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Immaterial engagement: human agency and the cognitive ecology of the internet

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Abstract While 4E cognitive science is fundamentally committed to recognising the importance of the environment in making sense of cognition, its interest in the role of artefacts seems to be one of its least developed dimensions. Yet the role of artefacts in human cognition and agency is central to the sorts of beings we are. Internet technology is influencing and being incorporated into a wide variety of our cognitive processes. Yet the dominant way of viewing these changes sees technology as an outside force "impacting" on our minds. Within this context, Material Engagement Theory (MET) seems well poised to help make sense of our cognitive involvement with the Internet as MET is precisely concerned with grasping the role of material culture in human cognition. This paper explores some of the resources MET provides to think through the effects the internet is having on human agency. This paper uses MET as a starting point for examining the way Internet technology can be involved with human agency, both to the provide a much needed and more adequate theorization of these phenomena, but also to illustrate ways in which the consideration of artefacts can be given a more central and adequate place within the 4E cognitive sciences.

Keywords Agency · Cognitive technology · Cloud technology · Material engagement · Artefactual turn · Strong agency · Planning · Reflection · Internet

1 Intro: engaging the cloud

This paper looks at the ecological structure of human agency and how it fits into our new artefactual culture, namely the ever-present background of the internet or web. Human cognition seems to be increasingly factoring in a world of internet-enabled

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digital artefacts (Smart et al. 2017b). We constantly carry with us, or wear, devices connected up to the cloud of data services and applications mediated by the wireless internet; something I have called cloud technology, or 'Cloud-Tech' (Clowes 2015). The paper focuses on how our agentive capacities fit into and are best understood against the backdrop of this technology. To do this, it seeks to build upon work on cognitive ecology (Hutchins 2010), cognitive scaffolding (Sterelny 2010), the extended mind (Clark and Chalmers 1998) and especially Material Engagement Theory (Malafouris 2004). Material Engagement theory (or MET) gives us a unique perspective upon the way that human capabilities are created, sustained and evolved in the dynamic and dynamically changing interactions of brain, body and world. Malafouris describes this process of co-constitution as metaplasticity (Malafouris 2009, 2010b, 2014, 2015, 2016).

We bring together two main contexts of this paper. The first context is a background discussion over the last several years whereby internet technology is worried to undermine or diminish the human mind, our social abilities, sense of agency, sense of self and especially executive function. A wave of papers and books express these worries and the fear that the cognitive implications of the Internet are largely negative (Greenfield 2015; Loh and Kanai 2014; Turkle 2011). Internet technology, they say, is changing the structure of our brains and undermining individual agency and autonomy in the process. We are claimed to be addicted to the internet, unable to concentrate in its presence, and afflicted by its cognitively destabilizing effects (Carr 2010). The internet is "impacting" upon our brains, the use of the impact metaphor being constant, and problematically presenting our artefacts as having all the agency and us as passive recipients. On this analysis, the prognosis for the future does not look good. My contention in this paper is that we vitally need a more sophisticated perspective that can allow us to understand how "brains, mind and technology conflate" and recover a sense of individual and collective human agency.

The second context are the perspectives and modes of analysis that arise from the embodied, embedded, extended and indeed enactive cognitive sciences (Clark 1997; Gallagher 2005; Varela et al. 1991). These have placed the role of embodiment and dynamic interaction with the environment as the centrepiece of cognitive analysis, making new analytical strategies possible. While the situated / embodied perspective on human cognition holds that the environment needs to be central to our analysis of cognition, this seldom stretches to any very serious analysis of the cognitive properties of artefacts.[1] Human material culture has many unique properties, yet the analysis of the human cognitive environment often relies upon analogies with the ecological niches of other animals (Laland et al. 2000).

We need to take human material culture seriously in its own terms to properly understand human cognition. In this regards, MET is an exciting point of departure (Malafouris 2004, 2013). Because of its origins in understanding the archaeological record, MET is far more sensitive than other 4E perspectives to the role of artefacts in producing and sustaining human cognition. Of utmost importance here, its focus in on human agency (Malafouris 2008) and the role of artefacts within human agency

[1] With some notable exceptions (Clark 2003; Hutchins 1995; Tribble 2005), even most work on situated cognition the extended mind places very little emphasis on the nature or properties of the real artefacts with which we interact. Most papers get little further than discussing the imaginary notebook of Otto.

(Knappett and Malafouris 2008). This article seeks to use MET to think about the implications for human agency implied by our new artefactual culture, i.e., Cloud-Tech. MET seems ideally placed to shape this investigation because its focus is precisely on the dynamic interchanges between human beings and our material culture over a variety of time scales. Above all, MET stresses that the distinctive forms of human agency emerge from this interaction. The aim of this article is to understand the potential of MET to get to grips with this new material culture. To this end:

Section 2 takes up the claim that the Internet is undermining human agency. It examines the specific character our emerging engagement with internet technology takes in its primary new form of Cloud-Tech. I examine how much contemporary understanding is shaped by what I call the 'impact thesis', and why this presents a one-sided view of the agency of this technology, and technology more generally. We take up the challenge by looking at some current theoretical frameworks that attempts to offer a more satisfying version of the human relationship with technology such as cognitive ecology (Hutchins 2010) and the idea of the extended mind (Clark and Chalmers 1998). MET plays a special role here as it proposes that the human capacity for agency arises from the interaction of brains bodies and tools, and puts the material stuff of artefactual culture centre stage. Moreover, MET helps us to theorize the emergence of new cognitive capabilities (Malafouris 2010a) and the fine-grained temporal structure of agency (Malafouris 2008); exactly the sort of orientation we need to help avoid a one-sided and negative view of our relationship with technology. MET as a framework focuses upon human material culture and its place in the shaping of skilled action. This however suggests a problem. The way the Internet interacts and structures human cognition, is difficult to grasp, precisely because the Internet's material composition is both ontologically complex and in some respects unprecedented as an artefact complex (Bratton 2016). Cloud-Tech is not just composed of a multiplicity of cloud-connected devices, the software apps they instantiate and the distant databases servers to which they and we are tethered, but also of personalised services instantiated in informational relations and accessed through the (sometimes skilful) interaction with multiple virtual interfaces. All of this can make the technology appear rather immaterial, or at least separate from our normal understanding of material culture. This sets up the problem for MET (and indeed any materialist framework) of trying to theoretically "grasp" this new stuff of cognition.

In Section 3, we recontextualize the problem of human agency and material culture by considering Michael Bratman's (2000) theory of Strong Agency. This strong or planning agency is characterised in terms of three interlocking aspects, that is, first, we make plans; second, we recognise ourselves as temporally extended and regulate ourselves through those plans and policies; and third we reflect upon ourselves as agents through our planfulness. However, Bratman develops his theory largely ignoring the role of material culture in giving rise to the properties he describes. I explore here how Bratman's ideas about agency implicitly assume a background of material culture which is never really acknowledged, in the process, rethinking Bratman's strong agency in the context of Malafouris' (2008) material agency. On this analysis, strong agency is on a continuum with many other forms of material agency and skilled practice, emerging from our engagement with material culture.

In the light of this rethinking of strong agency, Section 4 re-engages with the problem of the stuff of the Internet, especially in the form of Cloud-Tech. It explores how a new cognitive economy of mobile internet enabled artefacts might be working to

support or enhance some of our agentive abilities. This section examines by way of a close analysis of how we engage these artefacts, how they may sometimes help support human planfulness and reflection and sometimes inhibit the same. This enquiry into our new somewhat "immaterial" material culture, shines a light on some properties of the new regime of internet enabled artefacts. Indeed, the growing autonomy and agentive profile of some of technologies may under certain circumstances challenge our own agentive capacities. However, close attention to several specific instances of our interactive appropriation of these technologies helps us apply MET to the new context. As with Malafouris study of the potter at work (Malafouris 2008, 2013, 2014), our attention needs to be focused on not just the properties of the artefacts in themselves but what emerges in the interaction of artefact and skilled agent.

Finally, Section 5 offers some reflections on how and when technology might facilitate our actualization as strong agents and when it might inhibit the same. From this point of view, material engagement is a starting point from which we can begin an enquiry into how technologies may or may not enhance or restrict particular cognitive and agentive qualities. This concluding section notes some of the complexity and problematics of this sort of enquiry, but nevertheless, indicates some future foci toward which we can direct our enquiries on a sounder methodological and theoretical footing. This footing should help us make more informed choices about both the appropriation and design of technologies as we practically develop new engagements with Cloud-Tech.

2 Getting to grips with the internet

The Internet has rapidly become the ever-present background and context to many of cognitive processes (Clowes 2015; Smart 2012). We become ever more accustomed to performing cognitive activities accompanied by Cloud-Tech devices such as smart phones, tablets, watches and new forms of wearable technology. Our modes of interaction with them can be conducted via skilled gestures; we swipe and pinch at touch-sensitive screens. Or they can be more passive as we increasingly wear gadgets that monitor our bodies, movements and activities (Lupton 2014). Thanks to our highly portable gadgetry much of our cognitive activity now involves an embodied interleaving of the online and offline worlds (Floridi 2014; Smart 2014).

Interaction with a range of devices that mediate the mobile Internet is rapidly becoming second nature. In the process, many of us become skilful and constant users of these technologies, accommodating to their interaction metaphors, and developing new practices to interact with them. Cloud-Tech is rapidly acquiring a transparency of use that makes its functions and affordances competitors (or complements) with certain of our 'basic' capacities.[2] Properties of this technology include what has been called *totality.* Whereas it was hitherto effortful to use previous technology regimes to

[2] One must be careful in how we depict such 'basic' or 'native' resources (as an anonymous reviewer points out). It is true that one of the central arguments of MET is that many cognitive and agentive capacities that we take to be natural or native might have been interactively developed with material culture. Our advanced mathematical abilities are a good case in point (See Chapter 5 of Malafouris 2013). We must be careful then in any discussion of basic capacities that we do not assume they are natural and have been untouched by prior interaction with one or other regime of material culture.

'remember for us' (Donald 1991) taking digital records of everyday life can now be a largely effortless process, while the capacity of E-Memory is in principle limitless (Gemmell and Bell 2009). Such technology affords novel cognitive activities (Clowes 2013). As John Sutton (2010) has shown us, it is where a widely used technology offers complementary cognitive properties to those that we already have, that it is poised for deep and pervasive integration with our existing cognitive systems.[3] This gadgetry is not only highly portable and available but offers such novel cognitive properties, and is thus poised for deep integration with our basic human capacities (Clowes 2015).

Having such powerful, fast, portable, personalized, transparent-in-use technologies at our fingertip's end changes the epistemic environment in which all of our cognitive processes operate and are now embedded (Smart Forthcoming). Artefacts such as Wikipedia and Google seem to have already changed how we relate to knowledge (Simpson 2012). Matters of fact are now often settled by Googling rather than personal recall (or argument). Some empirical studies shows that regular users of such systems count the information they can access with their devices as part of their own knowledge, even when they do not have concurrent access to their devices (Ward 2013a). It is often simply easier, faster and more accurate to speak to Siri than it is to bring something to mind[4] (Clowes 2013; Michaelian 2014), so it is perhaps no surprise and even justifiable that many people are adapting to the new epistemic conditions (Clowes 2017). Whether such "extended knowledge" should count as part of what any individual agent knows, is still a highly contested matter (Clark 2015; Clowes 2015, 2017; Palermos 2014; Sterelny 2010).

At least some Cloud-Tech artefacts or systems are strong candidates for being counted as part of some of their user's extended minds (Clark and Chalmers 1998). For David Chalmers (2007) the moment when his iPhone should be counted as a part of his own extended cognitive systems was arrived upon some time back. But, even for those who see these technologies as primarily a new and powerful environment for the mind (Dror and Harnad 2008), or scaffolding (Sterelny 2010), the nature of many of our cognitive processes is undoubtedly changing as we accommodate, appropriate and adapt to our new artefactual background.

Yet, very often these changes have been refracted through a background climate that tends to see this technology as largely detrimental to the human mind and alien to us. Many contemporary theorists see the Internet as having a primarily negative effect on our cognitive abilities including our capacities to store and retrieve memories (Sparrow et al. 2011; Ward 2013b), our social competences (Greenfield 2009; Turkle 2011), reading (Wolf et al. 2009) and perhaps especially our abilities to control attention and sustain directed patterns of thought (Carr 2010; Loh and Kanai 2014).

Memory has been one of the key prisms for these questions. In a series of recent papers Ward (Ward 2013a, 2013b) and other colleagues of the late Daniel Wegner have presented evidence that the Internet is changing the way that human memory works. Ward claims the Internet affects our brains as a sort of supernormal stimulus (by analogy with junk-food). He contends that our memory systems treat the Internet as a

[3] See also Heersmink (2015) on complementarity and several dimensions by which the integration of artefacts can be analysed.

[4] The JFGI or "Just F&%$ing Google it" principle seems to show that the epistemic background of mind has undergone a radical change which we have as yet only dimly understood theoretically (Michaelian 2014).

global expert and, because of our tendency to socially distribute memory (Wegner 1987), individual brains tend to store less information internally. Sparrow et al. (2011) show that, at least in some situations we take advantage of computational resources to remember for us, in the sense that the brain's strategy can move from remembering the information itself, to how to access that information. Our brains, it appears, tends to store less information internally when we judge (consciously or otherwise) that we will be able to easily access that information from external sources later. We should not rush to judgement on these questions. It is worth considering whether such memory 'offloading' might be partly strategic and perhaps should be considered as an intelligent accommodation to new forms of worldly epistemic resources (Risko and Gilbert 2016). Being able to reliably save some information currently tying up working memory can release cognitive capacities for other parts of a task (Storm and Stone 2015). We should also be circumspect about how generalizable these findings are. Heersmink has questioned the ecological validity of the Sparrow et al., studies on the grounds that the experiments do not actually use the Internet but non-networked PCs (Heersmink 2016a). The question of whether, and in what ways, the incorporation of E-Memory diminishes or augments us is contested and complex (Clowes 2013, 2017; Heersmink 2016a, b). Given how we use these devices, it may make more sense to interpret agent's extended memory resources, at least some of the time, as proper parts of those agents (Clark and Chalmers 1998; Clowes 2012).

The internet is also allegedly having profound and predominantly deleterious effects upon executive function (Loh and Kanai 2015). Executive function is conceived of in cognitive psychology as the central processes that order and organise behaviour including such cognitive functions as conscious planning, self-monitoring, action initiation and the abilities to appropriately shift and direct attention. These functions are clearly related to those collected under Bratman's notion of strong agency. Strong agency – as described in the introduction – is to be understood as the interrelated human capacities of planfulness, reflectiveness, self-regulation and the ability to manage temporally extended projects (Bratman 2000, 2007). A persistent claim in the literature on the neural and psychological effects of the Internet is that it undermines these sorts of strong agentive capacities.[5] One widely influential version of this argument is Nicolas Carr's claim that the Internet is rewiring us to have easily distractable "juggler's brains" which deploy more shallow attentional strategies to continually switch between a variety of half-finished tasks (Carr 2010). According to Carr, the Internet is changing the brains attentional capacities through a constant barrage of multimedia data, and thus rendering us more easily distractible. Our ability to adequately perform as strong agents is thus undermined.

Some of the early empirical grounding for the claim comes from Ophir et al.'s (2009) study into the relationship between executive function and the use of multimedia. Ophir et al. found, in laboratory based studies, that heavy multimedia multitaskers (HMMs) were worse at maintaining mental focus and avoiding distractions as compared with light multimedia multitaskers (LMMs). This has been suggested as evidence

[5] It's important to note that strong agency is not supposed to be equivalent to what Malafouris calls material agency. However, as I will explore in Section 3, they may be strongly connected in human life. Strong agency, I claim, is best understood as a special form of reflexive material agency.

that HMMs adopt a wider but shallower pattern of attentional focus (Cain and Mitroff 2011). One worrying sounding finding was that HMM behaviour is associated with smaller grey matter density in the anterior cingulate cortex (Loh and Kanai 2014). This is especially peturbing if one assumes that such findings are *caused* by the use multimedia such as the internet. What is almost never mentioned here is that these findings are correlational. There is some evidence that exposure and usage of the internet can quickly change some patterns of activity in the brain (Small et al. 2009; Small and Vorgan 2008). But it is far from clear such changes of brain activity are anything different from the rewiring of neural circuits which take place when we learn any new complex skill. As correlation is not evidence for causation, it may just be that those who have a more diffuse cognitive style tend to adopt patterns of heavy multitasking with multimedia, rather than multimedia driving their apparently shallower cognitive style. Further, the empirical evidence is itself rather contested with some more recent studies on multitasking unable to replicate the earlier findings showing negative effects (Alzahabi and Becker 2013; Minear et al. 2013).

But let us assume for argument's sake that the use of the internet, at least in its web-browser manifestation, does indeed afford and even encourage a sort of multitasking and that this can in some circumstances negatively affect the ability to keep one's actions on track.[6] The danger here is to assume this is some sort of permanent and deep feature of the internet. It might be a rather temporary and transient aspect of our early accomodation to, and patterns of usage of, this technology (Clowes 2018). The manner, and device ecology by which we access the internet is of significant importance here and is currently undergoing radical change. The original form that most of us used to access the internet was through a desk-top, or possibly laptop computer. This generally involved being seated at a relatively large screen and interacting with the information it displayed with a combination of mouse and keyboard interaction devices. However, this model of the typical internet user is an increasingly partial one, as an ever-growing section of the population interact with the internet through tablets, phones and other forms of mobile and wearable devices. The web is evolving to incorporate many new forms of interaction device and embodiment (Smart et al. 2017a, Chapter 4 on Embodiment). Internet usage through a smart phone (currently) often implies interaction with one app at a time to do a discrete task. The patterns of usage these new internet-enabled devices make available may already be making available radically different patterns of cognitive activity not least because they are highly portable. From the user perspective there is not a singular internet but a series of devices through which we interact, and which constrain and enable our actions in concrete ways.

I have called the idea that the technology and artefactual systems of the Internet have a unidirectional and irresistible effect upon human cognition *the impact thesis* (Clowes 2018). Following the metaphor of impact, cognitive abilities are typically understood as residing in the head, and artefacts impact upon them, redetermining those capacities or damaging them in the process. The above mentioned and influential paper by Loh and Kanai (2015) uses the word 'impact' no fewer than 18 times. The impact thesis conceives of Internet technologies as unidirectional forces having generally destructive

[6] There are reasons to think that web, at least in early forms was not well-poised for cognitive integration in a variety of tasks (Smart 2012) and indeed the interaction mechanism of scrolling through a web-page full of clickable resources may not be the best mechanism of completing certain cognitive tasks.

effects upon human cognition. Such views tend to present human beings as passive in the face of technological change. The new technology is depicted as having all the agency in this relationship, transforming us against our will or sometimes without out notice (Carr 2008). Many of these conclusions fall directly out from the implicit conceptual frameworks that are used to frame the research, which often assume a broadly neuro-centric, nativist and individualistic picture of mind. The impact metaphor tends to obscure the way in which so many aspects of the human mind are constituted by our involvement with, and our construction and deployment of, material culture; while underestimating the human capacity to shape artefacts, and in the process, shape ourselves and our minds. The themes from Material Engagement Theory, whereby emphasis is given to the role that technology and material culture has in producing human agentive capacities in the first place, is entirely absent. Yet, there are a range of theoretical resources which we can draw upon that cast human cognitive abilities, including our artefactual abilities, against a wider backdrop.

2.1 Ecologies of mind

Some reasons to understand the Internet as a new cognitive ecology turn on the sheer range and scope of the cognitive operations it now supports (Smart et al. 2017b). Moreover, the Internet, which now incorporates large-scale embedded Artificial Intelligence (AI), incorporates into everyday devices, a scale of semi-autonomous intelligence which is unprecedented in human culture (Clowes 2015; Smart 2017).[7] Some see the notion of artefact to be no longer applicable to the Internet which is more accurately seen as a sort of combined human technology hybrid, edifice and global totalizing megastructure (Bratton 2016). It is however also worth exploring its deep continuities with previous regimes of intellectually potent artefacts and artefactual culture (Clowes 2018). Whichever way we choose to classify the Internet, from the cognitive standpoint, we have created a new pervasive artefactual system within which to think. Yet its widespread cognitive implications, and deep cognitive properties are still badly under-analysed.[8]

A central problem with the impact thesis is that it underestimates the role of material culture in constituting our cognitive abilities. In large part, the current complexity and scope of human cognitive abilities simply wouldn't be possible without environmental support, and especially the support of the human-made environment, of tools, artefacts and material culture (Boivin 2008; Gosden and Malafouris 2015; Knappett 2011; Vygotsky 1978). From the potter's wheel, to the scribe's stylus, to the cabbie's use of car and road, material culture constrains and requires vast repertoires of skilful activities. Material culture thus brings with it the requirement to developing skills to make use of this culture. For these reasons,

[7] I have labelled this factor of Cloud-Tech *autonomy*. Internet technology increasingly implements the fruits of 50 or so years of research in artificial intelligence. Companies such as Google, Microsoft and Amazon increasingly conceive of, design and market their products, as artificially intelligent systems. Insofar as these systems implement intelligent processes that now operate relatively independently of individual human cognitive activities, they can be regarded in this restricted sense, as autonomous.

[8] I have previously attempted to identify some of its novelty and broad, interactive cognitive potential here (Clowes 2015). A more developed account of the cognitive implications of the internet in terms of 4E cognitive science is here (Smart et al. 2017a)

human cognition is almost never best understood as the outcome of exclusively internal and native processing systems and always depends on the use and appropriation of ecological resources. It is very rare to hear this fact explicitly contested, but the real problem is how to theoretically and practically do justice to it.

Cognitive science has, at least until very recently, tended to systematically underestimate–or just ignore–the contribution of the environment, and especially material culture, to human cognition. According to Hutchins (2010) the understanding and explanation of cognitive phenomena "must include a consideration of the environments in which cognitive processes develop and operate" (p.706). But how to do this? Hutchins's notion of cognitive ecology stresses the "mutual dependence among elements of an ecosystem" (p.706) and places a focus upon how parts of a cognitive environment relate to each other as much as how they are used by their human elements. Material artefacts themselves generally exist in a mutually constraining ecology, or *device ecology*. A wireless network printer is only useful if you have an available wireless network, to take a facile example. Drawing on Bateson's (1972) work, much of Hutchins' interest is on refocusing our attention on *where* cognition happens. Cognitivism tends to assume that cognition happens inside of an agent, and typically within an agent's brain (Hutchins 1995). The ecology metaphor, redirects the focus to include the agent's interaction with her immediate environment.

The idea of an ecological niche (Laland et al. 2000) is one frequently invoked in this context and is sometimes defined as "the role an organism occupies in an ecosystem." According to work on niche construction, we should understand that lineages of animals are not just niche-occupiers, but also niche constructors. Organisms are active in creating the environments that allow them to deploy adaptive behaviours. By analogy, cognitive niches, for humans are human-made or human customized structures that are essential to the development, production and continuance of certain cognitive activities. This approach can be used to emphasize the active role of human beings in constructing environments in which to think. On such accounts, our cognitive processes are highly adapted to the environment, and material culture we have created, and hence, the notion of cognitive niche plays an important role in explaining unique human cognitive achievements (Menary 2014; Sterelny 2007).

The cognitive ecology approach recognizes that human cognitive processes change and can even change radically as we invent and adopt new material culture. Such processes need not necessarily diminish us and indeed the emphasis of this approach is precisely upon how human cognition – throughout the ages - exists within a web of artefactually anchored processes. This means that one can only really analyse the human mind in the context of the multiple ways in which the environment in general, and material culture specifically, allows human beings to achieve our specific cognitive abilities.

There are several alternative views on how to construe this environmental potency. The extended mind approach sees human cognition as partly stretched out and partly embodied into the extended systems with which we interact (Clark and Chalmers 1998). The scaffolding approach see our technology as a (merely) potent proximal environment which shapes our cognitive practices (Sterelny 2010). Whichever approach we favour, we require a conceptual vocabulary that can trace and explain the particular contributions of human artefactual culture to cognition. However, biological metaphors only seem to partly capture how we can consciously

transform ourselves, and our cognitive processes, with our material culture. Especially they do not seem to well capture the role of skilful practice within a niche. The ecology metaphor does not obviously give us a way to analyse the way that some technologies might be disruptive, without being destructive, changing the overall structure of the cognitive space while allowing new cognitive capacities to be created. Cognitive ecology tells us where we should look but doesn't offer us a way to obviously theorise how these new capacities are generated and refined.

The constraints between artefacts within a cognitive ecology can be both subtle and highly dependent upon the existing skilful practices of their human users. Many potentially useful artefacts may require suites of skilful practice to successfully use them. Those that require too much effort to develop or provide functions that are readily available elsewhere may become superceded. The skilful practices required to operate a slide rule become largely obsolete once the pocket calculator is in widespread use. Richard Menary's (2014) observation that the human use of technology to design custom mind-worlds is also of great importance here. I would add that without considering the environment, artefacts and cultures of usage, the skilful practices involved in appropriating and repurposing technology, we risk seriously misunderstanding the capacity for the emergence of new cognitive faculties. Agency comes into focus here as an aspect of self-actualization and mind-design. Human beings use material culture to bring new aspects of themselves into being. Or as Malafouris writes: "Things mediate, actively shape, and constitute our ways of being in the world and of making sense of the world" (Malafouris 2013, p. 44).

Malafouris argues, that MET's theoretical power "lies precisely in providing a new means for studying the complex nature of the interactions between the internal and the external resources of human cognition as well as the role of cultural practices in the orchestration of human cognitive processes." (Malafouris 2013, p. 38). The material engagement picture helps us to see *how* new aspects of mind can emerge through our engagement with material culture. MET allows us to see why cognitive capacities need not be preformatted in the brain but can emerge from interaction. Indeed, many human cognitive capacities only emerge with the creation of certain artefacts and extensive realm of skills which are constructed around them. One bravura analysis focuses on the Ancient Near East, and how the construction and the use of clay tokens, allowed human beings to extend their basic number sense into sophisticated mathematical capabilities (Malafouris 2010a, 2013, Chapter 5; Overmann 2016). The capacity for advanced mathematics was not pre-given in the brain, or best understood as a purely abstract intellectual achievement. It required a sophisticated material culture and gradually accreted practice to allow the concepts to be invented. The lesson is, that conceptual invention is not always, or perhaps often, a process of internal cogitation and 'mental gymnastics', so much as the drawing out of interactions with material culture. This view places new emphasis on the interaction profile between human beings and artefacts. We badly need such investigative attention to achieve a subtler and more illuminating understanding of how human agency is appropriating and being altered by the technological means of the internet.

One of Malafouris′ most compelling examples of the cognitive contribution of material culture is his work on the potter at the wheel (Gosden and Malafouris 2015; Malafouris 2008, 2014). Malafouris sees the potter at her wheel as a paradigm case of material agency where the material itself shapes the throwing of the pot as much as the

potter. He emphasizes how the intentions and acts of shaping the pot are determined by interaction with the clay itself. Malafouris writes, "The potter's hands are skilfully sensing and grasping the wet clay so that the potter can decide precisely how much forward or downward pressure is needed to centre the lump of clay on the wheel. What is it that guides the dexterous positioning of the potter's body? How do the potter's fingers come to know and control the precise force and position of the appropriate grip for the shaping of the vessel?" (Malafouris 2013, p. 209) His answer is that these are shaped by the material properties of the Clay itself.

In similar ways, acts such as wayfinding today are shaped and structured by the properties of our Cloud-Tech gadgetry, especially smart-phones and tablets, and the information stores behind those gadgets. Our gadgets and the modes of interaction they determine increasingly structure the way we inhabit and find our way through unfamiliar terrain. Consider the task of finding your way on foot to a restaurant dinner in an unfamiliar city. Today this task will often be accomplished in interaction with one or another app such as Google Maps. Using the app requires first entering (by speaking, typing or swiping) a destination. Once the location has been requested a series of complex interactions between the mobile device and data-stores in the cloud are performed. The Cloud then provides a route to a destination on a visual display or a vocal suggestion on how to turn. At one level, the task then just involves following instructions. This may not appear an especially skilled interaction. But this is not the whole story. To reliably locate oneself on the Google Maps often requires the user to take a random walk around their current locale. This allows the device to locate its user and project a more accurate path. Moving around, taking a turn left and walking up the road, is an intimate part of finding one's way. Given the often imprecision of the map, it can require one's legs to be employed as part of the interpretative effort. Finding one's route to the restaurant becomes composed of a series of micro-interactions involving careful attention to the app's directions, and speculative walking about that together reveal the best route to the destination. Such interpretative activity—perhaps unconsciously—may skilfully factor in the inaccuracies, infelicities of interface and poor network bandwidth, which are often particular to a certain user's implicit knowledge of her device. Wayfinding with Cloud-Tech devices, I contend, is—at least in present conditions—a skilful activity, both constrained and enabled by our current gadgetry. The closely coupled interactions with device and terrain to fine one´s current location can be regarded as what Kirsh and Maglio (1994) call epistemic actions.

The reader may perhaps doubt the skilful nature of such interactions. It is thus important to notice that Cloud-Tech wayfinders are not mere zombie-like followers of machine instruction. If, as when driving a car in the countryside, I am more familiar with the routes on offer from my smart-phone I may choose to ignore some instructions to avoid a route that I know involves going over rough terrain. The point is that my actual path to my destination is determined by the interaction of the guidance of the device and my own choices and (relatively) skilful actions. Wayfinding emerges as part of this interaction.[9]

Malafouris argues that clay itself is "neuro-compatible" by which he means "materials that afford the flow of noetic activity beyond skin and skull thus bridging

[9] From 2017 onwards, driving a car while navigating with a Satnav has now been incorporated as part of the UK driving examination. Surely official recognition of its skilful – and sometimes perilous - nature.

neural and cultural plasticity" (Malafouris 2008, p. 22). My contention is that the resources of Cloud-Tech are similarly neuro-compatible in the sense that they allow the flow of cognition to interactively bridge neural, embodied and artefactual interactants (Smart 2014). We are rapidly building new virtual environments, props and prompts for cognition that structure a vast range of our own cognitive abilities. I believe these new cognitive props are best understood, not as the impact of autonomous technologies upon us, but rather as a vast and partly conscious construction of new embodied and embedded cognitive activities and abilities. MET can help us grasp the new cognitive activities by paying close attention to, and documenting, the sorts of interactive episodes I have just illustrated.

Yet, we cannot avoid the problem this raises with considering "the stuff" (Miller 2010) of the internet. To be sure, our interaction is with real, concretely realized and specific artefacts. But, these artefacts makes use of interfaces and have virtual aspects realized through a vast variety of interacting systems and properties of those systems. Our manipulations of our devices often depend upon common metaphors of interaction such as windowing and the now almost ubiquitous pinch and swipe gestures, i.e., skilful practices. But behind these, are more intangible features such as our data profile which also constrains our interactions. This "data shadow" is inter alia composed of the history of our interactions, our location, the apps we have installed, and the ways we have customized a particular gadget. In short, the new technological ecosystem is both highly personalised and highly mutable. It is composed of a vastly heterogeneous ecology of technology, from massive data-stores often tightly coupled to our activity both as individuals and as groups, to the interaction constraints and interfaces of particular apps, to mediating influence, i.e., processing speed, screen size of the gadget we are using, and to the overall policies and design decisions made by technology companies. Grasping this (im)materiality, of the internet is made difficult because the nature of the internet's materiality is so complex, multi-layered and in several ways in question. The (im)material stuff of the internet is undoubtedly the means by which we are shaping and creating a vast variety of new cognitive activities, but its multiform nature makes the basic nature of this "stuff" difficult to grasp at a theoretical level.

3 Strong agency and its Artefactual supports

We have seen how artefacts make a substantial contribution to human cognition, and from the material engagement perspective they also make possible human agency as we know it. It is implicit in the material engagement approach that human agency is treated in its wide compass. Agency, as Malafouris argues, is not to be confined just to traditional planning, self-control and problem-solving activities emphasized by cognitivism. Nevertheless, it is important to reflect on the importance of material culture to such "high level" and arguably central agentive activities. When agency is treated through the notion of executive function it is generally a more restricted set of abilities to do with the governance and self-control of the agent. In this section then I want to focus more on these more reflexive capabilities and seek to locate them to the MET frame of reference.

According to the philosopher Michael Bratman, in addition to basic (animal) purposiveness human beings are *strong agents*. This specifically human agency (or

strong, or planning agency) consists in the following capacities: "We are reflective about our motivation. We form prior plans and policies that organize our activity over time. And we see ourselves as agents who persist overtime and who begin, develop, and then complete temporally extended activities and projects" (Bratman, p35). Bratman emphasizes how "merely" purposive agents do not have these capabilities and also how the capacities of strong agency tend to fall together. We often confirm to and manage prior plans, and use them to guide our actions. It is because of our abilities to reflect on these plans and policies, and the motivations and reasons behind them, that we can exist as interpretationally adequate and consistent beings involved in wider social institutions such as contracts and various social and collective activities.[10] It is through these temporally extended plans (and projects) that, in part, we recognise and regulate ourselves, and actualize ourselves as individuals. Falling together into a suite of skills or abilities, these strong agentive capacities characterize, Bratman argues, charaterizes what is unique about human agency.

What Bratman, largely leaves out is the role of material culture in sustaining and enabling this planfulness, reflectivity and sometime persistence of much human cognitive activity. To see, we shall focus on one of Bratman's favourite illustrations of these capacities: an author engaged in writing a book. Bratman notes the importance of the planning activities involved, and how the author holds herself to task through submitting, regulating and occasionally reinterpreting actions in terms of an explicitly made plan.

In one passage in his book *Being There,* Andy Clark considers the brain's eye vantage point on a particularly creative day in the life of a fictional author: John. John, attributes his fine day of writing to the workings of the inner activities of his brain. However, John's brain, in an imagined monologue, begs to differ. Noting the importance of its close interactions with the ensemble of proximal material resources, the brain remarks:

> "My role, as best I can recall, was to support John's rereading of a bunch of old materials and notes, and to react to those materials by producing a few fragmentary ideas and criticisms. These small responses were stored as further marks on paper and in margins. Later on, I played a role in the reorganization of these marks on clean sheets of paper, adding new on-line reactions to the fragmentary ideas. The cycle of reading, responding, and external reorganization was repeated again and again. At the end of the day, the "good ideas" with which John was so quick to credit me emerged as the fruits of these repeated little interactions between me and the various external media. (Clark 1997, pp. 224-225)

Bratman's abstract characterization of strong agency is not contradicted by this sort of close attention to activities where "brain, bodies and activities conflate" (Malafouris 2004), but Clark's analysis does illustrate how the role of material culture in

[10] It is of course possible to argue with the claim that lives are intrinsically meaningful without some sense of the future and our purposes. However a long Lockian tradition sees our long term sense of ourselves as enduring beings with interests and self-disclosable purposes are central to what it means to be a human agent (Parfit 1984).

constituting strong agency has been obscured by the classical cognitivist outlook. One can wonder moreover, the extent to which our much-vaunted agentive capacities really depend, not upon our human biological endowments, but upon our deep but easily and often overlooked dependence upon material culture.

But what of the reflective capabilities characteristic of strong agency? Writing of course encourages reflection. As Clark notes "By writing down our ideas, we generate a trace in a format that opens a range of new possibilities. We can then inspect and re-inspect the same ideas, coming at them from many different angles and in many different frames of mind. We can hold the original ideas steady so that we may judge them, and safely experiment with subtle alterations." (Clark 1997) But such reflection is not necessarily just an aspect of the higher intellectual skills of authorship. Working clay, Malafouris contends, supports the potter's capacities for reflection as much as they do immersion. A project that is not going to plan (a plan-in-action), can be rethought through the ongoing activity in much the same way as ideas are transformed through the manipulations of paper, and now text on a screen.

Bratman overlooks the constitutive role played by artefacts and material culture in making this kind of cognitive organisation possible. In this respect Bratman's strong agency is susceptible to the sort of critique Malafouris targets more generally at the idealizing tendencies of cognitive science (Malafouris 2008). But such under-reporting of the role of artefacts in the enactment of human agency is exactly the problem we need to get to grips with, if we are to adequately theorize our interactions with the new and emergent material culture.

How much of human planfulness and our temporally extended deliberations depend on our patterns of use of material culture? Is human executive function really part of the human essence or might those very capacities of planfulness, reflexively and self-governance depend upon material engagement? Or to put this another way, how far are these apparently lofty and vaunted capacities of human agents dependent upon artefacually anchored capacities which are only created and sustained through our engagement with material culture?

4 Attributing agency and grasping immaterial culture

As we have seen, the idea that human agency, through its proxy of executive function, is diminished through our use of Internet technology has widespread backing and seems to be the primary way that most media commentators, and many researchers, think about the implications of the Internet for human agency. Especially, the claim is that multimedia supporting artefacts, and the Internet in general, are deleterious to our ability to resists distraction and maintain executive function (Loh and Kanai 2015; Ophir et al. 2009). But might it be possible that our capacities for executive function, or to put it another way, agency, might similarly come to be enacted, and perhaps even be enhanced by the properties of this new 'immaterial' culture?

Applying Material Engagement Theory to the (im)material culture of the Internet requires some refinements, not least because it some respects the *material* aspect of the devices we use to access the internet today are so flexible and fungible. It is not so

much, the immediately graspable material aspect of smart phones, tablets and wearable devices which is so important from the point of view of the novelty of these devices (although these are novel). Rather it is what lies behind them in the cloud of data warehouses and massive computational power. The flows of information and representations that allow my smart-phone to ceaselessly track me, as an individual agent moving through a city, or as internet user with a vast history of web searches, depend upon a largely invisible computational infrastructure for which the new mobile devices are an interface (Swan 2013). The services this infrastructure offers, and ultimately its affordances (Norman 1993), depend upon a density of prior interactions which are recorded by companies such as Google and Amazon, and represent me as a unique individual (Lupton 2014). My abilities to make use of these systems certainly depend upon my skills in manipulating their interfaces, but also the traces I (sometimes involuntarily) leave of myself as I interact with them. Such features shape the nature of the unique artefactual properties, or "material" of the internet, which at least from the point of view of the individual interactant, partly depend on mechanisms which are hidden or implied, but not manifest in the artefacts which we hold in our hands.

This said, our principle interest here is to ask whether some aspects of these same artefacts might support aspects of our agency. Here we can use our analysis of Bratman's ideas as practical tools, to examine how certain aspects of (im)material culture of the internet, might be involved in, make possible, or undermine, the processes of strong agency. The idea of reduced executive function (Ophir et al. 2009) can be mapped onto Bratman's strong agency in the following sense. When an agent's executive function is compromised, that agent will likely function as a weaker and less coherent agent, more easily deflected from carrying through her plans, as well as being less able to reflect upon herself as a coherent agent. But it is worth considering whether our interactions with the stuff of the Internet might in some respects help maintain and express the properties of strong agency.

One example of potential agentive enhancement derives from my personal experience of interactions with the StayFocusd extension for the Chrome web-browser. Once installed and set up, this app runs in the background of my web-browser, observing and my browsing habits throughout my work day. It is set up to record when I am looking at one of a number of non-work-related website including facebook, the Guardian, and other sites upon which I have previously set a time limit. When the time I have allotted myself for the day is exhausted my browser closes whatever screen I am currently looking at and replaces the browser window with the message and image show in Fig. 1.

In this way, I set out to control my activities in accordance with a policy, much in the way that accords with the way Bratman sees strong agents operating. It is just that StayFocusd has taken on the immediate role of making sure I comply with my own previous policy. It has become part of my own extended mechanisms of self-control.

I also have similar time-management and parental control app called *Kids Place* operating on my son's android tablet. I use this to control his access to the various installed programs. Each app is set to a group with names such as "Play and Learn", "Just for Fun", "Bedtime and Reading" and (befitting its special status in the world of six-year olds), "Minecraft". Much to my son's chagrin there is a daily time limit for

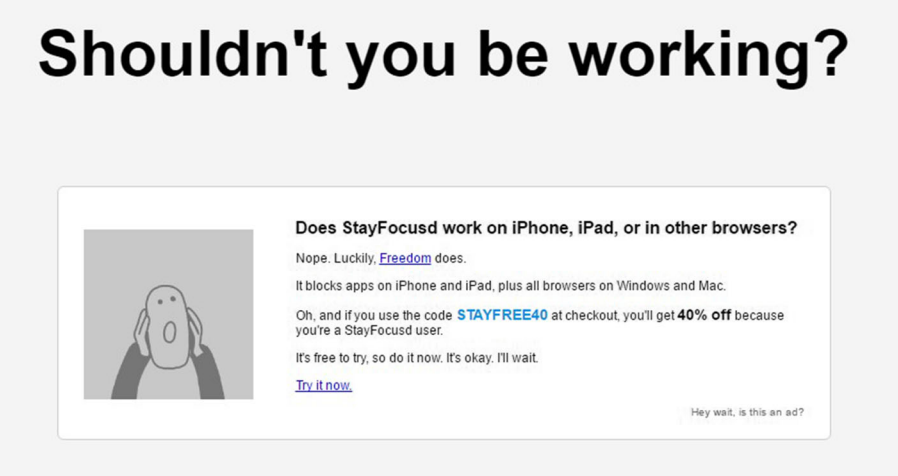

Fig. 1 A timely message from StayFocusd

how long he can play apps in each of the groups. These time limits, as well as which times of the day he can access certain apps, are determined by me. One policy for instance is that no Minecraft is allowed before school or after 8.30 in the evenings. Reading apps or other calming stuff has somewhat more liberal policies attached. *Kids Place* here operates as a regulative device in order to make sure my son doesn't play computer games all day. I hope, long term, this arrangement will help build certain intellectual skills with programs I consider valuable such as those that encourage reading or maths and spend less time on completely frivolous stuff. Whether the use of such devices should be seen as strengthening executive function, partly depend on who determines the scope of the policy that controls such apps. It is difficult to argue that this arrangement is contributing to my son's agency directly. I control the app and set its policies. My son is only dimly aware of what these policies are although he certainly knows he cannot play Minecraft early in the morning. I hope *Kids Place* may help my son develop his powers of self-control in the future, and the app certainly has promoted some reflection and discussion on how to manage his time.

Such regulative policies implemented in software apps have similarities to the way Latour's (1990) hotel-key operates to regulate the activities of hotel guests.[11] Although Kids Place embodies more sophisticated strictures than offered by the hotel key, it nevertheless constrains my son's actions, although perhaps eventually might help enabling his powers of self-control. The question of ownership and who is directing policies, controlling what the constraints are, and what is visible and invisible is of significance here, but is not a straightforward question. I have argued previously that taking personal ownership or 'cognitive possession' is a requirement of the deep cognitive integration of an artefact, and a constraint upon it really counting as part of your own cognitive equipment (Clowes 2015). Resources that operate according to hidden principles that are difficult to ascertain seem not to reach this bar. Nor do those which are simply controlled by another person, or invisibly controlled by some corporation. Such strictures are more easily interpreted as limits on autonomy and

[11] See discussion in Chapter 6 of Malafouris (2013)

agency. Computational systems and data structures that shape the nature of the interaction but which are invisible or inscrutable to the user, or fail to support her abilities to reflect on her ongoing activities, are similarly unlikely to support much strong agency (Clowes 2015).

Yet, some of the social and self-quantifying aspects of the new technology might make novel contributions to one's ability to observe and shape oneself (Lupton 2014; Swan 2013). Cultures of self-tracking can shade into self-shaping. Use of the Fitbit, a wearable device and accompanying app, that monitors the number of steps taken and the sleep patterns of its user can be seen as one such self-shaping device. The Fitbit (and related artefacts) are a class of devices that started out as networked pedometers, which can constantly monitor an increasing range of their wearers activities such as heartrate, activity levels, sleep patterns and especially the amount of exercise their user takes. Fitbit's accompanying app can give detailed information on its owner's everyday activities, but of equal important, allows the owner to produce a policy, namely to take X number of steps a day. The daily updates the device provides allows its user to monitor their own activities, strive to conform to their prior intentions, and when needed, update the policy.

Fitbit and StayFocusd and their software adjuncts indicate something of the role of a new range of artefacts within our current cognitive ecology of material agency. Insofar as they support, even encourage, Bratman features such as planning and reflection, they can be seen as facilitating forms of executive function. Forms that supposedly, and according to many pessimistic theorists, are under threat from Internet technology. Indeed, through the externalization of policies which are then used to regulate one's life, we might even find some agency enhancing effects here. (The social aspects of the Fitbit device whereby someone can compete with friends to keep up their fitness regime seems to be an important further means to encourage users to stay on target with their policies).

The new hyper mobile and wearable gadgetry of the internet is rapidly making possible patterns of activity that can support various aspects of human self-regulation. This can be viewed as a process of–partially consciousness–engineering the sorts of cognitive capacities we desire. On this analysis, re-engineering our extended cognitive ecology with devices such as the Fitbit, may offset many of the distraction effects supposedly inherent to the internet. Such devices and apps may even allow us to construct new forms of reflective self-regulation practices that help us complete plans and regulate ourselves in ways that are highly valuable. Close examination of these technologies, and how they are already undergoing a rapid evolution, suggests it is worth formulating new questions in this area about what sorts of technologies might also help articulate and support planning agency. It is certainly too early to write off the Internet as something which can only negatively impact upon human agency.

5 Acknowledging and shaping human agency

Human agency needs to be understood as bound up with our technology and material culture. Although there were some early indications that usage of multimedia and the web might undermine 'executive function', these finding are probably prisoners of the times and material culture in which they were embedded

as much as being evidence of any timeless facts. To reach beyond these problems, we need to more carefully analyse the complex ways in which a range of internet-enabled artefacts already invisibly track and shape our activities. In at least some of these interactions, as in the case of Fitbit, we can turn such user-monitoring devices toward structuring and enforcing our own policies. They are already becoming some of our preferred means of self-reflection and self-regulation. From such interactions, new forms of strong material agency are already emerging.

It is beyond the scope of this article to discuss all the factors by which our artefacts, apps and the databases of Cloud-Tech may allow us to regulate, shape or simply gain cognitive access to a range of our activities. These are multi-form indeed (Smart et al. 2017a). For these technologies to be involved in enhancing our agentive capacities, the ability to cognitively penetrate some often-hidden data-centric aspects of the technology seems to be an important property. Cloud-Tech tends to make some aspects of an extended cognitive coalition salient and open to reflection, while rendering other aspects transparent or even invisible. In this they are not unique (Norman 1993). When an interface renders a particular aspect of an activity inaccessible or invisible this will tend to render that aspects of our cognitive goings-on less open to conscious reconstruction or self-shaping. This may mean the technology needs to be designed to allow us to delve behind obstructive interfaces (Stephenson 1999). But we should not underestimate how interactions even at the surface of technology can yield surprising results. This is part of the lesson of Malafouris' potter who may not be able to give a detailed account of her actions, but can use practical knowledge to, interactively, shape the result to her desire.

If we pursue the parallel with the potter for a moment, coming to know how to shape a pot requires a masterly understanding of clay and how human hands can work with it. The properties of the clay may simultaneously become transparent in use and recalcitrant to verbal reflection. Without this skilful understanding, the capacities for agency that emerge from the interaction are likely to be curtailed. Thus, one question to put to our interactions with the new (im)material culture is whether it really supports the sorts of actions of skilful knowing, and perhaps especially skilful self-knowing that a potter can achieve at the wheel. Such questions are difficult to answer in the abstract and tend to require analysis of actual interactions.

I've argued that some patterns of our use of Cloud-Tech is rapidly adapting to support aspects of what Bratman called strong or planning agency. We should therefore be more circumspect about deriving one-sided conclusions about the internet's negative 'impacts' or human cognition. The MET framework can help us grasp the ways that technology can extend (and limit) certain capacities and even allow new capacities to be created. This requires analysing the detail of our interactions with particular artefacts as much as considering the properties of technology in themselves.

We are a species of serial self-re-shapers and the invention, use and elaboration of technology and material culture is the way we have done this throughout history. Our appropriation of Internet technology need not be different if we grasp it in the right way. If we are to get the sorts of results we desire, we need to try to own this process a little more.

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