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Eco-cognitive ageing: Post-human ecologies as enhancement technologies

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Abstract

Later life is associated with cognitive decline. Under the influence of universal cognitivism, this has commonly been conceived as a direct result of neurophysiological changes associated with ageing and senescence. Empirical evidence regarding dementia and associated pathology has long problematised the directness of assumed neurophysiology-cognition relations. While some interpret this as evidence of minor inadequacies, a more radical branch of cognitive science suggests that we should not expect neurophysiology to translate directly into cognition. Ecological cognitive theories position cognition as something that involves our brains, but also involves our bodies, activities, environments and extrinsic materials. There are remarkable affinities between ecological cognition and the social scientific fields of post-humanism and new materialism. Taken together, these intellectual traditions offer provocations for reimagining ecologies, broadly conceived, as malleable technologies with the potential to enhance cognition. Ultimately, this suggests that ageing brains need not dictate cognitive destinies.

Keywords: cognition, cognitivism, dementia, extension, materialism

Cognition & ageing

Later life is associated with cognitive decline. This cognitive ageing is difficult to study for many reasons and appears to be subject to considerable individual variability. However, cognition seems to generally decline across various domains from our 30s onward, hastening notably after the age of 60 (Hartshorne & Germine, 2015; Salthouse, 2019). In most cases, age-related cognitive decline causes little perceptible functional impairment – perhaps an occasional forgotten name or misplaced item – and is not a cause for concern. That said, more substantial forms of cognitive decline are similarly associated with later life. Ageing is the strongest single risk factor for developing Alzheimer's disease and is the only consistent significant risk factor among the oldest old (Ganguli & Rodriguez, 2011; Guerreiro & Bras, 2015). Sociologically, dementia is intimately bound up with experiences and expectations of cognition and ageing, with high intersubjective and institutional stakes, particularly when seeking to demarcate what counts as 'normal' cognitive ageing and, by extension, what should be considered abnormal or pathological (Fletcher, 2020; 2022; Fletcher & Maddock, 2021).

Traditionally, cognitive decline in later life has largely been attributed to neurophysiological manifestations of the multifactorial senescence that characterises the ageing process generally (Oschwald et al, 2020). Ageing brains are typically subject to familiar processes of inflammation, protein aggregation, oxidative stress and atrophy (Chinta et al, 2015; Taylor, 2016). Between the ages of 20 and 100, the average brain loses around 20% of its mass, and almost all people aged over 80 have some form of neuropathology that influences cognition (Boyle et al, 2021; Salthouse, 2009). This is one major reason that isolating dementias from ageing is so tricky, because people with dementia tend to be older people, so their brains tend to have evidence of various cognition-influencing pseudo-pathologies and general atrophy. Ultimately, growing older is characterised by an accumulation of various interacting neurophysiological insults that are likely to weigh, both singularly and in combination, upon cognition to varying extents (Herrup, 2021).

Cognitivism

The intuition that cognition, and the age-related deterioration thereof, is fundamentally attributable to neurophysiology is principally a legacy of universal cognitivism, which is itself something of a reanimation of phrenological ideas popular in the early 19th century. Briefly, universal cognitivism models the brain as a sort of biological computer, wherein cognition is performed as pseudo-algorithmic information processing, with different functions supported by associated neurological structures (Strydom, 2007). These ideas emerged as a dominant intellectual approach to understanding cognition in the mid-twentieth century,

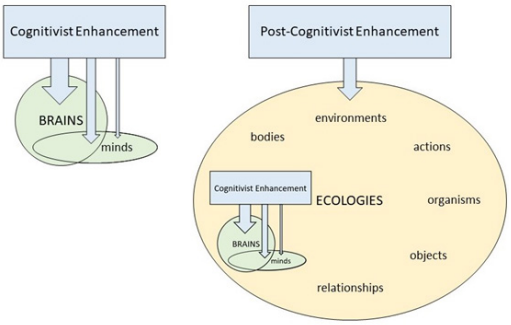

Figure 1. Post-cognitivism expands enhancement beyond traditional cognitivism, while also encompassing it

borrowing heavily from the rapidly developing field of computer science. It is important to clarify that, in practice, relatively little cognitive neuroscience subscribes absolutely to universal cognitivism, leaving at least some intellectual space for more traditionally psychological conceptions of the mind (Kok, 2020). Nonetheless, appeals to the brain as a cognition-orchestrating computer are commonplace, both in institutional cognitive science and public discourse (Cerulo, 2010).

Universal cognitivism heavily informs mainstream contemporary aetiological hypotheses regarding cognitive ageing and age-associated dementias. Broadly, it is widely theorised that brain deterioration translates into cognitive deterioration. However, empirically, cognitive impairment and neuropathology are not as neatly associated as one might assume. Stretching back to the early 20th century, researchers have puzzled over why some people can have considerable neuropathology without cognitive impairment, and vice versa (Fletcher, 2021). More recently, the development of drugs that successfully eliminate neuropathology have failed to address cognitive decline (Fletcher, 2018; Fletcher & Birk, 2019). The most popular interpretation of these results is that, while the overall notion of universal cognitivism is correct, some select minutiae of aetiological hypotheses are currently flawed. The leading theory in this vein is that neurocognitive deterioration is long-term and gradual, meaning that people who do have neuropathology but who do not have cognitive symptoms are in a pre-symptomatic stage, but are nonetheless progressing toward impairment. By extension, drugs that have addressed neuropathology but have not addressed cognition have potentially been administered too late in the disease process to address cognitive damage.

Post-human cognitive ecologies

A second, far more niche, interpretation of the dissociation between neuropathology and cognitive impairment can be found in contemporary cognitive science that rejects cognitivism in favour of more ecological sensibilities (*Figure 1)*. These ideas can be summarised in reference to the 4E tradition, encompassing embodied, embedded, extended and enactive cognition (Newen, De Bruin & Gallagher, 2018). The *embodiment* of cognition is evident in many aspects of our daily lives wherein we perform tasks in a seemingly unconscious manner, often drawing on what we might colloquially term muscle memory. You can easily experiment with your embodied cognition. For example, if you swap the glasses and plates around in your kitchen cupboards, you will likely continue to return to the old locations for those items for some time. *Embedded* refers to the reliance of cognition on the environments within which it occurs. For instance, you may find your thinking more laboured in an uncomfortably warm room or find it difficult to concentrate on reading a book while attending a loud music concert. Cognition is *extended* when it is at least partially supported by something extra-bodily. Much scholarship in this area centres on digital technologies, for example the navigation or reminder functions of smart phones, but I have witnessed the low-tech extension of cognition by people with dementia through items such as specialised paper calendars. Finally, *enactive* denotes the active nature of cognition, which is evident when you scan your eyes across a page to read it, count on your fingers, or write about a research problem as a means of thinking it through.

At the extremes of these 4E ideas, cognitivism is rejected outright. For instance, radical enactivism goes so far as to situate cognition entirely in the happenings of the physical world. The classic example of this is a slinky moving down a flight of stairs. While robotics experts have long struggled to devise machineries that can successfully go downstairs, the slinky executes this incredibly complicated task simply by manifesting the physical properties of its own form and its environment (Hutto & Myin, 2017). In sum, I find it helpful to amalgamate all these ideas under the umbrella of 'ecological cognition', recognising the deep entanglement and co-constitution of each facet within the living real-world happenings of cognition. Their implications can be deeply profound. As mentioned, I have witnessed people with dementia managing to perform complex cognitive tasks by virtue of the physical arrangements of relevant objects, and conversely failing to do so when said arrangements were disrupted (see Fletcher (2019) on making breakfast). As another example, a recent preprint documents the case of a man with extreme amnesia who has managed to work and travel for years by distributing his memory to a collection of smartphone apps (Annese et al, 2022).

Such observations are impressive in a general sense, but as a social gerontologist, what I find especially stimulating about ecological cognition is its potential for cross-fertilisation with contemporary post-humanist and new materialist social science. Post-humanism attempts to decentre the person in social science, recognising the intractable enmeshing of human life in vital ecologies. On the one hand, we are each mere components of social, economic, climatic, technological, etc. ecologies (e.g. food webs, company departments, families). On the other hand, we are all cyborg-like concoctions of artificial (e.g. tattoos, dental fillings) and biological (e.g. gut microbiota, head-lice) materials. New materialist theories require us to reformulate our intuitive beliefs about what material fundamentally is, particularly more radical conceptualisations that extent the definition of 'matter' to encompass anything, including emotion, sensation, meaning, etc. and reconfigure that matter as emergent possibility that is realised in action. Hence, matter is more like mattering. It only exists in a specific form in relation to other matter that is simultaneously specified through those relations. Taken together, the intersections of post-humanism, new materialism and ecological cognition offer much inspiration for profound reimaginings of later life cognitive decline, as well as prospects for cognitive enhancement.

Eco-cognitive enhancement

An ecological perspective has some immediately obvious technological ramifications for attending to cognitive decline. Indeed, much of the work around extended cognition in particular has centred on the use of technologies, especially digital technologies, as a form of cognitive enhancement. For example, a person who is repeatedly losing a set of keys can outsource that function to a relevant app, a person with incremental vision impairment can use a smart cane replete with sensors and touch feedback, a person with decreasing hearing can progress through increasingly sophisticated hearing aids, Bluetooth and Wi-Fi enabled in a manner that grants those people a range of cognitive abilities that their non-impaired peers do not enjoy. Post-humanism and new materialism rearticulate these examples, not as instances of impaired persons using assistive technologies, but as reconfigurations of cognitive ecologies that are constantly evolving to optimise cognition.

Specific digital products, such as mobile apps, are rather obvious examples of the potential for technology to enhance cognition, because they are the components of cognitive ecologies that we most intuitively recognise as technologies with cognitive ramifications. However, our expanded conceptualisation of all that constitutes cognitive ecologies provides new opportunities to look further afield. We can begin to approach ecologies in sum, as well as all their varied facets particularly, as technologies with the potential to enhance cognition, especially as it declines in later life. Climates, wallpaper, interpersonal exchanges, satellite navigation, pay scales, public transport, gender systems, internet search engines, pavements – human existence is replete with a limitless supply of prospective ecological technologies that might be manipulated in ways that enhance cognition. We formulate these technologies, and these technologies do cognition, so it intuitively follows that cognition is amenable to our technological (re)formulation. Ultimately, this is not a naïve appeal to ecological control as a means of abolishing cognitive decline outright. Rather, it is an optimistic argument that an appreciation of post-human ecologies as cognitive technologies suggests, in line with neuroscientific evidence, that our senescing brains do not absolutely dictate our cognitive destinies.

In a sense, such an ecological disposition returns us, albeit via a relatively dense theoretical detour, back to many of the social gerontological insights championed by Tinker over several decades. She has long emphasised the fundamental embeddedness of experiences of ageing in seemingly mundane infrastructures, with a particular focus on housing and transport (Tinker 1981; Tinker & Ginn 2015), and advocated more holistic and wide-reaching conceptualisations of technological adaptations to enhance the lives of older people (Tinker 2003). Her work has also been prescient in attending to the broader environment as a key medium of ageing, even calling on architects to centre the experiences of older people with cognitive impairments when designing built environments (Tinker 1997), at a time when such experiences were widely under-valued if not outrightly dismissed in much research and practice. Hence, the enduring characteristic commitments of Tinker's gerontechnological disposition now appear essential to the pursuit and realisation of contemporary eco-cognitive enhancement for ageing ecologies.

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