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How has neuroscience affected lay understandings of personhood? A review of the evidence

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Abstract

The prominence of neuroscience in the public sphere has escalated in recent years, provoking questions about how the public engages with neuroscientific ideas. Commentaries on neuroscience's role in society often present it as having revolutionary implications, fundamentally overturning established beliefs about personhood. The purpose of this article is to collate and review the extant empirical evidence on the influence of neuroscience on commonsense understandings of personhood. The article evaluates the scope of neuroscience's presence in public consciousness and examines the empirical evidence for three frequently encountered claims about neuroscience's societal influence: that neuroscience fosters a conception of the self that is based in biology, that neuroscience promotes conceptions of individual fate as predetermined, and that neuroscience attenuates the stigma attached to particular social categories. It concludes that many neuroscientific ideas have assimilated in ways that perpetuate rather than challenge existing modes of understanding self, others and society.

Keywords

folk psychology, neuroscience, public engagement with science

Introduction

On 17 July 1990, US president George H.W. Bush declared the 1990s to be the 'Decade of the Brain'. The following years saw major advances in neuroscience as a discipline – most notably in the establishment of fMRI as a standard methodological instrument – and an explosion in the volume of neuroscientific research published. As the field has progressed, the subjects it tackles have become increasingly complex, with particular acceleration of research with potential social and policy implications (Illes et al., 2003). Subject matters traditionally assigned to the humanities and social sciences – such as religion, love, art, crime and politics – now make frequent appearances in neuroscience journals (Frazzetto and Anker, 2009; Littlefield and Johnson, 2012). The expansion of the neuroscientific research programme to topics of acute social concern has raised neuroscience's

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profile in society, propelling it into the public sphere. Neuroscience has been appropriated by many diverse fields that see it as relevant to their own interests, including law (Walsh, 2011), marketing (Chancellor and Chatterjee, 2011), public policy (Seymour and Vlaev, 2012), education (Ansari et al., 2012), parenting (O'Connor and Joffe, 2012) and economics (Schüll and Zaloom, 2011).

For social scientists, the increasing prominence of neuroscience provokes important questions about how members of the public engage with this new knowledge. This issue is often framed in 'deficit model' (Wynne, 1993) terms, placing priority on evaluating the accuracy of public understandings of neuroscience (Herculano-Houzel, 2002; Pasquinelli, 2012; Sperduti et al., 2012). Whether a conception is scientifically correct or incorrect is, however, largely irrelevant to its substantive effect on people's thinking about themselves, others and society. The most important consideration in gauging neuroscience's societal influence is not lay ideas' correspondence with established scientific 'facts', but the meaning attached to neuroscientific ideas in personal and social life. Since the brain is regarded as the organ most closely related to mind and behaviour, some have speculated that the proliferation of neuroscientific knowledge has produced a shift in everyday conceptions of personhood or 'folk psychology' (Goldman, 1993; Sousa, 2006). Given the significance of folk psychological understandings in guiding everyday behaviour, perception and social interaction, examining neuroscience's influence on commonsense conceptions of personhood is arguably a more pressing task than establishing whether public understandings of the brain are scientifically correct.

Within discussions of neuroscience's societal significance, it is commonplace to encounter claims that neuroscience is producing revolutionary changes in understandings of individuals and society. For example, Lynch (2009) claims that neuroscientific knowledge is 'propelling humanity toward a radical reshaping of our lives, families, societies, cultures, governments, economies, art, leisure, religion – absolutely everything that's pivotal to humankind's existence' (2009: 7). Similar sentiments, though less dramatically presented, are in evidence throughout the academic literature that reflects on neuroscience's position in contemporary society. For example, Illes and Racine (2005) state that neuroscientific insights 'will fundamentally alter the dynamic between personal identity, responsibility and free will' (2005: 14); Farah (2012) asserts that 'neuroimaging has contributed to a fundamental change in how we think of ourselves and our fellow persons' (2012: 575); and Abi-Rached (2008) speaks of 'this "neuro-age"', whereby human behaviour and the other aspects that define us as a species are predominantly formulated in neurochemical terms' (2008: 1162).

Such claims clash with established models of public engagement with science, which cast doubt on the notion that new scientific knowledge, within a relatively narrow time-span, provokes revolutionary changes in public thinking. Social representations theory, one key paradigm for theorizing lay uptake of science, posits that the primary psychological task upon encountering new scientific information is 'to make the unaccustomed familiar' (Moscovici, 2008[1961]: 17) – that is, to transfer 'strange' new ideas into a conceptual register with which one is familiar and therefore comfortable. This is achieved by 'anchoring' the new idea within established cultural categories and 'objectifying' it with familiar symbols, images and metaphors. While different models of public engagement with science employ different analytical tools, research from a variety of theoretical standpoints converges on the conclusion that people selectively attend to and interpret science in ways that cohere with their pre-existing values, identities and beliefs (Joffe and Haarhoff, 2002; Kahan et al., 2011; Morton et al., 2006; Munro, 2010; Wynne, 1993). New scientific information can indeed challenge and modulate existing understandings; however, it can also assimilate into and reinforce established ideas. It is therefore not self-evident that neuroscience will substantively alter understandings of personhood in predictable directions. Delineating the influences neuroscience exerts on contemporary society requires careful empirical research.

A body of research examining the role played by neuroscience in everyday conceptions of personhood has recently amassed. However – perhaps because it traverses several disciplines, methodological approaches and fields of interest – it has thus far maintained a relatively low profile. It is often unacknowledged in scholarly or intellectual discussions about the cultural significance of neuroscience, with the result that such discussions remain largely speculative and polemical. The purpose of this article is to collate and review this empirical evidence concerning the influence of neuroscience on commonsense understandings of personhood. After probing the prominence of neuroscience in public consciousness, the article proceeds to examine the empirical evidence for three frequently encountered claims about neuroscience's societal influence: that neuroscience fosters conceptions of the self that are dominated by biology, that neuroscience promotes conceptions of individual fate as predetermined, and that neuroscience abates the stigma attached to certain social categories.[1]

How prominent is neuroscience in public consciousness?

With neuroscience's prominence in popular media escalating, several studies have undertaken to systematically examine the characteristics of media coverage of neuroscience. A recent analysis shows that references to neuroscience in UK newspapers increased sharply between 2000 and 2010, most often manifesting within advice on 'optimizing' brain function, demonstration of biological bases for intergroup differences, and recruitment of neuroscience's scientific authority to 'prove' arguments or assertions (O'Connor et al., 2012). Regarding neuroscience's practical applications, O'Connell et al. (2011) establish that the media show particular interest in applications involving lie-detection, marketing and public policy. Racine, Waldman, Rosenberg and Illes' (2010) analysis identifies three key trends in media coverage of neurotechnologies (e.g. fMRI, EEG, PET): *neuro-realism*, which refers to the use of neuroscientific information to make phenomena seem objective or 'real'; *neuro-essentialism*, which connotes representations of the brain as the essence of a person; and *neuro-policy*, which captures the deployment of brain research to support political agendas. Research also indicates a strong visual dimension to media coverage, with media text frequently accompanied by brain images produced by functional neuroimaging technologies (Dumit, 2004; Gibbons, 2007). The highly-mediated, technological nature of this image production is often obscured, such that the images may resemble direct photographs of neural activity (Beck, 2010; Roskies, 2007). These images may therefore afford a 'truth value' to the arguments proffered in media text.

The social significance of neuroscience's expanding media presence is intensified by experimental evidence suggesting that neuroscientific information may wield particular rhetorical force. Weisberg et al. (2008) show that explanations of psychological phenomena that include logically irrelevant neuroscience information are judged more satisfying than the same explanations presented without the neuroscience information. Similarly, McCabe and Castel (2008) document how articles summarizing cognitive neuroscience research appear more credible when accompanied by a redundant image of a brain scan than by a bar graph or no visual information. Three-dimensional brain images are particularly persuasive (Keehner et al., 2011). These experiments suggest that the symbols of brain research confer legitimacy on the arguments they accompany. However, it should be noted that these experiments required participants to evaluate fictitious scientific articles, which may not be a highly ecologically valid task. A more recent study focusing on evaluations of popular news articles reports that inclusion of fMRI images does not enhance an article's persuasiveness relative to articles accompanied by other, or no, imagery (Gruber and Dickerson, 2012).

Research thus indicates that neuroscience is widely reported in the mainstream media and is convincing in certain experimental contexts. However, this does not guarantee that it has

meaningfully penetrated public consciousness. Evidence shows that there can be considerable divergence between media and mental representations of a scientific issue (Ten Eyck, 2005). People exposed to media information may ignore it, quickly forget it, or interpret and deploy it in idiosyncratic ways. Unfortunately, little research exists interrogating neuroscience's prominence in the minds of the lay public. One exception is Wardlaw et al.'s (2011) survey of perceptions of neuroimaging applications, in which 17% of respondents report having 'no awareness' of neuroimaging applications, 47% rate themselves as 'a little aware', 26% as 'quite aware' and 10% as 'very aware'. These figures do not suggest extensive familiarity with neuroscience, and the level of public awareness they indicate may be inflated by the study's recruitment strategies, which included advertising the survey on science blogs.

Some insight into neuroscience's position in public consciousness can be derived from Rodriguez's (2006) semantic analysis of usage of neuroscience-related terms in everyday speech. This analysis shows that neuro-vocabulary frequently materializes in vernacular language (e.g. 'she is brainy'), suggesting that neurobiology occupies a space in the conceptual schemata that underpin people's everyday talk. As Rodriguez (2006) acknowledges, however, the study provides limited insight into the breadth of this space or the meanings that speakers have in mind when they use 'brain' terms.

In summary, empirical research has established that neuroscience is increasingly visible in the popular press. However, little direct research with members of the public casts light on either the extent to which brain-related ideas are spontaneously recruited in naturalistic thought and conversation, or the meanings that these ideas carry for people.

Does neuroscience foster a conception of the self that is based in biology?

Many commentaries on the societal significance of neuroscience have framed the issue within the historical battle between materialist and dualist theories of the person, that is whether what we call 'mind' is fundamentally physical matter or exists separately from the body on some non-physical plane. Neuroscientific advances have been hailed as the force that will drive dualism from society, ushering in conceptions of self, emotion and behaviour that are entirely rooted in biochemical processes (Churchland, 1995; Churchland, 2008; Crick, 1995). Sociological writings suggest that the assimilation of biological information into conceptions of self and identity is already in motion, a position exemplified by terms such as 'neurochemical self' (Rose, 2007), 'cerebral subject' (Ortega, 2009) and 'brainhood' (Vidal, 2009).

The suggestion that understandings of the self are becoming progressively materialized has, however, met with limited empirical support. In an analysis of focus groups composed of individuals with varying degrees of involvement with brain research (e.g. neuroscientists, patients, teachers), Pickersgill et al. (2011) report that participants professed an interest in the brain, but rarely directly attributed behaviour entirely to brain processes. Some participants actively resisted neuroscientific ideas, perceiving them as threatening their established conceptions of mind and self – for example, undermining the importance of family and socialization in development. This sense of threat was not universal, however, with others experiencing neuroscience as simply irrelevant to their self-perception. Choudhury, McKinney and Merten (2012) describe similar results from a study of how adolescents engage with the idea of the 'teenage brain': while teenagers stated that knowledge about the neuroscience of adolescence was important, they also rejected it as boring or irrelevant to their own self-understanding. Mirroring Pickersgill et al.'s (2011) findings, behaviour was rarely understood in purely biological terms, but rather seen as a product of relationships with parents, teachers and society more generally.

Research with clinical populations indicates a greater penetration of brain-based ideas into self-understanding. In Illes et al.'s (2008) survey of 72 patients diagnosed with major depressive disorder, 92% reported that they would want a brain scan to diagnose depression if possible, while 76% believed that brain scans would improve their understanding of their mental state. Buchman et al.'s (2013) interviews with 12 individuals diagnosed with mood disorder revealed that participants very decisively endorsed the 'chemical imbalance' explanation of depression. Qualitative analysis indicated that much of brain-based explanations' appeal derived from their apparent ability to provide an objective, morally neutral tool to legitimize people's experience. Dumit (2003) and Cohn (2004) suggest that the visual element of brain scans is a particularly potent legitimizing resource, allowing for the objectification of 'depression' or 'schizophrenia' as material entities rather than nebulous diagnostic categories. This 'proving' quality of neurobiological information can be mobilized in efforts to sustain a positive identity. Fein (2011), Rapp (2011) and Singh (2011), for example, observe that individuals with developmental disorders such as autism spectrum disorders (and their families) can adopt neuroscientific language to represent themselves as subject to unique, 'hard-wired' challenges and abilities. Such identity-protective positioning of neurobiological information also characterizes the burgeoning 'neurodiversity movement'. This campaign, spearheaded by the autism community, represents developmental disorders as simply alternative biological ways of being that are equally legitimate as 'neurotypicality' (Vidal, 2009). Thus, for people diagnosed with particular psychiatric conditions, neurobiological explanations of their thoughts and feelings are sometimes psychologically and socially functional, with their endorsement serving identity-supportive ends.

The divergent findings of research with clinical and non-clinical populations suggest that the brain's prominence in self-understanding is largely contingent on whether a person has been provoked to consider their 'brainhood' by extrinsic events such as diagnosis and medication. The brain may not intrude spontaneously in day-to-day consciousness, but rather becomes salient when something goes wrong (Pickersgill et al., 2011). However, even this experience-contingent salience is equivocal: neuroscientific explanations of disorder can be hotly contested (Martin, 2010) and rarely represent the exclusive explanatory mode deployed in conceptualizing the disorder. When neuroscientific ideas are accepted it is usually in partial and contingent ways, operating alongside alternative – sometimes contradictory – means of understanding experience. Bröer and Heerings (2013), for instance, employ a Q-sort methodology to establish that the disorder-understandings of adults with ADHD comprise a matrix of psychological, sociological and holistic concepts that exist alongside, and interact with, neurological conceptualizations. Gross's (2011) ethnography of a neuro-oncology unit further indicates the multi-dimensionality of disorder meanings, finding that brain tumour patients' self-conceptions are split into two elements: one that is based in, and another that is completely separate from, the brain. A form of Cartesian dualism allows these patients to conceive of the tumour not as an illness of the self but as the disease of 'just another organ'.

Thus, even when biological explanations of thought, emotion or behaviour are accepted, they do not drive out non-biological explanations. Assertions that neuroscientific advances will inevitably purge society of dualistic understandings of personhood flounder because they fail to acknowledge the complexity and multi-dimensionality of self-conception.

Does neuroscience promote conceptions of individual fate as predetermined?

Neuroscience has also been marshalled in the long-standing philosophical battle between conceptions of the person as a free agent with independent volition and as a being whose character, behaviour and life-course are pre-patterned by their biological constitution. Certain philosophers and

neuroscientists have painted neuroscience research as the definitive refutation of the notion of free will, which is cast – in Nobel Laureate Francis Crick's words – as 'no more than the behavior of a vast assembly of nerve cells and their associated molecules' (Crick, 1995: 3). This debate can extend beyond questioning whether free will exists in an ontologically 'real' sense (an issue outside the scope of the present article) to encompass clear predictions about neuroscience's influence on commonsense beliefs about free will. For example, Green and Cohen (2004) assert that 'the net effect of this influx of scientific information will be a rejection of free will as it is ordinarily conceived' (2004: 1776), celebrating this as a socially progressive prospect. It is important to note that such postulations are not universal: many scientists caution against premature over-extrapolation of empirical results (Lavazza and De Caro, 2010; Rose, 2005; Roskies, 2006) and the potentially troubling societal repercussions of rejecting free will (Baumeister, Masicampo and DeWall, 2009; Vohs and Schooler, 2008). In addition, recent findings regarding the brain's 'plasticity' or capacity for change have been interpreted as evidence *against* biological determinism. This will be discussed shortly; first, however, the article assesses the empirical evidence for the contention – still mooted from certain quarters (e.g. Churchland, 1995; Economist, 2006; Farah, 2012; Harris, 2012) – that the popularization of neuroscience will transform conventional understandings of free will.

One of the key social arenas in which the free will issue plays out is within attribution of responsibility for behaviour. Legal and moral codes, along with daily interpersonal interaction, hinge on the conviction that individuals have control over, and hence responsibility for, their actions. Some have suggested that viewing behaviour as biologically determined fundamentally undermines the concept of personal responsibility. However, research shows that people confronted with behaviour that is framed as neurologically caused continue to interpret it through the lens of individual responsibility (De Brigard et al., 2009). Laypeople do not necessarily see moral responsibility and biological determination as incompatible, and are willing to attribute responsibility to an individual even when clear that (s)he did not intend their actions (Nahmias, 2006). Attribution of responsibility for unintended acts is particularly likely if they produce destructive outcomes or are morally 'bad' (Alicke, 2008). This implies that the movement of neuroscientific evidence into criminal defence cases will not radically transform jurors' reasoning (Rose, 2007; Schweitzer et al., 2011). Research thus suggests that attributions of responsibility are complex and multifaceted, and a direct 'more neurologically determined–less personal responsibility' effect appears unlikely.

Belief in personal responsibility persists because it is predicated on what Morris et al. (2001) call implicit theories of agency: robust cultural theories, transmitted across generations, defining the kinds of entities that act intentionally and autonomously to cause events. In western societies, the individual human intentional agent is unambiguously positioned as the primary and 'natural' causal force (Wellman and Miller, 2006); people socialized into western cultures often cannot conceptualize how agency could operate at any level beyond the individual (Morris and Peng, 1994). Individual independence and self-determination is culturally valorised: the experience of possessing free will is positively emotionally valenced (Stillman et al., 2011) and people disfavour deterministic understandings of behaviour (Fahrenberg and Cheetham, 2000). It may be difficult for deterministic interpretations of neuroscience to pierce such culturally embedded folk understandings. In fact, far from contradicting traditional assumptions, some writers have suggested that neuroscientific explanations dovetail with individualistic attribution, directing attention inside the individual skull (Choudhury et al., 2009; Vidal, 2009). Neuroscientific understandings may thereby support the continued neglect of the socio-structural contexts that shape actions, perceptions and emotions.

An emerging nuance in debates about neuroscience and determinism acknowledges that neuroscience is a non-uniform body of knowledge, encompassing different ideas and approaches that could have differential societal effects. The implications of the brain for understandings of

determinism/free will depend on what *type* of brain is represented. A key dimension here relates to whether neural structure and function are seen as genetically pre-programmed or as 'plastic' and thereby modulated by experience. The latter representation has recently come to prominence and has been proclaimed the biological condition for individual agency, the idea being that neuroplasticity facilitates the ability to initiate self-change (Papadopoulos, 2011; Pitts-Taylor, 2010). Some argue that neuroplasticity also has political implications: if the brain is the seat of beliefs and emotions, then if the brain is malleable so too must be identity and concurrent societal processes (Thornton, 2011).

The concept of plasticity has assimilated into popular arenas, manifesting particularly in exhortations to 'boost' or 'train' one's brain (O'Connor et al., 2012; Pitts-Taylor, 2010). This trend represents the brain as a resource whose efficacy is contingent on its owner's actions: individuals can enhance their neural function through nutrition, mental exercise or artificial means (e.g. pharmaceuticals), or endanger it through exposure to risky activities or substances. While the salience of these messages in media dialogue has been empirically established (O'Connor et al., 2012), the extent to which people endorse them in everyday life remains unclear. Most investigative attention has focused on pharmaceutical enhancement of neural performance, a practice portrayed as widespread by commentators in the media (Forlini and Racine, 2009; Partridge et al., 2011) and academic literature (Farah et al., 2004; Schanker, 2011). Some data indicate substantial levels of unprescribed neuro-pharmaceutical use within certain populations – for example, university students (Smith and Farah, 2011) – though other studies suggest it is rare (Coveney, 2011). Uptake of pharmaceutical enhancement may, however, represent something of a red herring in evaluating the depth of engagement with brain optimization: more likely, it is via less extreme and costly practices – such as purposefully changing nutritional patterns or attempting crossword puzzles – that the logic of brain enhancement most deeply penetrates everyday life. As yet, no research with lay populations assesses receptivity to non-pharmaceutical brain enhancement, though sales figures for electronic 'brain-training' devices indicate a rapidly expanding market (NeuroInsights, 2009).

The prominence of the notion of plasticity could be interpreted as liberating, conveying that individuals can control their neurological destinies. However, some have voiced concern that plasticity places ultimately repressive demands on individuals to 'maximize' their untapped neurological potential (Pitts-Taylor, 2010; Thornton, 2011). Brain optimization ideas appear to cohere with the contemporary zeitgeist of self-improvement, at the root of which lie concerns about self-control, a cardinal value in western cultures (Joffe and Staerklé, 2007). In recent times, demands for self-control have been most vocally articulated within the health domain: 'healthism' pertains not only to physical health but to establishing oneself as a virtuous, disciplined citizen (Crawford, 2006; Rabinow, 1992). One works on the self through working on the body. The language and substantive content of appeals to brain optimization echo the central ethos of contemporary health discourse, emphasizing individual responsibility and lifestyle choices (Blaxter, 1997; Crawford, 2006). The brain is emerging as a new site at which efforts to achieve self-control and self-improvement can operate. Much of the brain optimization discourse has coalesced around the topic of dementia, the promised aversion of which stands as the most compelling incentive for 'brain-training' (Palmour and Racine, 2011; Williams et al., 2011). The fear dementia elicits can be largely traced to a perception that it dissolves personal identity, independence and self-determination (Van Gorp and Vercruysse, 2012). Public dialogue thereby conveys that disciplined regimes of brain optimization can stave off the ultimate, permanent loss of self-control. Thus, much popular discussion of the brain appears to reiterate a cultural ethic of self-control. How this translates into everyday experience remains unclear, however, as analysis of the self-control ethic in media

discourse has not been accompanied by research that directly examines how individuals engage with these ideas in daily life.

The suggestion that the diffusion of neuroscience will erode belief in free will therefore appears unsubstantiated. Deterministic ideas collide with deeply entrenched cultural understandings of individual responsibility and self-control, and as yet little evidence suggests that these values will buckle under the pressure. Indeed, it seems more likely that neuroscientific information is being co-opted into these value systems, rejuvenating them and driving them forward within superficial reframings.

Do neuroscience explanations reduce stigma?

A frequent context through which neuroscience manifests in society is the explanation of human variation, with observed differences between particular categories of people traced to reported differences in their neurobiological characteristics (Choudhury et al., 2009; Dumit, 2004; O'Connor et al., 2012). Systems of social categorization infringe on all stages of neuroscience research: from the selection of research topics – for example, investigating whether the predefined categories of criminals, adolescents or schizophrenics have distinctive neurological features; to research methodology – particularly in specifying the demographic variables to be factored into sample composition and the parameters of 'normality' that constitute an appropriate control sample; and research interpretation – as seen in the formal labelling of autistic traits as 'male' (Jack and Appelbaum, 2010). Neuroscience thus invokes and reproduces certain assumptions about social categories. Through what philosopher Ian Hacking (1995) describes as a 'looping effect', classifying people works on them and changes them, altering how they think about themselves and how others perceive them. If neuroscience is implicated in cultural efforts to delineate 'types' of people, how might this affect social identities and intergroup relations?

Some evidence suggests that new social identities are forming around neuroscientific information. As neurobiology has supported new classifications (e.g. certain psychiatric diagnoses) there have been instances of concomitant collective mobilization, with people assembling around shared neurobiological explanations to advocate for research, treatment and services (Novas and Rose, 2000). The aforementioned neurodiversity movement exemplifies this. Advocacy groups across a broad range of issues – for example, addiction, mental illness, juvenile justice and homosexuality – have embraced neuroscientific explanations, hailing their potential to divert society from a discourse of blame and moral condemnation (Corrigan and Watson, 2004; Hall et al., 2004; Walsh, 2011). Research with mentally ill populations has shown that patients themselves expect biomedical explanations to reduce the stigma they encounter (Buchman et al., 2013; Easter, 2012; Illes et al., 2008). Neuroscientific framings of behaviour – for example, representing addiction or mental illness as brain diseases – are thus widely expected to promote tolerance towards traditionally stigmatized groups.

The actual effect of neuroscientific explanations on orientations towards stigmatized groups may, however, be considerably more complex. Research on attitudes to mental illness indeed indicates that attribution of undesirable behaviour to biological factors reduces blame (Corrigan and Watson, 2004; Mehta and Farina, 1997; Rüsch et al., 2010). However, biomedical attributions for mental illness are also linked to increases in social distance (Bag et al., 2006; Dietrich et al., 2006; Read and Harré, 2001; Rüsch et al., 2010), perceived dangerousness (Corrigan and Watson, 2004; Dietrich et al., 2006; Read and Harré, 2001; Walker and Read, 2002), fear (Dietrich et al., 2006), perceived unpredictability (Walker and Read, 2002) and harsh treatment (Mehta and Farina, 1997). Longitudinal analysis of public attitudes shows that increased endorsement of

biomedical explanations of mental illness has not been accompanied by increased tolerance (Pescosolido et al., 2010). Aside from mental illness, unfavourable correlates of biological explanations have also been detected for attitudes regarding gender (Brescoll and LaFrance, 2004; Morton et al., 2009), race (Jayaratne et al., 2006; Williams and Eberhardt, 2008) and obesity (Teachman et al., 2003). Furthermore, some data suggest biological explanations operate as self-fulfilling prophecies for those to whom they are applied, for example undermining women's mathematical performance (Dar-Nimrod and Heine, 2006), increasing overweight individuals' calorie intake (Dar-Nimrod and Heine, 2011) and promoting fatalism among mentally ill people about their prospects of recovery (Easter, 2012; Lam and Salkovskis, 2007).

In a comprehensive review, Dar-Nimrod and Heine (2011) attribute the negative social consequences of biological explanations to the operation of psychological *essentialism*.[2] Wagner, Holtz and Kashima (2009) define essentialism as the attribution of a group's characteristics to an unalterable and causal 'essence', which involves (i) establishing discrete, impermeable category boundaries; (ii) perceived homogeneity within the category; (iii) using the essence to explain and predict the group's surface traits; and (iv) naturalization of the category. Representations of neuroscience currently circulating in society conform to these trends, with long-established stereotypes of particular social groups (e.g. women, overweight people, adolescents) reconstituted as invariable features of their natural constitutions (Fine, 2010; Kelly, 2012; O'Connor et al., 2012). Essentialism has destructive effects on intergroup relations, promoting a sharp 'us–them' split in which particular groups are marked out as biologically 'other'. Dumit (2003, 2004) and Buchman et al. (2010) argue that neuroimaging data have been particularly effective at constructing this 'otherness': it is commonplace both in academic and popular literature (on, for example, addiction) to encounter two differently coloured brain images placed side by side, establishing a categorical distinction between 'the normal brain' and 'the addicted brain'. There is little sense of addiction as a spectrum; rather, addicts are homogenized as almost a different species. Neuroscience may thus promote essentialistic representations of social groups and incite concurrent movements towards stigmatization and discrimination.

The consequences of neuroscience for attitudes to social groups cannot be characterized as unambiguously positive or negative. The effects of neurobiological frames seem to vary between domains: for example, effects are generally more promising for attitudes to homosexuality than race, gender, mental illness or obesity (Haslam and Levy, 2006; Jayaratne et al., 2006). Effects also vary within domains: for example between different mental disorders, with tolerance most compromised when the disorder purportedly involves violence (Schnittker, 2008). However, it seems unlikely that neuroscientific explanations will eradicate stigmatizing or prejudicial understandings of social groups. In some cases, neuroscientific explanations of human difference may reinforce, rather than dismantle, the social and symbolic boundaries that separate categories of people.

Conclusions

Lynch (2009) contends that we are on the cusp of a 'neurorevolution' whose effects will eclipse the great societal revolutions – agricultural, industrial and informational – that history has thus far witnessed. However, the bulk of the evidence reviewed above suggests that claims that neuroscience will dramatically alter people's relations with their selves, others and the world are overstated. In many cases, neuroscientific ideas have assimilated in ways that perpetuate rather than challenge existing modes of understanding. This is perhaps not surprising: beliefs relating to free will, self-control, individual responsibility and essentialism are entangled in dense networks of cultural narrative and symbolism and are consequently likely to prove obdurate. These beliefs are, however,

not entirely inviolable, with the research reviewed above also documenting instances where traditional understandings – for example, in the self-conceptions of psychiatric patients – have been modulated by neuroscientific information, even if in partial and contingent ways.

This review shows that many empirical questions remain about neuroscience's influence on lay conceptions of personhood. Uncertainties linger over issues as basic as whether the public are aware of neuroscience: is the media's attentiveness to neuroscience reflected in ordinary thought? While existing evidence indicates it is unlikely neurobiology will come to dominate folk psychology, might certain factors (e.g. individual differences or socio-demographic variables) differentially promote acceptance or rejection of neuroscientific understandings? Incorporating neurobiological information into self-perception is more likely within clinical populations, but even here neurobiological explanations are not absolute: how do they interact with other non-biological understandings? Media analysis suggests that neuroscience is assimilating into existing ideologies relating to free will, responsibility and self-control, but is this mirrored in ordinary thinking about these issues? Finally, while existing data cast doubt on neuroscience's potential as a stigma-reduction mechanism, research on biological essentialism has concentrated largely on mental illness. As neuroscientific categories move beyond the clinical domain – for example, into criminality, personality, gender and sexuality – their effects on attendant social identities and intergroup relations must be closely tracked.

The cumulative implication of the research reviewed in this article is that neuroscience's cultural influence cannot be evaluated in terms of a single narrative about personhood that it imposes on society. The neuroscientific ideas that reach the public sphere do not encounter passive receptacles of information, but active audiences who approach it through the lens of pre-existing worldviews, assumptions and agendas. Neuroscience is open to a multiplicity of interpretations and uses in society, and has a corresponding multiplicity of effects. For social scientists, this means that the critical priority for forthcoming investigation must revolve around disentangling the contingencies under which neuroscience exerts (or does not exert) distinctive impacts. Necessary developments include complementing analysis of neuroscience in the media with examination of its manifestation in personal lives; more extensive investigation of engagement with neuroscience within non-clinical populations; and departure from the hitherto near-exclusive focus on developed, western societies. Ongoing debates about the cultural significance of neuroscience should closely attend to such research developments, thereby supporting a dialogue in which the nuances of the domain are openly acknowledged and empirical findings prioritised over polemic and speculation.

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Notes

1. To provide some procedural detail on the literature review: the collection of literature on neuroscience and lay understandings of personhood reviewed here was amassed gradually over a two-year period. Relevant papers were identified via periodic keyword searches (using search-terms such as 'neuroscience & self', 'neuroscience & society', 'neuroscience & identity') of electronic databases (e.g. Social Science Citation Index, SCOPUS), and the bibliographies of papers thus acquired were examined to procure additional references. An electronic database was set up to store the literature gathered. This database was organized into folders based on papers' subject matter (e.g. 'neuroscience in the media', 'neuroscience and clinical categories'), with new folder categories created as required by incoming papers. The set of

categories in the database thus provided a broad overview of the literature's primary preoccupations. The majority of the categories addressed one of four overarching issues: neuroscience's public prominence, its influence on self-conception, its implications for deterministic beliefs and its effects on social stigma. These four issues set the structure for the present article.

2. Though Dar-Nimrod and Heine's (2011) review centres on the effects of genetic explanations, many of its conclusions can be generalized to neurobiological explanations (Haslam, 2011).

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