles are individuated, and different grain choices yield different conclusions about extension. Coarse-grained functionalism may support extension, but fine-grained functionalism—which many functionalists adopt—resists it by individuating mental states more narrowly. This grain-of-realization issue shows that the relationship between functionalism and parity is more complex than simple appeals to functional equivalence suggest.

Smithies (2018) develops an epistemological critique: epistemic accessibilism—the view that justification requires reflective access to one’s reasons—is incompatible with vehicle externalism. Internal beliefs are introspectively accessible in ways that external information sources are not, creating an epistemic asymmetry that defeats parity arguments. Even if Otto’s notebook plays the same functional role as Inga’s memory, the difference in epistemic access means the notebook cannot provide the same justificatory support for belief. This raises questions about whether functionally equivalent internal and external states can play equivalent roles in knowledge and justified belief.

Subsection 1.3: Integration, Complementarity, and Beyond Parity

The internalist critiques prompted a second wave of extended mind arguments that move beyond parity toward integration-based accounts. Menary (2006, 2010, 2013) develops the cognitive integration framework, arguing that external resources extend cognition not through functional equivalence but through complementary contributions integrated via learned cognitive practices. Integration involves bidirectional information flow, mutual

manipulation, and transformation of cognitive capacities through skilled activity. Writing systems, mathematical notation, and other cultural cognitive tools extend cognition because they enable cognitive operations impossible with neural resources alone—not because they replicate what brains do but because they do different things that integrate productively with neural processing. Enculturation plays a constitutive role: cognitive extension develops through acquisition of culturally scaffolded skills, making extended cognition a developmental achievement rather than a simple coupling relation.

Sterelny (2010) offers an important alternative that acknowledges the importance of external resources while resisting constitutive extension claims. He distinguishes scaffolded minds from extended minds: external resources typically scaffold rather than constitute cognition by structuring learning environments and supporting skill acquisition through evolutionary and developmental processes. Scaffolding resources enable cognitive development without becoming parts of cognitive systems themselves. This distinction suggests that much of what extended mind theorists cite as evidence for extension may better be understood as evidence for developmental and evolutionary scaffolding—a position that grants the practical importance of external resources while maintaining internalist boundaries.

Kirchhoff (2013) draws on mechanistic philosophy of science to propose mutual manipulability as a criterion for cognitive constitution. External resources constitute parts of cognitive systems when manipulating them reliably produces changes in cognitive outcomes and vice versa, and when they contribute non-redundantly to cognitive functions. This mechanistic approach offers empirically grounded criteria that avoid both the mark of the cognitive problem and the grain-of-realization issue: what matters is whether external resources are integrated into the causal-mechanistic structure that produces cognitive phenomena, not whether they satisfy intrinsic property criteria or achieve perfect functional parity.

Greif (2015, 2017) adds an aetiological dimension by grounding cognitive extension in evolved biological functions. He argues that cognitive traits should be extended when organism-environment couplings reflect long-term adaptive coevolution rather than transient technological attachments. This historical criterion supplements synchronic parity by distinguishing stable, evolved cognitive extensions (embodied skills, niche-constructed environments) from temporary functional equivalences (consulting a smartphone). The aetiological approach integrates extended functionalism with niche construction theory and developmental systems theory, providing evolutionary depth to complement integration and complementarity principles.

Palermos (2013) develops an epistemological integration framework where extended cognitive systems can ground knowledge when external resources are cognitively transparent (experienced as seamless parts of cognitive processing) and their reliability is trust-independent (does not require ongoing monitoring). This addresses Smithies's epistemic access objection by showing how integration can restore the kind of transparency and automatic endorsement characteristic of internal belief states. When

external resources are deeply integrated through practiced use, the epistemic asymmetry diminishes: a well-integrated notebook functions epistemically like biological memory rather than like testimony from an external source.

The shift from parity to integration represents a fundamental reframing of extended cognition debates. Rather than asking whether external resources functionally replicate internal ones, integration approaches ask whether and how external resources transform cognitive capacities through skilled, practiced activity. This reframing has several implications for understanding cognitive offloading. First, routine, practiced offloading to well-integrated tools (writing systems, familiar technologies) may constitute genuine extension, while novel or casual tool use may not. Second, what matters is not functional equivalence but productive complementarity—external resources enhance cognition by doing things brains cannot do alone. Third, cognitive extension is a developmental achievement that requires learning and enculturation rather than a simple matter of coupling. These insights suggest that the question is not whether minds extend but which offloading practices, under which conditions of integration, create genuinely extended cognitive systems.

Section Summary

The extended mind debate has evolved from the question of whether external resources can be functionally equivalent to internal ones (first wave) to the question of whether and how they can be integrated into hybrid cognitive systems (second wave). Key unresolved tensions remain: what integration criteria suffice for constitution rather than mere scaffolding, how to distinguish developmental support from synchronic extension, and whether functionalist commitments ultimately support or undermine extended cognition. The coupling-constitution fallacy charge and the mark of the cognitive debate reveal deep disagreements about cognitive individuation that cannot be settled by appeal to parity alone. Integration approaches offer promising alternatives by emphasizing transformation, complementarity, and mechanistic integration, but they face their own challenges in specifying when integration amounts to constitution. These philosophical debates provide the conceptual framework within which empirical research on cognitive offloading must be interpreted: whether offloading extends or merely supports cognition depends on which philosophical account of extension proves most defensible.

Section 2: Empirical Cognitive Offloading – Mechanisms, Metacognition, and Individual Differences

While philosophical debates about extended cognition have centered on thought experiments and conceptual analysis, a parallel empirical tradition has examined how people actually use external resources to support cognitive tasks. Research on cognitive offloading investigates when and why individuals externalize cognitive processes—setting reminders for delayed intentions, storing information in notes rather than memory, or relying on GPS for navigation. This empirical literature reveals that offloading is neither a simple response to capacity overload nor a uniform phenomenon, but rather a

metacognitively governed, individually variable, and context-dependent set of strategies. These findings both inform and complicate philosophical accounts of extended cognition.

Subsection 2.1: Metacognitive Control of Offloading

A central finding from empirical research is that cognitive offloading decisions are guided by metacognitive monitoring—people's assessments of their own cognitive abilities and confidence in their performance. Risko and Dunn (2015) introduced a paradigm where participants could choose between relying on internal memory or dragging items to external storage locations in a short-term memory task. They found that offloading increased systematically with memory set size, demonstrating strategic deployment based on metacognitive assessments of task difficulty. Crucially, participants sometimes overused external storage even when internal memory would have been more efficient, revealing that offloading decisions reflect metacognitive evaluations rather than actual cognitive capacity.

This metacognitive framework has been developed most extensively in research on intention offloading—the use of external reminders to support delayed intentions. Gilbert et al. (2022) synthesize evidence showing that reminder-setting is highly effective at improving prospective memory performance and is systematically guided by metacognitive beliefs about memory ability. However, the relationship between metacognition and offloading involves systematic biases. Gilbert et al. (2018) demonstrate that individuals persistently overuse external reminders relative to the optimal strategy, even when financially incentivized to choose optimally. This bias is predicted by metacognitive underconfidence—participants underestimate their memory abilities. Importantly, the bias can be eliminated through metacognitive advice (informing participants which strategy maximizes performance) and is mediated by manipulations of confidence through feedback, suggesting that offloading strategies are modifiable through metacognitive interventions.

The excessive use of reminders reflects two contributing factors. Sachdeva and Gilbert (2020) show that overreliance on external aids is driven partly by metacognitive underconfidence and partly by effort minimization. Even when reminders require effort to set up, participants still overuse them, suggesting a robust preference for cognitive offloading that goes beyond rational capacity management. This raises questions about whether external cognitive aids are used optimally or whether people offload because it is easier, not because it is necessary.

Despite these biases, Scott and Gilbert (2024) provide evidence that metacognitive control of offloading operates adaptively in real-world contexts. Surveying participants about their actual plans and subsequent fulfillment, they found that lower confidence about remembering prompted greater reminder use, which in turn predicted higher fulfillment rates. This pattern demonstrates that underconfidence can lead to compensatory offloading that improves real-world outcomes, complicating simple narratives of technology-induced cognitive decline. The metacognitive guidance of offloading appears

sophisticated enough to calibrate external support to genuine need, at least in naturalistic settings where stakes are meaningful.

At the neural level, Boldt and Gilbert (2022) used fMRI and multivariate pattern analysis to investigate the brain mechanisms underlying metacognitive control of offloading. They found that metacognitive monitoring (confidence judgments) and metacognitive control (reminder-setting decisions) engage partially overlapping but distinguishable neural patterns in prefrontal and parietal regions. The partial dissociation suggests that monitoring and control involve related but distinct computational mechanisms. This neural evidence grounds abstract discussions of offloading in concrete brain mechanisms, showing that decisions to use external resources depend on prefrontal-parietal networks supporting metacognitive assessment and strategic control. Zheng et al. (2025) extended this work using diffusion tensor imaging, identifying white matter tracts—particularly the superior longitudinal fasciculus and cingulum bundle—whose microstructural integrity predicts deviations from optimal reminder use. The fornix, by contrast, predicts confidence in internal memory, suggesting distinct neural substrates for internal capacity assessment versus external resource deployment.

The emerging picture is that offloading is governed by a sophisticated metacognitive architecture involving confidence monitoring, strategic control, and prefrontal-parietal networks. However, this architecture operates with systematic biases—people tend to overuse external aids, driven by underconfidence and effort minimization. These biases are persistent but modifiable, and in real-world contexts they can be adaptive rather than maladaptive. For extended cognition theories, this raises important questions. If offloading requires ongoing metacognitive monitoring of the boundary between internal capacity and external support, this suggests the relationship between agent and tool involves active management rather than seamless transparency. The persistent bias toward over-offloading complicates accounts of extended cognitive systems as optimally organized or functionally equivalent to internal processes.

Subsection 2.2: Individual Differences, Development, and the Heterogeneity of Offloading

Cognitive offloading is not uniform across individuals or contexts but varies systematically with cognitive capacities, developmental stage, and task characteristics. Ball et al. (2021) conducted a large-scale study (N=268) examining how working memory capacity modulates offloading strategies and effectiveness. They found that individuals with higher working memory capacity performed better when relying on internal memory, but this advantage disappeared when reminders were available. Crucially, individuals with lower working memory capacity chose to offload more frequently and benefited more from offloading, suggesting adaptive calibration to internal cognitive limitations. This pattern supports the view that offloading can serve compensatory functions, allowing lower-capacity individuals to achieve performance levels comparable to higher-capacity individuals when external resources are available.

However, offloading behavior is not simply a stable trait that generalizes across contexts. Meyerhoff et al. (2021) compared individual differences across two offloading paradigms—intention offloading and pattern copy tasks—and found that despite high test-retest reliability within each task, offloading behavior was uncorrelated between the two tasks. Both measures correlated with short-term memory capacity, suggesting that while offloading responds to general cognitive limitations, the strategies are task-specific rather than reflecting a domain-general offloading tendency. This finding challenges unified theoretical accounts of cognitive offloading and suggests that different offloading contexts may involve distinct mechanisms rather than a single extended mind process.

Developmental research reveals that offloading capacities and biases shift across the lifespan. Armitage et al. (2021) demonstrate that children as young as 4-5 years spontaneously devise external memory strategies without explicit instruction. When shown a task where target locations were shuffled out of view, these children independently placed markers on target containers to support later retrieval. Three-year-olds could use the strategy when demonstrated but did not generate it spontaneously, suggesting that the metacognitive capacity to recognize future uncertainty and proactively create external aids emerges between ages 3-4. This early emergence suggests that offloading may be a fundamental aspect of human cognitive architecture rather than a modern technological phenomenon—humans appear naturally disposed to create and use external memory supports.

However, the calibration of offloading to actual need develops gradually. Sun et al. (2024) examined offloading bias across ages 7-15 and found a striking developmental reversal. Primary school students (ages 7-11) tended to under-offload, relying excessively on internal memory compared to the optimal strategy. This under-reliance was linked to inaccurate metacognitive monitoring—younger children overestimated their memory abilities. By contrast, secondary school students (ages 12-15) showed the opposite pattern, over-relying on external aids. The shift from under-offloading to over-offloading suggests that appropriate external resource use requires developmental calibration of metacognitive accuracy, and different age groups make opposite errors in this calibration process.

The heterogeneity of offloading extends to clinical populations. Cherkaoui and Gilbert (2017) found that individuals with autism spectrum conditions, despite showing objective prospective memory difficulties, did not spontaneously increase reminder use to compensate. This dissociation between objective memory impairment and offloading behavior suggests that adaptive compensatory offloading requires intact metacognitive awareness, not merely poor memory. Similarly, Boldt et al. (2025) examined transdiagnostic compulsivity in a large online sample (N=600) and found that compulsive individuals showed reduced preference for external reminders. This reduction was only partially explained by relative overconfidence in memory abilities, suggesting additional motivational or affective factors modulate offloading decisions beyond metacognitive monitoring alone.

A historically influential finding about memory offloading came from Sparrow et al.'s (2011) study of the "Google effect." They demonstrated that when people expect information to be available online, they show reduced memory for the information itself but enhanced memory for where to access it. Difficult questions automatically primed concepts related to computers and the internet, and saving information externally reduced subsequent recall. Sparrow and colleagues argued that the internet has become a primary transactive memory partner, fundamentally altering memory strategies from content retention to location tracking. This macro-level shift illustrates how widespread external information availability can restructure what people encode and how they approach memory tasks, raising questions about whether such changes constitute cognitive adaptation or cognitive decline.

The pattern emerging from individual differences and developmental research is that offloading is multiply determined—modulated by working memory capacity, metacognitive accuracy, age, clinical traits, and cultural/technological availability. This heterogeneity poses significant challenges for philosophical theories seeking unified accounts of extended cognition. If offloading strategies are task-specific, compensatory for low-capacity individuals, and developmentally shifting, then no single philosophical model—whether parity, integration, or scaffolding—may adequately capture all forms of offloading. At the same time, the developmental evidence that young children spontaneously create external aids suggests that offloading is not merely a response to modern technology but reflects a fundamental feature of human cognitive architecture. Humans may be naturally tool-using cognitive agents for whom external supports are not exceptional extensions but typical modes of cognitive operation.

The empirical picture established by this research complicates both philosophical and normative debates about extended cognition. People actively monitor and manage the boundary between internal and external resources, often with systematic biases. Offloading effectiveness varies with individual capacity, suggesting external resources genuinely compensate for internal limitations. Yet offloading strategies remain context-dependent and require metacognitive development to deploy appropriately. This mixed picture resists simple narratives—neither seamless cognitive extension nor inevitable technological dependence—and calls for more nuanced philosophical accounts that accommodate the diversity and dynamism of actual offloading practices.

Digital Technologies as Test Cases – Smartphones, the Internet, and the Limits of Extension

Digital technologies present the most practically pressing test cases for extended cognition, bringing philosophical debates into direct contact with the cognitive tools that billions of people now use daily. Smartphones, internet access, and other digital devices combine features that seemingly support extension claims—ubiquity, information richness, rapid accessibility, personalization—with features that complicate them—attentional capture, algorithmic opacity, dynamic updating, and potential for manipulation. The empirical evidence about cognitive impacts is mixed and contested,

resisting simple narratives about either seamless extension or inevitable impairment. This section examines how contemporary digital technologies function as test cases where theoretical frameworks meet empirical complexity.

The Internet as Extended Cognitive System

Philosophical analyses of Internet-extended cognition have increasingly recognized that the Internet's distinctive features challenge traditional extended mind criteria developed for simpler technologies like notebooks and calculators. Smart (2017) provides comprehensive analysis of whether and how Internet technologies can constitute part of extended cognitive systems, examining different types of potential extension—memory extension via cloud storage, reasoning extension via search engines, knowledge extension through networked information access. He identifies the challenge of "network-extended cognitive bloat": the Internet's vast scope and networked structure make determining cognitive system boundaries particularly difficult, as any given online resource connects to virtually unlimited further resources. This boundary problem raises questions about whether Internet-based cognition can satisfy the kind of reliable coupling that Clark and Chalmers' original framework assumed.

Smart, Heersmink, and Clowes (2017) develop a "cognitive ecology" framework that treats the Internet as a transformative cognitive niche rather than simply an external tool. The Internet creates an environment characterized by information abundance, networked social interaction, and constantly evolving knowledge structures. This ecological perspective reframes the question from whether specific Internet tools extend cognition to how Internet environments reshape cognitive practices across multiple dimensions. Heersmink and Sutton (2018) argue that different online practices fit different theoretical frameworks: some web-based activities may satisfy extended mind criteria (personal cloud storage, customized information systems), others function as transactive memory systems (knowing which online sources to consult), while still others merely scaffold cognition without constituting cognitive processes. This pluralistic analysis suggests that the Internet supports multiple types of brain-environment coupling simultaneously, complicating any unified verdict about Internet-extended cognition.

Heersmink (2016) examines how Internet use affects the values that structure cognition—epistemic virtues including accuracy, speed, reliability, and understanding. He argues that while Internet search enhances speed and extends accessible knowledge, it may undermine deeper understanding and sustained critical evaluation. This normative dimension reveals that even if Internet use constitutes cognitive extension in some functional sense, we must evaluate what kind of cognition it produces. Schwengerer (2020) develops this concern into a philosophical argument: first-wave extended mind theory based on parity principles is incompatible with the intellectual virtues required for epistemically responsible Internet use. If external resources count as cognitive simply when functionally equivalent to internal processes, agents have no special epistemic obligations toward them. But responsible Internet use requires agents to critically evaluate sources, maintain informational hygiene, and actively curate their cognitive environments.

Schwengerer proposes that second-wave theories emphasizing integration and gradient accounts of extension better accommodate these virtue requirements, as they preserve the distinction between coupled resources that require ongoing management and fully integrated cognitive components.

Smart, Andrada, and Clowes (2022) challenge another traditional criterion for cognitive extension: phenomenal transparency. Many extended mind theorists have suggested that external resources constitute genuine cognitive extensions only when they become experientially transparent—tools that users manipulate without conscious attention to the tool itself. Smart and colleagues argue that transparency is neither necessary nor sufficient for cognitive extension. It is not necessary because opaque tools can still play constitutive cognitive roles when appropriately integrated into cognitive practices. It is not sufficient because mere phenomenological character does not determine constitutive status. This argument opens conceptual space for non-transparent digital tools—including algorithmically opaque AI systems—to qualify as cognitive extensions when they satisfy other integration criteria.

These philosophical analyses converge on recognizing that the Internet challenges simple application of original extended mind criteria while not definitively defeating extension claims. The plurality of frameworks invoked—extended mind, transactive memory, scaffolding, cognitive ecology—suggests that the question may not be whether the Internet extends cognition but which Internet practices, under which conditions, involve which forms of cognitive distribution.

Smartphones, Brain Drain, and the Contested Evidence

The “brain drain” hypothesis, introduced by Ward et al. (2017), claims that smartphone presence alone reduces available cognitive capacity. Across two experiments, Ward and colleagues found that participants performed worse on measures of working memory capacity and fluid intelligence when smartphones were present on the desk versus placed in another room, even when phones were turned off and participants were not using them. The effect was strongest for individuals high in smartphone dependence. Ward et al. attributed this to automatic attentional processes: the phone’s mere presence consumes attentional resources as individuals actively suppress the impulse to attend to it, draining capacity available for other cognitive tasks. This finding directly challenges optimistic accounts of smartphones as seamless cognitive extensions, suggesting they may function as cognitive distractors rather than integrated tools.

However, subsequent replication attempts have yielded inconsistent results. Ruiz Pardo and Minda (2022) conducted a pre-registered direct replication of Ward et al.’s Experiment 2 using identical methods but found no significant differences in cognitive performance based on smartphone proximity or power state. The failure to replicate the brain drain effect raised questions about the robustness of the original findings and the conditions under which smartphone presence affects cognition. Hartmann et al. (2020) similarly found no evidence that smartphone presence affected short-term or prospective memory

performance, suggesting brain drain effects may not generalize across all cognitive domains.

Two recent meta-analyses provide quantitative synthesis of the accumulated evidence, yielding partially divergent assessments. Böttger et al. (2023) analyzed 22 studies and found a significant overall negative effect of smartphone presence on cognitive performance across memory, attention, and general cognitive tasks. However, they documented substantial heterogeneity in effect sizes, varying by cognitive domain and participant nationality, suggesting moderating factors not yet fully understood. Parry (2023) conducted a more comprehensive meta-analysis of 56 studies (n=7,093) and found limited support for the brain drain hypothesis. Only working memory capacity showed a statistically significant negative effect of smartphone presence; sustained attention, response inhibition, and fluid intelligence showed null effects. Parry's analysis also revealed substantial methodological heterogeneity across studies and generally poor statistical power, limiting confidence in the evidence base. The meta-analytic evidence thus suggests that if brain drain effects exist, they are domain-specific (primarily affecting working memory), smaller than originally claimed, and moderated by factors not yet systematically identified.

Firth et al. (2019) provide broader context by reviewing neuroimaging and psychological research on how Internet use affects cognition across three domains: attention, memory, and social cognition. They find evidence that constant information streams encourage divided attention at the expense of sustained concentration; that Internet availability shifts memory strategies from internal storage to retrieval-focused approaches (consistent with the Google effect documented by Sparrow et al. 2011); and that online social interaction creates unique dynamics affecting self-concept and social processing. The review suggests both acute and sustained cognitive alterations may occur with Internet use, though distinguishing adaptive reorganization from cognitive impairment remains difficult. Age-dependent effects complicate the picture further: youth may show different trajectories than elderly populations, with implications for development versus decline.

The contested empirical evidence about smartphone impacts complicates both pro-extension and anti-extension philosophical positions. If smartphones do not reliably drain cognitive resources, concerns that they function as cognitive distractors rather than extensions are weakened. But if effects are domain-specific and context-dependent—affecting working memory but not attention, appearing under some task conditions but not others—this suggests the relationship between smartphones and cognition is more complex than either seamless extension or inevitable impairment. The replication difficulties and methodological heterogeneity highlight how philosophical debates depend on empirical findings whose robustness is still being established. The heterogeneity also suggests that unified philosophical accounts may oversimplify: smartphones may extend cognition for some purposes, impair it for others, and have neutral effects in still other contexts, depending on individual differences, task demands, and usage patterns.

Normative Concerns and the Question of Autonomy

Recent work extends beyond descriptive questions about whether digital technologies extend cognition to normative questions about cognitive autonomy and agency. Padalko (2025) argues that Internet of Things (IoT) environments fundamentally reconfigure cognitive practice by embedding cognition within algorithmic and service-based systems, reducing epistemic autonomy and deepening platform dependency. In IoT environments, cognitive processes become distributed not just across devices users control but across networked systems that operate through algorithmic mediation and automated protocols. Padalko introduces the concept of "Homo connectus"—a socio-technical form of subjectivity shaped by platform dependency, algorithmic meaning production, and reduced reflective decision-making. The Autonomy-Enabling Ratio (AER) is proposed as a metric for assessing the extent of cognitive autonomy within connected environments, capturing the ratio between autonomous and externally regulated scenarios of knowledge and decision-making.

Andrada, Clowes, and Smart (2022) examine how AI system opacity affects cognitive agency when such systems are integrated into human cognitive practices. They distinguish different dimensions of transparency—functional, procedural, epistemic—and argue that different forms matter for different aspects of cognitive agency. When AI systems function as cognitive resources through offloading, transparency requirements differ from when humans merely use AI outputs. The analysis reveals tensions between the extended mind framework's emphasis on functional integration and the normative requirements for maintaining human agency within AI-augmented cognitive systems. If external cognitive resources are algorithmically opaque and adaptively changing, agents may lose the kind of understanding and control required for cognitive self-determination even when such resources enhance functional performance.

These normative concerns suggest that even if digital technologies can constitute cognitive extensions in some functional sense, widespread offloading to opaque, algorithmically-mediated systems raises distinct questions about cognitive autonomy. The concern is not simply whether minds extend into smartphones and Internet platforms but whether such extension involves forms of cognitive dependence that undermine rather than enhance human cognitive agency. Soldatova and Ilyukhina (2025) address related questions about maintaining integrated subjectivity when cognitive processes distribute across multiple digital spaces and platforms. As individuals distribute cognitive work across numerous devices, applications, and online platforms, maintaining coherent selfhood becomes a practical challenge requiring active management and integration work.

These analyses reveal that digital technologies present challenges for extended cognition theories precisely because they combine cognitive enhancement with potential threats to autonomy. Unlike Otto's notebook—which Otto controls, understands, and maintains—contemporary digital cognitive tools often operate through mechanisms users do not understand, under terms they do not control, pursuing optimization functions they have

not specified. This asymmetry between functional integration and agential control complicates philosophical accounts that treat cognitive extension as inherently beneficial or that assume tightly coupled systems are necessarily well-integrated from the agent's perspective.

The empirical and philosophical literature on digital technologies thus resists simple conclusions. The Internet may extend cognition under some conditions while scaffolding or impairing it under others. Smartphones may drain cognitive resources in some domains but not others, for some individuals but not others. Digital cognitive tools may enhance functional performance while reducing cognitive autonomy. These mixed findings call for domain-specific, context-sensitive analysis rather than unified verdicts about digital cognitive extension. They also suggest that the relationship between humans and their digital cognitive tools involves ongoing negotiation and active management rather than stable, seamless integration.

Critical Perspectives – Alternative Frameworks and Unresolved Tensions

The extended mind thesis faces challenges not only from internalist critics but from alternative frameworks that reconceptualize the phenomena, methodological concerns about empirical tractability, and normative worries about cognitive autonomy. These challenges do not necessarily defeat the extended mind thesis but highlight that the question of cognitive extension is more complex than the original parity formulation suggested.

Enactivist and Predictive Processing Alternatives

Radical enactivism offers a fundamental challenge to the entire framing of the extended mind debate. Hutto and Myin (2013) defend "radical enactivism" (REC)—the view that basic cognition involves no content or representation whatsoever. On this account, the extended mind debate presupposes contentful mental states and merely argues about their location, leaving fundamental problems about content naturalization unaddressed. Basic minds (perception, action, simple learning) operate through direct engagement with affordances and sensorimotor contingencies without representational content, which emerges only through sociocultural practices like language. If radical enactivism is correct, many phenomena labeled "cognitive offloading" may not involve offloading representational content at all, but rather reconfiguring sensorimotor engagements. The offloading metaphor itself may presuppose discredited representationalist assumptions about cognition.

The enactivist critique extends beyond representation. Di Paolo (2008) argues that extended mind does not go far enough in breaking with cognitivist assumptions, proposing instead an "extended life" framework grounded in autopoietic enactivism: cognitive processes are sense-making activities of autonomous living systems, which are constitutively open to their environment. Extended mind preserves problematic internalist assumptions while merely relocating them. Sganzerla, Hutto, and Kirchhoff (2025) develop extensive enactivism as an alternative emphasizing sensorimotor engagement over

information processing. While both extensive enactivism and extended mind embrace wide cognitive boundaries, enactivism better captures cognition as active sense-making rather than information processing. This suggests that offloading research may be asking the wrong question. Rather than "does offloading extend cognition?", enactivists would ask "how does offloading transform sense-making?"

Predictive processing offers a different alternative framework with contested implications for extended cognition. Clark (2013) argues that prediction error minimization naturally supports extended mind through active inference: brains are hierarchical prediction machines that minimize prediction error through cascading top-down predictions and bottom-up error signals, and this framework extends to action—acting on the environment to make predictions come true. External resources can participate in prediction error minimization loops, supporting cognitive extension. However, Hohwy (2016) argues that the evidentiary boundary at sensory surfaces creates principled cognitive boundaries, making predictive processing internalist rather than externalist. The brain's task is to infer hidden causes of sensory input from behind this "evidentiary boundary"—prediction error minimization mechanisms are internal to this boundary, while the external world is what predictions are about. Action changes sensory input but remains external to the prediction-generating system. Fabry (2017) mediates between these positions, arguing for explanatory pluralism where different cognitive phenomena require different boundary placements. Hohwy's evidentiary boundary is descriptively accurate for some cognitive processes but not explanatorily exhaustive, and bodily and environmental dynamics contribute to prediction error minimization in ways that transcend sensory boundaries.

For offloading research, the predictive processing debate suggests reframing: offloading as strategic manipulation of environment to reduce prediction error or computational load of prediction generation. Whether external resources that generate prediction errors count as outside the cognitive system (Hohwy) or as participating in error minimization (Clark) matters for interpreting offloading phenomena. The disagreement mirrors the larger extended mind debate about individuation criteria, showing how theoretical frameworks shape interpretation of the same empirical evidence.

Britten-Neish (2025) adds an action-theoretic dimension, arguing that the extended mind debate requires an Anscombean rather than Davidsonian action theory. Opposition to extended mind stems partly from implicit Davidsonian assumptions that treat intentions and bodily movements as separately constituted with action as mere interface. On an Anscombean account, actions express intentions only within teleologically structured worldly contexts, and cognitive offloading manifests agency's general dependence on its bodily and environmental setting. This suggests that debates about offloading as evidence for extended cognition depend on prior commitments about the nature of agency and action that often go unexamined.

Methodological Concerns and the Question of Cognitive Autonomy

Extended cognition faces methodological challenges about individuating cognitive systems and making the thesis empirically tractable. De Brigard (2017) raises the dynamic boundary problem: if cognitive systems are individuated by coupling relations, then cognitive system boundaries constantly shift as agents couple and decouple from external resources. This creates instability in what counts as "the" cognitive system and makes extended systems incompatible with treating cognitive systems as stable units for scientific investigation. Internal systems by contrast have principled boundaries (organismal boundaries) that remain stable through environmental interactions.

Bukow (2013) argues that 4E approaches (embodied, embedded, extended, enacted) lack principled stop-criteria for determining what counts as part of the cognitive system. Intrinsic property criteria (marks of the cognitive) face indeterminacy or circularity. Extrinsic property criteria (reliability, functional role) yield arbitrary boundaries depending on choice of operationalization. Without well-founded stop-criteria, extended cognition licenses arbitrary individuation. This applies directly to offloading research: studies may arbitrarily decide what counts as "part of" the cognitive system versus external support without explicit, justified criteria for extending cognitive system boundaries in specific empirical contexts.

Hutchins (2010) proposes cognitive ecology as an alternative that sidesteps individuation problems by studying how cognitive ecosystems are assembled rather than where cognitive boundaries lie. Cognitive processes are distributed across brain, body, and environment through cultural practices and material structures. Rather than asking where cognition is located, cognitive ecology examines how cognitive ecosystems emerge from interactions across multiple components and timescales, from evolutionary to interactional. This framework offers a different lens for interpreting offloading phenomena as ecosystem-level processes rather than boundary disputes.

The methodological concerns connect to normative questions about cognitive autonomy. Padalko (2025) argues that IoT environments reduce cognitive autonomy through algorithmic mediation and platform dependency. Even if cognitive extension is philosophically coherent, widespread offloading to digital and AI systems may raise distinct normative questions about autonomy and cognitive self-determination. Andrada, Clowes, and Smart (2022) examine how AI system opacity affects cognitive agency when such systems are integrated into human cognitive practices. They distinguish different transparency dimensions (functional, procedural, epistemic) and argue that different forms of transparency matter for different aspects of cognitive agency. When AI systems function as cognitive resources through offloading, transparency requirements differ from when humans merely use AI outputs. Whether opaque AI systems can genuinely extend cognition or whether transparency is necessary for cognitive integration remains contested.

Chiriatti et al. (2025) propose a "System 0" framework for AI as cognitive extension while identifying a paradox: AI may simultaneously expand and constrain thinking. The normative dimension suggests that even if philosophical arguments favor some form of cognitive extension, the practical significance of the debate involves questions about what kinds of cognitive dependencies are desirable. Firth et al. (2019) review evidence that Internet use alters attention, memory, and social cognition, potentially reflecting neuroplastic changes. Whether such alterations constitute genuine cognitive changes or adaptive strategy shifts—and whether they represent cognitive enhancement or impairment—cannot be settled by metaphysical arguments about extension alone.

These methodological and normative concerns suggest limits on what extended cognition claims can establish. The difficulty of operationalizing extended systems empirically, combined with normative concerns about cognitive dependence, means that the practical significance of the debate remains contested. Even if cognitive extension is possible in principle, determining when it occurs in practice and whether it is desirable requires criteria that philosophical debates have not yet provided.

Conclusion

The trajectory from Clark and Chalmers' original extended mind thesis to contemporary cognitive offloading research reveals a field that has moved from asking whether minds extend beyond the brain to asking how, when, and under what conditions cognitive extension occurs. The debate's evolution reflects growing sophistication about the mechanisms and criteria for cognitive extension, but also reveals persistent tensions between philosophical theorizing and empirical research.

Philosophically, the extended mind debate has progressed through distinct phases. The first wave, grounded in the parity principle, argued that external resources count as cognitive when they play the same functional role as internal processes (Clark and Chalmers 1998). This approach faced substantial criticism: Adams and Aizawa's (2001) coupling-constitution challenge questioned whether functional equivalence establishes cognitive constitution, while Rupert's (2004, 2009) systems-based critique argued that cognitive systems should be individuated by persistent causal integration rather than transient functional similarity. The second wave responded with integration-based approaches that emphasize complementarity over parity (Menary 2006, 2013; Greif 2015). These frameworks argue that external resources extend cognition not by replicating internal processes but by contributing distinct, complementary capacities that transform cognitive possibilities through practiced integration. Sterelny's (2010) scaffolding alternative offers a middle path, acknowledging environmental dependence while questioning whether support relations constitute cognitive extension.

The empirical cognitive offloading literature has developed largely independently, establishing that offloading decisions are governed by metacognitive monitoring processes rather than simple capacity limits (Risko and Dunn 2015; Gilbert et al. 2022). People offload based on confidence judgments about their internal abilities, yet show systematic

biases toward overusing external aids (Gilbert et al. 2018; Sachdeva and Gilbert 2020). Individual differences research reveals that offloading is modulated by working memory capacity (Ball et al. 2021), varies across task contexts (Meyerhoff et al. 2021), and shifts developmentally—with young children under-offloading due to overconfidence and adolescents over-offloading (Sun et al. 2024). Neuroscientific findings identify prefrontal-parietal networks supporting metacognitive control of offloading, with distinct but overlapping patterns for monitoring and control processes (Boldt and Gilbert 2022; Zheng et al. 2025).

Digital technologies—smartphones, the Internet, AI systems—present contemporary test cases where philosophical and empirical questions converge. Internet-based offloading has generated competing interpretations: Smart (2017) and Heersmink and Sutton (2018) analyze web cognition through multiple frameworks (extended mind, transactive memory, scaffolding), acknowledging that different online practices may fit different frameworks. Empirical evidence about smartphone impacts remains contested, with Ward et al.'s (2017) "brain drain" hypothesis facing replication difficulties (Ruiz Pardo and Minda 2022) and meta-analytic results showing heterogeneous effects (Bottger et al. 2023; Parry 2023). The Google effect (Sparrow et al. 2011) demonstrates that internet availability alters what information is encoded, shifting memory strategies from content storage to location tracking.

Yet the connection between philosophical theorizing and empirical offloading research remains underdeveloped. Philosophical debates center on conceptual distinctions between constitution and causation, analyzing thought experiments like Otto's notebook. Empirical research focuses on measurable offloading behaviors and their metacognitive determinants, typically without explicit engagement with extended mind frameworks. Integration approaches offer the most promising bridge: Menary's emphasis on cognitive practices and Kirchhoff's mutual manipulability criterion provide frameworks that could be operationalized empirically. But systematic attempts to test whether specific offloading behaviors meet integration criteria remain scarce.

Several key tensions persist. First, the scaffolding-extension distinction: Does the metacognitive management revealed by offloading research—where agents actively monitor and control the boundary between internal and external resources—support or undermine claims about seamless cognitive extension? The finding that offloading requires ongoing metacognitive assessment suggests external resources are not transparently integrated but actively managed, potentially favoring scaffolding over extension accounts. Second, the heterogeneity problem: If offloading strategies are task-specific rather than domain-general (Meyerhoff et al. 2021), and if individual differences are substantial, can any unified philosophical account capture all forms of cognitive offloading? Third, the normative dimension: Contemporary concerns about cognitive autonomy in AI-mediated environments (Padalko 2025; Andrada, Clowes, and Smart 2022; Chiriatti et al. 2025) complicate purely descriptive extended mind claims. Even if philosophical arguments support cognitive extension, the algorithmic mediation and

opacity of digital cognitive tools raise distinct questions about cognitive self-determination.

Alternative frameworks challenge whether extended mind provides the best conceptual tools for understanding offloading phenomena. Radical enactivism (Hutto and Myin 2013) rejects the representational assumptions underlying both internalist and extended mind positions, suggesting that much offloading may involve sensorimotor reconfiguration rather than redistribution of representational content. Predictive processing offers competing interpretations: Clark (2013) argues that prediction error minimization naturally extends across brain-environment boundaries, while Hohwy (2016) contends that evidentiary boundaries at sensory surfaces create principled cognitive limits. Hutchins' (2010) cognitive ecology framework sidesteps individuation questions entirely, focusing on how cognitive ecosystems are assembled rather than where cognitive boundaries lie.

Methodologically, both philosophical and empirical work face challenges. De Brigard's (2017) dynamic boundary problem highlights that if cognitive systems are individuated by coupling relations, system boundaries constantly shift, making extended systems scientifically intractable. Bukow's (2013) critique shows that 4E approaches lack principled stop-criteria for determining what counts as part of cognitive systems, creating arbitrariness in how offloading studies operationalize cognitive extension. These concerns suggest that even if extended mind is conceptually coherent, translating it into testable empirical predictions remains difficult.

The research project at the intersection of extended mind theory and cognitive offloading research addresses where philosophical questions about cognitive boundaries meet empirical evidence about how people actually use external resources. Studying this intersection can yield better philosophical theories—informed by behavioral and neural data about metacognitive mechanisms, individual differences, and developmental trajectories—and better empirical research programs—informed by conceptual distinctions between constitution and causation, integration and scaffolding, parity and complementarity. Key contributions might include: clarifying how different philosophical frameworks generate different predictions about offloading behavior; identifying operationalizable criteria for when offloading constitutes genuine cognitive extension versus instrumental tool use; and evaluating the normative implications of digital cognitive dependence in light of both empirical findings about costs and benefits and philosophical arguments about cognitive autonomy. The field has established that cognitive offloading is a pervasive, metacognitively governed, and individually variable phenomenon. Whether it also constitutes genuine cognitive extension remains the central unresolved question.

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