

Dossier

The dynamics of zero: on digital memories of Mars and the human foetus in the global memory field

Anna READING

Professor, Kings College, University of London, UNITED KINGDOM and University of Western Sidney, AUSTRALIA
A.Reading@uws.edu.au

Abstract: The dynamics of digitisation and globalisation are synergetically and dialectically changing the ways in which human beings individually and collectively capture, document, share and preserve memories of the past. This paper develops further the concept of the “global memory field” with a discursive overview of the development of “digital memory” and the significance of zero in the meaning and practice of digital memory. The paper then explains the key elements of this epistemology, with an emphasis on the significance of zero or nothing in relation to two contrasting examples of the medical imaging of the human foetus to the capturing and sending back to Earth by NASA’s Curiosity robot images from the surface of Mars.

Keywords: digital memory, global memory field, epistemology of memory, new media technologies, medical imaging, Mars

*La dynamique du zéro: la mémoire numérique de Mars et le fœtus
humain dans le domaine de la mémoire globitale*

Résumé : La dynamique de la numérisation et la mondialisation changent de manière synergétique et dialectique la manière dont les êtres humains individuellement et collectivement saisissent, documentent, partagent et préservent les mémoires du passé. Cet article développe le concept de « champ de la mémoire globitale » avec une perspective discursive du développement de la « mémoire numérique » et l'importance du zéro dans le sens et la pratique de la mémoire numérique. Ensuite, l'article explique les principaux éléments de cette épistémologie, en mettant l'accent sur l'importance du zéro ou rien par rapport à deux exemples contrastés de l'imagerie médicale du fœtus humains dans la capture et l'envoi vers la Terre des images prises sur la surface de Mars par le robot Curiosity de la NASA.

Mots-clés : mémoire numérique, champ de la mémoire globitale, épistémologie de la mémoire, nouvelles technologies des médias, imagerie médicale, Mars

Introduction

“Zero is qualitatively different from a number. It does not pretend to make reference to something countable, something there, in any ontological sense. Zero does not denote a thing. Zero marks absence and (perhaps) nothingness at the same time as it holds a place open for – represents the potential for – signification” (Weston, 2005, 39)

“Nothing can be made out of nothing” (King Lear. Act 1.1 and Act 1.4) William Shakespeare.

In terms of cultures of record, we are in the midst of one of the greatest revolutions humankind has witnessed since the advent of the printing press, and prior to that the development of writing itself. Within this, it is possible to observe that the relationship between communication and memory has fundamentally altered over the past 20 years, and especially in the past ten years. We are not, of course, at the end of this great social, economic and cultural shake-up and we cannot see where it will lead; but it is possible as intellectuals to observe and feel enough to know that what makes us human, that is memory and communication is being transformed. Memory is a cloud, it is data, it is code. Memory is polymorphous, electric, algorithmic. Mediated memory in a digital global world penetrates to the

core of the human body, the depths of the ocean, through the geological sedimented deep time of the planet and extends to the furthest known edges of the Universe. Memory, which was once conceptually delineated between the individual and the collective is now conceptualised as traversing hitherto established binaries of individual and collective, of communicative and cultural, of local and global. Thus within the field of memory studies and recent work on memory, memory is understood as connective (Hoskins, 2009) travelling (Erl, 2008) and multi-directional (Rothberg, 2009).

1. Provocation

The digital transformations of memory are illustrated by the social and cultural impact in terms of the digital memory of the iphone (Barnier, 2010). More than the Personal Computer, the mobile as a personal wearable communicative device changes communicative practices (Park, 2008) enabling people to wear an archive of ‘memabilia’ (Reading, 2009) a world memory of books, films and music; a pocket gallery of sonic and visual memories; a personal database of contacts and calls (Reading, 2008, 2009).

The 2005 London Bombings, the 2009 shooting of Neda Agha Soltan, the 2011 Mubai Bombings and the 2011 Spring Revolutions in the Middle East: all of these events have in common the fact that mobile and social communications technologies were significant to their immediate record, and the public sharing of that record, or what can be termed the mobile witnessing of the events. (Chouliaraki, Vol. 7 Nr 3 2010). So, too, with natural catastrophes such as the earthquakes in Haiti in 2010, the Tsunami in Japan in 2011; the huge floods in Queensland in Australia in 2010-11: it is now commonplace that mobile and connective technologies are used to “witness” such events and which are taken up by and disseminated not only horizontally between “witnesses” or prosumers but vertically through mainstream news organisations or state and corporate memory agents. Then there are the everyday memory practices that extend cultures of record and dissemination from within the human body as well as at the other extreme the extensions of record out into our solar system that include the 2012 explorations of potential for life with the robot geologist, Curiosity, capturing and sending images from Mars surface back to humans on Earth.

The examples all involve trans-medial glocalised mobile connectivities and mobilisations that traverse the material and energetic. Such provocations suggest that it is not so much the significance of a discrete image or particular tweet to our understanding of memory in a digital global world, but the significance of the trajectories and mobilisations of memory assemblages, developing then modes of analysis that somehow enable the capturing and understanding of movements, of flows of memory and the dynamics between them. Further, an unexplored element that is ontologically critical to memory in a digital global world is the significance of

the dynamics of nothing: the use of the Zero as a place holder in relation to One in the transfer and communication of digitised data.

This article asks then how is it possible to understand memory in this new world where under the skin of the screen zero or nothing is significant? How can we understand where human beings and communication fit into this? And how can we seek to understand the epistemology of what is happening to us through using new frameworks for analysis that are epistemologically connective, travelling, and situated. How can we understand memory not in terms of end points, but in terms of what the philosopher Michel Serres has expressed as the importance of the movement between, (Serres, 2000) including the state between the process that underlies the transfers of digital memory between zero and one.

This article begins by explaining briefly the etiology of the “global memory field” within my own work. I then describe examine the significance of zero and the development of “digital memory” through analysing its use as a term within computing and leisure discourses over the past 60 years. I then examine the meaning of “code” within a digital global world. I explain the implications of this methodologically in terms of six dynamics that help to reveal the different kinds of patterns and emergences in memory in what I have termed “the global memory field”. The article seeks to understand how zero or nothing is ontologically a significant factor in understanding the “global memory field” by examining two particular examples: the internal tracking of human life in the nuchal scan of the human foetus and the interplanetary images being sent from the robot Curiosity during August 2012 from the surface of the planet Mars.

2. The Etiology of the Global Memory Field

The etiology of the concept of the “global memory field” lies within much earlier work conducted in the mid 1990s. This work attempted to explain change and continuity in gender relations through what I then conceptualised as “socially inherited memory” in Eastern Europe, with a particular focus on Poland, the UK and US (Reading, 2002). From that, I began to address the role of different media and communicative spaces, including memorial sites and museums in relation to the gendered memory of the Holocaust, firstly in European contexts, and then in the United States. This work led into a consideration of digital memory: I examined how the Shoah Visual History Foundation was recording thousands of digital interviews, storing them, indexing them and returning collections of Holocaust survivors stories to national museums: with many Holocaust museums developing digital interfaces and on-line memorials as well as web-site extensions of exhibitions and archives (Reading, 2003). I then developed work on the impact of social and mobile communication technologies on memory. The research inquired into the domestic impact of the mobile phone as a mobile gallery, as well as the public witnessing of the “war on terror”. I examined for example how people manage their personal

memories, biographies and on-line profiles on social networking sites; how digital witnessing or the use of the cameraphone to capture atrocities and terror such as with – in the London Bombings, the Hanging of Sadaam Hussein, the Shooting of Neda Agha Soltan, the non-witnessing of the shooting of Osama Bin Laden and traced changes to human memory languages, practices and forms (Reading, 2011a; Reading, 2011b).

This research led to the development of the conceptualisation of “the global memory field” which I argue is characterised by transformations across six communication dynamics. These include (trans) mediality, velocity, extensity, modality, valency and viscosity. Further, the studies showed that the global is not universal, even or indeed global: there is a gendered political economy to the global memory field articulated through communication resources that are uneven and unequally distributed. Hence, established media organisations, national memory institutions, states and NGOs have more resources to disassemble, reassemble and securitize meanings of the past within the field. This particular essay seeks to give some further breadth and depth to this conceptualisation by exploring the development of “digital memory” and within this to the significance of zero using case studies that are at the furthest current extensions of mediated memory – those that come from within the human body and those that come from another planet.

3. Why Zero?

So let us begin briefly then with Zero and why it may be important to understanding memory in the digital and global media age. Zero according to Charles Seife is one of humankind’s most dangerous ideas. Zero is a number and a digit used to represent that number which then acts as a placeholder (Seife, 2000). The word itself comes from the Arabic, zefiro, which means ‘it was empty’ which in turn is a translation from the Sanskrit – sunya which means ‘empty’. A Jain text from India, the Lokavibhaga used shunya ‘void or empty’ as a place-value system. In the Inca empire, within the Quipu memory system based on knotted cords, it was the absence of a knot in a particular position in a quipu that represented zero (Ifrah, 2000; Kaplan, 2000).

Zero underlies what is a problem for scholars of memory: this the way in which software is both ubiquitous and invisibl. The friendly face of social media largely obscures an ecology of software in which algorithms and databases are actors which mediate our encounter with digital memory’ (Sluis, 2010: 227). David Beer has suggested that part of this is the underlying power of the algorithm within contemporary culture (Beer, 2009) which forms the “technological unconscious” of capitalism (Thrift, 2005). Within the synergetic dynamics of the digitisation and globalisation of memory we need then to explore the hidden significance of zero as both absence and as a placeholder in what Van Dijk terms this “culture of connectivity” (Van Dijk, 2010) that is part of the shift to what Andrew Hoskins has

coined as “connective” rather than collective memory (Hoskins, 2009) or what may be termed the “globital memory field”.

Digitisation in relation to memory involves the conversion of diverse forms of memory documentation that might include voice, image, sound or moving image into into a single *binary code*. *Binary code involves signifying symbols or instructions in sequences of 0 or 1 known as digital digits or bits*, with longer sequences of 8 bits known as *bytes* (Glaser, 1971). The use of binary code within computing is based on a system developed by Claude Shannon who put into practice a system of Boolean Algebra developed in 1847 in a paper by George Boole entitled *The Mathematical Analysis of Logic* in which a binary, yes-no, or on-off could represent the three processes of and, or and not. Shannon’s thesis in 1937 became the basis for the use of binary code within computing (Redshaw, 1996).

Zero is thus important to memory because of the ambiguous way in which it makes possible through the language of new technologies memory in the digital age. Digital memory in a sense is both something and nothing. It is global but it is also indeterminate and broken up into bits – hence it is globital. Yet zero’s meaning is still within the context of the embodied human subject, which includes human memory then, is shaped by this technosocial world (Rotman, 2008).

4. Digital Memory Today

How then can zero come to be both the something and nothing of digital memory? In contemporary computer discourse Zero is in one sense absolutely everything since digital memory is promised to provide all we need. Digital memory within contemporary computer discourse is described in various scenarios as being able to take us from cradle to a life logged forever beyond the grave: hence in the US “digital gravestones” are being marketed and sold that allow for mourners to use their mobile phones to scan a QR tag to access a digital record of the deceased at the gravestone. The company Epitaph states for example:

Epitaph replaces the familiar gravestone-inscription and is inserted in the gravestone or is installed as a isolated object at the burial-location. In the latter case a gravestone or graveplate becomes redundant (Anon, 2012).

The software site for Memolane which provides a lifelogging service that synchronises data from a person’s electronic interchanges into a timeline from facebook, twitter and other on-line sources promises its customers:

“Lifelogging allows you to have a precise and complete record of your past: an electronic memory that is far more accurate than our biological memories.” (<http://bigthink.com/hybrid-reality/compiling-our-digital-memory>)

Digital memory within and by the computing industry itself is thus constructed within discourse as better than human memory in ways that will make unreliable organic memory redundant or obsolete. We will no longer be required to remember our own lives or the lives of those who have passed away: an electronic chip can do it all for us. We are being relieved for ever more of the burden of remembering. Yet as Ulises Mejias argues in the *Internet as Playground and Factor*, this obscures the fact that we are still the human producers of this memory content and in created it we are also then the producers of useful data that can mined so that it can be sold back to us in another form. Digital memory in contemporary popular discourse thus hides the commodification inherent in memory work, it obfuscates the economies of digital memory, which involve providing profit for a small number of companies through which we can upload and share out profiles and our past. Thus commenting on the impact of “server farms” in repositioning the personal computer as an access point only to distributed memories, Sluis argues, “When the collection and distribution of media becomes the collection and distribution of data, our digital memories become subject to the economics of information production and knowledge management” (Sluis, 2010, 229).

At the same time, however, instead of the “reliable” prosthetics of discs, drives and cards, digital memory is also articulated in terms of the metaphor of “the cloud”. Douwe Draaisma reminds us that each new metaphor of memory places a different filter on our perceptions of memory (Draaisma, 2000). Building on this, Andrew Hoskins takes the metaphor of the network deliberately to remind us of the ways in which media and communication are changing memory not through retrieval or representation but through what he terms “technosocial practices” (Hoskins cited in Erll, 2010, 92).

It is here within the metaphor of the cloud that we begin to encounter the ambiguous meaning of Zero that disturbs the construction of digital memory as totalizing, permanent and complete. The ontological significance for digital memory of the newer metaphor of the cloud, in contrast to the older metaphor of the network, which we have lived with for almost two decades, lies in how a cloud bespeaks digital memory’s own intangibility. The cloud suggests digital memory’s erasure, its disappearance, changeability, volatility, and, its unreliability. It is indeed like the weather, which as Michel Serres loves to point out in French *temps* is also the same word for time (Serres, 1995). Yet Sluis also reminds us, “as the archive is re-invented as the cloud, it is important to imagine digital memories as not just vaporuous, immaterial, streams of data - but as data which is embedded in the material structures of hardware and software” (Sluis, 2010, 231).

So what of the earlier discursive constructions of digital memory? How within the term’s etiology is the ambiguity of zero articulated? In this respect, it is useful to briefly trace the historical development of “digital memory” though computing discourses over the 20th century: in this way we can begin to see how two previously

distinct terms digital and memory came together and from this what the term thus filters from our understanding of what is happening with these changes to technosocial practices in relation to memory.

5. Discursive Etiology of Digital Memory

A digital search of English language works for the term “digital memory” using the schematically useful digital tool of the NGram search engine¹ is usefully revealing. The Ngram viewer shows a graph displaying over time how the phrase has occurred in the corpus of English language books digitized by Google that includes a sampling from 6000 published books per year. This is of course flawed as a sample, as indeed are all samples, but it does reveal some interesting key trends and developments (Jean-Baptiste, 2010). The search shows that the term digital memory gained most popularity within publications published in English in the late 1980s. Prior to this, a search of English language publications, including fiction, reveals that digital and memory come together for the first time largely within medical discourse and music at the beginning of the 20th century, with digital memory meaning the use of the fingers for medical examination or for playing music. It also had some currency within mathematical treatises meaning numeric value in relation to music particularly.

The digital search then reveals that the first computer, technically, to be recognized as using “digital memory” was the Atansoff_Berry Computer or ABC at IOWA state College in 1942, which was an electronic computer with digital memory (Stankus, 1991). It was the first computer to use binary bits to represent all numbers and data. The ABC performed calculations electronically rather than through using wheels, ratchets or mechanical switches and organised this through a system that separated computation from memory (Stankus, 1991).

The Ngram search then suggests that the composite term “digital memory” emerges within scientific journals of electronics and mathematics from 1950 onwards. There is the mention, for example, of the possibility of something termed “digital memory” in a 1950 National Research Council document *Mathematical Tables and Aids to Computation* (Lehmer, 1950). There are five mentions of digital memory in a 1953 in a special issue of the journal of Electro-technology on Electro Manufacturing (Anon, 1953). Digital memory is then used as an aggregate term in the mid 1950s largely within manuals of computing (Krohn, 1955).

The term “digital memory” is thus something that is discursively present only within specialist technical papers on computing and electronics. But by the late 1960s the term ‘digital memory’ is then commonplace within wider journals of computing and by the 1970s and early 1980s, the term digital memory begins to gain

¹ The Ngram search engine can be found at <http://books.google.com/ngrams/>

definition within academic books on computing. Thus a 1977 “Introduction to Digital Computer Technology” states, “A digital memory is an element that can maintain either of two stable states indefinitely (as long as power is not shut off). A flip-flop falls under this definition, as does any magnetic recording or storage medium” (Nashelsky, 1983, 367). In the 1970s, the term begins to be used not so much for processes but more in relation to storage within discussions articulated in mainstream science discourse, such as *New Scientist* and *PC Magazine* in the 1980s.

By the 1990s, discussions in popular handbooks and magazines of computing are about the possibilities of trans-mediation and translation, not about calculation: and it is here that we see the beginnings of what the cultural theorist Lev Manovich (Manovich, 2002) described as one of the particular features of the digital – its modularity. This also comes to the fore in public discourse about images, speech in cheap forms of storage or digital memory and the increasingly elimination of the need for older forms of storage. The term “digital memory” in the 1990s then enters into popular leisure discourse through magazines aimed at readers engaged in related hobbies and leisure pursuits such as photography and music, where digital technologies are also becoming important, rather than the more specialist hobby of computing. What we see then overall in this brief discursive etiology is the way in which the term has its origins in a notion that included the body, that included the organic but it is through the technical discourse of computing that it becomes for some decades disassociated from the body and a wider social context.

6. Digital Memory Studies

In one of the earliest academic discussions of digital memory within the humanities and social sciences, David Bolter, in *Turing's Man: Western Culture in the Computer Age* (1984) defines digital memory in terms of “an electronic memory device...any machine or component that fixes the evanescent signals of the central processor” (Bolter, 1984, 152). His work is significant in that it marks the migration of the term from the discipline of computing and mathematics into English literature and cultural studies.

Within the field of Memory Studies specific work on media memory and within this what might be termed the emergent subfield of digital memory studies Motti Neiger, Oren Myers and Eyal Zandberg (2011) make a distinction in terms of what they see as the particular media of “new media” in contrast to other media that include the press, television, cinema and radio. There also then, however, attempts to reconceptualise collective memory not necessarily in relation to a specific medium but through the concept of new media ecologies seen to cut across all media through the process of digitisation which is resulting in the “fluidization of digitised content”: this results in transmedial memories that cut across previously established boundaries of private and public through digitised consumer generated content (Hoskins, 2011, 279).

To Jose Van Dijck digital technologies such as digital medical imaging is changing not just how we think about how memory works in the brain but changes our relationship to ourselves through externalising a visual representation of those processes: “digitization has important epistemological and ontological implications, not only with regard to our memory objects and the technologies we use to create them but also with regard to our very concepts of memory and experience” (Van Dijck, 2007, 46). To scholars such as Mark Poster, what we are seeing with digital media technologies is the development of the “huma-machine” in which computer interactions take on an interior state of consciousness: the self, he argues, is constituted through database articulations that are beyond the knowledge of particular individuals, becoming effectively a digital unconscious (Poster, 2006, 36). This usefully suggests how the global memory field is not a distinct digital media prosthetic but rather that human agents constitute memory in and through it.

Within work on digital technologies and studies of human computer interaction digital memory is usually termed “e-memory” or electronic memory, giving emphasis not to the process of digitization, but to the electronic energetic dimension of memory within the computer age. Thus CG Bell and J Gemmell (2010) in *Total Recall* argue that the e-memory revolution constitutes a new epoch for human beings. Likewise, Viktor Mayer-Schonberger (2009) argues that digital remembering threatens forgetting, which is a crucial component of human identity and culture.

Yet, at the same time, digital memory is said to be likely to tip us into a cultural dark ages, as suggested in the insightful work of Jennifer Gabrys (2001). In *Digital Rubbish* she argues for the mutability of what she terms electronic memory. Interrogating Ted Nelson’s idea of Computer Lib/Dream Machines she argues that computers offer a daydream of storing everything digitally instead of physically: but the reality she argues is that electronic memory requires a continual migration, transference and updating to newer formats in order to render them accessible. What is initially presented in digital memory as an aide to memory is in fact a new order “of memory, of time and processing” (Gabrys, 2008, 6). Electronic memory is actually fleeting and transient, volatile and continually in erasure. She thus draws our attention not to the memory of the digital but the temporal of the digital and thus to its dispersal and its changeability. This, I would suggest, also then points the way to an epistemology that understands the significance of the ambiguity of Zero within the digital across dynamics that are changing and transient.

In *Digital Memory and the Archive* Ernst and Parikki (2012) also argue for a reworking of a redevelopment of method in relation to understanding digital memory. However, Ernst states the case for the method of media archeology in which the analyst is no longer interested in semantics or surface meaning but rather seeks to analyse the world from the perspective of the communication between machines.

Media archaeology poses the question of the “origin” of operative media on a deeper level, which is the technomathematical one’ (Ernst, 2009).

Media archaeology refers to the past only insofar as it addresses the condition of the possibility for current media operations, which means: being (still) at work. The temporal category “past” thus appears rather like a temporal function of a present process, as an unfolding of presence-in-action, in the mathematical sense (Ernst, 2009, 3).

Purely analysing digital memory in terms of the communication between machines however, leaves out human agency. But what Ernst usefully points out is that past media are not “dead, but undead”: they are in a radical state of latency, awaiting reactivation. In this way, digital artefacts are “embedded in another temporal logic which defies historical discourse”. They are in a state of “museal latency” but can be “re-activated, that is: switched from Zero to One, like signals as a function of time” (Ernst, 2009, 9). It is here then that we begin to see again the specific ontological to digital memory of zero. The Zero of digital memory is a placeholder in time *and* space.

Lev Manovich’s (2002) argues that what is distinct about “new media” are the ways these in which numerical representation, or the conversion to binary logic allows for modularity or the ways in which there can be discrete and independent elements within a larger whole. In addition – and this is important for memory, software automation results in the adjustment of content, with the production of slightly different versions as well as transcoding or the translation from one format to another with a computer. What is missing from this account, however, is, a sense of the digital’s ontological or material significance in terms of the ‘polymorous potential’ of digital data” (Hansen, 2005, 34). It is this ontological or material significance, which is important to understanding the significance of zero. This to Hayles may understood in terms of intermediation – the dynamics between the human and computer, between the organic and inorganic. At a deeper level it also involves the modifications by code between speech and writing, not discretely but relationally in terms of the dynamics between globally distributed ones and zeros - code - and the various computer and human languages, practices and forms which they intermediate. The electronic text should be understood as consisting, at bottom, of binary code, the sequences of ones and zeros that underlie all the languages built on top of them (Hayles, 2005, 102).

Underlying “digital memory” then is Zero as code: code which Frederic Kittler suggests is the leading philosophy of our epoch (Kittler, 2011). Kittler shows that “the digital” and what is by extension then ‘digital memory’ should be seen as part of a longer historical development that began with Napoleon and messengers on horseback being replaced with the optical telegraph which used secret codes to remote control France’s army. He cites Wolfgang Coy’s definition of code, as that

which is “from a mathematical perspective a mapping of a finite set of symbols of an alphabet onto a signal sequence” (Coy cited by Kittler, 2008). Zero, however, is crucial in terms of both name and matter of what makes contemporary digital memory, which remains nevertheless culturally situated (Corner, 1980) and articulated within a particular set of cultural practices (Montfort, 2008). What distinguishes it from earlier epochs, however, is that the codes that map finite alphabet symbols onto signal sequence over time are both transmitted and stored. The current digital global epoch thus involves a dialectical or rather polylectical dynamic between globally distributed code and human memory languages. It enables polylogical trans-mediality between the organic and inorganic.

The global digital – the globalisation of memory through code based on bits of Zeros and Ones – the *globital* is thus distinguishable by its simultaneous materialisation of something and nothing:

Zero is qualitatively different from a number. It does not pretend to make reference to something countable, something there, in any ontological sense. Zero does not denote a thing. Zero marks absence and (perhaps) nothingness at the same time as it holds a place open for – represents the potential for – signification (Weston, 2005, 39).

Within mathematics zero keeps other numerals in “their place” and thus assigns them value (Weston, 2005, 39). Similarly then with code – with digital memory – zero keeps the Ones in their place and thus assigns the bits and bytes their meaning. Underlying the development of digital memory then and our experience of it is both an absence and “a potential for occupation”. Further since digital memory includes a “movement ... implicit in the sign” (Weston, 2002, 39), methodologically it is arguable that a form of analysis that seeks to understand these multiple movements within their cultural context is critical to the epistemology of digital memory.

7. The Globital Memory Field

The concept of the *globital memory field*, established in my earlier work, is one way of reconceptualising memory in the digital global age. But within this, the significance of Zero then points more deeply to a method that can be revealing in terms of the continuities and contradictions of “digital memory” through suggesting the kinds of analytical dynamics through which memory can be understood and researched.

The term *globital memory field* brings together a number of different terms. Etymologically “globital” mashes together the word global with bit, the smallest component within computing that put together as a contiguous sequence makes up a byte. Globital is intended to be suggestive of the uneven and interrupted processes

and dynamics that take place energetically and materially with the combination of the synergetic forces of globalisation and digitisation.

The concept of the global memory field draws on the concept of “cultural field” from the French cultural sociologist Pierre Bourdieu’s. Field theory draws on the insights of relational dynamics offered by field theory from the discipline of physics. Bourdieu suggests the concept of the cultural field as a way of understanding the production and consumption of culture in terms of the relational dynamics arising from different agents. His work in relation to cultural production analysed for example the relationships between market and state actors and the ways in which they those relationships have consequences in the economic and political fields. With cultural consumption he analyses the relationships between institutions of cultural legitimation, including the education and occupational class to explain the uneven distribution of cultural capital. The concept of the global memory field builds in part on this idea of field theory, by suggesting that memory can, in part, be explained as a field. With this, agents of memory, which includes individuals, but also corporations, states, public memory institutions, journalists, archivists, educationalists compete to mobilise and secure memory capital.

Within the global memory field, the memory “assemblage” with multiple non-linear trans-medial trajectories and connectivities may be uneven and contradictory. They traverse conventional communicative binaries, body-machine, analogue-digital, public-private. The assemblage involves composition of things and bodies with utterances and expressions. This composition of material practices and discursive formations is then consolidated and changed through the other axis, which includes horizontal axis of prosumers, citizen journalists and vertical axis of mass media organisations, public memory institutions. The memory assemblages within the global memory field involve trajectories of mobilisation and securitization that can be analysed across six dynamics: (trans) mediality, velocity, extensity, modality, valency, viscosity summarised as follows:

The Global Memory Field: Six Dynamics: Fig 1.

Dynamic of analysis	Definition
(Trans) mediality	the extent to which assemblage travels and is transformed into and between different media
Velocity	speed in terms of time with which the assemblage travels across the electric, algorithmic, geographic and organic dimensions of the field
Extensity	limit and reach from the historical point of origin
Modality	sets of patterns such as ceremonial forms, protocols or conditions that may assert or deny the possibility, impossibility, contingency, or necessity of content
Valency	the number of bonds between the assemblage and other assemblages
Viscosity	the assemblages internal resistance to flow or change:
Axes	<i>X = composition of material and discursive formations</i> <i>Y = mobilisation and securitisation</i>

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Figure 1. The Global memory Field: Six Dynamics

These six dynamics can be used as an analytical framework to reveal the emergences and trajectories of memory within the context of digital and connective communication. First, analytically, there is the extent to which mediated memory is no longer secured within one medium but through digitisation and connectivity is mobilised across different media: this is termed the dynamic of transmediality. The marking of absence by zero not only holds a place open for – represents the potential for – signification it results in signification. So we might ask for example what happens to the sequence as it moves from one medium to another. Does it change?

Secondly, within the global memory field there is the dynamic of velocity, which may be rapid or slow with which mediated memory assemblages can be mobilised across the electric, algorithmic, geographic and psychic dimensions of the field. At its extremes, for example, we might with the image witnessing of the surface of Mars by the robot geologist Curiosity, how fast zero travels and how does this articulate with the reception of memory?

Thirdly, there is the mediated memory assemblages' limit as well as reach from the historical point of origin: this is termed the dynamic of extensity. We might ask here how extensive is the distribution of the Zero from Mars, or the Zero from inside a mother's uterus of the growing foetus? Fourthly, there is the degree to which a mediated memory assemblage conforms or is secured within a general pattern, particular group or category: analytically, this is termed the dynamic of modality. How is zero transformed from one modality to another? From the transfer of data as

“scientific record” from Mars for example, into a popular media image of Mars? Or how is a medical record of the moment in time of foetus transformed into the different modality of an image as a screen saver on the mother’s mobile phone?

Fifthly, drawing on the idea from chemistry of understanding how atoms have different numbers of bonds with other atoms, there is the degree of sticky points between the assemblage and other assemblages: analytically, this is termed the dynamic of valency. How does Zero – something and nothing – and the transfer between allow for or enable the multiplication of sticky points for some memory assemblages and not others? Sixth, suggested by Zygmunt Bauman’s idea of liquid modernity, there is the mediated memory assemblage’s internal resistance to flow or change: analytically, this is the dynamic of viscosity: how does zero allow for the transformation and reassemblage of some memory assemblages and not others? Finally, it is important to recognise that these analytical dynamics may be discursively articulated across several different axes. The first axis (x) concerns the material practices and discursive formations of the assemblage which are then subject to the y axes processes of mobilisation and securitisation.

In the final two sections of this paper, I examine this in relation to two examples: the medical scan or memory of the human foetus and the robotic geologist’s record by Curiosity of the surface of Mars in August 2012.

8. The Zero of Mother and Baby

At one extreme of the global memory field, visual memories of the interior of the human body are captured and now shared via connective technologies: no where is this more evident than with the ultrasound scanning of the growing human foetus inside a mother’s uterus.

The image generated in obstetric sonography that the parent sees in a medical examination is produced through Ultrasound. This is a cyclic sound pressure wave that penetrates through the flesh and tissues of the mother in order to measure the echo or what is termed the reflection signature which can reveal the details of the growing human foetus. A transducer sends sound waves and receives the echo back. A scan converter transforms the ultrasound beam into a digital matrix which can then be formatted for display. The image processor then converts the image for display which is then shown on a computer screen whilst also being saved as data. (Sprawls, Undated) In many hospitals the patient is then given the option to purchase the digital image, and/or video of their first “scan”.

The scanned images of the early stages of human life can then be shared between medical staff within the hospital or beyond; but furthermore, the images are also now routinely shared by parents via iPhone, email, Facebook and YouTube. Images are kept as part of the developing family album; they are used as screen savers on

mother's computers and phones. They are printed out and stuck on refrigerator doors. They are shared with close family, with friends. But they are also shared with the wider public with parents uploading their foetal videos to Youtube for example. One video "Baby at 12 Week Scan Ultrasound Amazing Video" (terryjreed, 2007) for example has 38,622 views. This has also then led to various websites dedicated to the loving memory of babies that did not make it and died before term or who were still born such as *Angel Babies Memorial* in which the videos in memory of the lost babies always begin with ultrasound image or video (Memorial, 2011) Another video "In Loving Memory of Cate and Cole" has almost 6 million views since it was uploaded several years ago (Chenoweth, 2009).

So what can we learn from this process using the analytical framework of the global memory field? First of all in terms of the dynamic of *transmediality*: the sonic relationship to the interior organic is transformed into a moving image/static image of the foetus which is stored, copied and shared. It can be printed out and put into a photoframe or conventional family album. In terms of the dynamic of *velocity*: the organic memory of the memory captured as zeros and ones, travels rapidly as data beyond the medical file of the pregnant woman, to other medical practitioners in the hospital. The data articulated through code as an unknown gendered foetus travels out of the hospital across the electric, algorithmic, geographic and organic dimensions of the field. With the dynamics of *Extensivity* – there are no limits to the journeys from the historical point of origin. It may travel to wherever there is a network. A once private and personal organic memory becomes not only a mediated familial memory but a public memory, a public record, a public memorial. With the dynamic of *Modality* – data captured for one purpose – for a medical purpose is then used for another purpose for marking the beginning of what later becomes a person: a narrative is focussed on the image rather than on the hidden and felt processes of growth. With the dynamic of *viscosity* – the image resists flow or change – it remains within a medical framework. Obstetric scanned images always include a date and place stamp and very often tags on body parts. The mother remains invisible except for the digitally included partilineal surname. The dynamic of *valency* suggests that the digital image of the foetus may remain discrete within the medical file or linked only to medical image; but in the parental and then public domain the image is linked to later digital memories of the babies and family development.

Within these dynamics is then the betweenness of Zero and One: what is significant here is in the scanned memory of the foetus the possibility of indeterminacy and of contingency becomes fixed. The zero enabling the image at 12 weeks may be said to allow the parents to know the "genetic health" of their baby and "the intrauterine place" of their baby. Many people also choose to know the sex of the baby with the Nuchal scan, so that the memory of the child's gender, which once had a period of unknown and unknowable ungendered or both gendered pre-birth history that was subject only to speculation and magic (the spinning of a

wedding ring on the end of a chain, or the showing of the mother's palms for example). But now most often, the biological unsex of being simply baby is bifurcated at the point of the 12 or 16 weeks foetus. For a small number, 5 per cent, this also then has to change at birth, since scans are not entirely accurate.

For example, the embodied memory of the felt growth and movement of the baby inside a woman's body is externalised, peered at, recorded, digitised, networked. Secondly the digital Zero in allowing for an image that can be transferred to the parent can then be commodified. Hence hospitals for usually require a donation or a payment for the image. The mother or father are then free to circulate the image, share it and copy it, but in doing so they are contributing to the content of various servers and networks, that can then mine their data and sell back to them goods and services linked to their activity.

Thirdly, the digital Zero through the dynamics of the global memory field enters the body politic of the mother's uterus and the body of the unborn foetus. The once professionally securized medical x-ray in the new form of the digital image or scan of the now known gendered foetus is then circulated via computer networks and made public through copying and sharing with friends and family, as well as becoming part of the conventional album as well as the digital book of that new person's biography, or on-line memorial if the baby dies before term or shortly after birth.

There is then a difference in terms of not only the remembered personal narrative of the baby but also how it is thought about by the rest of its community, its family, the medical community, friends. Zero also stands in for something here that is necessary to forget in order to "see" the image we want to: when we look at the scan or medical image of a foetus from inside a mother's uterus we must forget the inside that you are also looking at, the woman carrying and growing the foetus. With the medical scan of the human foetus, Zero through the dynamics of the global memory field results in both a void and presence. Some of the contingencies of the analogue or organic are lost. Yet, at the same time tracing Zero across these global memory dynamics reveals emergent processes of dis embodiment, dis embedding and dis connection.

9. Zeros from Mars: Something or Nothing?

On August 6th at Canberra Deep Space Network (CDSN) out in the bush at Tidbinbilla 40 km from Canberra, Australia, members of the public as well as scientific experts gathered to see the first images captured and sent to earth from the robot Curiosity soon after it had landed in the Gale Crater. The process of this digital witnessing, is described by NASA's Jet Propulsion Laboratory as follows: Images are first captured using a digital camera. The camera records over a million

pixels on a scale of 0 – black to 4096 – white, with three versions recorded using red, green and blue filters. The on board computer takes all the 1,048,576 values recorded by pixels and converts them into digital code sent as 0's and 1's called bits. The radio transmitter sends this as a bit stream to Earth sent via radio waves. These are electro-magnetic radiation that like light travel at the same speed – 186,000 miles per second – via the Deep Space Network – one of the largest telecommunications systems in the world. Consequently, the signal from Mar's with Curiosity's first image took around 14 minutes to reach Earth (Network, 2005).

Curiosity's bit stream is then converted into radio waves to travel through space that reached the DSN antenna in Canberra, which are then were converted into bits and sent to JPL's Multi_Image Laboratory in Pasadena which creates the 2 dimensional visual images that humans can read (NASA, 2005) The digital objects can then be transferred electronically to archives, scientists, the media and the public. Within a few hours the first image of Mars' surface captured by Curiosity and sent to earth had been shared on FACEBOOK around 12,500 times and around 10.5 million people had watched the live stream (Thomas, 2012).

The (CDSN) site is surrounded by low hills operated in radio silence, with visitors asked to switch off mobile phones and laptops before arriving at the site. In the Moonrock Cafe, members of the public could premeditate their experience through an X Box game in which they could land the robot. There was then a 'show and tell' session drawing on space memories with staff talking about particular space programme artifacts: One guy talked about a lump of concrete he had collected from a Soviet era space programme sites; another had a copy of a seismic tracing of the impact of the landing of APOLLO 11 (Corbett, 2012.)

A large digital screen showed a live feed from the Jet Propulsion Labs in Pasadena, California. The process of communication of radio signals of the landing by Curiosity involved first the relay of those signals to Martian satellites, as Curiosity at a point in its journey had Mars between itself and earth. From at least two satellites those signals were then relayed to earth, first of all to the radio dish in Canberra; this then relayed the signal to JPL Pasadena which were then related back to Canberra once the data had been rendered into images.

To begin with then, what the public saw at Canberra were not images of the surface of Mars but of the flight directors and the team's reactions at Pasadena. As one spokesman, Glen Nagle said : "By the time we receive the first signals here to say that we've entered the atmosphere of Mars, the spacecraft has been on the surface, alive or dead, for at least seven minutes" (Geographic, 2012). Science fiction author, Claire Corbett described the experience at the Canberra event thus:

At Canberra... the drama unfolded through a series of specific stages of success such as the parachute opening, the sky crane lowering the rover vehicle and so on,

which were each received with reactions of applause, and smiles and so on. Then came a low resolution black and white grainy image of the surface of Mars taken by Curiosity just after it had landed. It had taken 14 minutes for signals to reach us from Mars. So we were already looking at history. We were aware in the audience that already a success or failure had occurred before we were able to witness it (Corbett, *Personal Communication*, 2012).

The witness images from Mars were viewed around the world in various ways: in Times Square in New York crowds gathered to watch a huge public screen. Images on Nasa's Facebook Mar's site had received 321, 624 likes mostly by 25-35 year old males in California by 23rd August. The robot provided and continued to provide its own first person commentary tag to each image, such as this example for the image of its tyre tracks:

Recalculating... I was so giddy about my first drive yestersol that I tweeted the wrong specs. Correction: 4.5 meters forward, 120° turn, then back (Rover, 2012).

The images have then led to lots of digital modifications and interpretations including ones that have inserted on the planet's surface little green aliens protesting at the US invasion of their planet.

The first images went to specialist science sites, including NASA's own site and *New Scientist* and *National Geographic*, but the images were also distributed via mainstream news sources that included on the day: *The UK Guardian*, *the Telegraph*, *CNN*, *The Australian*, *Al Jazeera* and *BBC News* which also has its own twitter stream [@CNNLightYears on Twitter](#) dedicated to updating its audience (Landau, 2012). Links to earlier images transmitted by earlier robots to Mars such as Mars 3 and Viking 1.

Thus, first, in terms of the dynamic of *transmediality* the mediated memory of Mars begins as a digital image, is translated into microwaves, which is then translated into data that is then made into a digital object that can be mobilised and transformed across different media that include newsprint, on-line websites, and broadcast media. Within this process zero has been critical in the translation of the gradations of pixels, the absence and presence of light from the sun reflected from the planet's surface. In terms of *velocity* – there is the critical fact that with the images from Mars they can travel no faster than the speed of light. The images are travelling a distance of approximately 60 million kilometres to reach the Earth. The images take a minimum of 14 minutes to reach earth and then must be relayed from the dish near Canberra to Pasadena where they are processed and then back as digital data to the video link at Canberra. Thirdly, in terms of the dynamic of *extensity*: although radiotelescopes have brought back data from further afield in the Universe, these are the extent of images from another planet's surface. The images in contrast to those from inside a mother's uterus of the growing foetus illustrate the full extent of the global memory field and how it is now extended through Zeros via robots by people. Fourthly, the image's original modality is within a general

category of scientific discourse. This continues to operate despite the possibilities offered by Zero to enable transformations from one modality to another, although the image does shift marginally in popular mediations from being 'scientific record' from Mars for example, into a popular media image of Mars.

Fifthly, with the dynamic of valency, the Zero – the something and nothing – allows for the multiplication of sticky points of the images from Mars – their reworking into older narratives of images produced by older robots as well as connections with other space stories. Sixth, there is the dynamic of viscosity. Here the digital image in this case is continually at risk as a document through the capacity of Zero to enable modifications: hence the addition of digitised little green men or the enhancement of images to suggest a fossilised human finger as reported in the Mail on Line (Wrenn & Farberov, 2012). But what is also then interesting is that the modality of the image – its production as a scientific image means that it largely resists the possibility of flow or change. The image is distributed in an initially highly controlled way through the vertical axis of scientific organisations and mainstream news organisations, which is then cut across by the alterative distribution of amateur astronomers and social media.

Conclusion

In this article I began by arguing that what we are witnessing is a major shift in memory and communication through the combination of digitisation and globalisation. This has already resulted in important reworkings of our understanding of collective and mediated memory into conceptualisations that give emphasis to how memory now traverses across the public and private and organic and inorganic through new media ecologies. Underlying many of these changes is the ontological significance of Zero and code which suggest a methodology or analytical approach to memory that is dynamic and involves giving emphasis to understanding processes of change and transformations within what I have termed the global memory field. In this particular essay I then examined how these dynamics work in relation to two examples of memory at the extremes of the field: those produced from echoes within the flesh of the human body and those produced from digital data captured on Mars.

An attentiveness to the significance of Zero enables us to dig deeper into why it is that digital memory seems so like the weather or as its latest metaphor suggests like a cloud. What this analysis does not do, however, is explain then the significance of human agency and affect in terms of production and reception and dissemination of these images, which is evident in both cases is also critical. This of course prompts another study altogether, suggesting that indeed something can come of nothing.

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