

# Extended cognition

Mark Sprevak  
*University of Edinburgh*

4 September 2018

## Article Summary

Extended cognition takes the idea that your mind is ‘on’ your smartphone literally. It says that human cognitive states and processes sometimes spill outside our heads and into objects in our environment. Alleged examples include not just use of smartphones, but also our use of simpler technology (pencil and paper to perform a calculation), our own body (ticking off our fingers when we count), and other people (our spouse who remembers upcoming appointments so we don’t have to).

There are three main arguments for extended cognition.

*Functionalist* arguments rely on similarities in functional structure between extended processes and (actual or possible) internal cognitive processes. Cognition extends because the physical mechanisms that support it ‘work the same way’ in both cases. *Inference to the best explanation* arguments rely on the possible explanatory benefits of extended cognition to the study of psychology. We should believe that cognition extends because it would make our psychological theories more unified, elegant, and fruitful. *Second wave* arguments rely on the way our brains integrate with the environment. Cognition extends because brains, bodies, and environment are so tightly intertwined that, when we solve certain cognitive tasks, they count as a single system.

Extended cognition is attacked on many fronts: it generates absurdly high levels of extension, creating *cognitive bloat*; it is inferior to the more ontologically conservative hypothesis of *embedded cognition*; it confuses *causal coupling with constitution*;

and its key cases fail to satisfy some *mark of the cognitive*.

Extended cognition concerns only the cognitive, information-processing aspects of mental life. It has, however, inspired similar claims about mental extension for other aspects of our mind. Examples of states and processes that have been claimed to extend outside the head include consciousness, emotions, moods, intentional agency, knowledge, and selfhood.

Extended cognition is part of the wider ‘4E cognition’ research programme – extended, embedded, embodied, and enactive cognition. Each E offers a distinct, related perspective on how the environment shapes cognition. Other forms of externalism about cognition – [content externalism](#), [direct realism about perception](#), [collective intentionality](#), and [group cognition](#) – are less closely related.

## 1 Extended cognition

Humans love their devices. Smartphones, tablets, computers, paper notebooks, calendars, and to-do lists play a pervasive role in our lives. These pieces of technology cause us to behave in certain ways, and we in turn modify them to influence our future behaviour. Often we don’t appreciate how much we rely on them until they’re gone. Empirical work in psychology suggests that this dependence runs very deep. Even during relatively undemanding tasks – e.g. copying a simple coloured pattern made of puzzle pieces – we off-load information processing onto the environment to reduce work for our brains (Ballard et al., 1997). Once one recognises this phenomenon, one sees it everywhere: a bartender lines up cocktail glasses of different shapes to remember a complex order, a mathematician uses pencil and paper to guide her steps in a calculation, a child uses her fingers to count off days until her next birthday. These observations reveal that intelligent, adaptive human behaviour need not always be produced by the brain alone. It often involves a two-way cooperative interaction between the brain, body, and world. (Dennett, 1996; Hutchins, 1995; Simon, 1969).

The hypothesis of extended cognition (HEC) goes beyond this relatively uncontroversial observation in a controversial way. Environmental processes don’t merely interact with our brain processes to help produce intelligent behaviour. Those environmental processes *have as much claim to be mental or cognitive* as their brain-based collaborators. Human cognition literally extends into smartphones, tablets, notebooks, to-do lists, and cocktail glasses.

**HEC** Some actual human cognitive states/processes extend outside our brains to include, as parts, states/processes in the environment

HEC is frequently misunderstood, so it is worth taking care here.

HEC applies the slightly puzzling concept of ‘extension’ to cognitive processes. It is important to realise that HEC is not a claim about cognition considered in some abstract logical sense, or about cognition considered from a first-person phenomenological point of view. It is a claim about cognition’s physical, mechanistic basis. That physical, mechanistic basis has a location and extent. Traditional wisdom has it that the physical basis of human cognition (its ‘realiser’ in functionalist terms) is located always inside a human brain. HEC says that is wrong: sometimes, the physical mechanisms that underlie our cognition are a mix of neural and environmental processes.

What counts as the ‘environment’ may not always be precisely defined. For our purposes, it can be understood roughly as anything outside the brain or central nervous system of the agent in question. Thus, your cognition could extend into your external devices (smartphones, notebooks), your non-neural body (fingers, limbs, tendons), our occurring resources around you (useful sticks and stones), instances of public language use (appropriately shaped ink marks and sound waves), or the brains and bodies of people you trust (your spouse).

There are several claims that are often mistakenly associated with HEC.

HEC does not say that the environment is as ‘important’ as the brain for cognition. Brain activity may often be the dominant cause of intelligent human behaviour (see Clark, 2007a, for more on this). HEC also does not say anything about the proportion of human cognition that extends. It is compatible with the majority of human cognition being internal and wholly brain-based. HEC is also silent about whether extended cognition is a ‘good thing’ for the agent in question. Sometimes it may be (e.g. it may increase long-term memory capacity or reliability in inference), but sometimes it may not (extended cognition may be involved in certain psychiatric disorders, see Sprevak, 2011; Borsboom, Cramer and Kalis, forthcoming). HEC is also silent about whether cognitive extension is a consequence of some deliberate choice by the agent in question (or anyone else). We are often drawn into entanglements with the environment without our awareness or consent. Finally, HEC does not say anything about objects like smartphones having a free-standing mental life of their own. As far as HEC is concerned, a smartphone by itself need have no more mental life than a neuron sitting by itself in a Petri dish. It is only when a smartphone stands in right relationship to our brain that it becomes part of our cognitive life and thereby endowed with mental properties.

## 2 Arguments for extended cognition

There are three principal arguments for the hypothesis of extended cognition (HEC). All three appear in Clark and Chalmers' (1998) original paper and they can all be illustrated with a (now classic) thought experiment:

Inga has normal human memory. One day, she hears of an interesting exhibition at the Museum of Modern Art (MoMA). Inga thinks, recalls that MoMA is on 53rd Street, and sets off. Otto suffers from a mild form of Alzheimer's disease and he always writes down useful information in his notebook. On the same day, Otto also hears of the exhibition at MoMA, retrieves the address from his notebook, and sets off.

Clark and Chalmers say that Otto has a belief that MoMA is on 53rd Street. This belief – and Otto's cognitive processes of storage and recall – extend outside Otto's failing brain and into his notebook. Before proceeding to the arguments, it is worth noting that this is not meant to be a realistic description of Alzheimer's disease or a description of some real life case. Clark and Chalmers are using the thought experiment to draw attention to idealised interactions with the environment that give rise to extended cognition. They claim that these interactions also occur in more complex, realistic, and common cases (e.g. real world smartphone use).

*Functionalism arguments.* The claim here is that Otto and Inga are similar in ways that matter to functionalism. **Functionalism** is a philosophical theory about what makes certain physical states or processes mental/cognitive. A functionalist about beliefs, for example, says that what makes a brain state a belief is that it functions in ways appropriate to a belief for the agent in question. Clark and Chalmers observe that Otto's notebook functions in a similar way to Inga's biological memory. The state of Otto's notebook causally interacts with his desires and beliefs in a similar way to that in which the state of Inga's biological memory interacts with her desires and other beliefs. Exposure to new information causes Otto to modify the state of his notebook. Exposure to new information causes Inga to modify the state of her biological memory. Otto's notebook causes him to stop at 53rd Street. Inga's biological memory causes her to stop at 53rd Street. The functional role of the stored information seems to be the same in both cases. Clark and Chalmers conclude that just as Inga has a belief that MoMA is on 53rd Street, so Otto has a belief (partly realised in his notebook), with the same content.

The argument relies on accepting functionalism about beliefs, but also on the 'parity principle':

If, as we confront some task, a part of the world functions as a process which, *were it done in the head*, we would have no hesitation in recog-

nizing as part of the cognitive process, then that part of the world *is* (so we claim) part of the cognitive process. (Clark and Chalmers, 1998, p. 8)

The parity principle allows us to say that *only* a physical state's functional role matters to its mental/cognitive status, not its physical location. We should not be to any degree *prejudiced* against treating Otto's notebook as realising one of his cognitive states merely because it is outside his head. Recent versions of the functionalist argument for HEC exploit the parity principle to block an obvious objection to the original functionalist argument: that Otto and Inga are not *exactly* functionally alike. This flaw was pressed by early critics of HEC (Adams and Aizawa, 2001; Rupert, 2004). Otto and Inga are not exactly functionally alike, but Otto *is* functionally identical to a hypothetical being who uses a notebook inside its head to store information (e.g. a Martian who uses internal ink-marks to encode some of its memories). If it is *possible* for an intelligent being to use an internal memory system like Otto's notebook, and we accept the parity principle and functionalism, then we should say that Otto's *actual* notebook counts as a case of extended cognition. (For a discussion of this argument, see Sprevak, 2009)

*Inference to the best explanation.* The claim here is that there are *explanatory benefits* to psychology if we accept that Otto and Inga share the same cognitive state. The argument takes the form of an *inference to the best explanation (IBE)*. We should infer that HEC is true because of the explanatory benefits its assumption would bring to psychology. Clark and Chalmers argue that Otto and Inga can profitably be treated as sharing the same psychological explanation. Just as Inga arrived at 53rd Street because she *wanted* to go to MoMA and *believed* that it was there, so Otto arrived at 53rd Street because he *wanted* to go to MoMA and *believed* that it was there. Explaining both agents in the same way allows us to see a shared high-level decision-making psychological architecture at work, irrespective of whether the agent uses internal or external resources for information storage. The alternative – explaining Otto's success always in terms of his internal beliefs *about* his notebook – seems needlessly complex. The notebook is a constant in Otto's life, similar to Inga's biological memory. It would be redundant to point to it in every explanation of his behaviour. Accepting that HEC is true makes the notion of belief 'deeper and more unified, and ... more useful in explanation.' (Clark and Chalmers, 1998, p. 14). (For a discussion of this argument, see Sprevak, 2010)

*Second wave arguments.* 'Second wave' arguments tend to downplay the data supporting the functionalist and IBE arguments; they instead emphasise 'complementarity'. What is meant by this is that external states and processes need not be similar – either functionally or in their role in explanation – to any internal ones. Instead, what justifies HEC is tight, reciprocal *integration* between brains, bodies, and the

environment. The approach has affinities with dynamical systems theory, which models the brain, body, and environment as a single system whose elements cannot be prised apart when solving a cognitive task (Thelen and Smith, 1994). In their original paper, Clark and Chalmers call this ‘active externalism’: all parts (internal and external) are ‘active’ and work together in a non-redundant way to solve a cognitive task. The resulting interaction need not be similar to any (actual or possible) internal cognitive process and there is no reason it should be classified as such by psychology. Otto’s notebook isn’t cognitive because it is functionally like Inga’s memory, or because it is explanatorily beneficial for psychology to group them together. Otto’s notebook is part of his cognitive life because it is systematically, reciprocally, and inextricably integrated with Otto’s biological brain during certain cognitive tasks. (For a reconstruction of second-wave arguments, see Menary, 2010a; Sutton, 2010). (Note that talk of a ‘second wave’ may suggest that the ‘first wave’ was a failure. However, it is by no means clear that either the functionalist or IBE arguments cannot be made to work.)

### 3 Objections to extended cognition

The idea that external objects are part of our mental life has, unsurprisingly, encountered resistance. Here are four objections to the hypothesis of extended cognition (HEC).

*Cognitive bloat.* Fans of HEC say that HEC is non-vacuously true – extended cognition is something that *actually happens*. However, usually they don’t want to say that it happens so much that our existing mental concepts are rendered pointless, absurd, or unfit for purpose (e.g. that we end up saying you believe everything on the Internet or that you and I believe the same things just because we live in the same environment). Avoiding cognitive bloat requires drawing a line between those functional/explanatory/integrational relationships to the environment that genuinely generate cognitive extension and those that do not. This has not proved easy. Consider that not only your smartphone, but also your office computer, local library, friends, co-workers, and in many cases the whole Internet, contains information on which you routinely draw to guide your behaviour in a way not dissimilar that in which Otto relies on his notebook. Consider too that you and I often draw on the same set of external resources to guide our respective behaviour. An argument for HEC needs to guard against doing violence to our existing mental concepts. Introducing restrictions here, however, may cut against assumptions required to motivate any form of HEC at all – for example, it may violate the parity principle (see Sprevak, 2009).

*Embedded cognition.* The hypothesis of ‘embedded cognition’ (HEMC) is a rival hypothesis to HEC that claims to offer all the benefits of HEC but without the claim that notebooks have mental properties. HEMC and HEC agree on almost every point: extended processes are functionally similar to internal cognitive processes; appeal to extended processes is sometimes useful to psychology; our brains are causally integrated with the environment when we solve cognitive problems. The hypotheses differ in that HEC says that the external part of these processes is entirely cognitive/mental, whereas HEMC says that it is not. They agree on the functional, explanatory, and causal facts, but disagree on the distribution of cognitive/mental properties in the world. According to HEMC, extended processes have separate cognitive and non-cognitive parts – the cognitive parts are inside the head. According to HEC, they are cognitive/mental all the way through – both internal and external parts are cognitive. Fans of HEMC argue that we should abandon HEC for HEMC because HEMC provides all the benefits of HEC but it is more ontologically parsimonious (it attributes fewer cognitive/mental properties to the world) and it is more conservative (it fits better with traditional internalist views about the mind) (see Rupert, 2004; Sprevak, 2010).

*The coupling/constitution fallacy.* Arguments for HEC often describe a two-way coupling relationship between our brains and the environment. One might be tempted to think that cognition extends *because* of this coupling relationship. However, just because X and Y are coupled does not mean that X is part of Y. The expansion of a bimetallic strip in a thermostat is causally coupled to the motion of atoms in the surrounding air in the room, but that does not mean that the strip’s expansion is a process that extends into the atoms of the air (Adams and Aizawa, 2007, p. 91). Similarly, your brain and the environment may be causally coupled but that does not mean that your cognition extends into the environment. This objection appears to most directly threaten ‘second wave’ arguments for extended cognition. These arguments emphasise tight, two-way causal coupling between the brain, body, and environment. One needs to identify something beyond mere coupling that justifies cognitive extension. A natural resort for an advocate of HEC would be to appeal to either the *explanatory value* of treating the coupled system as entirely cognitive or the *functional similarity* between the coupled system and a genuine (actual or possible) case of cognition. But this would collapse ‘second wave’ arguments into their ‘first wave’ versions (see Adams and Aizawa, 2001; Adams and Aizawa, 2007).

*The mark of the cognitive.* This objection is often presented more as a plea for ground rules in the debate about HEC rather than as an objection against it. However, the plea is often combined with a specific proposal about those ground rules that critics expect will rule out many (or all) cases of extended cognition. A ‘mark of the cognitive’ is set of conditions that are either necessary or sufficient for a physical process to be cognitive. If we knew the mark of the cognitive, we could use this to



decide whether disputed cases (like Otto's notebook) really are cases of extended cognition. However, reaching agreement on a mark of the cognitive has proved hard. Proposed marks tend to be at least as controversial as the claims they are supposed to help us decide. Proposed marks include: (i) a cognitive process must involve non-derived representational content and it must be functionally similar at a fine-grained level to actual cases of brain-based human cognition (Adams and Aizawa, 2007); (ii) a cognitive process must be part of an integrated persisting system and it must causally contribute to a wide range of cognitive phenomena (Rupert, 2009); (iii) a cognitive process must 'belong' to a subject by causally contributing to the intentional content of the subject's personal-level states (Rowlands, 2010). Critics of HEC tend to favour conservative marks of the cognitive, such as (i) or (ii). Fans of HEC tend to favour more liberal marks, such as (iii). One might worry that there is no such thing as a mark of the cognitive. Just as there is no single set of necessary and sufficient conditions that demarcate which physical processes are *living*, or *cancerous*, or *healthy*, so there might be no set of such conditions that demarcate which physical processes are *cognitive* (Allen, 2017).

## 4 Extended cognition's kindred views

Philosophical attention has focused, not just on arguments for and against the hypothesis of extended cognition (HEC), but also on tracing HEC's connection to other externalist claims about the mind. Two types of externalist claim stand out: extension claims about other aspects of the mind and other kinds of externalism about cognition.

*Extension claims about other aspects of the mind.* Clark and Chalmers (1998) were careful to restrict their claim only to the cognitive, information-processing aspects of our mind (e.g. storage and retrieval of the information that underlie certain beliefs). Clark and Chalmers flagged occurrent conscious experience as a possible exception to their arguments: a part of the mind whose physical mechanisms are likely to be entirely neural and internal. Noë (2004) disagrees. Using variants of the IBE and second-wave arguments of §2, he concludes that the physical basis of our conscious experience extends outside our brain and into our body and the environment. In a rejoinder, Clark (2009) says that such extensions are unlikely because our brain's causal interface with the world (our eyes and our hands) has a narrow bandwidth, which (information-rich) conscious experience cannot cross.

Consciousness is not the only source of novel claims about mental extension. Carter, Gordon and Palermos (2016) argue that, irrespective of whether consciousness extends, our emotions can extend because the physical processes involved in an



emotion's component of [cognitive appraisal](#) can extend. Colombetti and Roberts (2015) argue that affective mental states (emotions, moods, sentiments, and temperaments) can extend because of the way we tend to use external objects to regulate those affective states. Vierkant (2014) argues that intentional agency and our [will](#) can extend. Pritchard (2010); Carter and Kallestrup (2016) explore extension claims for epistemic states like [knowledge](#). Clark (2007b) argues that the dispositions defining the boundaries of our selves extend. Essays in Anderson et al. (2018) illustrate extension claims by past philosophers about aspects of mental life that differ dramatically from the task-based, problem-solving examples favoured by Clark and Chalmers (e.g. friendship and imaginative engagement with a text).

*Other kinds of externalism about cognition.* HEC is often described as part of the programme of '4E cognition'. The other Es are *embedded*, *embodied*, and *enactive* cognition. We have already met *embedded* cognition with the hypothesis of 'embedded cognition' (see §3). *Embodied* cognition says that cognition depends in some way – different versions of the view cash this out differently – on the physical nature of our bodies. Embodied cognition may be used to express a form of extended cognition, one that uses bodily processes to implement cognitive processes (e.g. when a child counts on her fingers, her mathematical cognition extends into the physical movement of her ten digits). But it may also be used to express a range of other claims about embodiment. Lakoff and Johnson, for example, say that the human body influences the semantic content of our abstract concepts, including our logical and mathematical concepts (Johnson, 2007), something about which HEC has almost nothing to say. *Enactive* cognition says that cognition is a looping interaction between perception and action that spans our brain, body, and the world. This has obvious affinity with 'second wave' arguments for HEC (§2), but versions of enactivism might also differ from HEC in important ways. Some enactivists reject HEC's framing in terms of representations and information processing. They emphasise instead other aspects of our interaction with the world. For example, 'sensorimotor' enactivists say that cognition is constituted by our implicit, non-representational bodily skills (Noë, 2004); 'autopoietic' enactivists say that cognition is constituted by biologically-based notions of autopoiesis, adaptivity, and sense-making (Di Paolo, 2005).

HEC has a more distant relationship to other kinds of externalism about cognition. [Content externalism](#) claims that the representational content of our cognitive states does not supervene on the physical state of our brains. HEC has almost nothing to say about this. HEC's claims are not about the supervenience base that determines semantic content, but about the location of the physical vehicles that bear that content. [Direct realism about perception](#) says that perception involves standing in a relationship to a real external object beyond the brain. HEC assumes almost nothing about whether this theory of perception is correct. Indeed, HEC is frequently stated

in intentionalist (as opposed to direct-realist) terms. [Collective intentionality](#) is the claim that groups of humans sometimes share mental states, such as belief, knowledge, and intention. Closely related to this is the notion of [group cognition](#): a cognitive state or process is attributed to a group rather than to the individuals that compose that group. What HEC has in common with these two ideas is the proposition that cognitive states and processes are not restricted to individual human brains. However, unlike those two ideas, HEC is a claim about individual, not group, cognition. It need not endorse the existence of group minds or collective mental states. HEC may be asserted together with a variety of other externalist claims about the mind, but it makes a separate, unique claim about how the mind spreads out into world.

## Related Articles

- [Belief](#)
- [Collective intentionality](#)
- [Consciousness](#)
- [Content: Wide and narrow](#)
- [Emotions, nature of](#)
- [Functionalism](#)
- [Inference to the best explanation](#)
- [Perception](#)
- [The realization of knowledge](#)
- [The will](#)

## Articles that might consider linking to this article

- [Belief](#)
- [Collective intentionality](#)
- [Content: Wide and narrow](#)
- [Functionalism](#)
- [Metaphysics of knowledge](#)

## Bibliography

Adams, F. and K. Aizawa (2001). “The bounds of cognition”. In: *Philosophical Psychology* 14, pp. 43–64.

- (One of the earliest, but still one of the best critical responses to extended cognition. Adams and Aizawa developed the points in more detail in their later book.)
- Adams, F. and K. Aizawa (2007). *The Bounds of Cognition*. Oxford: Blackwell.  
(Building on their earlier work, Adams and Aizawa offer a detailed critical reaction to extended cognition. This book contains one of the best articulations of the ‘coupling/constitution fallacy’ – see §3.)
- Allen, C. (2017). “On (not) defining cognition”. In: *Synthese* 194, pp. 4233–4249.  
(Allen argues that there is no ‘mark of the cognitive’ – see §3.)
- Anderson, M., D. Cairns, M. Sprevak and M. Wheeler, eds. (2018). *A History of Distributed Cognition*. 4 volumes. Edinburgh: Edinburgh University Press.  
(This anthology explores how various claims about extended cognition were supported, and suppressed, in the past.)
- Ballard, D. H., M. M. Hayhoe, P. Pook and R. Rao (1997). “Deictic codes for the embodiment of cognition”. In: *Behavioral and Brain Sciences* 20, pp. 723–767.  
(A good example of empirical work that demonstrates how we ‘off-load’ information onto the environment when we solve a cognitive task. Rather than store a puzzle pattern in our brain, we just remember where to look in the world to find it.)
- Borsboom, D., A. Cramer and A. Kalis (forthcoming). “Brain disorders? Not really... Why network structures block reductionism in psychopathology research”. In: *Behavioral and Brain Sciences*. DOI: [10.1017/S0140525X17002266](https://doi.org/10.1017/S0140525X17002266).  
(The mechanisms underlying certain mental disorders span brain, body, and environment.)
- Brooks, R. A. (1991). “Intelligence without representation”. In: *Artificial Intelligence* 47, pp. 139–159.  
(A simple robot can generate intelligent, adaptive behaviour by off-loading information processing and representation onto its environment.)
- Carter, J. A., E. C. Gordon and S. O. Palermos (2016). “Extended emotion”. In: *Philosophical Psychology* 29, pp. 198–217.  
(Human emotions extend when their cognitive appraisal component extends.)
- Carter, J. A. and J. Kallestrup (2016). “Extended cognition and propositional memory”. In: *Philosophy and Phenomenological Research* 92, pp. 691–714.  
(Explores links between extended cognition and extended claims about the epistemology of memory.)
- Clark, A. (2007a). “Curing cognitive hiccups: A defense of the extended mind”. In: *The Journal of Philosophy* 106, pp. 163–192.

- (Extended cognition offers explanatory benefits to psychology – see §2. Clark also clarifies the important decision-making and organisational role that the brain plays in cognition.)
- Clark, A. (2007b). “Soft selves and ecological control”. In: *Distributed Cognition and the Will*. Ed. by D. Ross, D. Spurrett, H. Kincaid and G. L. Stephens. MIT Press, pp. 101–122.  
(The boundaries of the self extends.)
- (2008). *Supersizing the Mind*. Oxford: Oxford University Press.  
(This book pulls together many years of Clark’s work on extended cognition into a coherent and highly readable monograph. An Appendix contains the original ‘Extended mind’ paper and there is a useful foreword by David Chalmers.)
- (2009). “Spreading the joy? Why the machinery of consciousness is (probably) still in the head”. In: *Mind* 118, pp. 963–993.  
(Although cognition extends, conscious experience does not.)
- Clark, A. and D. J. Chalmers (1998). “The extended mind”. In: *Analysis* 58, pp. 7–19.  
(This seminal paper remains one of the clearest and best articulations of extended cognition and the arguments that support it.)
- Colombetti, G. and T. Roberts (2015). “Extending the extended mind: the case for extended affectivity”. In: *Philosophical Studies* 172, pp. 1243–1263.  
(Affective mental states extend, including emotions, moods, sentiments, and temperaments.)
- Dennett, D. C. (1978). “Where am I?” In: *Brainstorms*. Cambridge, MA: MIT Press, pp. 310–323.  
(Dennett describes fitting radio transmitters to a human’s neurons. He considers implications of this extended cognition for our traditional concepts of the mind and personhood.)
- (1996). *Kinds of Minds*. New York, NY: Basic Books.  
(Dennett has developed over many years a view of human cognition (and consciousness) that emphasises our reciprocal interaction with external resources like public language. In this book, he describes a hierarchy of different kinds of minds, including ‘Gregorian’ minds whose contents are partly defined by their interactions with external tools.)
- Di Paolo, E. A. (2005). “Autopoiesis, adaptivity, teleology, agency”. In: *Phenomenology and the Cognitive Sciences* 4, pp. 429–452.  
(An overview of ‘autopoietic’ enactivism – see §4.)

- Hutchins, E. (1995). *Cognition in the Wild*. Cambridge, MA: MIT Press.  
(An anthropological study of how humans off-load cognition when making navigational calculations at sea.)
- Johnson, M. (2007). *The Meaning of the Body*. Chicago, IL: University of Chicago Press.  
(Argues that our abstract concepts are shaped by our physical bodies – see §4.)
- Menary, R. (2010a). “Cognitive integration and the extended mind”. In: *The Extended Mind*. Ed. by R. Menary. Cambridge, MA: MIT Press.  
(Along with John Sutton’s chapter in the same volume, this defends a ‘second wave’ argument for extended cognition – see §2.)
- ed. (2010b). *The Extended Mind*. Cambridge, MA: MIT Press.  
(A useful anthology. It contains several chapters that develop ‘second wave’ arguments for extended cognition as well as back-and-forth exchanges between Clark and his critics).
- Noë, A. (2004). *Action in Perception*. Cambridge, MA: MIT Press.  
(Conscious experience extends during visual perception, albeit in a way better understood by ‘sensorimotor’ enactivism than extended cognition – see §4.)
- Pritchard, D. (2010). “Cognitive ability and the extended cognition thesis”. In: *Synthese* 175, pp. 133–151.  
(Explores the relationship between extended cognition and ability claims in contemporary epistemology. This paper has been influential in the ‘extended knowledge’ programme.)
- Rowlands, M. (2010). *The New Science of the Mind: From Extended Mind to Embodied Phenomenology*. Cambridge, MA: MIT Press.  
(Rowlands argues for a ‘mark of the cognitive’ that is favourable to extended cognition – see §3.)
- Rupert, R. D. (2004). “Challenges to the hypothesis of extended cognition”. In: *The Journal of Philosophy* 101, pp. 389–428.  
(Rupert argues for a rival to the hypothesis of extended cognition, the ‘hypothesis of embedded cognition’ – see §3.)
- (2009). *Cognitive Systems and the Extended Mind*. Oxford: Oxford University Press.  
(Rupert argues for a ‘mark of the cognitive’ with persistence and integration determining whether something is part of our mind – see §3.)
- Shapiro, L. (2011). *Embodied Cognition*. London: Routledge.  
(An excellent textbook on extended cognition and related views.)

- Simon, H. A. (1969). *The Sciences of the Artificial*. Cambridge, MA: MIT Press.  
(Simon's 'parable of the ant' in Chapter 3 shows how complex behaviour can be generated by a simple internal mechanism coupled to the environment.)
- Sprevak, M. (2009). "Extended cognition and functionalism". In: *The Journal of Philosophy* 106, pp. 503–527.  
(The functionalist argument for extended cognition succeeds, but it generates serious cognitive bloat – see §3.)
- (2010). "Inference to the hypothesis of extended cognition". In: *Studies in History and Philosophy of Science* 41, pp. 353–362.  
(IBE arguments for extended cognition do not work because the hypothesis of 'embedded cognition' provides a rival hypothesis with indistinguishable explanatory value – see §§2, 3.)
- (2011). "Neural sufficiency, reductionism, and cognitive neuropsychiatry". In: *Philosophy, Psychiatry and Psychology* 18, pp. 339–344.  
(Looking for the mechanisms of psychiatric disorders with fMRI may fail to find them because those mechanisms may stretch outside the brain.)
- Sutton, J. (2010). "Exograms and interdisciplinarity: History, the extended mind, and the civilizing process". In: *The Extended Mind*. Ed. by R. Menary. Cambridge, MA: MIT Press, pp. 189–225.  
(Along with Richard Menary's chapter in the same volume, this presents a 'second wave' argument for extended cognition – see §2.)
- Thelen, E. and L. B. Smith (1994). *A Dynamical Systems Approach to the Development of Cognition and Action*. Cambridge, MA: MIT Press.  
(Defends the research programme of modelling the brain, body, and world as a single, integrated dynamical system.)
- Vierkant, T. (2014). "Mental muscles and the extended will". In: *Topoi* 33, pp. 57–65.  
(The will and intentional agency extend outside the head.)
- Wheeler, M. (2005). *Reconstructing the Cognitive World*. Cambridge, MA: MIT Press.  
(Explores links between extended cognition and phenomenological ideas about embodiment in Heidegger.)