
The plastic brain: Neoliberalism and the neuronal self

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Abstract

Neuroscience-based representations and practices of the brain aimed at lay populations present the brain in ways that both affirm biological determinism and also celebrate plasticity, or the brain's ability to change structure and function. Popular uses of neuroscientific theories of brain plasticity are saturated with a neoliberal vision of the subject. Against more optimistic readings of plasticity, I view the popular deployment of plasticity through the framework of governmentality. I describe how popular brain discourse on plasticity opens up the brain to personal techniques of enhancement and risk avoidance, and how it promotes a neuronal self. I situate brain plasticity in a context of biomedical neoliberalism, where the engineering and modification of biological life is positioned as essential to selfhood and citizenship.

Keywords

lifestyle, risk and health, technology in healthcare, theory

We have recently seen a widespread importation of scientific knowledges of the brain into popular culture, resulting in as a rise in neurocentrism, where the brain is conceived as foundational of many aspects of human nature and social life and where the ability to know key truths about the self and the social are dependent upon developments in neuroscience. Popular neuroculture proliferates in the significant gaps between what neuroscientists are now seeing of and knowing about the brain and what they, and we, can know about the implications of this knowledge for individual and collective subjectivity, health and wellness (Harris, 2000). Public brain discourse, found in science journalism and on websites, blogs, trade books and other popular media, addresses a wide range of topics and themes. Many accounts affirm a biological view of the body/self, particularly those that address the gender and sex differences in the brain, the

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biological roots of various kinds of mental illnesses, and the diagnostic possibilities of new technologies of visualizing the brain (PET and fMRI). For example, there is a great deal of discussion in neuropsychology and in the media about brain ‘types’ and differences in brain anatomy and function among various categories of people, including men and women, and the case is being made for the biological basis of a wide range of behaviors and social problems once thought to be moral or psychological matters. In the law, neuroscientific knowledge is being presented as a challenge to notions of free will and personal responsibility (Dumit, 2004), and biologized notions of morality are being offered through the use of fMRI in courtroom settings (Littlefield, 2009). In evolutionary psychology the brain has been marshaled to support conservative ideas about social roles (Machamer and Sytsma, 2004). Anne Beaulieu (2003: 563) notes that new mapping techniques of the brain are being used to reconfigure the nature/nurture debate, such that complex ideas like culture can be translated into biological reactions in the brain: ‘It is not only nature that counts; nurture also counts, but only once translated into a measurable activation in the brain.’ For critics, much of this discourse raises the prospect of biological determinism.

However, there is also much public excitement about brain plasticity. Brain plasticity or neuroplasticity refers to the capacity of the brain to modify itself in response to changes in its functioning or environment. The basic concept of brain plasticity has existed for decades; in fact, as early as 1895 Ramon y Cajal was likely to have proposed the ‘use – disuse’ hypothesis, which posed that ‘the initial [synaptic] connections present in infancy are modified by exercise throughout life’ (Rutledge, 1976: 329). The mid-20th century saw much development on the concept, but plasticity did not emerge as a primary way of thinking about the brain until the late 1970s and 1980s. While once thought to be restricted primarily to early in the lifecycle and to certain parts of the brain, neuroscientists now generally agree that plasticity applies to the whole brain and to later in life as well (Mountcastle, 1998). Plasticity refers to multiple processes of brain function and structure. The brain can make new cells (neurogenesis) and new synaptic connections between neurons (synaptogenesis), and see established connections strengthened and weakened (synaptic modulation). Changes in neuronal connection can range from short to long term, and can be related to shifts in the density and length of dendrites (the receiving part of the neuron), ‘axonal sprouting’ (the expansion of nerve endings responsible for electrical output), increases in synaptic activity, and metabolic changes, among other factors (Kolb and Wishaw, 1998). Plasticity has been correlated not only with early learning, but also with shifts in stress levels and hormones, with recovery from trauma and injury, and with learning new skills in adolescence and adulthood.

Understanding how plasticity works is conceived in neuroscientific circles as having significant clinical potential, such as for reversing the effects of various neurodegenerative diseases and traumas of the brain. But for many, mastering knowledge of neuroplasticity is understood to have broader implications as well. As Andy Clark (1998) points out, the plastic brain is a situated brain, culturally, biologically, and socially. Plasticity appears to challenge biological reductionism by providing room for the environment in brain development and functioning, thus opening up a bridge between the hard and social sciences, and between views of the mind/self as natural and hard-wired and those of

it as nurtured and socially shaped (Cromby, 2004; Eisenberg, 1995; Machamer and Sytsma, 2004). In addition, it historicizes individual brains, since each brain responds to its environment and also to its own workings over the lifespan (Malabou, 2008; Mountcastle, 1998).

Some scholars have also pointed to brain plasticity as a concept which could be marshaled to lessen some of the more politically conservative implications of current neuroscientific thought, such as that various attributes of individuals and groups are hard-wired in the brain. Elizabeth Wilson, for example, has described how the complexity of the neurological-psychological interface defies simplistic determinism. Contesting some of the literature in feminist and constructionist psychology which has rejected brain-based explanations of psychic life (Cromby, 2004), she argues that 'neurological determinism is most powerfully contested through neurological intimacy' (Wilson, 1999: 417), particularly intimacy with the details of how the brain – psyche – environment interface generates new brain structures and ontologies. Her reading of Peter Kramer's (1997) popular book *Listening to Prozac* suggests that it complicates rather than endorses biological determinism, because Kramer describes the brain as physiologically changeable, for example in response to psychic trauma.

Rather than simply leading to or facilitating depression, neurological matter itself may become weakened, neurasthenic, depressive. Not simply the effect of extraneurological events, and not simply the regulator of extraneurological events, this weakened and depressed neurology instantiates the literate, generative, and sometimes melancholic nature of biological matter in general. (Wilson, 1999: 419)

Here Wilson recasts the brain as a complex actor or agent, pointing to its dual capacity to respond to psychic experience and also to generate it. Rather than seeing the brain as a chemical source of depression or as a surface upon which psychic life can be inscribed, Wilson highlights its complexity and its positive or productive features. The key shift she makes here is to argue that foregrounding the brain as organ and biological matter is compatible with complex and politically tenable interpretations of psychic life.

Other theorists celebrate plasticity as a biological condition for human agency, explicitly linking what Wilson sees as the 'generative' possibilities of the brain to critical possibilities for embodied selfhood. They also affirm Wilson's call for seeing neuroscientific knowledge as a resource for critical, rather than conservative, thought. Sean Watson (1998) sees contemporary neuroscience as vital for sociologists, whose enthusiasm for social constructionism has led to a neglect of the material body, or the body as biological matter rather than a mere surface for cultural inscription (Newton, 2003; Radley, 1995; Williams, 2006). Contemporary neuroscience can provide explanations regarding 'how culture comes to inhabit a biological organism' (Watson, 1998: 24). It can also provide details – material grounding – for theories which unsettle liberal notions of stable subjectivity, such as Deleuze and Guattari's notion of 'becoming'. Watson (1998: 39) describes plasticity as the idea that 'throughout the brain there is a fantastic multiplicity of spontaneously erupting experimental responses to outside conditions, drive requirements and other stimuli'. For Watson, this means chaos, in

a politically fortunate sense, and creativity, as well as that the subject is decentered, unfixed. Parallels between Deleuzian theory and the neuroscience-based theories show that we are ‘infinite multiplicities’:

Where there is multiplicity there is an ‘exceptional individual’ or an ‘Outsider’. The ‘Outsider’ is anomalous as opposed to abnormal. The latter deviates from rules in a way which ensures he remains within the system. The anomalous is no longer inside, he is unintelligible. (Watson, 1998: 42)

Brian Rotman (2000) also links plasticity to a multi-subjectivity, particularly in the context of high-tech life. Rotman sees the inner workings of our brains as incorporating the outside in ways that render everything in the environment part of our brain processing. Along with Andy Clark (1998), who calls everything we interact with ‘wideware’, Rotman (2000: 74) sees the outside as co-constituting the inside:

all these artifacts, from windowed screens to hypertexts are rewiring the very brain/minds that imagined them. In this way we are facilitating the emergence of a larger – collectivized, distributed, pluralized – ‘intelligence’ by allowing ourselves to become more ‘othered,’ more parallelist, more multi, less individualized – able to see, think, enjoy, feel and do more than one thing at a time.

The outcome of this for Rotman is a progressive postmodern subjectivity. Singular subjects and truths, linear history, hegemonic dominance of singular ideas, are dying. Newly emergent is ‘the possibility of a new plurality of truths and futures: beings with an awareness of our/their multi-directional itinerary’ (Rotman, 2000: 77–78).

Philosopher Catherine Malabou also sees progressive possibilities in plasticity. Like Watson, plasticity indicates for Malabou the possibility of rebellion, of creativity, and of nondeterminism. Plasticity

directly contradicts rigidity. It is its exact antonym. In ordinary speech, it designates suppleness, a faculty for adaptation, the ability to evolve ... to talk about the plasticity of the brain means – to see in it not only the creator and receiver of form but also an agency of disobedience to every constituted form, a refusal to submit to a model. (Malabou, 2008: 5–6)

Malabou sees ‘true plasticity’, however, as something that needs to be secured through a political consciousness. Unlike more poststructural and queer approaches, Malabou (2008: 8) claims the possibility of controlling our neuronal destiny – and perhaps our broader social and political life – through a neo-Marxist ‘neuronal liberation’, or a political consciousness of the implications of plasticity for the self and the social:

securing a true plasticity of the brain means insisting on knowing what it can do and not simply what it can tolerate. By the verb *to do or to make* we don’t mean just ‘doing’ math or piano but making its history, becoming the subject of its history, grasping the connection between the role of genetic nondeterminism at work in the construction of the brain and the possibility of a social and political nondeterminism, in a word, a new freedom. (Malabou, 2008: 13, emphasis in original)

These interpretations, to varying degrees, offer optimistic readings of plasticity, reflecting theorists' preference for biological flux rather than fixity, and for historicity over stasis. Here plasticity is framed through postmodern, poststructural, queer, or progressive understandings of subjectivity and social life. What is missing from these accounts, however, with the exception of Malabou, is an account of the power relations involved in seeing ourselves as neuronal subjects. A Foucauldian governmentality perspective suggests reason for caution in celebrating plasticity as inherently liberating. My description here of how brain plasticity is taken up in popular neuroculture affirms the view that the use of neuroscience does not inherently lead to determinism and can promote its opposite. But I also show here how brain plasticity positions neurological ontology not only as ever open to change, but also open to *being* changed. Plasticity is deployed to encourage us to see ourselves as neuronal subjects, and is linked to the continued enhancement of learning, intelligence, and mental performance, and to the avoidance of various risks associated with the brain, including mental underperformance, memory loss, and aging. While endorsing a view of the body/self which resists biological determinism, I find that the popular discourse on plasticity firmly situates the subject in a normative, neoliberal ethic of personal self-care and responsibility linked to modifying the body.

Neoliberalism and the neuronal subject

The governmentality literature can illuminate how popular brain discourse on plasticity reflects the language and practices of neoliberalism. In her article on governmentality, health promotion and chronic illness, Rose Galvin (2002: 127) identifies 'micro-political technologies of health' as 'those actions, objects, attitudes, and processes through which people define and achieve their state of "being," be it well or ill, with regard to certain norms, values, and goals'. Galvin sees a neoliberal political rationality underlying the micro-political technologies of health related to prevention and management of chronic illness. Similarly, I argue that such a rationality underlies much of the popular discussion of the implications of brain plasticity and encourages micro-political technologies of health on the part of individuals. Further, extending the insights of theorists who have argued that contemporary biocapital forces a molecularization of subjectivity (Fullagar, 2009; Rose, 2007), I suggest that current deployments of plasticity pressure subjects to see themselves not only in biomedical but also in specifically neuronal terms.

A critical framework for thinking about plasticity must include an acknowledgement of contemporary biopolitical economy. In post-Fordist societies, we have seen the decline of security in wages and employment, the shrinking of the welfare state and an embrace of market-based political rationalities. Neoliberalism replaces an ethic of state care with an emphasis on individual responsibility and market fundamentalism (Ericson et al., 2000). In relation to health, neoliberal societies have seen the vast privatization of health care and the escalation of commercial investment in the body and biology (Clarke et al., 2003; Galvin, 2002; Rose, 2007; Waldby and Cooper, 2008). Market-based health care policies construct populations of individuals who are encouraged to ensure their own health and promote their own personal wellness and success in the face of economic insecurity and globalization; they simultaneously render patient populations consumers.¹ Health maintenance becomes a responsibility or a duty rather than a right, and bodies and

selves are targeted for intense personal care and enhancement (Crawford, 1977, 2006). One result is that we are encouraged to see ourselves as biomedical subjects (Rabinow, 1999). In addition, we have seen the extension of biomedical investment beyond disease and illness, toward enhancement and healthcization, and the creation of what Gilles Deleuze (1990) calls 'subjects at risk'. As many have argued recently, pressures around our personal abilities to improve our wellness and prevent disease and even aging are suggestive of a form of power Michel Foucault identified as governmentality, where the notions of risk and empowerment play crucial roles (Foucault, 2003; Gordon, 1991; Lemke, 2001; Petersen, 2003). They also play significant roles in the commercialization of bodies and biological materials in biocapitalism. Biological vitality, from the levels of surface flesh all the way to molecule, neuron and gene, has become a prime resource for 'marketization' in biocapitalist economies (Waldby and Cooper, 2008: 58).

I see much of the current popular framing of brain plasticity as shaped by this context. Below I address four key themes that are prominent in media representations of neuroscientific knowledge about brain plasticity, each of which can be seen as reflecting neoliberal models of embodied selfhood. After exploring these themes I look more closely at Malabou's critique of the neoliberal deployment of plasticity and argue for an even more critical view of the neuronal subject. I suggest that the development of plasticity discourse is highly compatible with the neoliberal pressures of self-care, personal responsibility, and constant flexibility.

Such pressures do not ensure, of course, self-caring, personally responsible, and flexible subjects. Neoliberalism cannot be, as some descriptions might suggest, utterly totalizing and hegemonic. Brenda Weber (2009), following Wendy Brown (2006) and Aihwa Ong (1999), emphasizes how neoliberalism is a complex ideological apparatus that is inconsistent and ever-changing. Rather than creating wholly 'passive and complacent' citizens, Weber (2009: 52) argues that it instead mutates and is mutating, and is incomplete in its ability to shape the citizenry. In Weber's (2009: 52) terms, 'it can itself make over and be made over'. Limitations on the power of the plastic brain as an accomplishment of neoliberalism begin with the problem that plasticity is not the only popular discourse associated with the brain; it competes with deterministic accounts, among others. In addition, we have to position plasticity as part of a constantly emerging understanding of the brain; we cannot take for granted its endurance as a dominant mode of thought. Finally, we cannot assume that the neoliberal construction of subjects in neuroscience, medicine, and the public sphere is wholly successful; whether or not people actually relate to their brains in the ways they are encouraged to relate to them is a matter needing ethnographic attention. My account here, then, contributes broadly to an understanding of one representation (a dominant one, I argue) of the brain among others, and suggests the need for further investigation into the lived experience of having/being 'embrained' (embodied) in the current social context.

Popular neuroculture

In the first decade of the 21st century, representations of contemporary brain science in newspaper and magazine articles, television and radio programs, blogs and web pages have been ubiquitous. They vary from hard to soft to quasi-scientific, and include close, dry descriptions of recent studies and scientific findings, interviews with

cognitive neuroscientists, psychologists, and psychiatrists, commentaries by scientific professionals, 'tabloidized' or exaggerated accounts of current findings (Seale, 2003), and lay translations of brain science by trade authors and consultants who apply the findings of cognitive neuroscience to fields like personal development, management training, marketing, and education policy. When judged against the dryer, more cautious language of the published scientific studies they draw from and refer to, accounts meant for general readers are often simplistic, and sometimes exaggerated or misleading. However, this does not diminish their social significance, since much of what people know about biomedical science comes from the press and from the experts in the self-help market who attempt to reach lay audiences through various kinds of media (Conrad and Markens, 2001; Galvin, 2002; Seale, 2003).

In a broader project I undertake content-analysis of 250 print media accounts (primarily newspaper and magazine articles, but also transcripts of news programs) of neuroscientifically based knowledges of the brain for general readers and audiences that were published between 1999 and 2009. The 250 articles were gathered through a database search (Lexus-Nexus) that was limited by language (English) rather than location; thus further analysis would be needed to make any claims about national variations in media discourses.² About one-third of the articles (65) focus on plasticity. I base my analysis below on this latter group of articles. In addition, several dozen web pages, blogs and internet sites less systematically informed my analysis. Although they varied stylistically and made references to different kinds of neuro-experts, they were strikingly attuned in their messages, and often repetitive in their use of phrases and terms, like those borrowed from fitness culture. In the next two sections of this article I address key themes that featured prominently in my content analysis of these texts. First, the brain is described as a potentiality: it is positioned in terms of a resource for the body/self that is both limitless and largely untapped. Second, the plastic brain is celebrated for its flexibility, its need for newness, and its adaptability. Third, brain health and performance are linked to personal responsibility, and discourse about brain health draws from metaphors about labor and physical fitness. Finally, the brain is linked to risk.

The limitless and flexible brain

For decades, Einstein's brain, which Roland Barthes (1972) described in *Mythologies* as a fetishized object, was seen as biologically exceptional. The organ has been literally passed around for various kinds of tests and anatomical explorations, to see if Einstein's intelligence can be found somewhere in the preserved biological material of his brain. Now, however, it appears that biological exceptionalism is no longer the primary way of thinking about massive intelligence potential. One internet blog, called 'The Genius in All of Us', articulates the paradigm shift in the following terms:

Forget everything you think you know about genes, talent, and intelligence. The outdated concept of genetic 'giftedness' has run its course. In recent years, a mountain of evidence has emerged suggesting a completely different paradigm: not talent scarcity, but latent talent abundance. Human talent and intelligence are not permanently in short supply like fossil fuel, but potentially plentiful like wind power. The problem isn't our inadequate genetic assets, but our inability, so far, to tap into what we already have. (Shenk, 2009)

Einstein may have had a terrific brain, but our brains are collectively an enormous reservoir of latent power.

In biomediated capitalism, biology both drives production and is the resource mined, excavated, and produced (Clough, 2008; Cooper, 2008). The transformation of biological material into capital is happening across the globe, including through oocyte markets, genetic patents, and bioprospecting, tissue harvesting, organ transplants, and other biotech practices (Cohen, 2001; Lock, 2001; Rose, 2007). It is perhaps unsurprising then that in popular neuroculture, one dominant characterization of the brain is as a *resource*. To some it is the ultimate biological resource; neuroscientists are regularly quoted in media accounts as hailing its majestic, stunning, complicated, and amazing character, usually in relation to its plasticity. Its plasticity ensures that it is incredibly flexible and adaptable, with an ‘almost unlimited potential to form new patterns of association’ (Applegate, 2001). While vulnerable to weakness, neglect, disease, and loss (attributes that position it as at risk in various ways), the brain is capable of being ‘woken up’ and ‘strengthened’. Seen as a ‘computer that can learn’, that can undergo continual remodeling or reorganizing, the brain is conceived as a smarter, better version of any man-made high tech tool. The brain can increase its efficiency and performance – it can be ‘boosted’ and made ‘sharper’ – to levels that defy delineation (see, for example, Janes, 2002). Regularly, the brain’s capacity is described as limitless or infinite. Kaushik Sunder Rajan (2006) has pointed out that the value of biological materials in biocapitalism – or what Catherine Waldby (2000) termed *biovalue* – is often articulated in the hyped up language of future possibilities brought by current biological investment. That is, biovalue depends upon speculation. It requires faith that scientific developments and biotech applications will yield often unspecified benefits from bioresources. Fundamental to the premise of biovalue is the view that current understandings and uses of biology are insufficient. In popular accounts of the brain’s value as a bioresource, we are continually instructed that most people’s brains are underutilized. Again and again, the brain’s potential is presented as untapped.

The democratization of genius, then, is limited to *potential*. The normative message of seeing an untapped resource in the brain is that it ought to be tapped. Unused brain power is wasted power:

If people were better educated or taught how to think effectively, everyone would be able to use the entire mind to its fullest potential, says Dr. Samuel Barondes, a professor of psychiatry and neurobiology at the University of California at San Francisco. ‘Humans are lazy creatures,’ he says. ‘We try to get by with the least amount of work we can. If we get away with it, we develop those habits.’ (Waters, 2003: B01)

In the above article from the *Washington Times*, a distinction is made between people who ‘use their brains in the best manner’ and the rest of us. Rather than endorsing biological exceptionalism, this view presents a competitive field where anyone can vie for brain prowess. Such logic also implies that those who do not have it might ultimately have to blame themselves.

The brain’s capacity for flexibility and adaptability are often framed in the accounts I examined as its best attributes, but these attributes require work on the self. A ‘full-fledged

life' for the brain is linked to constant change (Kokurina, 2006). The brain is described as needing continuous stimulation, the key to which is variation:

Compare a large city with many people constantly moving around, extensive infrastructure, and plenty of lights, on the one hand, and an abandoned village where a handful of elderly people are living out their time, on the other. A human brain that does not solve complex tasks and does not engage in creative activity is like an abandoned village. (Kokurina, 2006)

In another article, a consultant on neuro-health says that: 'We have to get out of ruts. The brain doesn't like ruts' (Nohlgren, 2005: 3A). One must not only be aware of the flexibility of her brain, but also ought to *be* flexible, adaptable, and open to newness to take advantage of this trait. Because the brain's capacities are almost always underutilized, brain potential is presented as needing to be actualized through our willingness to use it in a certain way. The brain needs a new lifestyle; therefore, so do we.

As Galvin (2002: 122) observes, expert knowledges can be considered political rationalities which not only 'define what can be known' but which are also translated into systems of practice. Science journalists as well as neuroscientists themselves (in their own books and blogs) have recommended a wide range of practices that are meant to offer the brain the possibility of enhancement. Some practices are aimed at boosting cell production, but much of the advice is aimed at encouraging the brain to form new neural connections. To do this, the brain needs what are oft-referred to as 'supertasks', or training designed to form new modes of thought and thus new synaptic connections. Brain-enhancing tasks aimed at using the brain differently are regularly described in the language of labor and physical fitness. Brain cells are 'underemployed', for example, and they need 'workouts' (Dembling, 2005: 27). The ordinary brain doing routine tasks is engaged in 'low-voltage' thinking or is inactive; brains that are agile or sharp or even 'alive' tap into brain power. Healthy, stimulated brains need 'power-lifting' (Dembling, 2005: 27); complex thinking and mental stimulation constitute 'flexing grey matter' (Armstrong, 2006: 12). On the quotidian level, this could mean engaging in new tasks, finding new reading material, changing one's physical environment, developing new hobbies, learning a new language, and engaging in ambidextrous practices. Techniques also include mnemonics, or exercises specifically geared toward boosting memory. One example, based on a self-help book and summarized by Anastasia Stephens (2001: 29–30) teaches:

Don't rely on diaries – they get lost. Instead, think of a journey with 31 stages, each representing days of the month. You could use a walk which climbs to the top of a hill. The stages could include fields, ditches, houses and fences. To remember a hot date on the sixth, imagine your potential partner eagerly waiting at your stage six.

Advice tomes like *Building Mental Muscle* (Bragdon and Gamon, 2003), widely cited in the media, promise to build mental speed, improve memory, and help readers regulate hormones that affect the brain. In addition to brain puzzles, technologies for brain enhancement include bionics, which uses electrodes to send small currents of electricity to the brain, neurofeedback, or 'thought control', techniques like so-called Conscious

Speaking, and computer games. They also include 'smart drugs', like Modafinil, which can be used to enhance memory and other mental functions through pharmacological modulation (Turner and Sahakian, 2006), although rarely in the accounts I examined were smart drugs promoted as the primary solution for tapping the brain's resources. Currently, lifestyle changes, brain labor, and brain fitness regimens are more celebrated in the media than pharmacological manipulations. These practices are recommended across the lifecycle, from infancy to elder adulthood. The recent 'Baby Einstein' phenomenon, in which babies were targeted for an expanding array of products and technologies meant to stimulate, and thus enhance, their brains at the level of their neuronal development, could represent the beginning of whole lifetimes of brain-enhancement practices.³ Brains are also targeted pre-natally, and thus good pregnancy and motherhood are now constructed in neuronal terms.

The ideal subject constructed here should see herself in biomedical terms and should relate to her body at the molecular level, taking on a regimen of practices to ensure her neuronal fitness. She is not a passive biomedical subject, but one who is encouraged to relate to her own consciousness, learning, memory, and intelligence as constituting an 'individual, somatic problem' to be solved, to use Simone Fullagar's (2009: 309) terms. In these accounts, solutions align with neoliberal culture. Overall, brain potentiality represents a competitive field in which one's willingness to let go of sameness, to constantly adapt, and to embrace a lifelong regimen of work on the self (and on one's children) are the keys to individual success. Retirement from work, incidentally, is an obstacle, 'not conducive to the plastic brain' (Sboros and Holmes, 2006: 7). Security and predictability are not valuable here, nor is leisure; hard work, individual responsibility, and flexibility are vital. Thus popular neuroscience discourse links brain enhancement to what some scholars have called a 'flex-subject' who thrives in the kind of environment presented by neoliberal economies (see Bratich, 2007; Weber, 2009). For women, such demands are further complicated by pressures linked to reproduction as well as production and consumption.

Lifestyle and risk

In these accounts, brain potential is linked to technologies of the self across the lifecycle. Such techniques and practices are recommended not only to enhance performance and compete well, but also to avoid risk. The language of risk is inextricably tied to a neoliberal political rationality. In her study, which examines the 'victim-blaming' of people who are chronically ill, Galvin (2002) identifies the following aspects of risk discourse in neoliberalism: first, risks are regularly shifted from the external to the internal – while we once might have focused on social problems, we are now increasingly concerned about the individual, and the body. Second, the presence of risk becomes a source of power: one's ability to avoid risk is equated with empowerment. At the same time, risk is a tool for blame, and its applications are infinite – there can always be detected a way in which a person did not adhere to some recommendation or can otherwise be blamed for his or her illness. Finally, risk discourse increases individuals' reliance on expert discourses and the marketplace, both of which increasingly offer solutions.

As infinite as the brain appears to be as a resource, it is also presented as highly vulnerable. The mantra of brain plasticity is a neoliberal version of the use–disuse

hypothesis: 'use it or lose it' (see, for example, Appleyard, 2002). The brain can be underutilized; thus all brains can be foggy, sluggish, or fuzzy headed, and in danger of atrophy. In addition, the brain can be underhydrated, polluted with toxins, or in need of more glucose or fatty acids. Aging itself presents the greatest risk, especially for 'lazy brains' or those with 'bad brain habits'. Gradual decline is a likelihood for most brains – in some accounts eventual senility is described as hard-wired, even though, paradoxically, it can be minimized (see, for example, Walker, 2007). In addition, the brain will surely be damaged along the way. For example, as *The Times* (London) points out, 'After 50, most of us will have had tiny strokes or small areas of degenerative disease that leave some areas of the brain ineffective. This can particularly affect short-term memory' (Crompton, 2000). Mini-strokes are just one possibility; every brain faces the prospect of decay. In this context, brain practices become not only a matter of enhancement, but also a key way to prevent or delay brain decline.

Brain health consultants, neuroscientists, and neuropsychologists now regularly offer advice on how to escape the threat of brain decline. Like enhancement practices, preventative measures begin early in life, even pre-natally. For example, Paul Nussbaum, a clinical neuropsychologist and an oft-cited expert on brain health, trains people to think of brain health and dementia prevention as part of everyday life. In a series of media interviews as well as in his own books, such as *Your Brain Health Lifestyle*, Nussbaum (2009) outlines a regimen of brain techniques that are meant to stave off dementia. These include, for pre-natal subjects, maternal diets rich in folate, exposure to classical music, and maternal attention (reading aloud, talking, and touching the stomach). Toddlers should learn sign language before they are verbal, and should also be exposed to classical music. Self-seeking of stimulation should be encouraged. Young adults should become bilingual and ambidextrous and learn to play instruments; adults should do the same, and remember to 'engage in complex, novel pursuits' (Nohlgren, 2005: 3A). For them as well as for seniors, Nussbaum also recommends prayer and meditation. These practices do not differ from those aimed at enhancement, but it is worth noting that here babies and toddlers are treated as aging, and thus risky, subjects whose brains could (or will) eventually fail.

Sometimes brain enhancement is not only linked directly to the avoidance of brain injury and decline, but even to other, more general measures of health. For example, the *St Petersburg Times* reported on a study that linked creativity not only to memory gains or mental performance, but also to needing less medication, having better coordination, suffering fewer injuries, and having improved vision:

Several scientists are exploring how the creative process affects brain health.

One chorale group in the nation's capital produced some tantalizing research results along with sweet music. Participants ranged from 65 to 100 years old, with an average age of 80. A year of rigorous, weekly practices clearly nurtured the singers' bodies and minds. They averaged nine visits to the doctor, compared with 13 for a control group of nonsinging peers who were equally healthy when the year began. The singers averaged seven medications, compared with 8.5 for the nonsingers. The chorale group reported fewer falls and fewer vision problems during their singing year than they experienced the year before they started. (Nohlgren, 2005: 3A)

In this article, there is significant slippage between the concept of brain health and health in general. A person with good brain habits will apparently need less health care.

It is clear that enhancement and risk are inextricably linked. But in the neoliberal model of health, maintaining the body and avoiding illness and even aging also become responsibilities (Crawford, 1977, 2006; Rabinow, 1999). Appeals for brain health are normative models. Proper subjects take care of themselves and prevent decline; it is lazy or inattentive individuals who live in their bodies without worry or care. Not only is the brain passively vulnerable to injury and decline, but we are culpable in injuring our own brains. As M. Datuk Rajen (2007: 44), a pharmacist, puts it in a newspaper interview, there are 'simple and stupid things you can do to damage your brain'. To summarize several accounts: eating too much, not exercising, inhaling polluted air (even just not opening the windows), not getting enough sleep, being stressed or depressed, and even lacking complex thoughts are actions that kill brain cells, promote brain shrinkage, force neurons to withdraw dendrites and thus reduce synaptic connectivity, or render the brain inefficient.

The disciplinary tone of such accounts suggests the links between good citizenship and biomedical subjectivity. Like Galvin, Fullagar (2009) addresses how ill people are blamed for moral failure for being unable to prevent illness. In her study, women who take anti-depressant medications are seen as having allowed themselves to be neurologically deficient. The power relations of depression diagnosis demand neurochemical treatment; without it, women are seen as lacking in self-care: 'The neurochemically deficient self is . . . required to exercise responsibility and self-control to restore and maximize their life potential via biomedical expertise' (Fullagar, 2009: 403). One of the lessons of reading popular accounts of neuroplasticity is that this moral pressure applies not only to people who have been diagnosed with a neurochemically based disorder like clinical depression, or to people who suffer chronic illnesses and disorders, but also to healthy subjects who have no known illness or complaint.

Ontology, representation, and neoliberal biopolitics

For a number of scholars in a range of fields, plasticity offers the possibility of taking up the biological matter of the body while defying biological determinism. For sociologists of the body and medicine who have been looking for ways to overcome the limitations of social constructionism, brain plasticity appears to present the material body in a way that opens up, rather than closes down, sociocultural accounts of embodied subjectivity. In psychology, plasticity may offer those opposed to materialist views of both normative development and psychic suffering a way to account for physiological aspects of both without endorsing evolutionary or hard-wired views. For postmodernists, poststructuralists, and others interested not only in displacing the liberal subject but also in productive alternatives, plasticity seems to offer positive chaos, creativity, and multisubjectivity. For those pursuing posthumanism at various levels, plasticity renders the world as an infinite source of 'wideware' for the brain, and positions the individual brain as inherently connected to others – things, artifacts, other brains. But investigating the deployment of plasticity in the cultural landscape also leads to another interpretation. Popular discourse on plasticity suggests instead how it can be deployed in support of neoliberalism.

As a way of drawing out the implications of this for critical social thought, I want to take up Catherine Malabou's work, which situates neuroplasticity in a framework of political economy. Malabou (2008: 10, emphasis in original) recognizes nothing less than a '*neuronal form of political and social functioning*, a form that today deeply coincides with the current pace of capitalism'. The new brain language of adaptability and flexibility, delocalization and neural networks echoes political economic restructuring in post-Fordist societies. She describes how the last three decades of the 20th century saw significant shifts in the ways companies and corporations operate; they have eschewed centralization and hierarchies and reorganized the flows of productivity according to new principles which embrace the flexible network. Ideal now are lateral over hierarchical flows of communication, multitasking and co-creation among multiple individuals and groups over discreet, localized production. Valued are leanness and efficiency, creativity and flexibility, and the ability to respond to change with innovation. Here, connections are most important: how many there are, how they are organized, to what tasks they are oriented. Malabou (2008: 40–41) sees deep parallels with current neuroscientific thought on the brain:

How could we not note a similarity of functioning between this economic organization and neuronal organization? How could we not interrogate the parallelism between the transformation of the spirit of capitalism (between the sixties and the nineties) and the modification, brought about in approximately the same period, of our view of cerebral structures?

Malabou (2008: 41) argues that 'many descriptions of plasticity are in fact unconscious justifications of a flexibility without limits'. The intimacy between neoliberal capitalist models of organization and neuroscientific models of the plastic brain that Malabou recognizes is two-directional. Malabou finds global capitalism saturated with neuroscience-based language, so that neuroscience serves ideologically to naturalize global capitalism. To add to Malabou's insight, I find the converse is also true: neuroscientific language about the brain, particularly that meant for laypersons, is saturated with neoliberal capitalist models of thought. As my account here shows, flexibility in popular neuroscience-based discourse is linked to the 'flex-subject' – to the language of labor, to constant change, to adaptability, to eschewing security. These are characteristics not only of healthy brains, but of brain-healthy subjects.

Malabou is ultimately enthusiastic about neuroplasticity, and I want to offer a criticism of her account. First, though, it is useful to point out that she wisely avoids two related tendencies that I have noted in some of the aforementioned scholarship which celebrates it. First, she refuses to see biological determinism as the only or key problem presented by uses of neurosciences. Much of the enthusiasm for the 'new' neuroscience of plasticity by some psychologists, sociologists, feminists, and social theorists is shaped by the debates between determinism and social constructionism, with the former almost always being identified as the conservative force of biological thought, and the latter representing the more progressive framework that makes room for human agency and social change. Social constructionism has been preferred for many good reasons, but at the cost of undertheorizing biological matter itself (Cromby, 2004). Theorists who are critical of the body's material erasure have found in plasticity a way to incorporate the body and the

hard sciences into constructionist frameworks. This debate may still be hugely important (and indeed, many of the texts I am studying in my broader project on the brain do link biology to determinism). However, to the extent that it has dominated social thinking about neuroscience, it may have led to an overly eager embrace of plasticity as offering an immanent critique of biologism. Second, Malabou resists the 'positive postmodern' impulse to link flexibility, or the brain's generative possibilities, with freedom, queerness, or creativity. These may be possibilities opened up by plasticity, but there is nothing inherent in plasticity to suggest a progressive politics. Instead, her political economic reading of neuroscientific language, like my own analysis here of popular neuroculture, shows that nondeterminism can be as useful to power relations as its opposite. To a great extent, neoliberalism is an economics of plasticity, and as such it offers a powerful force shaping the ways in which biological plasticity becomes publicly relevant.

While Malabou's diagnosis is affirmed here in my analysis of popular neuroculture, her neo-Marxist prescription is unsatisfactory. She wants to liberate the plastic brain, and 'neuronal man' (*sic*), from the pressures currently imposed by neuroscience and capitalism. Like Wilson, Watson, and others, she sees promise in the ontology of the brain itself. To parse this, she distinguishes between *plasticity* and *flexibility*. The former is the ontology, the possibilities present in the biological matter itself. The latter is the ideological framing of plasticity in ways that support capitalist structures. Plasticity itself needs to be recovered from the current neuroscientific discourse, which is 'unwittingly producing criteria, models, and categories for regulating social functioning and increasing daily the legitimation of the demand for flexibility as a global norm' (Malabou, 2008: 53). Neuroscience is currently serving undemocratic purposes, but it can be placed at the service of emancipatory politics. For Malabou (2008: 79), what is needed is a new consciousness of the brain, both by neuroscience and by ourselves, that asks 'what should we do with our brain?' as a politicized question.

Yet is it possible in this way to extract plasticity from flexibility, and ontology from epistemology? There is in the first place an unfortunate parallel with current biocapitalist figurations of biological matter: such a proposition thinks of the brain as a kind of resource to be saved, or mined, or extracted, from its surrounding frameworks of meaning. This unhappily upholds the brain's status as biovalue, even if we can now think of this as, say, democratic rather than dominated biovalue. Further, the unlinking of the ontological and the epistemological is an enormous, unsolved problem (Newton, 2003; Williams, 2006), and Malabou's conception of neuronal liberation does not tell us how to accomplish this, or establish that it can be done at all. My sense is that if we are to take plasticity seriously, as we probably should, one thing it tells us, ironically, is that it *can't* be extracted from the epistemological. Instead, as all of the scholars I have cited are aware, we now have to think about this ontology's historicity. We now have to think not only about how neoliberalism knows and presents the brain, but what kinds of brains are *produced* in neoliberal societies. The brain has joined the rest of the body in becoming integral to self-identity, opened to self-styling and modification. The brain not only *appears* to us (through neuroscientific revelations) to be ontologically open to shaping, but (if the theory is right) it is always already actively shaped and shaping. Thus plasticity cannot be seen as an ontological condition captured, or not, by capital, or as a biological fact to be freed from social and cultural ones.

Finally, the call to a new neuronal consciousness or a new way of thinking of and using the brain ignores the politics of how subjects are encouraged to think of ourselves in neuronal terms in the first place. Attention not just to the economics but to the biopolitics of contemporary neoliberal societies suggests that subjectivities are constituted in and through biopolitical relations, so 'neuronal man' and 'neuronal consciousness' are not simply effects of ontology that can be captured by capital, but are in fact generated through micro-political technologies of health. Seeing ourselves in neuronal terms may be becoming a duty of biomedical citizenship, since failure to think about our brains in neuroscientific terms, or at all, not only invites risk but may increasingly constitute moral failure. We need to pursue how this framing of the brain constructs ideals of selfhood in neuronal terms. A more critical awareness of plasticity than that offered by some current theories is vital for grasping how the expanding role for the brain matters for embodiment and embodied self-awareness in the 21st century.

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Notes

- 1 There is overgeneralization in the literature on neoliberalism as well as in my account of it here; for an excellent example of a locally contextualized account of neoliberalism and health practices see Lakoff's (2004) account of Argentinian consumption of psychopharmaceuticals during economic crisis.
- 2 See Conrad and Markens (2001) for an example of such a comparative account in relation to media coverage of the 'gay gene'.
- 3 The controversy over Baby Einstein products recently led the parent company, Disney, to issue refunds to parents who were led to believe that seeing Baby Einstein videos would improve babies' mental performance.

References

- Applegate J (anchor) (2001) Keep Your Brain Alive: Author Lawrence Katz Gives Advice on Improving One's Memory. *Later Today Show*, NBC News Transcripts, 31 May.
- Appleyard M (2002) Mental Muscle: Keeping Fit Is One Thing But Exercising Your Brain Power Can Be an Even Better Way to a Long and Happier Life. *Daily Record*, 16 October, p. 13.
- Armstrong R (2006) How to Train Your Brain: Worried You're Losing Your Marbles? The Latest Computer Games Are Designed to Help. *Mirror* (London), 4 July, p. 12.
- Barthes R (1972) *Mythologies*. Trans. Lavers A. New York: Hill & Wang.
- Beaulieu A (2003) Brains, Maps and the New Territory of Psychology. *Theory & Psychology* 13(4): 561–568.
- Bragdon A, Gamon D (2003) *Building Mental Muscle: Conditioning Exercises for Six Intelligence Zones*. New York: Walker & Company.

- Bratich JZ (2007) Programming Reality: Control Societies, New Subjects, and the Powers of Transformation. In: Heller D (ed.) *Makeover Television: Realities Remodeled*. London: IB Tauris, 6–22.
- Brown W (2006) *Edgework: Critical Essays on Knowledge and Politics*. Princeton, NJ: Princeton University Press.
- Clark A (1998) Where Brain Body and World Collide. *Daedalus* 127(2): 257–280.
- Clarke A, Mamo L, Fishman J, Shim J, and Fosket J (2003) Biomedicalization: Technoscientific Transformations of Health, Illness and U.S. Biomedicine. *American Sociological Review* 68: 161–194.
- Clough P (2008) The Affective Turn: Political Economy, Biomedica, and Bodies. *Theory Culture and Society* 25(1): 1–22.
- Cohen L (2001) The Other Kidney: Biopolitics Beyond Recognition. *Body and Society* 7(2–3): 9–29.
- Conrad P, Markens, S (2001) Constructing the Gay Gene: Optimism and Skepticism in the US and British Press. *health: 5*(3): 373–400.
- Cooper M (2008) *Life as Surplus: Biotechnology and Capitalism in the Neoliberal Era*. Seattle, WA: University of Washington Press.
- Crawford R (1977) You Are Dangerous to Your Health: The Ideology and Politics of Victim Blaming. *International Journal of Health Services* 7: 663–680.
- Crawford R (2006) Health as a Meaningful Social Practice. *health: 10*(4): 401–420.
- Cromby J (2004) Between Constructionism and Neuroscience: The Societal Co-constitution of Embodied Subjectivity. *Theory and Psychology* 14(6): 797–821.
- Crompton S (2000) The Way to Maintain Your Brain. *The Times* (London), 7 March.
- Deleuze G (1990) Postscript to the Societies of Control. *L'Autre Journal* 1(May): 3–7.
- Dembling S (2005) Enrol in a Gymnasium for the Brain. *Weekend Australian*, 3 December, p. 27.
- Dumit J (2004) *Picturing Personhood: Brain Scans and Biomedical Identity*. Princeton, NJ: Princeton University Press.
- Eisenberg L (1995) The Social Construction of the Human Brain. *American Journal of Psychiatry* 152(11): 1563–1576.
- Ericson R, Barry D, and Doyle A (2000) The Moral Hazards of Neo-Liberalism: Lessons from the Private Insurance Industry. *Economy and Society* 29: 532–558.
- Foucault M (2003) 'Society Must Be Defended': *Lectures at the College de France 1975–1976*. Trans. Macey D. New York: Picador.
- Fullagar S (2009) Negotiating the Neurochemical Self: Anti-Depressant Consumption in Women's Recovery from Depression. *health: 13*(4): 389–406.
- Galvin R (2002) Disturbing Notions of Chronic Illness and Individual Responsibility: Towards a Genealogy of Morals. *health: 6*(2): 107–137.
- Gordon C (1991) Governmental Rationality: An Introduction. In: Burchell G, Gordon C, and Miller P (eds) *The Foucault Effect: Studies in Governmentality*. Chicago, IL: University of Chicago Press, 1–52.
- Harris P (2000) Introduction: Brain Cultures. *SubStance* 91: 3–6.
- Janes S (2002) Brain Boosters: Can Chewing Gum Really Improve Your Memory? *Mirror*, 13 June, pp. 31–33.
- Kokurina Y (2006) An Active Mind Is the Key to Longevity. *Moscow News*, 31 March.
- Kolb B, Wishaw IQ (1998) Brain Plasticity and Behavior. *Annual Review of Psychology* 49: 43–64.

- Kramer PD (1997) *Listening to Prozac: The Landmark Book about Antidepressants and the Remaking of the Self*. New York: Penguin.
- Lakoff A (2004) The Anxieties of Globalization: Antidepressant Sales and Economic Crisis in Argentina. *Social Studies of Science* 34(2): 247–269.
- Lemke T (2001) ‘The Birth of Bio-Politics’: Michel Foucault’s Lecture at the College de France on Neo-Liberal Governmentality. *Economy and Society* 30(2): 190–207.
- Littlefield M (2009) Constructing the Organ of Deceit: The Rhetoric of fMRI and Brain Fingerprinting in Post-9/11 America. *Science Technology and Human Values* 34(3): 365–392.
- Lock M (2001) The Alienation of Body Tissue and the Biopolitics of Immortalized Cell Lines. *Body and Society* 7(2–3): 63–91.
- Machamer P, Sytsma J (2004) Neuroscience and Theoretical Psychology: What’s to Worry About? *Theory and Psychology* 17(2): 199–216.
- Malabou C (2008) *What Should We Do With Our Brain?* Trans. Rand S. New York: Fordham University Press.
- Mountcastle V (1998) Brain Science at the Century’s Ebb. *Daedalus* 127(2): 1–36.
- Newton T (2003) Truly Embodied Sociology: Marrying the Social and the Biological? *Sociological Review* 51(1): 20–42.
- Nohlgren S (2005) Challenging, Nurturing the Brain Keeps It Healthy. *St Petersburg Times* (Florida), 13 March, p. 3A.
- Nussbaum P (2009) *Your Brain Health Lifestyle*. Tarentum, PA: Word Association.
- Ong A (1999) *Flexible Citizenship: The Cultural Logics of Transnationality*. Durham, NC: Duke University Press.
- Petersen A (2003) Governmentality, Critical Scholarship and Medical Humanities. *Journal of Medical Humanities* 24(3/4): 187–201.
- Rabinow P (1999) Artificiality and Enlightenment: From Sociobiology to Biosociality. In: Biagioli M (ed.) *The Science Studies Reader*. New York: Routledge, 407–416.
- Radley A (1995) The Elusory Body and Social Constructionist Theory. *Body and Society* 1(2): 3–23.
- Rajan, KS (2006) *Biocapital: The Constitution of Post-Genomic Life*. Chapel Hill, NC: Duke University Press.
- Rajen MD (2007) You Are What Your Brain Says You Are. *New Straits Times* (Malaysia), 19 August, p. 44.
- Rose N (2007) *The Politics of Life Itself: Biomedicine, Power and Subjectivity in the Twenty-First Century*. Princeton, NJ & Oxford: Princeton University Press.
- Rotman B (2000) Going Parallel. *SubStance* 91: 56–79.
- Rutledge LT (1976) Synaptogenesis: Effects of Synaptic Use. In: Rosenzweig MR, Bennett EL (eds) *Neural Mechanisms of Learning and Memory*. Cambridge, MA: MIT Press, 329–339.
- Sboros M, Holmes M (2006) Practise Aerobics for Your Mind. *Business Day* (South Africa), 20 September, p. 7.
- Seale C (2003) Health and Media: An Overview. *Sociology of Health & Illness* 25(6): 513–531.
- Shenk D (2009) Remember This Day: February 4th 2009. *The Genius in All of Us* (blog). Available at: <http://geniusblog.davidshenk.com/2009/02/index.html>.
- Stephens A (2001) Grey Matters: To Juggle Your Life You Need a Sharp, Alert Brain. Here’s How to Get One. *Mirror*, 17 May, pp. 29–30.
- Turner D, Sahakian B (2006) Ethical Questions in Functional Neuroimaging and Cognitive Enhancement. *Poiesis and Poetics* 4(2): 81–94.

- Waldby C (2000) *The Visible Human Project: Informatic Bodies and Posthuman Medicine*. New York: Routledge.
- Waldby C, Cooper M (2008) The Biopolitics of Reproduction. *Australian Feminist Studies* 23(55): 57–73.
- Walker L (2007) Keep Your Brain Power Up. *Washington Post*, 12 September, p. HE9.
- Waters J (2003) Think about the Brain: Potential Unlimited if Only We Used It More. *Washington Times*, 15 April, p. B01.
- Watson S (1998) The Neurobiology of Sorcery: Deleuze and Guattari's Brain. *Body and Society* 4(4): 23–45.
- Weber B (2009) *Makeover TV*. Durham, NC: Duke University Press.
- Williams SJ (2006) Medical Sociology and the Biological Body: Where Are We Now and Where Do We Go from Here? *health*: 10(1): 5–30.
- Wilson E (1999) Melancholic Biology: Prozac, Freud, and Neurological Determinism. *Configurations* 7(3): 403–419.

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