Economy and Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713685159

Increasing resolution, intensifying ambiguity: an ethnographic account of seeing life in brain scans

Simon Cohn [a]
[a] Goldsmiths College University of London.

To cite this Article Cohn, Simon(2004) 'Increasing resolution, intensifying ambiguity: an ethnographic account of seeing life in brain scans', Economy and Society, 33: 1, 52 — 76
To link to this Article: DOI: 10.1080/0308514042000176739
URL: http://dx.doi.org/10.1080/0308514042000176739

Economy and Society Volume 33 Number 1 February 2004: 52–76

Increasing resolution, intensifying ambiguity: an ethnographic account of seeing life in brain scans

Simon Cohn

Abstract

This paper argues that current images of the brain are providing a potent way in which human life itself is being constructed. In addition to material conceptions, exemplified by the human genome, scans that claim to illustrate features of the living brain serve to augment these with the idea of life as activity. Drawing from ethnographic research, the paper illustrates how, even among neuroscientists themselves, life is used as an implicit notion to hold together a range of contradictory methodological features of their work. The final section suggests that because this version of life is necessarily restricted, it may have a number of wider social and cultural consequences.

Keywords: neuroscience; anthropology of science; life; vitality.

Introduction: trying to see life itself

The glossy book that accompanies a recent US television series charting stages of the human brain from birth to old age proclaims the programme's emphasis is on 'life' (Restak 2001). Echoing the sentiment of many others excitedly reporting current developments in neuroscience, the text and illustrations are accompanied by the perception 'not only how much scientists have discovered . . . but also how much there is still to know'. This is indicative of the plethora

Simon Cohn, Department of Anthropology, Goldsmiths College, Lewisham Way, London SE14 6NW. E-mail: s.cohn@gold.ac.uk.

ISSN 0308-5147 print/1469-5766 online
DOI: 10.1080/0308514042000176739

of popular references to the brain, whether as a self-help resource by which people can improve their lives or a contemporary means to sell 'intelligent' products or new management styles. The point is, as Fodor has recently asked without personal irony, 'Why, why, does everyone go on so about the brain?' (Fodor 1999). From an anthropological source, Lock's latest comparative study of the cultural background to definitions of brain death can equally be read as an implicit ethnography of how the brain has, more than any other part of the body, become synonymous with life (Lock, 2001). This paper will address the question: what is this new image of life, as it is being communicated through the science of the brain? How is life pictured in the scans and anatomical maps? And what is the value or content of claims that seem inevitably to be qualified by statements that stress how little is actually understood? It will explore these questions via ethnographic fieldwork carried out at a small sample of laboratories where these novel images are being produced, and will go on to examine to what extent the new science is colonizing notions of life by conflating images of the brain with subjective feelings, thoughts and experience.

Some commentators, taking their cue from Canguilhem (1994), have already begun to examine how conceptions of life reflect the cultural and historical context in which they are conceived. They have generally applied this to the contemporary status of the gene, where it appears to have become the central symbol, in which, intertwined with strands of DNA, are stories of creation and genesis. Certainly there are many popular images, references and allusions to life as information or code, to be unzipped, replicated, read and re-read, and so providing the doctrine of biological determinism with renewed vigour (Lewontin 1993). This is the kind of life that one can imagine to be frozen, or locked in amber, perhaps to be digitally re-assembled in the future. For Franklin *et al*. (2000), genes are inherently iconic because of the ever-increasing number of things that can be done to them: through the gene, life itself can be owned, catalysed and even patented. But this potentially presents a new world of equivalence – in which it is impossible to distinguish life from information, or define the living as against the non-living. It correspondingly may be blurring the distinctions between people and objects, forms and processes, commodities and moral principles. Life as the gene is consequently a strange kind of life: it is life that is not alive, a potential or capacity rather than a force or activity, ever on the brink of being disassociated completely in labs and test-tubes from living things. Ironically, the reductionist trope of the biological and medical sciences thereby threatens our core conception of life itself. In sum, it is life without much vitality at all and apparently very different from that recounted through the ubiquitous representations of the 'living brain'.

Perhaps a clue to establishing the role of the brain in contemporary cultural constructions of life comes from an important strand in Canguilhem's work that needs to be teased out further. In this he emphasizes the tension between regarding life as a substance and seeing life as energy. Canguilhem points out that the Greeks did not have a singular word for life. In *De Anima*, Aristotle proposes that all living things have a force, which he describes as that which

animates the material (Aristotle 1968). Anima refers to the actualization of the living body, one aspect being the psyche, a capability for sensory impressions by all living things, classified as *zoe*. The substance or form of the body merely has the possibility of life, while the force, frequently translated as the soul, was not intended to have religious connotation, though was later adopted as such by such thinkers as St Augustine and Descartes. The key point is that, for Aristotle, life was essentially *ethos*, a way of understanding the world, applied not only to form or matter but also the vigour that imbues the earthly material. For Canguilhem, this worldview, that the 'soul was not only the nature but also the form of the living thing', reveals the absence of a conceptual divide between substance and energy that only more recently appears to have become irreconcilable (1994: 303).

In a series of short essays Morris (1996) charts the progression from this early cosmological view to a mechanistic one intrinsically connected to a wide range of Western dualisms. He, like others, perceives this development as essentially 'anti-life', effectively dividing and then promoting the machinery of living things over and above their vital essence. For some, this supplanting of life by automation arose inevitably from the fact that the old concepts of vitality necessarily required an indivisible, and hence metaphysical, component (Jacob 1989: 118). By shifting focus from the entire organism to the cell and then to the gene, vitalism was increasingly eschewed, becoming neither possible nor necessary. But, for Canguilhem, science's continued description of a 'living mechanism' is, in a sense, a 'ruse' to nevertheless hold together two uncomfortable associates (1994: 292). As Hacking says of Canguilhem, mechanism did not so much displace vitalism, as provide a materialist transformation of it (Hacking 1998). The point is that saying a machine 'works' continues to invoke an aspect of vitality. More than simply a description of objective characteristics, it reveals judgements of such things as regulation and purpose. Such teleological arguments are still commonplace in biology, such as by stating sycamore seeds have helicopter wings *because* the DNA within them needs to be dispersed (a famous image used by Richard Dawkins) or that humans developed cognitive capabilities *because* they were needed (which underlies aspects of evolutionary psychology proposed by Steven Pinker). It is because things are conceived of as possessing life that these explanations are employed to invoke direction and determination. Schrodinger, famous for his contribution to quantum physics, responded to the apparent cessation of a scientific concept of life by arguing complexity and statistical uncertainties will always deny mechanistic explanations, and therefore that life, as a conceptual entity, can nevertheless be given room to breathe (Schrodinger 1992). Thus, it is the very complexity of DNA and the various physiological paths and systems that are emphasized to embody biology's vigour; in other words, it is the density of information, and its apparent multiplicity of operation, that now contains life.

If a language of code, complexity and assembly is actually still built upon an ethos of vitality, it is apparent that the metaphor of information should equally refer to a sense that it is a material substance and to the idea that it is the

enactment of code, independent of whatever form it is recorded in.[1] But, if the gene really is as iconic of this model of life as people are suggesting, it is surely understood largely as the former, i.e. as information made concrete. The fact that the concept of the gene is itself actually so highly rich in metaphors (Nelkin 1995), or that to take it as synonymous with life is a form of fetishism (Haraway 1997: 141), illustrates this elision between information and materiality still further. The gene represents life so naturally because it presents, effortlessly, life as matter. It is this aspect above all others that really allows for the possibility of genetic instrumentalization that Franklin and more recently Strathern have raised, and by which life can be treated as property (Franklin 1995; Strathern 1999). By imagining life as coded substance, it staunchly fails to distinguish the organic from the inorganic, people from things, agents from non-agents. Yet these remain crucial concerns, and the foundation upon which a world of biopolitics is actually maintained: life has to mean more than the bare bones of base pairs.

A form of life is still required, in addition to that of the material model, to which people, both scientists and non-experts, can 'relate' and by which people can ascribe a set of a priori, non-material principles. Agamben (1998), echoing Canguilhem, gracefully demonstrates historically how, since the Greeks, 'bare life' has become intertwined with human norms and expectations of proper living, of *bios*. The union soon led to a particular value put on human life – a value most explicitly articulated in the Divine Right of a sovereign over his or her subjects, but later in more diffuse ways in the conception of the citizen. As a consequence of this politics of life, humans who are given no political membership rapidly revert to 'bare life', and, as such, are as valueless and expendable as bodies in an extermination camp. The argument is compelling because it is not 'human life' that is presented as that which is reified, but political life. Thus, people still expect more from scientific representations than barren material portrayals because life is also about engagement in the world. The point is that the brain scans are not seen to present the 'bare life' of rudimentary elements that DNA conveys, but are evocative of a human existence in its totality, of the essence of what makes us conscious and social, of *bios*. I wish to argue, therefore, that the general absence of life, as that by which we actually live our lives, in the information-made-material portrayal is the cause of a new kind of anxiety, and one that the growing popularity of representations of the 'functioning brain' is attempting to address.

Visualizing activity

The uses of recent and remarkable technological developments in neuro-imaging provide insight into the ways such an alternative conception of life as the activity of living is being made. To avoid any claim of simple technological determinism, however, I wish to draw on the argument that the most fundamental aspect of medical technology is the way in which a thing like life arises as

something to be revealed for medical or scientific scrutiny at all (Blume 1992). PET scans of the brain are made from recording a radioactive isotope injected into the bloodstream. By tailoring the isotope markers to a range of compounds, the uptake of oxygen in different regions can be observed. FMRI scans are produced by entirely different means: they register the oxygen use in parts of the brain via powerful magnetism and radio frequencies. Both continue to be used since they reveal different neurological processes. Their common claim is that they can capture the living, or as it is generally termed 'active', brain. The technological innovations, which are rapidly allowing greater resolution by using faster sweeps of the scanner and greater sensitivity, are thereby able to generate images of brain activity in greater and greater detail. With these advances come grand promises of greater understanding and direct clinical application. It was precisely these that underlay the 1990s being heralded as 'The Decade of the Brain' (Pechura 1991) and, hot on the heels of that, the World Health Organization's recent proclamation that neuroscience is 'permitting researchers to see the living, feeling, thinking human brain at work' (WHO 2001).

This enthusiasm is widespread in journals, articles and textbooks, frequently conveyed through the metaphor of exploration and discovery that encapsulates the sense that new things are being seen and revealed. As one leading neuroscientist, proudly surrounded by an array of monitors and with his back to the large glass screens that separated him from an enormous scanner, declared to me: 'This new science is very complex, overwhelming at times. . . . There are still many technological and methodological kinks to be ironed out. . . . But, of course, its really, very, exciting!' The language is of charting a new landscape; for example, an introductory textbook pronounces 'new imaging techniques make the internal world of the mind visible. . . . As we enter the twenty-first century functional brain scanning machines are opening up the territory of the mind just as the first ocean-going ships once opened up the globe' (Carter 1998). The narrative is consequently of quest and discovery; new landmarks, regions, territories, of brave explorers bringing back stories of a far-off and wonderful place, of revealing the mind for the first time. This frontier mentality was recently evoked at a large international conference when a leading imager fanatically proclaimed, 'This is Wild West science!' The optimism associated with these new advances is, for all the old disciplines, converging to generate a single complex model of the working brain. The range of experts at the imaging sites of this research come from both medicine (such as neurologists, psychiatrists and clinicians) and the non-clinical sciences (such as the cognitive psychologists, physicists, chemists and mathematicians), working together as a team to endorse the claim that neuroscience is the new meta-life science. At one imaging location at least, though, when it comes to lunch, the two camps notoriously occupy different tables in the canteen. A solitary researcher happens regularly to flit between the two, thus embodying in his tray-balancing manoeuvres this somewhat unaccustomed research assembly. The territory is not yet fully fixed, at least.

Technology plays a central role in this new field not merely because of the

forms of data that can be now collected, but equally because of the new ways in which they can be represented. Thus, the story of brain imaging must also be a description of shifts that are currently occurring from two dimensions to three, from static to real time, from localized oxygen uptake to more complex routes of blood flow and neural pathways. In the past, the key advances frequently used to introduce the history of science have been the printing press, the microscope and the telescope. All are visual technologies, further endorsing the ocular-centric metaphor that to see something is to know it. It is against this backdrop that Posner and Raichle (1997), in a classic introductory textbook on brain imaging, end a review of developments by exclaiming that the new techniques of PET and fMRI will, like the inventions preceding them, not merely generate more information, but also necessitate new scientific paradigms. The images serve to demonstrate that the wonder and complexity of the brain, the essence of what it is to be human, can now be the subject of scientific scrutiny. The implication, of course, is that technology is allowing not only new things to be seen, but new things to be legitimately conceived of for scientific discovery. It is not a coincidence, therefore, that this new version of life emanates from a visualizing technology. In an edited volume by Levin (1993), the Western 'culture of vision' is considered, ranging from the dominant metaphors that betray how the visual is given priority over other senses, to more subtle effects, such as how the notion of ideology is itself constituted through conceits of clouding or masking what is authentic. A central issue that many of the essays question is the link between subject–object dualism and Cartesian optics, by which light is that which both links the observer and the observed, and yet also ensures that the division remains secure. Though Descartes himself saw optics as merely an analogy, more recent commentators have tended to regard his accounts of vision as instrumental for his rationalist position (Judovitz 1993). The overall argument is that objects of science have largely gained a kind of objective independence through the sense that they are detached from ourselves – they are things that can be seen, but equally are seen to be not ourselves.

Extending this argument, science uses visual representations, however, not merely to reflect reality, but as active constituents of how that reality is constructed and validated. For example, Lynch (1990) discusses the ways in which visual representations in science do more than illustrate, serving to reconfigure objects in very particular ways and with very specific intents. He argues that the images can be analysed to reveal some of the processes that lie at the heart of scientific endeavour, selecting, defining, modelling, adding and so on. Most relevant here is his discussion of 'mathematization', by which objects are rendered in such ways that they demonstrate the mathematical-scientific principles to which they can be subjected. In other words, rules of uniformity, geometry and linearity all serve to ensure the scientific representation is a 'merged' one of the natural phenomena and the set of methodological principles by which they come to be known. The brain image appears as just such a merged image. But, because the transformation is done from the outset through the very process of data collection rather than simply through the application of stylistic

principles afterwards, the image cannot be generated or known other than through this mathematizing work. There is no pre-existing natural phenomenon available (unless one really resorts to messy neural tissue), and no alternative representation of it outside these principles. So the brain scan is also endorsed in a new way – through the exclusive property of its technological construction.

Cartwright (1995) has argued that medical representations in the twentieth century were transformed by the technology of the cinema. Her argument is not simply that the moving image allowed living processes to be reproduced, but that those processes themselves were conceived and transformed by the observers' growing acquaintance with cinematography – a kind of narrative reconstruction. Certainly, it is not a new claim to suggest that the history of biomedicine is a history of visualization – making the invisible increasingly visible, and so rendering it accessible. Yet perhaps what the cinema allowed for, for the first time, was a method to capture the living as something available for examination. Through its flickering animation new means to represent systems and processes were established. Do the most recent images of the living brain do anything more than this? I believe so, not because of the technology *per se*, but because the rhetoric itself promises something new and so brings it into vision; not merely to represent something as animate, but to tell the story that it is revealing human life itself. In conversation, most researchers tend to dismiss the images themselves as merely useful summaries of information that, in its primary state, exists within the archived terabits of data. Consequently the fact that the images are so explicitly constructed is not their weakness, but a new form of their authority. They are able to legitimate truth claims in two ways: from the historical tradition of 'seeing', both statically as objects and in animation to show process, but also from a new virtual basis of knowledge based on the sense that the digital data that lurk beneath are, in some way, pure and authentic, and so possess irrefutable veracity.

Consciousness is now being tentatively welcomed back into neuroscience and psychology as a legitimate object for enquiry precisely because it can now be registered. The old debates at the turn of the last century spurned introspection and experience largely because of the positivist aspirations of the new discipline of psychology. Now, however, imaging technology is providing a new link that, it is claimed, will allow the two to be united. Though a 'complex and yet to be determined relationship' (Frith *et al*. 1999), the very promise of a neurologically based theory of consciousness is already shaping the field. For example, what is striking in such reviews as Velmans (2000) is the lack of philosophical positions, and indeed the virtual abandonment of the word 'mind' altogether.[2] Work by Damasio extends this, by arguing that the 'secrets' of the mind are being opened up through the complexity of a multifaceted brain. What these texts do, however, is to give the illusion that the categories have somehow stayed the same, that consciousness was merely an object lying in wait for these new technological techniques, and so disguise the very fact that they have been increasingly subjected to cultural and historical modification. The point, as Foucault constantly reminds us, is that the

scientific gaze is not merely one that frames and penetrates, but also one that illuminates and composes.

Sceptics of neuroscience, too, may be falling in to this trap of assuming that the categories of knowledge are remaining fixed. The philosopher Levine (1983) has famously tied these contemporary innovations in neuroscience to the old philosophical mind/body problem. For him, the problem remains in the form of an explanatory gap between the physical working of the brain and the qualia of the conscious mind – in other words, how can greater and greater detail of the structure and workings of the brain ever inform an understanding of the mind? For Horgan too, this gap will never be bridged by neuroscience, despite its greatest efforts, because the reductive process will increasingly fragment the unity of consciousness: as he says, they may 'excel at taking the brain apart, but have no idea how to put it back together again' (1999: 23). But such critics may themselves be making a category error of sorts, since the concepts of the mind and consciousness are far from static, and increasingly are being redefined by the constant innovations of neuroscience. Beaulieu (2002) has argued that functional imaging is serving to recast the categories of the mind and brain. When asked, virtually all researchers in my investigations rejected any usefulness to a generalized concept of the mind: 'The mind is for philosophers to worry about, not us', said one; 'the concept of mind means nothing to me', said another. The problem they face in the question, of course, is that Cartesian mind-substance would be completely disconnected from an image of the brain – being non-spatial, and having no size or location. To extend this, what can be witnessed among researchers at the forefront of the technology is a claim that the mind is being mapped onto and into the brain, subsumed by a complex materialist paradigm, and so doing away once and for all with any legacy of dualism. The assertion is clear: that ideas of life and the mind will now be contained, enclosed, within the emerging science of the brain.

The dominant motif of this emerging discipline inherited from neurology of the past, and which is able to hold together these hesitations about the mind and consciousness, is the division between structure and function (see, for example, Sokoloff 1985). The two categories are rarely questioned at any epistemological level: the structure is the physical organization of the brain, the function is a description of what parts of the brain do what. The division is actualized through the methodologies of brain scanning, since different scans are needed to capture the two. In order to gain as much structural detail as possible, many thin 'slices' are taken in order to obtain as great a resolution as possible. Functional scans, however, are in effect intended to capture change over time. They therefore need to be taken quickly, at precise moments during an experiment. They comprise fewer slices, as a sacrifice, and therefore do not have nearly as good resolution. The point is that, during a scanning session, functional scans and structural scans are taken separately. It is only later that the two are combined, and overlaid on top of each other, such that it is possible to identify with any accuracy at all which particular area was activated at specific times during the procedure. The combination of the two scans is, of course, at the centre of the

fervour and excitement attached to this technology. Yet the fact that the two sets of data are collected discretely, and combined much later not only outside the person but also at some distance from the scanning event itself, is never questioned. It is a straightforward methodological necessity that may be eliminated in the future when the scanners become more 'powerful' or through combining techniques at the same time. A clear parallel exists in this division between structure and function with the broader argument presented so far. Models of the living brain consist of both activity and substance. But though this is viewed as arising out of the technology, the historical perspective suggests that it is the very distinction between the two that constitutes the present methodological dilemma, and, further, that in the articulation of this 'problem' exists a sense of vitality. In other words, far from being incompatible with the two concepts, structure and function serve in combination to portray life, since life is the common underlying value that legitimates each way of looking at the brain.

There is more to this, however, than simple interpretative slippage. In Hacking's historical account of the science of memory, he at one point follows Foucault's distinction between surface knowledge, *connaissance*, and an underlying grammar of understanding, *savoir* (Hacking 1995: 198). Hacking makes the point that a discipline such as psychiatry can progress and develop *connaissance*, through its routinized practices, without actually having to establish a deep knowledge at all. Specifically, he argues that the science of memory attempted to gain its claim of *savoir* only during the nineteenth century when it began to serve as an objectifying vehicle for broader questions about the human soul. But we can also draw on this idea of surface and deep knowledge when we are talking about the penetration of the brain images. The excitement of looking beneath the skin, to the living brain, is highly suggestive for the researchers themselves of the promise that the new is indeed establishing a depth of knowledge that will orchestrate diverse areas of research. The illusion is simple: the brain has long since been the locus of various surface knowledges that up until recently have developed relatively independently. But the functional brain image holds the promise of establishing a renewed confidence in both depth and unification towards a science of consciousness itself. Thus, the claim, described earlier, that this is the birth of a meta-science of the brain is itself embodied in the very focus upon what is seen as the essence of the corporeal person.

I want to go on to describe the expanding knowledge that is regarded as building this sense of *savoir*, and that is potentially transforming and transgressing cultural notions about the brain, its relationship to function, perhaps even what the neuroscientists claim – the very concept of mind itself. Key to this is the assertion that the technology does indeed portray something of life, in terms not only of meagre existence, but of the living person. In the alterations of blood flow and neuro-chemicals taken as demonstration of brain activity, it captures people – who they are, what they may be feeling or thinking, or what they may be suffering from – and so renders life as something visible. What I am suggesting is that, in a relatively small branch of science that claims to be so highly materialist and in which a complex reductionist paradigm is providing a

major resource for the rise of a new biological psychiatry, these extraordinary machines are also being charged with providing an image or form of life as it is actively lived.

Experiencing the scanner: inside and outside, subject or object

In this section I focus on the various individuals who collaborate to form the research teams – neuroscientists, radiographers, psychologists, clinicians and the like – based on ethnographic fieldwork conducted at three leading imaging sites in London.[3] My assistant and myself conducted extensive fieldwork during 2001 and 2002. We were generously given access to all aspects of the scanning sites in order to observe the daily activities of the scientists and interview at length many of the researchers, healthy volunteers and patients. In homage to participant observation we, ourselves, volunteered for scans on a number of occasions, so continuing anthropology's own play on being both an insider and an outsider.

I want to show here how the neuroscientists have themselves had to hold on to ambiguous conceptual categories, and in fact need continually to alternate between them, in order to make their knowledge at all steady. The researchers constantly have to negotiate many of the boundaries that shape traditional scientific practice. At the heart of the matter is the reality of what they are investigating; more than merely the human brain, or even the *working* human brain, it is a science that needs to recognize the person being scanned as a conscious, aware and reflexive individual. It is here, consequently, that a materially based model of living is tied to one of activity. But I also want to show that there is another sentiment apparent in their activity that plays across conventional research boundaries, an implicit allegiance to a concept of vitality. It is this 'vision of life itself' that allows the researchers to switch between object and subject, mental and physical, past, present and future. It serves to bind the various experts loosely together, provides fervour to their exploratory work and generates the awe apparent as they huddle around the computer screen each time an image of the functioning brain is generated. It is the computer itself that is the surface upon which this chronicle of blurring is played out. The images occur here – not as printouts or on volunteers' souvenir tee-shirts – but on the surface between the observer and the vast amounts of computing power needed to generate them from what some evocatively term 'raw data'. It is these images – transitory, manipulable, flexible – that are the true 'objects' of the research, and that possess the quality of life.

The history of studying the brain and human behaviour has been fraught with a concern over the status of subjective experience, and the development of an objective body of knowledge. But, with the shift of focus during the nineteenth century from thoughts, ideas and reflections to observations that could be subjected to the experimental method, an old explanatory gap was reconfigured between the external observable behaviour and the mental processes it was

deemed to imply or insinuate. Advocates present the promise of contemporary brain imaging as a resolution of this – to make the internal visible and external, and bridge this divide. In so doing, neuroscience views itself historically as 'coming of age', finally able to include the old quests within a scientific paradigm. The subjective experience of an individual is presented as being available to scrutiny for the whole of science – not only the internal made external, but the subjective made objective.

Certainly, any awareness of these fundamental distinctions becomes indistinct in the actual scanning procedure. As one is rolled backwards, into the circumference of the scanner's mouth, the world slips from view. One's head is held steady by a frame and compressed sponging, so that only the eyes can move, darting about as the world retreats. Inside the claustrophobic machine the outside disappears entirely; the tunnel is closed behind, the only thing remaining visible being the small mirror-screen used to project the experiment stimuli. In one hand, on the outside, is a small box with an array of buttons used to register responses during the test. In the other, a panic button, activated by air rather than electricity, to ensure a fail-safe device. There's also a microphone, somewhere about, that is said to be activated, but there's no way of knowing. That is the only contact with the researchers, who are beyond the room, in an enclosed cubby-hole, divided off by a large glass screen. There, three or four of them carry out various tasks in subdued lighting; while one operates the scanner, another checks the data as they are collected, and another is in charge of the specific experiment being conducted. As the scanner starts the noise is unexpectedly loud, the earplugs not shutting out the whirring and clanking of the machine that occurs intermittently. But the sound is dulled, like the sound that reverberates when your ears are submerged in bath water.

From the outside, the story is equally disconnected. The volunteer is glided on a horizontal bed into the scanner opening, their arms, parallel to their body, clutching the two boxes of buttons. Final instructions and reassurances are given, but the face and head soon recede. The researchers then retreat to their small control room, where frantic tapping and switching is mixed with coffee slurping and banter. One of the many monitors shows a small dot dance about on a black screen – registering the eyes' movements – while another takes note of any minute head movements in order to correct for them as the scan is taken. But by the time an experiment or battery of tests is begun there is calm. The researchers wait, with expectation, to see the first preliminary images generated by the scanner to appear on one of the multitude of monitors. They wait to see the person again – but this time through the technology, on the screens. There is a scrappy note on the frame of some of the high-resolution monitors instructing people not to touch the glass. 'Do not even *think* about touching the screen', it warns.

There are a number of ironies in this procedure to image life. Though the marker on the forehead can eliminate movement to some degree, the person is forced not to move within head restraints. Coughing, laughing, sneezing, dozing can all potentially ruin the scan. In other words, all external signs of life must be

eliminated in order to capture life on the inside. Sound also serves to demarcate – the muffled sound of the outside is masked, while an MRI machine makes surprisingly loud mechanical whirr and clicks as it reverberates around the head, further excluding the world beyond. Though the person may speak via a microphone at the beginning there is the distinct absence of anyone else while in the scanner. Such distancing between the person and their brain activity is further played out by the layout of the equipment and the scanning rooms. Though there are clearly practical reasons for the use of space, the stark division between the person in the scanner and the researchers further ensures a breach, initially between the person and the scientists, but ultimately between the activity in the brain and the physical world. Both the person and the researchers effectively retreat to their positions, awaiting the operation of the machinery that pursues something in between them both. At one scanner, the researchers actually turn down the lights in their control room, to ensure that the person, already cocooned in the scanner, cannot possibly be distracted. But the mood of the scientists changes in the dim light; there is a sense of theatrical expectation, of a vivid show soon to begin on the screens. There is also, in the very rigid and confined ways in which the technology is put into operation, and the very formalized routine of the procedure, a sense that scanning is a precarious event. On numerous occasions researchers see the volunteers or patients as the problem, as though somehow what they do, or what they bring to the laboratory, is the source of corruption. The truth of the matter is that, though extraordinary, and involving some of the most advanced aspects of physics, engineering and computer software, the technology as an ensemble frequently does not work. Software crashes, isotopes lose their efficacy and the continual reconfiguration and adjustment of the hardware is frequently delayed. Yet these anxieties are transmuted into a sense that it is the ephemeral and fleeting nature of that which needs to be captured which is the problem, as though the brain activity can all too easily slip away and disappear from view.

When an initial image forms, it is usually a somewhat nebulous one. It means little to a non-expert, but it is what the research is all about. It is not just an image of the brain, but of *activity*. Prior to further complex parametric analysis, it is said to convey little; as one researcher kept reminding me, 'Don't concentrate too much on these images. They're not important.' Yet, despite not being fully processed, and though not yet tied to the experimental conditions, these preliminary images are nevertheless awaited with expectation. They show the inside of a person, on the outside. The images are commented upon, talked over and shared between the researchers. As well as debates about quality, the time delays in generating them, the choice of resolution and other perimeters of the scan, jokes may be made, and someone may already be casually playing with different cross-sections and angles. The private inner world of the volunteer is swiftly made visible and social. Radiographers in particular may judge the person, even get cross with them, based on concern over the final quality of the image – the representation of the brain being read as one of the person. The volunteers are looked at through the scan; they are judged; 'a good one',

'sensible' or 'a twitchy'. The volunteer, somewhat disorientated, is ushered in to see some of the results. The structural scan, usually taken at the end, showing with remarkable detail all the various soft tissue in the head, is proudly displayed on a large screen. The dynamic nature of the digital image is usually shown off, as a computer cursor sweeps cross-sections through the three planes of the virtual head. The volunteer usually watches entranced, enchanted. Part narcissism, part technical wonder, they stare at themselves transformed. And the researchers, too, nonchalantly acknowledge that this is all something rather strange, their objects of study being introduced to themselves. Finally, a sample printout is provided, proof not only of participation, not only of the brain, but something that can convey the slippage of being inside and outside. So volunteers go clutching the copy, wanting to try and convey the feeling to others: 'If you've never had a scan you can't understand what it feels like to know that that's you . . . that they can see inside you, and know what you're thinking.'

Researchers have to be confident that the results they finally get can be justifiably associated with the experimental conditions. As one reluctantly confessed, 'you just can never be sure that they're not thinking about the weekend, or something'. Careful checking is therefore conducted prior to a scan to ensure the volunteer knows exactly what to do. They are told not to worry, to relax and to try not to think about things other than the task that they have been set. They are briefly 'trained'; that is, taught what to expect in the scanner and what procedures or actions they are required to do. The mind of the volunteer should not be too enquiring. In fact, so fearful are the researchers of the volunteer's wayward thoughts contaminating the data that a number informally use 'danger categories': some refuse to work with curious students, others with psychologists. The worry is that such volunteers may constantly be second-guessing the experiment, and thereby not actually doing (i.e. thinking) what they are meant to. The vetting of volunteers, especially to establish their real motives, is consequently considered essential. So the information that is relayed is not only about the technical aspects of fMRI or PET but also the theoretical and ethical contribution that this kind of research may, one day, make. Volunteers are frequently prompted with considerations of gift giving and the 'greater good'. The provision of only travel expenses, souvenir printouts and t-shirts, in combination with the explicit denial of providing actual payment, all serve to enforce this narrative further. Volunteers are invited to ask questions, they are shown around and made to feel at least in part an active member of the project. Such participation is, consequently, not merely vague flattery; the researchers themselves rely on the sense that the volunteer has a shared understanding and communicative relevance in order to establish mutual trust.

As the data are processed the volunteer subjects slowly disappear from view, and are converted into something else. Their names, curiously however, remain – attached as labels to the data and the images that are slowly worked on. So it was that one researcher, on our first meeting, complimented me by saying 'Oh, hi there. Yes, yes I already know you very well . . . from your scan. . . . I've been working on you for weeks!' The data take as long as six months to analyse, and

each site has a host of computers and desks where people spend most of their time peering at images and clicking through numerous procedures. By the time of results, presentations and reports the volunteers' individuality and participation have unsurprisingly disappeared completely from view. They are converted to numbers, averages, norms, while their subjectivity and co-operation, their consent and training are all rendered invisible. There is, for example, even a strict code developing to determine which image and statistical manipulations, if any, can be used in publications. But, though the volunteer is transformed for the scientific community and wider public, this is not really an end point within the scanning labs. The researchers switch, alternate and oscillate as they consider activity in the research site, and dissemination beyond, always able to review the data, re-analyse and re-model them. There is, then, a tension between trying to establish fixed and definitive findings, and being able to keep the data unlimited in order to re-examine the subjectivity that is at the centre of the experiments.

Such methodological oscillation is not all that new. A famous historical study, cited in many histories of neuroscience, presents the case of Walter K. During the late 1920s this young sailor complained of severe headaches and failing eyesight. As these got worse he began to hear a humming noise as well. He was initially told that he was imagining these, since no one else could hear them. Finally he was seen by a doctor who, with the aid of a stethoscope, confirmed that the noises were actually the sound of blood passing through abnormal vessels directly over the visual cortex at the back of the head. In the received history of current neuroscience the significant point is that the sounds – and thereby the blood flow – increased whenever Walter K strained to use his vision. But, for me, through the description of neuroscience practice, the significance of the classic status of Walter K is not based on the specificity of function and its association with blood flow. Rather, it is about a dilemma set up by having to acknowledge a mental world made physical; in other words, that a mental world needs to be acknowledged, somehow, as a viable resource for scientific study. Brain-imaging researchers insist that their world is a physical world. As one exclaimed, 'I want to move away from the laboratory-type tasks . . . to talk about real experiences. . . . I'm a very concrete person!' This position is widespread in the research into both healthy people and people with mental illness; there is a consistent agreement that both areas of knowledge will be unified as understanding of brain structure and function grows. The point is that it is not just a physical comprehension, but one that necessarily includes the subjectivity of the object of study.

The underlying message of Walter K's story is mirrored in a recent set of experiments conducted on individuals suffering from schizophrenia (Silbersweig *et al.* 1995). A number of these patients, who claimed frequently to hear voices, volunteered to have an fMRI. They were given a button to depress whenever they had an auditory hallucination, so that these timings could later be correlated with brain activity. According to one of the senior researchers, the results were 'extraordinary'. Whenever the volunteers had thought they could

hear something, significant activity was recorded in some of the auditory and memory areas of the brain. And so, for the first time, biomedical science acknowledged schizophrenic hallucinations not merely as subjective experiences, but as something 'more'. Further, they were made concrete, given not only visual substance but a qualitative reality in terms of specific localized brain activity. It is as though they were hallucinations no more. Not merely was the subjective experience made corporeal but it was also made accessible to collective view. Private life becomes, quite literally, public property. It is not that the mental has become physical, but simply that, at key moments, one becomes visible through the conceit of the other. So, for the study of hallucinations this moment was not at the time of the voices, or, in fact, of the pressing of the button, but afterwards, when the data were fully processed, and by which time the volunteers had all but been transformed into objects. The implications of this are widespread. Already, user groups of many illnesses, especially on the Net, are demanding moral and legal recognition through the apparent newfound physical evidence of their conditions. Many sufferers of schizophrenia, depression, ADHD, chronic fatigue, Gulf War Syndrome are in unison seeking legitimization through the combined capital of an enchanted science and territorial claim of physicality (see Dumit 2002). Such knowledge is not merely about confirming a diagnosis, but about how this knowledge is constituting the disease, fixing it as tangible and materially present. Once it is 'visible', the medical and social debates shift irrevocably, whether the foundations of the new reality are later confirmed or not.

A notion of living

One can regard the relationships set up by the neuroimagers in trying to control what is the subject and what is the object as being the very things that constitute what they are taking to be life itself. In other words, it is the very productive nature of trying to reconcile the two that is actually shaping how something like life is coming to the fore as a somewhat unwelcome part of their discourse. Let me take as a further example an intriguing experiment in which the procedure was deceptively straightforward: volunteers played the childhood game of 'scissors-rock-paper' in a brain scanner with an opponent on the outside, sometimes announced as a computer and sometimes a real person (Gallagher *et al*. 2002). The study seems to show that, depending on whether the volunteer thought they were playing a person or a machine, different parts of their brain were active. The tantalizing conclusion for the neuroscientists, of course, is that the scanner may have identified that part of the brain concerned with 'theory of mind', that is, the understanding and interpretation of someone else's subjectivity. The claim, then, is that some dimension of conscious life, in this case the projection of subjectivity onto the unseen opponent, is consequently revealed and made visible. But what is of interest here is that in reality subjects were only ever playing a computer, since this was the most convenient way of

following an experimental design and isolating a single variable. The sense that they were playing another person was only based on what they were told; the area of activation identified as something to do with the theory of mind was based, in fact, on an illusion. One could argue, therefore, that the scientific 'finding' is merely the consequence of utilizing the technology – both physical and intellectual – in an experimental event that itself set up the productive relationship between subject and object. The assertion that part of the brain associated with 'theory of mind' was observed is merely a consequence of this. But, once established, it gains a kind of stability that quite easily masks the actual convoluted nature of the experiment, and the fact that it was based from the outset on articulating a pre-existing relationship that could become embodied in a particular, defined area of the brain.

Although said as a kind of colloquialism, imagers invariably describe the specific activated areas as having 'lit up'. When I naively asked one researcher whether parts of the brain really illuminated, she replied, 'Of course not! It's just a silly phrase to describe specific activity. We don't actually "see" anything of the brain, after all.' But the metaphor is further endorsed by a colour convention in which red is used to describe most activity through to blue and then black to portray least. The conflation of light and activity, and hence of discovery, runs much further, from a cartoon poster of an electric bulb above a scientist's head in one office, to at least one of the scientists playfully calling the images 'photographs', through to the language of pursuing experiments in order to reveal a discrete area of activity such that clear results can be seen. In fact, the experimental methods used in the scanner are frequently little more than Thorndike's original puzzle boxes that tested the relationship between stimulus and response. Homemade contraptions to drip tastes into the subject's mouth, or lift their arm involuntarily, or administer a puff of nicotine at a key moment, routinely juxtapose the most space-age technology with bits of sticky-tape and crudely fashioned levers. Though claiming to access the interior of the person, the research correspondingly mimics the earlier psychological research that detached behaviour from everyday life and the external measurable form from the immeasurable inner psychic experience. To a major extent this is because there remain quite considerable constraints around the current technology that largely force the researcher to isolate observable singular brain activity that can be associated with singular stimuli.

Temporality is central to the methodology. Most obviously, of course, this relates to studies of memory, of champions who can learn the random order of cards in a pack, people learning to read music or post-surgery people with epilepsy and their reduced cognitive function. But, in fact, all investigations rely on a schema of scanning, before and after the introduction of the key variable. At sometimes rowdy and boisterous meetings, outlines of proposed experiments are generally discussed via time-lines, themselves animated via PowerPoint slides or multiple overhead projections. Most designs consist of three key alternating periods: a distracter task (which is frequently disguised as an active element of the test), a normal state and the experimental state. The periods and

fluctuations of each are considered in great detail by the entire research team. Predicted affects and targeted brain regions are hotly debated during an initial bid to book valuable scanner time, while literature reviews are presented always to contextualize future research in terms of findings that have already been established. Only then is the final experiment settled and put into practice. The design is an attempt to pull apart the various constituents of activity, the manipulation of time in the scanning serving to 'open' up experience such that a singular variable can be associated with a single area of the brain. Later, the methodologies of separation and comparison are reintegrated when it comes to analysis. The vast quantities of data collected throughout the scan go through sequential processes of manipulation, while the chronology of the experiment is disassembled and then reordered. Thus the final image used in presentations and publications, which appears inert, even atemporal, is actually a carefully chosen abstraction of difference over time, one in which it is the subtraction of data, rather than the amalgamation of data, that provides meaning. The central cogency of the methodology is very clear: activity is observed through temporal changes. In other words, life processes are conceived of as fluctuations that exist between one scan and another. In the interpretations that follow, the idea of life is consequently 'poured' in between, linking the two observation states that are taken to be merely ephemeral snapshots of never-ending alterations. The technology is fast developing such that the delay necessary to process the data is disappearing. Some now talk of approaching 'real-time' representations on their screen of the active brain being scanned. Real time is a goal because it would further present the imaging monitor as a convincing window through which activity could be witnessed. Subtraction would be ongoing and automatic so that differences would be observable from one moment to the next. But the concept of what is actually 'real' in these real-time representations is interesting: is the fact that the image changes at, more or less, the very moment a change happens in the brain good enough? In a sense, what is hoped for is a more convincing, cinematic illusion, in which the vast amounts of technology and the extraordinary arrays of computational processes can disappear from view and be forgotten altogether. Real time, involving more manipulation not less, will allow for a greater sense of real life.

But practices within current neuroscience research centres are more jumbled than the final unitary and bounded objects of knowledge shaped for the wider community may suggest. This itself is nothing new, and could be taken as simply an extension of cleansing the data,[4] extracting the human and cultural elements that inevitably shape events within a laboratory. But there is also a remarkable resistance to this by researchers during their daily work; indeed, there appears to be some commitment not to fix certain categories. It may be that within such safe institutional settings the researchers remain relatively free from obvious external scrutiny, allowing initial findings to be made unguarded. It is as though, in the face of the complexity and intangibility of what they are doing, the researchers allow themselves to remain ambiguous. As one said, 'What we do is science, but although no one admits it, it's an art as well. You

have to decide what makes sense, how to generate the images, what to put in and what to leave out. . . . It makes me feel a bit uncomfortable at times.' Imagers frequently invoke a desire to get back to the individual, to somehow register the process of the experiment and the experience of the volunteer. Frustrated, some express how the inevitable abstraction does not reflect the process of research itself: 'I struggle with the issue of subtraction . . .', said one junior neuroscientist, 'but I'm always very aware that you're dealing with people, people's lives.' Unlike their view of genetics, which is frequently regarded as a rival discipline based on more or less fixed and constant knowledge, neuroscientists elevate the brain through proclaiming it is so intricate and so changeable that the scan 'ultimately disregards the whole story'. As another put it, 'Something is lost in all this. Those pictures don't really give the same feeling that you get when you're in the control room and a volunteer is in the MRI.' This limitation, however, appears to authenticate the science further. As a result, the task to study activity – whether it is of the blood flow or specifics of one of the known receptors – is contrasted with forms of knowledge that suggest fixed linear causalities: 'We look at relationships, changes, styles and strategies, latencies. . . . The list is endless. I don't think we'll ever get a complete picture, because of the very nature of what we're looking at.' This kind of life indeed appears to reside in irreconcilable complexity. In the probing quest to identify brain activity I have tried to show that there are still traces of a notion of life, a sense of vitality, playing out of this ambiguity and this sense of discomfort. This is not vitality as a simple force, as a motor or drive or passion. But it is a new kind of rhetorical claim that, embedded within a highly material paradigm, they are searching for that which makes us human. When another clinical researcher recounted how people are so amazed, impressed, intrigued and fascinated by these images, she spoke with such fervour that it was clear that she was not excluding herself from these sentiments. She went on, 'We're just playing with models. The subjects can never be standardized fully, and the models will always be an approximation.' 'Of what?' I ask. 'Of life,' she replied.

Conclusion: life encompassed

One of the themes I have addressed is that, though the concept of life has all but disappeared from official scientific discourse, it remains implicit in everyday practice. Visual styles and conventions can serve as non-linguistic constructions that can contain and shape discursive elements without ever having to refer to them explicitly. The rise of neuroscience is undoubtedly engaged in the production of new norms and models of deviation and treatment, but at a more fundamental level it is also instrumental in implicitly constructing the life to which those aspects of medicine are related. As one researcher put it, 'the snapshot ultimately disregards the whole. The complexity of the brain may ultimately resist a scientific approach; the images will never be able to show how the brain works, but it's fun trying!' In all this, the fact that inner subjectivity is blurred

with outside objectivity, that the mental need no longer be demarcated from physical or that the image need not be read as a single moment captured in time does not necessarily mean the new knowledge is more open and reflexive. If one accepts the interpretation that the concept of vitality resides in the switching between categories, the real question is: what kind of life is it that is being construed?

I have suggested that neuroscientists frequently claim that the explanatory gap between understanding the brain and knowing the mind is no longer an issue, that the mind has been done away with. I have shown that this does not mean that under the surface there does not remain an anxiety that necessitates the constant switching between vantage points and that the mechanistic view of the brain is not necessarily incompatible with a sense of vitality. In these high-tech environments, it is not life as a force or substance or life as reproduction that prevails, but life as activity that serves to contain the oscillation between categories of knowledge: between subject and object, between people and things, between mind and body and between one state and another. As an implicit rather than explicit notion, it thereby avoids any recourse to accusations of mysticism, spirituality or, conversely, to merely reducing life to the material and physical. Roepstorff (2002?) has recently argued that brain imaging laboratories can be usefully considered 'sites of transformation', in which the production of knowledge is a process of converting the brains of volunteers, via the technology and computer programmes, into abstract claims for scientific consumption. But I have implied that the concept of transformation is limited, since it can too easily ignore the transcendental properties that are continually negotiated within the course of generating the images. The real issue, as I see it, is not about the processes of conversion, but the opposite: the ways in which cultural dimensions are reproduced and further disguised by such technological developments. Neuroscience increasingly entraps all aspects of human experience within a single gaze; all aspects of human life, from emotions to suffering to dreaming, are now legitimate areas for valid investigation. In so doing, the technology does not merely transform but newly generates these categories as discrete objects for the new scientific. And, in so doing, life is effectively being recast, though it remains transient enough never to be defined or even acknowledged.

There are some worrying aspects to a notion of vitality that is able to hold opposites together. First, it is a highly sanitized. Just as the digital data are initially cleaned of extraneous factors, so the life that is witnessed is one solely derived from seeking clarity. Even in clinical experiments, where volunteers frequently suffer from debilitating or traumatic conditions, life is decontaminated and the conditions compartmentalized, free from the experience of suffering. The very procedure, as described, reflects this process. It is effectively a life that is digitally re-mastered, the analogue nature of the primary data being converted and then worked on through multiple transformatory equations in order to achieve a clear and standardized image. It is also a life that is highly disaggregated. The computer screen divides the person from the researchers. This is, then, life devoid of context and sociality. Life in the scans is accordingly one

from which humanness is abstracted, yet which nevertheless claims to represent it. It is a presentation of a disembodied self, entirely discrete and encapsulated, intrinsically organized and pinned down by glowing areas of life's activity. Unlike earlier medical attempts to present vitality within an ideology of holism, the life within the screen is one that need not be unified with anything else, because it is, by definition, transitory, unconnected and not visibly there. It lurks beyond and beneath the screen. And, though the subjective perspective is important, it can be removed easily when it comes to dissemination beyond the laboratory, freed from the ambiguities that are at the heart of daily practice. Overall then, this is a vision of life that need not be located at all. It is a concept made virtual simply by the slippage of scientific practice, and with it carries no responsibilities and no obligations. When asked about the work they do the researchers startlingly report little social relevance beyond the specifics of their studies, and look blank concerning the growing popularity of the brain as an iconic image. The official knowledge is seamless, less troubled as the ambiguities are now played out only on the glass of a monitor.

In Jay's (1998) essay on modern visual culture he suggests that the twentieth century will have presented various challenges to the traditional hierarchy of scopic regimes. With the rise of such things as hermeneutics, pragmatism and post-structuralism in particular, he questions whether there has been a 'dethroning of Cartesian perspectivalism'. Certainly, within the everyday practice of the research sites in this study there is some genuine hesitancy to claim the clear and fixed distinctions that such a regime would be composed of. I have briefly suggested that this is because, throughout the research process, the investigators are aware not merely of the subjectivity of their volunteers, but that it is this that must necessarily be interwoven with their construction, or discovery, of facts. But I have also tried to argue that the visual trope nevertheless still serves to 'contain' this kind of ambiguity and that the two are not necessarily incommensurate. For example, the techniques of subtraction used to fashion images of activity, and the goal of real time sought to provide a direct and immediate image, both promise for change and process, the building blocks of their model of activity, to further become merely objects like any other. Following Virilio (2000) real-time and time-space compression cannot be dismissed in a language of the 'virtual' – they are the physical consequences of technology that is already having indisputable consequences for the dislocation, or relocation, of agency.[5] By collapsing the spatial and the temporal there is no 'room' left for traditional political and social processes that in the past relied on the division between subject and object. In other words, there are fewer and fewer alternative perspectives – the success of the technology itself controlling both the vantage point and the interpretation. Already the scope of the gaze is broadening, to include experiments into religious experience, the neurological location of love and even political fanaticism, demonstrating that the traditional boundaries between science and the social sciences are regarded as redundant. For brain scanning, this promise of human investigation is effortlessly reifying the images, and the new discipline, still further – the living person and the image

becoming virtually synonymous with each other. That scrappy note on the frame of the monitor, instructing people not to touch the screen's glass, is actually replicated on many of the machines at different imaging sites. Of course, ostensibly, this is because people want to point, indicate and show others some particular aspect or other of the picture. But a multitude of greasy fingerprints bear witness to many misdemeanours. It is as though as an image appears, built up line by line, the temptation to touch the screen, to touch, reciprocally, the subject, becomes all too apparent; as though, 'There, there is the head, the brain, the person, Look! See!' But this is a self-fulfilling revelation; it is a life made visible by the technology that enframes it. The touching of a screen is in fact a dubious act, for it confirms the illusion still further.

The central metaphor, then, becomes one in which everyone, not only the neuroscientists, are observing, and so nervously recreating, life through technology. MRI and PET are clearly not the only ones involved in the process, and it far from dismisses the central importance of conceiving of life as a property or substance. But by offering a visual play on the two vantage points – 'I on the inside' and 'I on the outside' – scans are serving as iconic representations of this transformation. This vision of life, life as active information, takes on very human characteristics. Their very 'life-like' appearance serves to fix this, propelling it, whether it is legitimate or not. The act of recognition need not be one merely of seeing what is familiar, but of seeing something that appears intuitively understandable. Volunteers who are proud to be able to make out their own individual profile or the researchers who await the first computed image from a scan are but the most obvious examples of this process. The scans are permeated by a Benjamin-like aura of authenticity because they are regarded, through the process of their production, to have captured something of the person, something intangible. But it is not merely in the form of a picture, by which volunteers recognize themselves and so find meaning in the familiarity of portraiture. The true claim to the humanness of the life is the unspoken assertion that agency, thought and feeling are all now also potentially visible. They are both metaphoric, conveying life through a highly formalized technology that constructs the data into a visual representation, and metonymic, encapsulating some very physical essence of a person.

For Rabinow (1998), the consequence of Canguilhem's distinction between life as form and as experience generates a pathos out of the conceptual struggle for normativity. Rabinow concludes that 'life today is more *zoe* than *bios*'; in other words, that simple bare life is increasingly given value above and beyond any concern with how life is actually lived. His point, then, is that the sense of morality that was perhaps once attached to activity and action appears to have transferred to life *per se*, inverting the original hierarchical relationship between the two. Rabinow argues not that we should despise this, but that we should engage in a struggle against the all too easy elision between life in its barest form and the subsequent work we allow it to do. Though I began this paper with the suggestion that the vitality of the brain is qualitatively different from the elementary nature of DNA, and that, in a similar sentiment to Rabinow's, there might exist an anxiety

about what now constitutes living, what perhaps really distinguishes the scan is the success of its elision between the two ways of conceiving life and its vigorous claim to establish '*connaissance*'. The 'life itself' that the imaging technology portrays is formulated as being the functional essence of an individual's brain, precisely because it conveys nothing of the living person beyond the restricted confines of the scanner and the experimental design. If one reverts to Agamben's thesis, referred to at the beginning, perhaps one can glimpse some of the inherent cultural power of the image beyond its place in a growing field of science. Life becomes 'detached' – it is a capacity of the body, rather than of being human, that can be stared at from afar. Functions, actions and behaviour are all linked directly to an apparently 'bare life' that animates the individual, offering a moral simplicity not only for neuroscience, but also for the person in a social world where the values accorded to *bios* are increasingly slipping from view. One could argue that, in so doing, human motivations, responsibilities and so forth are being neatly sidestepped. But what I am contending is that, in so doing, the person is actually being reconfigured, such that in some contexts at least the person does not have any life other than this life itself. There is already some diffuse evidence for such a broad claim. The popularity of images of the brain in the media, whether in films, soap operas or the science pages of newspapers, is not simply because people are curious, but because they are curious to make sense of themselves in a very particular way. People are seeking ways of understanding themselves, their own thoughts and behaviours, 'from the outside', without having to engage with actually scrutinizing their lives at all.

That any 'form of life' is socially constructed is in the end a very straightforward claim. I have argued that the contemporary version of life described here is one that bridges an explanatory gap, but one broader than the theoretical ones originally posed by philosophers. The scientists and researchers described are implicitly shaping a cultural concept of life, beyond their highly materialist models of the brain and biology, in order to access such immaterial objects as emotions, memory and consciousness. It is a way of spanning a set of key methodological problems derived from the classic experimental paradigm they purport to follow, but also derived from a more general way of looking at the world. The images serve to 'fill in' a gap between interpreting what can be seen as substance and what needs to be regarded as process and activity. The notion of life that shapes brain-imaging research is one that is seen to be inherently human, but, through this, what is seen to be human is being redefined. The reconstructed image of the brain is establishing a novel and compelling means by which the body, through one of its organs, becomes a vehicle for an externalized vision of the self, and a new but partial means by which life can be known and be seen to be encompassed.

Acknowledgements

I should like to thank my colleague, Ms Jo-Anne Bichard, for her close collaboration and sharing of fieldwork material, and the ESRC Innovative Health

Technologies Programme, which generously funded the research. I should also like to thank the organizers and sponsors of the 2001 conference Visions of Life, at which I was able to present an earlier version of the ideas contained above.

Notes

1 There may be a significant gender ascription to these aspects of life, just as Aristotle himself conveyed. Perhaps life as substance, in the form of popular understandings of the gene, retains a sense of the female – providing the raw materials of life – while life as force or energy – enacting, reading and applying the code – continues to convey masculine fortitude and virility (see Helmreich 1998: 115–16).
2 Velmans pronounces in the volume that, in fact, psychology is 'turning to its roots'; that is, turning to its pre-positivist emphasis on introspection (1998: 17)
3 I must acknowledge the careful and dedicated work here of my colleague, Jo-Anne Bichard, who carried out many of the interviews that inform this paper. The actual sites must remain confidential, but it is important to note all three are internationally significant, and are investigating both normal and pathological brain function.
4 This is a large aspect of the post-scan processing. All data regarded as 'noise' must first be extracted before the scan can be fitted to a normal brain template and analysed in any detail. Brain activity is thereby not only encoded, but necessarily dissociated from the person.
5 For Virilio, this is a crucial aspect of postmodernity that serves to collapse spatial and temporal distances that once shaped all key human activities (Virilio 2000). The centres of C3I during the Gulf War, for example, providing not merely the hubs of decision-making, but in a sense the site of the war itself .

References

Agamben, Giorgio (1998) Homo Sacer: *Sovereign Power and Bare Life*, trans. Daniel Heller-Roazen, Stanford, CA: Stanford University Press.
Aristotle (1968) *Aristotle's De Anima*, Books II and III, trans. D. W. Hamlyn, Oxford: Clarendon Press.
Beaulieu, Anne (2002) 'Images are not the (only) truth: brain mapping, visual knowledge, and iconoclasm', *Science Technology & Human Values*, *Journal of the Society for Social Studies of Science* 27(1): 53–86.
Blume, Stuart (1992) *Insight and Industry: On the Dynamics of Technological Change in Medicine*, Inside Technology Series, Cambridge, MA: MIT Press.
Canguilhem, Georges (1994) *A Vital Rationalist: Selected Writings from Georges Canguilhem*, ed. François Delaporte, New York: Zone Books.
Carter, Rita (1998) *Mapping the Mind*, London: Seven Dials.
Cartwright, Lisa (1995) *Screening the Body: Tracing Medicine's Visual Culture*, Minneapolis: University of Minnesota Press.
Damasio, Antonio R. (1999) *The Feeling of what Happens: Body and Emotion in the Making of Consciousness*, New York: Harcourt Brace.
Dumit, Joe (2002) 'When explanations rest: "good-enough" brain science and the new sociomedical disorders', http://symptom.mit.edu/
Fodor, Jerry (1999) 'Let your brain alone', *London Review of Books*, 21(19), 30 September.
Franklin, Sarah (1995) 'Romancing the

helix: nature and scientific discovery', in L. Pearce and J. Stacey (eds) *Romance Revisited*, London: Falmer Press.
——, **Stacey, Jackie** and **Lury, Celia** (2000) *Global Nature, Global Culture: Gender, Race and Life itself*, London: Sage.
Frith, C. D., Perry, R. and **Lumer, E.** (1999) 'The neural correlates of conscious experience: an experimental framework', *Trends in Cognitive Sciences*, 3: 105–14.
Gallagher, Helen, **Jack, Anthony**, **Roepstroff, Andreas** and **Frith, Chris** (2002) 'Imaging the intentional stance', *Neuroimage* 16(3): 814–21.
Hacking, Ian (1998) 'Canguilhem amid the cyborgs', *Economy and Society* 27(2–3): 202–6.
—— (1995) *Rewriting the Soul: Multiple Personality and the Sciences of Memory*, Princeton, NJ: Princeton University Press
Haraway, Donna (1997) *Modest_Witness@Second_Millenium. FemaleMan_Meets_OncoMouse*, London: Routledge.
Helmreich, Stefan (1998) *Silicon Second Nature: Culturing Artificial Life in a Digital World*, Berkeley, CA: University of California Press
Horgan, John (1999) *The Undiscovered Mind*, New York: The Free Press.
Jacob, François (1989) *The Logic of Life*, Harmondsworth: Penguin.
Jay, Martin (1998) 'Scopic regimes', in H. Foster (ed.) V*ision and Visuality*, New York: New Press.
Judovitz, Dalia (1993) *Dialectic and Narrative*, New York: State University of New York Press.
Levin, David M. (ed.) (1993) *Modernity and the Hegemony of Vision*, Berkeley, CA: University of California Press.
Levine, Joseph (1983) 'Materialism and qualia: the explanatory gap', *Pacific Philosophical Quarterly* 64: 354–61.
Lewontin, Richard (1993) *The Doctrine of DNA: Biology as Ideology*, London: Penguin.
Lock, Margaret (2001) *Twice Dead: Organ Transplants and the Reinvention of Death*, Berkeley, CA: University of California Press.
Lynch, Michael (1990) 'The externalized retina: selection and mathematization in the visual documentation of objects in the life sciences', in M. Lynch and S. Woolgar (eds) *Representation in Scientific Practice*, Cambridge, MA: MIT Press.
Morris, Brian (1996) *Ecology & Anarchism: Essays and Reviews on Contemporary Thought*, Malvern Wells: Images.
Nelkin, Dorothy (1995) *The DNA Mystique: The Gene as a Cultural Icon*, New York: Freeman.
Pechura, Constance (1991) *Mapping the Brain and its Functions: Integrating Enabling Technologies in Neuroscience Research*, Washington, DC: National Academy Books.
Posner, Michael and **Raichle, Marcus** (1997) *Images of Mind*, Scientific American Library.
Princeton Weekly Bulletin (2000) 1 May http://www.princeton.edu/pr/pwb/
Rabinow, Paul (1998) 'French Enlightenment: truth and life', *Economy and Society* 27(2–3): 193–201.
Restak, Richard (2001) *The Secret Life of the Brain*, USA: Dana Press/Joseph Henry Press.
Roepstorff, Andreas (in press) 'Transforming subjects into objectivity. An ethnography of knowledge in a brain imaging laboratory', *FOLK, Journal of the Danish Ethnographic Society*, 44: 145–70.
Schrodinger, Erwin (1992) *What Is Life?* Cambridge: Cambridge University Press.
Silbersweig, D. A., **Stern, E.**, **Frith, C.**, **Cahill, C.**, **Holmes, A.**, **Grootoonk, S.**, **Seaward, J.**, **McKenna, P.**, **Chua, S. E.**, **Schnorr, L.** *et al.* (1995) 'A functional neuroanatomy of hallucinations in schizophrenia', *Nature* 378(6553): 176–9.
Sokoloff, L. (ed.) (1985) *Brain Imaging and Brain Function*, New York: Raven Press.
Strathern, Marilyn (1999) *Property, Substance, and Effect: Anthropological Essays on Persons and Things*, New Brunswick, NJ: Athlone Press.
Velmans, Max (ed.) (2000) *Understanding Consciousness*, London: Routledge, Taylor & Francis.
Virilio, Paul (2000) T*he Information Bomb*, London and New York: Verso.
World Health Organization (2001) *World Health Report 2001 Mental Health: New Understanding, New Hope*, Geneva: WHO.

Simon Cohn is a lecturer in the anthropology department of Goldsmiths College University of London. His areas of interest include the anthropology of science, health and medicine, focusing on modern psychiatry and neuroscience. He is currently managing two funded research projects, one on Gulf War Syndrome and another exploring the impact of modern neuroimaging on concepts of mental illness.