

Hybrid Memory, Cognitive Technology and Self

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Abstract. Recent years have seen an explosion in the production and use of technologies that allow us to record, store and recall ever-increasing amounts of information about our lives. Some welcome these trends as offering new possibilities for self-understanding and expression. Others think that things have already gone too far and worry deeply about what the future might hold. Does mem-tech really promise (or threaten) a radical change to the cognitive profile of human beings? If so, how are we to assess the possibilities and attempt to understand whether they offer a hopeful or dangerous turn in the human condition? This paper attempts to develop a balanced understanding of current trends in mem-tech and also consider some of its more probable future trends. In so doing it identifies four factors about the new memory devices: Capaciousness; incorporability; autonomy; and entanglement that suggest not just technical, but important psychological implications.

1 INTRODUCTION

Human nature and intelligence is not just a matter of our genetic endowment but relies heavily on a variety of factors including our cultural background, historically specific modes of thought and, not least, the pre-existing artefactual world into which we are born. Artefacts have in a variety of ways altered the lives of human beings and, directly or indirectly, the way we think.

Technologies which work more directly on our cognitive abilities we can call *cognitive technologies*². Yet, in fact, many developments of tools can bring with them changes in the modes or scope of human thinking. A favourite example of mine is cooking. Developing the ability to cook meat with fire may have dramatically reduced the amount of time early humans needed to spend finding food hence releasing time in which to think and, perhaps, invent culture. However, pragmatically including cooking as a cognitive technology makes the scope of any enquiry very large. We have to narrow this scope somehow.

Provisionally let's take cognitive technologies to be those technologies that perform functions which, were they to be performed by the human brain, would be regarded as cognitive³. No special claims are here made on whether or how cognitive technologies, or indeed other environmental resources might actually count as part of the mind. We will here side-step the ontological discussion around the extended mind and defend no

strong position on whether cognitive technologies extend our minds [2, 3] or merely act as a new sort of environment in which they work [4]. Rather we are centrally interested in what happens to minds as they come to rely on the specific cognitive implications of digital technology, especially digital recording technology, handheld devices and all the paraphernalia of the mobile internet. As these technologies become increasingly pervasive in our culture, it is interesting to ask what if anything might be happening to our minds in the process. Most specifically we will focus on those digital technologies which may be reshaping human memory⁴.

Despite avoiding the ontological question, we will use a terminology which suggests a tentative endorsement of the extended mind hypothesis by referring to E-Memory and O-Memory. The term O-Memory we here use to refer to organic or, perhaps better, organismic memory. O-Memory refers to an undoubtedly heterogeneous set of systems and processes which underlie the ways in which human beings and their brains retain and organise knowledge during episodes of experience which they can later bring to mind to put to work in a variety of ways. E-Memory similarly is used to refer to a heterogeneous bunch of devices and systems which fulfil similar functions either by replacement, extension or augmentation. One recent study[5] details how E-Memory⁵ systems can support a range of human memory functions, including what the authors call the five Rs, namely: *recollecting*, *reminiscing*, *retrieving*, *reflecting* and *remembering intention*; the latter referring to way E-Memory systems (such as Microsoft Outlook) can allow us to track tasks, projects and actions that we intend to perform. Still, we should remember that the E / O Memory distinction is a conceptual division. One of the main points of interest of this article is to shift our focus toward the current and future hybrid systems that are being forged as E and O-Memory systems interact in ever more intimate ways.

On the rough (and in several ways) problematic definition of cognitive technology just offered, we are spending ever-increasing amounts of time interacting with a new regime of cognitive technologies and especially E-Memory systems that have become a constant background to many everyday cognitive tasks. Google, Wikipedia and an ever-enlarging panoply of smart phones, personal gadgets, devices and software technologies, seem to be performing a variety of cognitive functions which either relate to, replace or augment O-Memory systems. These technologies include the encoding, storing and retrieval of memories and the full range of the five Rs just mentioned. And yet as these technologies and our habitual use of them is increasingly becoming a part of everyday life, the tendency is for

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² Richard Gregory coined the related term mind tools [1] to refer artefacts that have a direct effect on the way we think. However, the term cognitive technology seems to be in more general academic usage and even has its own journal: *Cognitive Technology Journal* published by Robert Rager Press.

³ This way of looking at thing closely follows Clark and Chalmers original article on the extended mind. [2]

⁴ Although we will mainly stay clearly of the ontological discussion it is interesting that memory seems to be becoming a crucial test instance for the extended mind.

⁵ The authors were actually specifically discussing lifelogging, which we shall come to shortly.

them to become invisible, fading into the background of everyday life and skilled action.

Considering the amount of time we now spend interacting with these technologies, and arguably the possible profound implications for our minds, a series of important questions need to be addressed about what might be happening to us in the process. What are the cognitive implications of relying heavily on prosthetic technologies which fulfil tasks and functions that we once would have performed with our brains alone? To focus on memory, the main subject of this article: How are organic memory systems being changed by our encounters with and increasingly heavy usage of E-Memory devices? Given the central role memory plays in our cognitive architecture and its role in constituting our sense of self, is our use of E-Memory already or likely to start changing our basic cognitive profile? And, if so, how? Does this have implications for our broader humanity and the sorts of beings we are? These are deep questions then and difficult to answer - but we have to start somewhere.

In fact these questions have not passed entirely unnoticed in the wider culture; there are a series of authors who are deeply worried about what might be happening to us [6-11] in the process of our mass adoption of these technologies. Some of this work is a serious attempt to engage with what these technologies might be doing in interaction with our minds and some of it has a more sensationalist cast. This rather pessimistic outlook on what might be born out of this interaction between the mind and the new cognitive technologies is interesting in the light of some of the more utopian things that have previously been written about the internet's cognitive implications [12-14].

If anything, we are currently going through a backlash against such utopian thinking and so now, more than ever, we need to keep open the possibility that technology can add, as well as subtract, from the mind. Arguably, the history of technology and the mind up until now has been one where technologies with the most important intellectual implications, from writing, to the book, to the telescope, to the microscope have given the mind more than they have taken away. This article is an attempt to get a grasp on how mem-tech (digital memory technology) might already be having profound effects not just on organic (biological and traditional practices) of memory, but on our sense of self, and our wider processes of thinking.

2 E-MEMORY, LIFELOGGING AND ITS COGNITIVE IMPLICATIONS

Just as the amount and density of information that is being recorded about us in everyday life is ever-increasing [11, 15], so the ability of everyman to record the sound, images and many other sorts of digital traces of his life are showing a similar expansion [16]. The early twenty-first century has already seen a massive increase in the cheapness, availability and capacity of digital recording, storage and retrieval technologies that have placed an ever expanding arsenal of external memory technology in the hands of millions of people. The availability of cheap digital voice recorders and mega-pixel cameras embedded in mobile phones, as well as the powerful smart phones and tablets that many carry about all mean that increasing numbers of us are recording detailed records of our lives in ways which would have been scarcely possible only a few years ago. In addition, apps on smart phones and tablets are placing an arsenal of new

software in people's hands that can put this information to innovative and exotic purposes.

The invention and widespread permeation of these technologies seem sure to have deep and widespread social consequences and perhaps offer to transform the way that both individuals and a society recollect and give meaning to both their personal and collective pasts. This process is continuing to the point that some now think it makes sense to believe that in the near-future we will seek to record the sum total of our experience: the dream (or chimera) of total capture [5] or total recall [17]. If there is little doubt that we have seen a technical E-memory revolution, then should we expect that our existing O-Memory systems will change and adapt to accommodate them?

Before tackling this question, however, it is worth asking whether what we are seeing is really novel. E-Memory is far from being the first technology to change how we use our organic systems. Arguably the history of the human race is in part of the history of how our O-Memory systems have been undergoing a constant process of elaboration and adaptation as we have created wave after wave of extended memory technologies [18, 19]. From spoken language – if it can be counted a technology [20] – through drawing and painting [21], to the development of counting systems, knots in rope, to writing systems [22, 23], through the development of record-keeping bureaucracies, the whole history of human art and technology can be seen as a history of revolutions in memory. And that is not even to make mention of techniques which have sought to reorganise (generally upgrade) human memory, from classical training in mnemotechs, to the medieval training use of memory palaces[23], to the rote learning systems practiced in twentieth-century schools. All of these inventions can be seen as important historical moments when our relationship with the technology of memory has undergone fundamental changes.

It is thus highly contestable that the purported reorganization of memory around particular technologies today is really historically unprecedented. Yet, it is surely worth pondering what, if anything, is new or distinctive about the particular cognitive technologies which are currently being developed. Only then can we decide if they might have novel cognitive and psychological implications for the human race. I suggest there are four aspects of the current crop of E-Memory technologies that have important qualitative or quantitative differences from previous mem-tech and that we should focus our attention here to understand what is really new. They are:

1. **Capaciousness & Comprehensiveness:** E-Memory promises to record our everyday activities on a scale and with a fidelity and completeness that would have been practicably unimaginable under previous regimes of mem-tech.
2. **Incorporability:** E-Memory technologies potentially possess a transparency of use that makes them competitors (or complements) with certain of our internal resources. They are thus poised for deep and pervasive integration with O-Memory systems.
3. **Autonomy:** E-Memory repositories increasingly do not merely store data but actively process it. Thanks to tagging, indexing and AI systems we can expect E-Memory systems to not merely store and re-present information, but restructure it in a way that complements our native cognitive profile.
4. **Entanglement** –E-Memory often tracks interactions between people (or people and organisations). The form of the

data that composes many E-Memory stores is inherently relational⁶.

Although there are no doubt many other dimensions of E-Memory technology which could have profound implications, each of the four I suggest picks out a quite fundamental aspect of the new mem-tech and, moreover, each is also a candidate for having important implications for O-memory, our minds more widely, our sense of self and even our humanity. We will now look in more detail at what is potentially novel about these aspects of the technologies before returning to their cognitive and psychological implications.

The most commented upon aspect of E-Memory is its promises to be able to record, and perhaps recall just about everything we might experience. This claim to a totality of capture and recall we have called **Capaciousness and Comprehensiveness**.

Perhaps the trend or idea that brings this out most clearly is lifelogging. Lifelogging consists of creating a personal and ever more detailed digital multimedia record of one's life as it happens. Compared to any previous technology to record memories, it makes an important departure: The aim of lifelogging is that rather than making the decision and effort to take a photo or record a telephone conversation, or make an entry in a diary; recording becomes effortless and the default setting⁷.

The practice may be viewed as only making explicit a trend which is already deeply embedded among heavy users of the new digital technologies. Perhaps the most thoroughgoing and pervasive experiment so far attempted has been carried out by Gordon Bell and Jim Gemmel. Bell is a septuagenarian researcher with Microsoft but was an early pioneer of the networked computer. The project, directed by Bell and his Microsoft colleague Jim Gemmel, is called *MyLifeBits*⁸. As Bell tells the story, the project began with his desire to digitise, store and catalogue the books and articles he had written over the years. But, as the project progressed, Bell was no longer content with simply backing-up hardcopy but, as the technologies came online, Bell's aspiration became the creating of a digital record of everything he hears, thinks and sees. With this new orientation the *MyLifeBits* project turned its focus to capturing the ongoing stream of sensory information more or less as Bell himself received it.

Today, Bell not only has software on his computer to record and capture his every webpage visit, but he wears a SenseCam: a device which can be set to detect the presence of faces and was automatically set by Bell to take photos of those he encounters as he goes through his day[24]. Bell has also been experimenting to do similar things with audio technology and has equipment which records and attempts to categorise all of his conversations (and not just those on the phone). Bell now speaks about his aim

as nothing less than to use electronic memory technologies to make a total record of an individual's sensory experiences: total capture [17]. In fact he more usually speaks about total recall: the ability to use all of this information to recollect any event in his past with total fidelity. Bell sees his quest for total capture and recall as in the tradition of inscription found at the entrance to the Oracle of Delphi: Know Thyself. Moreover Bell sees *MyLifeBits* as allowing him to develop new ways of knowing oneself that are a historic departure for the human race. Bell thinks his devices can allow him to know himself in ways no human has achieved before.

Viktor Mayer- Schönberger is another who believes that the possibilities of E-Memory and 'recording as default setting' portend profound effects on us, but he is far less sanguine about the prospects and, at the very least, he thinks it forces us to confront a new problem: How to forget,

"through millennia, forgetting has remained just a bit easier and cheaper than remembering. How much we remembered and how much we forgot changed over time, with tools and devices emerging to aid our memory. But, fundamentally, we remembered what we somehow perceived as important enough to expend that extra bit of effort on, and forgot most of the rest. Until recently, the fact that remembering has always been at least a little bit harder than forgetting helped us humans avoid the fundamental question of whether we would like to remember everything forever if we could. Not anymore" [15] pg. 49.

Mayer- Schönberger believes we are on the cusp of changing a fundamental feature of our psychological lives with E-Memory technology. He worries that 'total capture', rather than putting us in deeper touch with ourselves, might reshape and even undermine our sense of self in profound ways. Much of this turns not so much on how much information we might store, but how we are starting to use it. (We shall return to this issue in section 4 below).

Our second factor, **Incorporability**, deals with the ways E-Memory might facilitate, bond with, augment or replace O-Memory such that the technology becomes second nature to the user, or, to use a more technical term, *transparent-in-use*. The sense here derives ultimately from Heidegger's observation that when we use a piece of equipment with which we are skilfully familiar, we cease to notice it as an object in itself with its own properties and our attention instead flows toward the task at hand and object on which we are working. Many technologies, including, in Heidegger's example, the humble hammer, can become transparent to the skilled user in the relevant respect. But arguably there are aspects of how E-Memory systems might become transparent-in-use that are qualitatively new. To pose this as a question: What happens when knowledge technologies⁹ become cognitively transparent in this way?

There are several technical innovations behind these knowledge-technologies but of central importance is the availability of high bandwidth mobile connections, powerful

⁶ The inspiration for this notion comes from data-entanglement, see: [16]

⁷ Work which foreshadows lifelogging can be traced back at least to the 1980s in the work of such pioneers as Steve Mann who was experimenting with using digital cameras to record his everyday activities. In 1994 Mann set about using a wireless webcam to record his daily life 24 / 7 for artistic, experimental and in part also political reasons: Mann's project was political in that he was seeking to invert trends toward the surveillance of public space with an ever-growing arsenal of CCTV cameras, he aimed to surveil the surveillers.

⁸ A detailed description of this project and Bell's motivations can be found in: [17]

⁹ I am here using the idea of knowledge technologies in a different way from cognitive technologies. The idea is supposed to be more specific and is used to mean technologies with a role in propagation of knowledge. Many internet technologies are prime examples.

mobile devices, cloud computing and, centrally, internet search. This ubiquitous computing technology makes it possible for us to have constant access to huge amounts of data, and mobile data applications, that may already compete with the authority of our organismic resources. As these technologies become more mobile (effectively a constant in our lives), ever easier to interact with, while our skills in using them deepen, it is likely we will tend to rely on them – incorporate them in our cognitive world – to an ever-greater extent.

Could there ever come a point where it is just easier to rely on ambient (or even biologically grafted in) memory devices than our own native O-Memory resources? Consider an example now familiar to many millions of users: Google Search. The internet based technology for finding information has for some time been used by many office workers dozens of times a day. As these search applications are increasingly accessed by mobile devices, they are rapidly becoming a constant part of the epistemic backdrops of our lives. With Google Search it is often quicker and easier to find out facts we might otherwise remember using O-Memory. Consider the act of bringing to mind the first name of an artist whose name is on the tip of your tongue, say the drummer with a band you once loved but haven't thought about in years. In the recent past you might wrack your brains trying to recall the name or try to think of something else assuming it will come to you in a short while. Today for millions of users of desktop computers and mobile devices you might instead type what you remember into the Google search engine. (I just typed 'drummer roxy mudic', I meant to type 'drummer Roxy Music', but my inaccuracy doesn't matter as the answer 'Paul Thompson' comes back in 0.3 seconds.) Typing a search query now often seems easier and in some cases more accurate than relying on our native O-Memory systems. In such circumstances typing search queries (or speaking into iPhones), has already become an everyday part of the recollection process itself.

Deep incorporation will turn on several factors of our use of these technologies. Of importance here is not merely how easy it is to interact with facility and effortlessness with our E-Memory devices, but how available they are to be incorporated into the patterns of everyday activities and thinking. To put this another way, it is not merely how *transparent-in-use* they become to us, but how deeply we come to rely on them. Other issues of importance are: The constancy and reliability of the resources; the constancy of our reliance on them; and perhaps centrally, our trust in them.¹⁰ It is likely that deep incorporability does not merely depend on bandwidth or ease of use but on how comfortable we become with the idea of relying on E-Memory systems to make important decisions in our lives. Factors that influence this trust are likely to depend heavily on the social and institutional landscape in which these technologies emerge.

When one wrote an entry in one's diary – even if one were using it in the way of Otto from Clark and Chalmers's famous thought experiment [2] – one might reasonably expect the record to remain the same when one next came to look at it. E-Memory technologies however, have an ever more active profile and anything recorded with current tech is likely to be able to be represented back to its user in any number of augmented ways. E-memory devices can increasingly be expected to have the capacity to reorganise and repurpose the information they present in ways that are increasingly open-ended and

reconfigurable. E-Memory 'stores' are really active repositories which increasingly transform and augment what they hold. This activeness and **autonomy** of E-Memory technologies might turn out to be their most distinctive characteristic. How we adjust cognitively and socially to this autonomy is likely to be key in our future relationship with E-Memory systems.

To elaborate further, it is not merely that Google is easy to use and returns information quickly but that it is itself an active memory. Google, by storing pointers to, and ratings of, the mass of information which is available through the internet can return a page rank on any search term in a fraction of a second. Its database of content is constantly updated but, more importantly, for us, so are the algorithms and processes that are used to find that information. Information is not passively retained by Google but – in the pursuit of its twin goals of being useful and turning a profit – it is constantly being sifted and sorted with ever more sophisticated techniques with information undergoing processing and augmentation in various ways. (This is not even mentioning projects such as Streetview where Google is also creating huge new databases from scratch and using this to augment the information it holds and points at).

Thanks to the relative autonomy and active processing nature of E-Memory we can expect that it will become ever more transparent in use; although it is likely to become at the same time more *opaque in its workings*. The implications of this are that we may use it with felicity but increasingly have less idea of how it works. It is not just that technologies like Google may be passing beyond our powers of easy analysis but that companies like Google, in order to protect their competitive advantage, will continue to try to obscure the deep working of their technology.

There is a partial equivalence here with our native organic systems, as most people do not understand the deep workings of their minds either. (It has been the job of scientific psychology to attempt to understand the principles of organic human memory and there remains much work to be done.) But the type of autonomy of E-Memory means that the user's relationship with it is likely to be very different to his relationship with his organic memory. The main reason is arguably nothing to do with the technology *per se* but that the companies who are building E-Memory systems are likely to have different interests from the users of the technology. This may ultimately be a limit on how our trust relationships with the new cognitive technologies develop and perhaps upon whether we should ever ontologically consider such technologies as a part of our extended mind.

The way that E-Memory is likely to be organised, at least in the short term, is as much around the interests of corporations making software as anything we decide. What is made visible to others may not be what we desire. The conditions under which information is made visible to us is often something of which we are not even aware. *Edgerank*, the algorithm which Facebook uses to present timelines to its users is not in the public domain (*de facto* cognitively impenetrable). Most users are not even aware that they do not see a large proportion of the updates of their 'friends'. It may even be that, given the large amount of information that flows through systems like Facebook, such selective presentation is necessary, but this surely also has ethical and cognitive implications, especially if these systems become deeply entwined with our minds.

The autonomy of E-Memory technology is perhaps the qualitative dimension which sets it most apart most from previous regimes of memory technology. Moreover, it is likely

¹⁰ All issues which echo Clark and Chalmers Extended Mind Paper.

that ever more active and perhaps autonomous E-memory systems will become increasingly pervasive. However as this happens, we are likely to find others sampling our activities to find patterns just as often as systems working to sample it for ourselves. This brings us to our fourth issue: **Entanglement**.

The idea of memory entanglement is that much of the data we are creating now, and the systems that control it, operate in part to stimulate or replicate recollection (such as Facebook history), is so deeply entangled with the lives of others to the point that it cannot accurately be considered data about *individuals* at all. What systems like facebook really track, are patterns of interaction. Social Media has been the main driver of this trend, but as it has expanded to encompass much of the activity of the internet some of our most personal data is now not only not held by us, but is deeply entangled with that of others.

Data from entangled repositories is already used to occasion memory processes, either according to our own wishes or because some organisation has chosen to remind us of something for its own purposes. The lines of who owns what are morally (if not legally) very blurred. Some are deeply worried by this [15], although there is a case to be made that there is really nothing new here. It is, after all, not merely our digital traces but our lives that are necessarily entangled with the lives of others. With or without digital media this is unavoidable. The desire to withdraw ourselves from public entanglement might really be a flight from the very idea of engagement with others [10].

Moreover, the types of entanglement made available by social media are probably changing rapidly. Some people apparently now use Facebook in the way people might have used diaries in the past. But a social network diary must function for very different purposes and presumably plays a different role for the individual.

Considering entanglement together with the autonomy point just discussed raises interesting questions about the determinants of how social media might help us to remember and forget. Facebook's edgerank algorithm is not a passive memory of our interactions with others. To the extent that its workings are opaque to us – and in part this is the flipside to transparency in use – we are not even aware of the criteria by which it might help us recall certain interactions with others. The properties of future E-Memory / O-Memory hybrid systems are likely to turn heavily on these sorts of interactions.

3FUSING ORGANIC AND E-MEMORY

Just as the central thought experiment to illustrate the idea of the extended mind in the original article[2] featured Otto, who suffered with Alzheimer's, some of the most suggestive work on E-Memory and O-Memory integration has involved those suffering from memory deficits. Deacon Patrick Jones for instance suffered from Traumatic Brain Injury, leaving him with anterograde amnesia (inability to acquire new long-term memories) and difficulties in making use of existing ones. Deacon Jones describes the profundity of some of the difficulties in the context of meeting his children: "When they walk through the door, I don't know whether they will be three or thirty, I just try to interact with them as I find them." [25]

Nevertheless Deacon Jones has made considerable inroads into overcoming at least some of his problems by using the note taking software EVERNOTE and mind mapping software CURIO on his computer and through his iPhone. Thanks to

cloud computing this software and his data store is available to him whenever he needs it in his everyday life. He uses EVERNOTE as a sort of long-term prosthetic memory and CURIO as an extension to his working memory. Many cognitive tasks that would be done entirely internally by most people are now being handled by the Deacon with his remaining organic resources in interactions with the E-Memory systems organised through an iPod, Tablet or his home computer. His ability to make use of this complex to edit a blog and look after a ministry (he has become ordained *since* suffering the most serious aspects of memory loss) is impressive, even inspirational. Given the profundity of his O-Memory deficits, Deacon Patrick's ability to live his life in a positive manner is undoubtedly extraordinary. It also indicates some of the possibilities E-Memory systems have to be integrated in the life and mind of an agent.

Another use of E-Memory devices by someone suffering from memory impairment is reported by the developers of the SenseCam in their attempts to help a female patient known as Mrs. B. who has severe memory impairment following limbic encephalitis) [24, 26]. Mrs B and her husband use a sensecam to record the events of their everyday life as they happen and then use desktop computer software to 'recollect' these events together. Mrs B's capacity when using the sensecam and then reviewing playback with her husband is as high as 70% recall for significant events (when she and her husband used written records as a comparison it is as low as 44%) [26]. It should be noted that the way they seem to be using the camera is not 'record-everything-by-default' in true lifelogging fashion. Rather, they take photos in the more traditional manner when they see something worthy of recording. Also note that Mrs B and her husband are using E-Memory in a highly collaborative fashion in order to aid her recollection: they sit at a desktop computer and review together pictures taken over a day. Nevertheless the SenseCam seems to have had positive implications both for Mrs B's O-Memory systems and for her life with her husband.

Or, consider again Gordon Bell's *MyLifeBits* project. Implicitly a major aim of the project appears to be to build an E-Memory that supports certain sorts of memory decline through aging. One part of this is incorporating face-recognition software into Bell's setup that can, on a real-time basis, report the name and contextual information - such as the last time Bell met a given acquaintance or the contents of an email from them - as Bell meets them going about his everyday life. So where Bell might have otherwise forgotten a one-time colleague's name, or some important information about her, his good devices are able to give the appropriate cue just as he needs it.

The intensive use of E-Memory might then eventually get a foothold in the senior population or among those with O-Memory disabilities, as people start to use E-memory as a straightforward replacement for fading organic memory systems, or with those who have O-Memory deficits for other reasons.

But as these technologies get used more widely it is likely they will start to support a whole range of extended cognitive functions. Similar systems to Bell's could use the internet to prompt users with information the user may never have encountered before, perhaps instantaneously Googling an unfamiliar colleague and providing unknown information as though it were remembered. Thus E-Memory technology might quickly come to support other cognitive functions as much as simply replace existing resources. In this way, E-Memory

devices might quickly shade into cognitive augmentation devices.

We might worry about this rapid evolution but it is also worth reflecting that this may be the natural trajectory of all technologies as novel uses are continually found for inventions not necessarily intended by their creators. If this is right, the path to the future is created as replacement or support seamlessly transitions into augmentation.

The open-endedness of this possible cognitive transformation is a source of worry to many commentators. Some have suggested that, as we rely ever-more on digital prosthesis, our organic capacities are under threat of atrophying [7]. Others that our humanity itself might be undermined [10]. What are the implications for those with ‘normal’¹¹ memory profiles for the widespread adoption and incorporation of E-memory systems into their cognitive ecology? Could the reliance on E-Memory foreshadow a decline in our organic memory systems in the general population?

A basic premise of the organisation of organic memory systems and the deployment of neural resources appears to be ‘use it or lose it’. Think for example of how somatosensory cortex remaps itself when a limb is lost. It is possible, that at least with regards to certain domains of knowledge, we will start to be able to explicitly remember less with organic systems as we use E-Memory systems more intensively. But the integration of E and O systems may be more complex than a zero sum game. The *complementarity principle* [27] holds that we will adopt extended resources insofar as they complement our basic (organic) cognitive architecture. The idea is that ambient resources will be useful insofar as they provide functions which, rather than replace, *contrast* with the brain’s native methods of cognition and representation. If this is right, one would expect us to make use of E-Memory insofar as it makes available resources that are new and different from our native organic (or otherwise already enhanced) memory resources. On this analysis it is precisely because E-Memory – like other memory resources of the past – is offering something that is different from our native abilities, that there is likelihood it will be incorporated.

Here consideration of the idea of the extended mind has some interesting implications. If what really matters about us is the course-grained functional profile of our minds then the distribution of our cognitive resources between internal and prosthetic systems might really not matter very much. This may be one way of relaxing about the implied disuse of organic memory systems if we come to rely ever more heavily on electronic prosthesis.

Another reason turns on more practical concerns of how we use these technologies. Consider the satellite-navigation devices that many of us now use in our cars. Now consider using one to navigate an unfamiliar city over a period of weeks. One could imagine that using the sat-nav in this way might prevent one ever coming to learn to pattern of the city. Yet this does not seem to be the case. Instead the sat-nav gives one the possibility to drive to a destination while knowing next to nothing about where one is or where one is going other than the destination address. However, using the device over a period of weeks gradually familiarises the driver with the pattern of the roads in the city to the point the driver develops a good practical understanding of its navigation. Eventually it is no longer necessary to use the

device. Really this should be no surprise as our O-Memory systems do not just stop working because we employ E-Memory devices and the sorts of interactions that may take place in true complementarity are likely to be subtle and complex.

If this analysis is along the right lines then rather than simply trading E-Memory for O-Memory it makes more sense – especially within the broader history of mem-tech – to think of an ongoing dovetailing process where technological and organic systems fuse in the overall organisation of the agent in a way that need not imply any necessary diminishment. Shouldn’t we then learn to stop worrying and love the new mem-tech?

4 PERSONAL IDENTITY, SUPER SELVES AND FORGETTING

The idea that memory might be the key to our sense of self is a longstanding one going back at least to Locke, who held that while it was consciousness that constituted the unity of persons and self, memory was the means of connecting consciousness over time. In the contemporary discussion, the idea of an extended (or narrative) self which can be unified over time is a clearly related notion and so memory continues to play an important role in what many theorists think makes us persons [28, 29]. Yet from Reid’s response to Locke until today it has been widely accepted that human memory is a problematic and fallible medium with which to achieve unification¹², for it is widely agreed that neither memory, nor narrative, are able to reliably achieve self-identity over time.

The *MyLifeBits* project and its successors might give us pause for thought, however. Our forgoing discussion of cognitive and memory augmentation suggests an interesting possibility. E-Memory, when used, as an adjunct to O-Memory might help us better fulfil the conditions for unity over time. Perhaps, by being able to store and then recall episodes in his life he might otherwise have forgotten through E-Memory systems, Bell, or other E-Memory pioneers, could potentially achieve a level of unity that us un-augmented humans cannot. This suggests the possibility that future humans, making extensive use of very authoritative and densely incorporated E-Memory systems, might have or become *Super-Selves*: Human beings whose unity over time is supported and guaranteed by their deep incorporation of an extended regime of E-Memory technologies and devices.

However enhanced unity over time might, in several ways, be counterproductive. Imagine Fred’s teenage years are extensively documented by technologies like Facebook and feature episodes that in later years he would rather forget. Unfortunately, the social media traces Fred has left behind him are proving more persistent than he would like. Part of the problem is they are entangled with the traces left by others. Photos he would sooner now delete do not merely exist in his profile, but in the profiles of his ‘friends’ and moreover now proliferate through other systems that have reproduced them. Such traces plausibly might continue to shape and influence his sense of himself; its ongoing persistence could even constrain his future and what he might become.

For related reasons, some [8, 10] have started to worry that this persistence of certain types of entangled E-Memory might have seriously detrimental effects on humans beings in general,

¹¹ Of course there is no implication here that aging is not normal.

¹² For a nice recent discussion of the issues at stake and especially how these relate to recent findings about O-Memory, see [30]

but in particular on identity formation among young adults [10]. For, if we assume that some experimentation is necessary for the development of a stable and developed personality, then perhaps the capaciousness and authority of E-Memory might indeed risk undermining something essential in the human character: our capacity to move on from the past. Thus, we may come to see certain types of E-Memory as more of a prison than a source of useful reflection. Some now believe we need to develop institutional devices that declares some sort of moratorium on the potentially total retention of E-Memory [10, 31]¹³.

Mayer-Schönberger goes further and argues that forgetting is an integral part of human memory which plays an essential role in our cognitive profile and what it means to be human [15]. As Schacter [32] and others have pointed out, recollection at least is a largely reconstructive process. Each time we access a memory it can, at a neural level, be understood as being recreated. Forgetting is in part a process where our minds selectively maintain that which is useful for them and (as Freud knew) suppress much that is inessential or unhelpful. Forgetting may not be a bug in human memory but part of what the self-regulatory architecture of our minds does in order to have selves at all, at least as we currently understand them. Arguably our identity as unique human beings arises not just out of what we remember but out of what we forget. On this analysis rather than creating a super-self, E-Memory supported remembrance might actually undermine our sense of self.

On the strongest interpretations, E-Memory Entanglement becomes a sort of dominating determinant of our sense of self [8]. Mayer-Schönberger believes that if we come to accept that E-Memory can challenge the authority of our organic systems then we are in danger of losing something crucial about what it is to have or be a self. In a basic sense, if E-Memory systems seem more authoritative than our organic resources, our sense of self might become something estranged from us or alien. Yet this seems to approach a contradiction. Surely if there is anything which we have authority over it is our sense of self. Could the deep incorporation of E-Memory lead to a possible outcome where the sense of self is not really our own anymore?

This discussion of the entanglement of E-Memory brings up some difficult problems about the very meaning of the term self. Namely, self is taken by many – especially those trained in sociology – as rather than being something private (a hidden essence, character or set of memories), as something public and interactive. A dominant influence on the contemporary discussion of how social network technologies might interact with our sense of self is the work of Goffman [33] who is taken to say that the self should be understood less as an inner essence and more a public mask or series of performances¹⁴. (In fact,

¹³ Although there is not space to fully do this point justice here I think we must remember that not all societies have had a moratorium on youthful memories. The teenage years, where this sort of experimentation often occurs, are a particularly 20th Century invention and there have been many societies in the history of the world that have been hostile to this sort of personal experimentation. This is not to say that such experimentation is not important and valuable to us but it seems to stretch the issue to make it something necessary for the development of a sense of self *per se*.

¹⁴ It's highly questionable if this is even a coherent interpretation of Goffman, see [30] page 104 – 105.

Goffman maintains a distinction between self and mask which many of his followers tend to collapse.) But it must be remembered this notion of self is very different to the tradition begun by Locke. The very idea here is that selves are unified thinking things, not masks. Nevertheless if this inward sense of self is strongly influenced by public performance then the facilities that social network technologies make available seem likely to play a role in this.

Even with the fledgling E-Memory technology of today we do not consider ourselves infallible and our remembrance is often open to revision, especially if we find that other people – or sources – remember or portray things differently. We already have to factor in the vagaries of memory into our lives. Perhaps in the future it will just be a little harder to indulge in certain outright fictions about ourselves.

But it is not clear why this should endanger our sense of self *per se*. E-Memory's *de facto* entanglement with others in many ways is continuous with how a sense of self is constructed in the past: i.e. through interactions with others. That Mayer-Schönberger assumes rather than demonstrates that our sense of self (or personal identity) might be undermined by E-Memory is largely to do with how individuals come into conflict with organisations that can now more readily access and store more information about us than we would wish[11]. The growing imbalances of power between individuals and the companies that hold ever increasing amounts of information about us is undoubtedly a problem [e.g., 11] but this is a rather separate issue from the determinants of our sense of self.

5 SELF-KNOWLEDGE, POINT OF VIEW AND THE DEEP COGNITIVE BACKGROUND

Do the limits of the organic processes of consciousness and O-Memory really exhaust all we might wish to know about ourselves? This seems unlikely. The potential uses of E-Memory devices precisely promises to make available, or make explicit, information about aspects of our lives and ourselves that otherwise would be hidden in the background. Whether we will all always be happy with the forms of self-knowledge this information makes available is certainly questionable. But our felicity is surely no criterion for what should count as knowledge.

We need to take a step back from questions of power imbalances – important though they are – and ask whether E-Memory might nevertheless offer us new resources to constructively reflect on ourselves. Gordon Bell has been engaged in a practical form of this project and, as we have seen, conceives of the *MyLifeBits* project as a Delphic investigation into self-knowledge. We need to take seriously the claim that we could come to reflect on and know ourselves in ways that only this technology could make available. Let us consider again the claim that E-Memory can deepen self-knowledge by paying attention to the four factors which we previously held seem likely to be of the greatest cognitive and psychological import: Comprehensiveness; Incorporability; Autonomy; and Entanglement. In addition we will consider whether our interaction with systems with these properties might alter the sorts of beings we are.

Let us first consider some objections: It could be argued that Bell's dream of achieving an enhanced (perhaps even total?) form of self-knowledge with *MyLifeBits* is premised on a mistake about what self-knowledge is. Bell may be collecting

and digitizing data about himself with an unprecedented comprehensiveness, but that does not make it *self-knowledge*.

One reason to suppose this is that the data and E-Memory systems that Bell has amassed do not really count either as part of him, or his memory. Insofar as the E-Memory data does not deeply interact with Bell's own O-Memory systems, (it remains inferentially chaste), this seems a reasonable point. However E-Memory systems that are both easily incorporable and autonomous might quickly override such concerns. (We shall look at an example that touches on this point in a moment.)

Another objection is that self-knowledge, is not *merely* knowledge about oneself, but is only a distinctive category insofar as it is really the agent's own knowledge. To put this another way, self-knowledge proper has to in addition belong to the agent or be integrated into the agent in such a way as it can be said to have the property of *mineness*. Of course this does not solve the problem as we now have to be clear about what it would mean for an E-Memory system or its contents to have this property. One possibility of what we should want to mean by *mineness* is that the system is deeply integrated into the agent itself, and / or forms part of the agent's perspective, or point of view. E-Memory systems might thus really 'belong' to the agent insofar as they are deeply integrated into his cognitive processes, or form integral parts of his viewpoint.

Even if this is right, it is interesting that it may not disqualify even some current uses of E-Memory systems such as those developed by Gordon Bell. Consider how the SenseCam hangs around Bell's neck all day automatically taking and storing images. The images taken with it are – in a very literal sense – from Bell's point of view. Arguably this is not however the relevant sense of the term, for while the SenseCam may record information from Bell's point of view, it does not form *part* of his point of view. This raises the question of how and whether an E-Memory system, or information produced by that system, could ever come to count as part of one's point of view.

The following discussion will attempt to make it apparent that it is the details of exactly how an E-Memory system is incorporated with our organic systems – essentially the functional profile of their interactions – which will really count here. A deeply incorporated and trusted E-Memory system could indeed be considered to form a proper part of an agent's viewpoint, and systems that meet these requirements are much closer than we might think.

Rather than continuing to consider these points in the abstract, let us now consider three scenarios where E-Memory tech gets progressively more embedded in an agent's cognitive profile. We will consider a slightly fictionalized version of Gordon Bell's *MyLifeBits* system for illustrative purposes.

Scenario 1 – Here, type 1 E-Memory systems primarily operate in a passive way continually recording information in good lifelogging fashion that can later be reviewed by the agent. The striking feature of such systems – compared to previous regimes of memory technology – is the comprehensiveness of what is being recorded and the ease with which this is done.

It might be thought that such systems have only minimal cognitive implications, yet they already make available content that might contribute to one's self-knowledge in virtue of making available information that would otherwise be inaccessible or absent. This is broadly how Bell uses the *MyLifeBits* system now, although it is already shading over into another system more like our second scenario.

Scenario 2 – Let us imagine a more advanced E-Memory system which is more active, autonomous and deeply incorporated than the previous version. Instead of waiting the agent to perform a search it continually prompts him when it notices something that might be useful. The system is active in helping to organise the agent's attention.

Such a system might integrate a SenseCam and similar recording devices that capture images every couple of seconds and other contextual traces as the agent goes about his everyday business. It would automatically store these traces in an active database where various algorithms tag and do further processing on them. Those traces could then be contextually recalled when useful. (We have already discussed such a system: the one Bell uses to retrieve a colleague's name when they appear in view.)

This mark 2 system is, in addition, constantly on the look-out for images or other traces that contain persons or objects already tagged as interesting. It 'notices' the recurrence of such interesting material in the current sensory stream and cues the user through some reality augmentation equipment. Over a period of time, as the agent interacts with and felicitously deploys such a technology, it might become – like Google search today – second nature for him (and thus *transparent-in-use*).

An interesting implication here is that even images or other traces that are stored in the database, and that the agent never looks at or consciously reflects upon, may nevertheless play a role in his cognitive architecture. This is because those stored traces in aggregation can trigger processes that cue or bias what is presented back to the agent – acting more like an organic implicit memory. Thus, the invisible and only indirectly known contents of the database might start to influence the agent's cognitive profile. (Cognitive opacity might here go hand-in-hand with transparency-in-use).

Scenario 3 – In a final scenario, an E-Memory system mark 3 incorporates many and varied autonomous systems which are hooked into the internet.

This near-future E-Memory technology continually sifts one's personal cloud-based data of multimedia "memories", perhaps constituted of every photo we have ever taken, every recording of our conversations, every email, etc, etc, and cross-references them against the resources of the internet.

Such a system might quickly start to seem less an adjunct to our mind and more as though it were an actual part of it. Because of its transparent usage, and the agent's reliance on it, such a system might become not merely a bias, but deeply incorporated with the agent's systems of attention. This third scenario suggests that the more autonomous and agentive technology, that we are already starting to see with some of today's web-bots, might start to play a more active role in the organisation of our thoughts.

Still the fact that mark 3 systems might incorporate in an *ad hoc* manner unknown internet based resources suggests that there may be fundamental trust issues here which would always prevent the user from treating such systems as though they were really parts of one's own minds. However, standards of trust may differ. Deep integration might turn out to depend in part on the agent's credulity.

Consider a scenario sketched by Andy Clark [34, 35] where a mark 3 E-Memory system has started to radically change what we mean by, and how we think of, ourselves. In a thought experiment Clark describes a subscriber to the Mambo-Chicken

Bot, a web-bot of the near future which “has been learning about, and contributing to, [his] taste for the weird and exotic for three and a half decades, coming online when [he] was five and first fell in love with astrophysical oddities.” [35, pp. 128-129] In the thought experiment the subject has just discovered the Mambo-Bot has been disabled for the last three months and connects this with his feeling flat and uninspired for a while.

The idea here is clear; the autonomous and deeply incorporated cognitive technologies of the near future may well contribute not only to our sense of self but what we are; and in ways that do not have clear precedents in previous regimes of cognitive technology.

What are we to make of such systems? Are we to treat them as parts of the agent’s memory, or adjuncts? And insofar as the agent relies on the retrieval and contextual information systems made available by advanced E-Memory systems, are we to regard those systems as part of the agent himself? Partly constitutive of his sense of self?

We have already hinted that part of this may depend on the cognitive transparency of the E-Memory system. At least in the *MyLifeBits* system, as the algorithms were largely set up by Bell to do tasks he intends, they can be naturally seen as extending his cognitive economy. Moreover, insofar as Bell has built those systems, he is likely to have a good sense of how far he can trust, rely upon and even defer to them. Such properties may not be maintained intact if someone else, who knew little about its workings, used the systems. The cognitive opacity of such systems to the user might make us unwilling to count them as proper parts of our minds essentially because we do not know enough about them to trust them; or indeed know enough to know we should not trust them. (This raises interesting questions about the cognitive transparency of minds more generally which unfortunately go beyond the scope of this paper).

What of the future for human beings where such systems are a commonplace? Such a future is likely to include social-media and personal Mem-Tech composing important tools for structuring and reflecting on ourselves. But, it is the autonomous and active nature of current and near-future E-Memory technologies that portends the most interesting and radical implications for who and what we are. If you doubt such a vision is in play with some of the top technologists of our time, consider this 2009 statement by Google executive Eric Schmidt on where he sees search technology going:

“In the case of individuals, it’s the model where the sum of what Google does becomes the third part of your brain – you know, there’s a left brain, a right brain and there’s a third part where the collaborative intelligence that Google can help bring to you really helps you get through every day.”

There is reason to doubt E-Memory will fatally undermine our sense of having or being a self. In part this is because in order for there to be a deep integration between E and O-Memory it is likely to work according to something like the principle of complementarity and as a part of an integrated agent. So even though the resources on which the mind might draw are wide there is little reason to suppose that such a wide mind will not continue to have a sense of self. Even deep incorporation of E-Memory does not obviously imply the loss of that sense,

However E-Memory pioneers are increasingly becoming hybrid agents incorporating tools and software as it proves useful and changing their cognitive profiles in the process.

While we have tried to sketch some of the contours of how these changes might take place, only future research and practice will reveal its reality. It may, however, quickly come to seem that E-Memory might not merely facilitate new forms of self-knowledge, but new sorts of selves. We should not underestimate the agency both of practitioners and theoreticians in deciding how E-Memory should bond with O-Memory.

We have seen that E-Memory holds open the promise of novel possibilities for complementing our organic and culturally derived memory resources. A deeper understanding of these technologies’ novel qualities, potentialities and also the complex and sometime contradictory roles memory plays in human life can only help us put them to more humanistic ends and perhaps avoid some of the more egregious pitfalls. There is little doubt however that they will be playing a larger role in our lives and, perhaps, our minds.

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