

## THE RISE OF NEUROESSENTIALISM

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### INTRODUCTION

NEUROESSENTIALISM is the position that, for all intents and purposes, we *are* our brains (Roskies, 2002). It is not so much that we are not also our genes, our bodies, members of social groups, and so on, but rather that when we conceive of ourselves, when we think of who we are as beings interacting in the world, the *we* that we think of primarily resides in our brains. The goals of this chapter are to review the scientific advances and cultural trends that have resulted in the rise of neuroessentialism, to provide a portrait of the varieties of neuroessentialist thought that draws on our current understanding of brain function, and then to use these insights to see how neuroessentialist thinking might alter the mores of society. I will argue that there are domains of modern life in which neuroessentialist thinking supports the development of policies that can be viewed as progressive and prosocial, supporting the objective of aligning innovations in the neurosciences with societal and individual values. At the same time, I shall highlight instances in which neuroessentialist thinking may have nuanced but important unintended consequences, and that proponents of this worldview should thoroughly consider the ramifications of neuroessentialist thought becoming a cultural meme.

### THE RISE OF NEUROESSENTIALISM

The dawn of neuroessentialism began as long ago as the mid-1600's when Elisabeth of Bohemia posed a daunting question to Descartes as part of their long correspondence (Shapiro, 2007). An early and robust challenge to dualism, her question went something like this: if there is an immaterial soul, how might it communicate with the material brain? In the succeeding four hundred years, and in particular in the last fifty years as the research program of the neurosciences has matured, the weight of evidence in favour of neuroessentialism has grown considerably. Today, amongst those steeped in the neurosciences, there is little debate about the merits of neuroessentialist thinking. As one draws concentric circles around this core group, clarity on the topic gives way in some circles to folk-psychology and in others to deep philosophical discourse. It is not just that folk-psychology and its kissing cousin substance dualism are comforting, but rather that these conceptions of the world suffuse modern culture in so many ways that they are unlikely to be easily displaced.

There are serious scholars of the mind who heartily reject dualism but nonetheless disagree with neuroessentialist thinking (Bennett and Hacker, 2003, Glannon, 2009; Pardo and Patterson, in press). The debate as to whether neuroessentialism represents a defensible position or not is outside the scope of this chapter. Rather, the question that I wish to pursue is, "*If there were widespread adoption of neuroessentialist thinking, what might be the implications for society at large?*" I will argue that in some instances neuroessentialism is likely to lead to a more just society, while in others it may raise concerns. As with advances in technology, changing the worldview of humans is not to be entered into lightly.

One of the most compelling accounts of the consequences of neuroessentialist thinking is Josh Greene and Jonathan Cohen's broadside on the impact that neuroscience may have upon the law (Greene and Cohen, 2004; reprinted in this volume). After making (what neuroessentialists might view to be) a credible case that discoveries in the neurosciences are increasingly chipping away at folk-intuitions about how the brain works, Greene and Cohen conclude by stating,

"...advances in neuroscience are likely to change the way people think about human action and criminal responsibility by vividly illustrating lessons that some people appreciated long ago. Free will as we ordinarily understand it is an illusion generated by our cognitive architecture. Retributivist notions of criminal responsibility ultimately depend on this illusion, and, if we are lucky, they will give way to consequentialist ones, thus radically transforming our approach to criminal justice. At this time, the law deals firmly but mercifully with individuals whose behaviour is obviously the product of forces that are ultimately beyond their control. Some day, the law may treat all convicted criminals this way. That is, humanely." (p. 1784)

Ending on this decisive note, Greene and Cohen suggest that the relentless rise of neuroessentialist thinking will lead us away from practices that were perhaps well-intentioned but are clearly indefensible in light of modern understanding of the brain. Moreover, in this newly enlightened age, society will be guided not by the wishful thinking of folk-psychology but rather by the clear-eyed rationality of neuroessentialism.

The public is not (yet) marching in lock-step with the neuroessentialists, but there is little doubt that recent years have witnessed a groundswell of popular fascination with the workings of the human brain, with academics, journalists and artists taking note of the trend. The cultural historian Fernando Vidal collaborating with the philosopher Francisco

Ortega states that "From public policy to the arts, from the neurosciences to theology, humans are often treated as reducible to their brains." (Ortega and Vidal, 2007, p. 255). More recently, Vidal has described a phenomenon that he terms 'the cerebral subject' which embodies, "the ascendancy, throughout industrialized and highly medicalized societies, of a certain view of the human being." (Vidal, 2009, p.6). Sociologist Scott Vrecko suggests that "explanations of the neurosciences are changing the understandings that lay individuals have of themselves and their worlds" (Vrecko, 2006, p. 300). Utilizing cognitive semantic analysis of ordinary language and cultural images, Paul Rodriguez argues that, "the impact of neuroscience is an emerging, modern, common sense understanding about the reduction of behavior and mental phenomena (e.g. thoughts, desires, memories, feelings, etc.) to brain entities or processes." (Rodriguez, 2006, p. 302). In a similar vein, Giovanni Frazzetto and Suzanne Anker have established a NEURO CULTURE PROJECT whose aims include documenting images and concepts associated with 21st century brain science in an explicit effort to examine their penetration in contemporary culture. In a recent paper they have argued that "we are witnessing the rise of a neuroculture (or neurocultures), in which neuroscience knowledge partakes in our daily lives, social practices and intellectual discourses" (Frazzetto and Anker, 2009). Finally, journalist Marco Roth argues that in literature there has been a new trend towards the *neuronovel* that "follows a cultural (and, in psychology proper, a disciplinary) shift away from environmental and relational theories of personality back to the study of brains themselves, as the source of who we are." (Roth, 2009, pp. 139-140).

In an attempt to provide quantitative support for the claim that neuroessentialist thinking is on the rise, Roland Nadler, a research intern at the National Core for Neuroethics, and I investigated the frequency of the word *neuroscience* or *neuroscientist* in the popular press. As can be seen in Figure 1A, there was a 31-fold rise in the number of articles that utilized this term between 1985 and 2009.

We also considered the hypothesis that there was a general upswing in interest on the part of the public in articles about science in general, and that our data might reflect this trend rather than a specific increase in interest in the neurosciences. To test this hypothesis, we searched the same database for the term “biology”, finding that there was a 5.8-fold increase in mention of this term over the time period 1985-2009. When we divided the neuroscience data by the biology data (Fig 1B), there was still a 5.5-fold increase in the number of neuroscience articles when normalized to the increase in biology articles. Thus, the increase in neuroscience articles outstrips the overall increase in articles referring to biology.

These data provide a measure of the incursion of neuroessentialist thinking into modern thought. It seems reasonable to conclude that, at least in certain circles, the world around us is indeed moving towards neuroessentialism as an important paradigm by which people view themselves.

[Insert Figure 1A and 1B HERE]

### THE VARIETIES OF NEUROESSENTIALISM

Neuroessentialist thinking is hardly monolithic. For the purposes of the present discussion, I will highlight three points of view that are relevant to understanding the trajectory that neuroessentialist thinking might have on modern society.

The first perspective is that of the *hard neuroessentialist*. The archetypical member of this group might be a practicing neuroscientist, steeped in the canon of modern neuroscientific thought. The hard neuroessentialist would readily provide explanations for all manner of behaviour, from catching a ball to falling in love, as reducible to the activity of neuronal circuits in the brain. The hard neuroessentialist would subscribe to what Barry Stroud refers to as *naturalism* (Stroud, 1996), and Owen Flanagan clarifies as *scientific naturalism* (Flanagan, 2008): utter rejection of anything that hints of supernatural forces in understanding the world around us. In the realm of neuroessentialist thinking, I would suggest that

this philosophical stance would best be termed *neuroscientific naturalism*.

The second perspective that I wish to describe is that of the *soft neuroessentialist*. Imagine an individual who is inquisitive, reasonably well read, and interested in human behaviour – a member of the informed public, but hardly an expert in the workings of the brain. While acknowledging that the brain is the primary seat of behaviour, the soft neuroessentialist remains somewhat uncomfortable in ascribing all of human behaviour to the workings of the brain. When pressed, the soft neuroessentialist might agree with the logical position that the brain is the ultimate seat of behaviour, but they also harbour intuitions, consciously or unconsciously, at variance with neuroscientific naturalism. These intuitions may be the result of general enculturation, religious beliefs in such non-material phenomena as a divinity, an afterlife, etc., or even skepticism with the program of modern scientific progress. This hypothetical conflicted soft neuroessentialist dominates the cultural audience whose worldview might be expected to be modified by the images and concepts of modern neuroscience, such as those curated in the neuroculture project (Frazzetto and Anker, 2009).

The final example in our hypothetical triad is that of a *neuroessentialist naïf* who has not only had no exposure to modern neuroscience, but has not considered the contribution that brains make to behaviour. It is not so much that the naïf denies the role of brain in behaviour; rather, the issue lies outside of his or her worldview.

### TOWARDS A NEUROBIOLOGY OF NEUROESSENTIALIST THOUGHT

In thinking about the impact that the rise of neuroessentialist thinking has upon society, and in particular what impact it might have on soft neuroessentialists, it is worth briefly reviewing a few salient observations regarding the neurobiology of decision making in the brain. It is now well-established that our brains integrate information from disparate sources, and it is this integrative activity that ultimately results in the decisions that govern behaviour. At the top of the hierarchy is the prefrontal cortex, a key

structure that orchestrates thought in alignment with internal goals (Miller and Cohen, 2001). The prefrontal cortex is often invoked as the region in the brain responsible for top-down control of behavior, integrating information from both cortical regions and subcortical structures. In many ways, the prefrontal cortex is the ultimate locus for logical thought.

An important conceptual advance in thinking about the neurobiology of decision making came with the elucidation of Antonio Damasio's somatic marker hypothesis (Damasio, 1996) which suggests that prior experience leads to the development of undeliberated responses to events. These responses, often but not exclusively expressed as emotions, provide important contextual information about a given situation. By so doing they provide useful constraints to the options available to the logical machinery of the prefrontal cortex. According to Haidt's social intuitionist model of moral decision making (Haidt, 2001), a particularly noteworthy feature of these inputs is that they provide *rapid* access to relevant contextual information, resulting in the sorts of intuitions that humans regularly experience in the course of everyday social cognition. Thus, one can coarsely divide decision making in the human brain into two camps: *deliberative thought* which is relatively slow and is carried out by cortical structures such as the prefrontal cortex, and *intuitions* which provide rapid access to preconceived notions about the state of the world. Both modes of thinking are highly adaptive: deliberative thought allows us to use our intellect to assess the world around us, while intuitions allow us to react quickly to situations that merit brisk responses.

It is not just the speed of processing that distinguishes deliberative thought from intuitions. It turns out that intuitions, which have been formally studied as *implicit attitudes* (Devos and Banaji, 2003), are largely unavailable to conscious perception (Greenwald and Banaji, 1995) in marked contrast to deliberative processes that primarily occur in what Stanislas Dehaene has championed as the conscious global workspace (Dehaene and Naccache, 2001). Finally, while under certain conditions implicit attitudes can be demonstrated

to change (Gawronski and Bodenhausen, 2006), the dominant observation is that implicit attitudes are stable and resistant to modification (Wilson et al., 2000).

Summarizing, we find that there is a distinction between deliberative thought which involves relatively slow processing, is available to conscious perception, and is highly plastic, and intuitive implicit attitudes that provide rapid access to pre-conceived deductions, to a substantial degree are devoid of conscious reasoning, and are generally resistant to change.

In considering the incursion of neuroessentialist thinking upon the modern mind, these observations are relevant. Hard neuroessentialists, by definition, are those individuals who have long incorporated the neuroscientific naturalist perspective. I would further suggest that for many hard neuroessentialists, this manner of thinking would be manifest not only in their deliberative thought processes but also, to a greater or lesser degree, in their intuitive, implicit attitudes. The naïf, living outside of the realm of neuroscientific naturalism, is essentially agnostic on the issues that concern us here.

Most relevant to the present discussion is the brain of the soft neuroessentialist, the individual who I have argued is most likely to be affected by the rise of neuroessentialist thinking in popular culture. To the soft neuroessentialist, these ideas are new and intellectually challenging, and require the sort of deliberative processing exemplified by prefrontal cortical circuits. At the same time, within the brain of the soft neuroessentialist, these new ideas must compete with the long-standing, culturally imposed and highly adaptive perspectives that have formed their implicit attitudes about the world around them. The tension between these two ways of thinking about the world will likely determine the social impact of the rise of neuroessentialist thinking.

#### **THE NEUROBIOLOGY OF NEUROESSENTIALISM PREDICTS EFFECTS ON SOCIAL MORES**

My claim is that for those categories of human behaviour which allow sufficient time to

consider issues in a reflective manner, neuroessentialist thinking will have an ever increasing impact upon social mores, while for those behaviours which are dominated by emotional responses, the rise of neuroessentialism will have little or no impact. Furthermore, the underlying neurobiology of decision making by the hypothetical triad of naïf, soft and hard neuroessentialist suggests that the effects will be most marked on those individuals who might be characterized as soft neuroessentialists. A few illustrative cases are provided below.

#### RETRIBUTIVE JUSTICE

In considering the impact that neuroscience will have on the law, Greene and Cohen argue that modern neuroscience suggests that free will, “is an illusion generated by our cognitive architecture. Retributivist notions of criminal responsibility ultimately depend on this illusion” (Greene and Cohen, 2004). Proponents of retributive justice argue that neuroscience has little impact upon the issue, as responsibility persists regardless of what evidence neuroscience offers (Morse, 2008). It is not so much the propriety of the consequentialist or retributivist arguments that concern us here, but rather the manner in which people will evaluate the positions put forward by these two camps.

The hard neuroessentialist will readily accept the neuroscience argument about the illusion of free will (Wegner, 2004), and would likely side with Greene and Cohen in this debate. Soft neuroessentialists, on the other hand, will be put in a position where they must weigh the arguments carefully, arriving at their own conclusion on the topic. Because the issue is subject to careful deliberation, I would suggest that this is precisely the sort of topic where the rise of neuroessentialism might indeed have a substantial impact. After all, the process by which jurists, legal scholars, and even jurors consider issues such as the value of retribution is one in which there is ample time for informed debate.

As optimistic as Greene and Cohen may be about the move towards a more humane manner of treating criminals, it is not clear that soft neuroessentialists, whether part of the judicial

system or not, will be swayed by consequentialist arguments. Culturally inscribed intuitions about free will and moral responsibility are deeply ingrained, and it may be wishful thinking to imagine that mores will change on the basis of arguments alone. In a thoughtful essay on neuroscience and the law, David Eagleman suggests other ways in which neuroscience might alter this equation: by developing new neurotechnologies that increase the criminal justice system’s ability to predict recidivism, and to develop new drugs and behavioral techniques that in rehabilitation by modifying the brains of criminals (Eagleman, 2008).

#### BEHAVIORAL ECONOMICS

One arena of modern life in which we can expect neuroessentialist thinking to play an important role is the field of behavioral economics. As comprehensively documented by Richard Thaler and Cass Sunstein in their book *Nudge*, humans in the real world bring a range of biases to their economic decision-making and consequently behave in ways that are contrary to the frictionless behavior of classical economics (Thaler and Sunstein, 2008). Drawing upon the seminal work of Tversky and Kahneman (1981), they describe the myriad ways in which underlying unconscious biases affect decisions in the economic sphere. It is noteworthy that these biases fit very nicely under the rubric of intuitions as described above, as they represent shorthand approaches to problem solving that are traditionally adaptive, but put the individual at a disadvantage in the world of modern economic activity.

To take but one example, most individuals will opt to receive a smaller reward today than a modestly larger reward at some future time point (Frederick et al., 2002). The phenomenon is called *temporal discounting* and has been extensively studied by psychologists who suggest that it is intimately related to issues of impulse control (Ainslie, 1975). The dominant hypothesis is that the impetus to accept the modest reward today is driven by intuitive reasoning, even when logic suggests that waiting for the larger reward will produce a greater gain for the individual. Consistent with this

hypothesis, fMRI studies have demonstrated that when people are presented with the prospect of an immediate reward, parts of the limbic system associated with the midbrain dopamine system are preferentially activated, while the prefrontal cortex is activated regardless of the temporal delay offered (McClure et al., 2004). One way of thinking about these data is that the immediate reward activates both the rapid response, intuitive circuitry of the brainstem (which urges us to take the reward) as well as the deliberative architecture of the prefrontal cortex (which weighs the options carefully); the delayed reward only activates the ‘logical’ deliberative areas of the cerebral cortex. The empirical observation is that unless the delayed reward is very much greater than the near-term reward, we opt for immediate gratification. Thus, the activation of different regions of the brain provides a neurobiological explanation for temporal discounting in humans.

Understanding biases inherent in our neural circuitry, that is *neuroessentializing* our economic world, provides an opportunity to modify the economic landscape in ways that minimize the errors in which humans brains are likely to make. Consider for a moment the use of credit cards. A variant of temporal discounting allows a person to maximize the value of a reward today while at the same time minimizing the increased deferred cost that interest charges add to the cost of the object. What Thaler and Sunstein (2008) suggest is that if we consider these biases in establishing the rules by which economic activity is coordinated, we can construct a more equitable society. Although they do not state it as such, what they are really saying is that if we take a neuroessentialist view of economic activity, we can ‘nudge’ people to behave more in line with the considered reasoning of their prefrontal cortical circuitry and be less influenced by their intuitive biases.

This is not just a justification for adopting a neuroessentialist view of the world, but also an important issue of distributive justice. It is hardly the case that hard neuroessentialists are immune from the influence of unconscious biases in the economic sphere, but I would argue that these individuals are in a strong position to

utilize their deliberative cortical architecture to minimize such biases. In like manner, soft neuroessentialists are reasonably well positioned to understand and mitigate these intuitive biases, although we might expect that their ability to do so would be less than hard neuroessentialists. On the other hand, naïfs are least equipped to analyze the situation logically, and therefore would be most helped by the sorts of nudges that Thaler and Sunstein (2008) suggest. Thus, application of neuroessentialist thinking to the world of behavioral economics is likely to make the economic sphere fairer to all.

#### STIGMA

There is a school of thought that suggests that increased understanding about the neural basis of mental illness and addiction will reduce stigma (Rüsch et al., 2005). The idea is that once one understands that these maladies are caused by changes in brain chemistry, they will be viewed in a manner similar to other somatic diseases of the body. It is easy to see how this idea is, at its core, advocacy for the value of neuroessentialist thinking. Promoting the idea that brain disease is a result of altered chemistry is grounded in beneficent and utilitarian thinking, and is intended to promote enlightened social and legal policies. However, as we have argued elsewhere (Buchman et al., submitted), such claims may reduce blame while paradoxically resulting in increased social distance, inscribing individuals suffering from mental illness and addiction with the mark of being *neurobiologically other*, yielding the unintended consequence of fostering discrimination.

In order to understand how this process works, it is worth remembering that at least part of the biological basis of stigma is *moral revulsion* towards individuals with infectious disease (Chapman et al., 2009). These intuitions presumably served an adaptive value during the millennia when humans lived as a social species and social distance prevented infection (Kurzban and Leary, 2001; Schaller et al., 2003). This perspective dovetails very nicely with our outline of the neurobiology of neuroessentialist thought (above) with intuitive processing being predominantly subcortical, quick and relatively

automatic, and generally less available to conscious perception than introspective deliberation which involves relatively slow cortical processing. Together, these two cognitive processes contribute to an individual's decision about how to evaluate people with mental illness and addiction, and play an important role in the phenomenon that is commonly characterized as stigma.

How might depictions of the neural basis of mental illness and addiction affect the spectrum of neuroessentialists that we have described? I would suggest that hard neuroessentialists would readily agree with the premise that these maladies are the result of altered brain chemistry and would support compassionate treatment of these 'afflicted' individuals. That is not to say that hard neuroessentialists are immune from stigma: like everyone else, they harbour implicit attitudes, and these might still result in subconscious feelings of moral disgust. Given time to consider the matter however, hard neuroessentialists would be the most likely of our triad to quell whatever feelings of moral disgust they may entertain, but if pressed to decide on the matter quickly, might well respond with behaviours consistent with traditional stigmatizing attitudes. Soft neuroessentialists might be a bit more hesitant in accepting the premise that mental illness and addiction arise secondary to a change in brain chemistry, but again, if given sufficient time and education, would likely agree; when pressed to decide quickly, they, like the hard neuroessentialists, might respond by stigmatizing the target group. Naïfs are the least likely to be swayed by the argument that mental illness and addiction is due to a change in brain chemistry, and would have the most difficult time of the three overcoming their subcortical attitudes of moral disgust. Of course, there are many individuals, be they naïfs, soft or hard neuroessentialists, who are compassionate and able to overcome inherent biases in the absence of knowledge about the neurochemical underpinnings of behaviour irrespective of their views on neuroessentialism; our discussion merely highlights that fact that neuroessentialist thinking about mental illness and addiction may have unintended

consequences, and that these may paradoxically increase some aspects of stigma.

These conclusions are in accord with what has been observed when individuals have been educated about the genetic attributions of mental illness and then subsequently queried on their attitudes towards the mentally ill. Jo Phelan and her colleagues have investigated the effects of describing schizophrenia as having a genetic cause upon stigma and found that while blame was indeed reduced, measures of social distance were strengthened (Phelan et al., 2002; Phelan, 2005), and similar conclusions have emerged from the work of others (Lam and Salkovskis, 2007; Bennett et al., 2008; Jorm and Griffiths, 2008; Schnittker, 2008). These observations suggest caution when attempting to modify public perception of the biological basis of mental illness and addiction via educational campaigns (Corrigan and Watson, 2004; Henderson and Thornicroft, 2009; Lincoln et al., 2008). Whether these attempts to expand neuroessentialist thinking about mental illness and stigma to the public succeed or not may depend upon the basic structure of our brains, and the ways in which moral intuitions intrude upon the decision-making process itself.

#### **THE RISE OF NEUROESSENTIALISM AND THE FUTURE OF SOCIETY**

One of the most important functions of the field of neuroethics is to follow advances in the neurosciences and discern their potential implications for society before they have widespread impact. The rise of neuroessentialism fits well into this purview, and the current analysis provides a framework for examining not only the range of neuroessentialist thinking that appears to be emerging but also provides some guidance as to the impact that such a shift in public perception may have on society at large.

The data in Figure 1 imply that neuroessentialist thinking is indeed on the rise. An important question is whether widespread adoption of a neuroessentialist perspective may be nihilating (Doucet, 2007; Farah and Heberlein, 2007; Roskies, 2006; Roskies, 2007; Kaposy, 2009). Supporting this view are two particularly noteworthy experiments in which it was

demonstrated that merely reading a text which suggested that free will did not exist resulted in an increase in cheating behaviour and aggression (Vohs and Schooler, 2008; Baumeister et al., 2009). Fearing just such an outcome, there have been calls in some circles for the adoption of ‘necessary illusions’ to forestall the emergence of an existential crisis in response to neuroessentialist thinking (Nadelhoffer and Feltz, 2007; Smilansky, 2001).

There is merit in this view, and certainly considering these issues carefully is worthwhile, but at the same time I would recommend that we approach the matter without undue hyperbole. As we have seen in examining the implications of neuroessentialist thinking upon three domains of modern life, retributive justice, behavioral economics, and stigma, under some circumstances there are substantial prosocial effects of expanding the impact of neuroessentialist thinking to the public at large.

The key issue is how best to strengthen the moral compass in the face of the potentially nihilating influence of neuroessentialism. It is worth recalling that neuroscientific materialism and normative ethics are distinct issues. In his treatment of this topic, Owen Flanagan helpfully points out that, “the ends of creatures constrain what is good for them.” (Flanagan, 2008, p. 15).

That is to say that we remain social beings, and that the mores that we collectively decide to accept are ones that advance individual and collective aspirations for living well. These mores are codified in our legal system, which, for better or worse, provides guidance on such lofty issues such as human rights and liberty, and more mundane issues such as property theft and illegal parking. Moreover, the mores of society are widely discussed in the news media, sometimes when a prominent figure exhibits a lapse in ethical behaviour but also in the vigorous public debate of the ‘culture wars’ (Jensen, 1997). One useful suggestion would be for neuroessentialists to join social theorists and educators in calling for improvements in moral and character education (Gardner et al., 2002; Narvaez, 2008), thereby aligning social policy with the rise of neuroessentialism.

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### Neuroscience

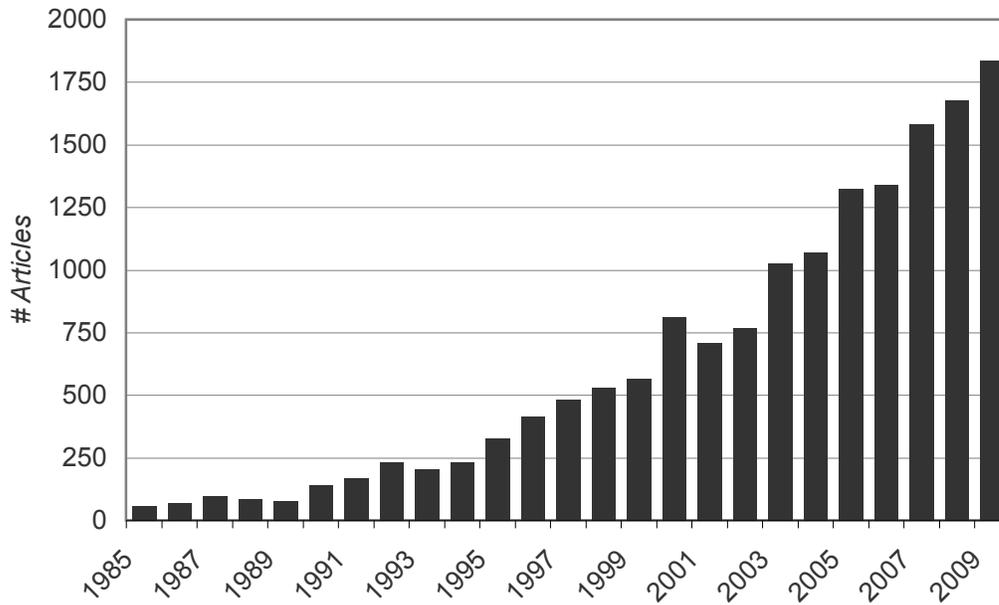


Figure 1A. Annual frequency of the word ‘neuroscience’ or ‘neuroscientists’ in major world English language newspapers for the years 1985-2009.

*Neuroscience (normalized to Biology)*

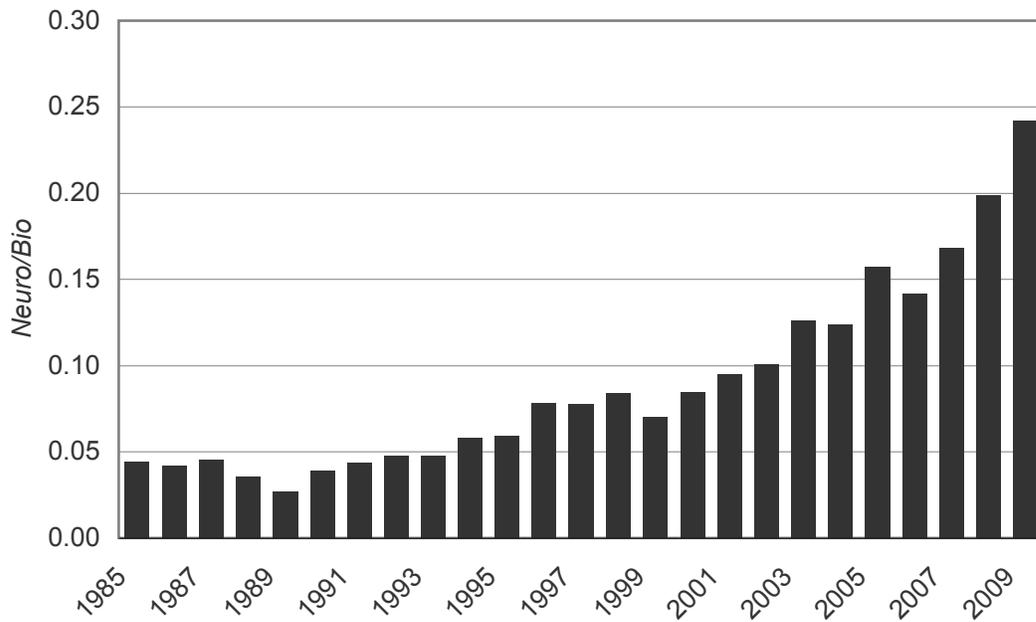


Figure 1B. Annual frequency of the word ‘neuroscience’ or ‘neuroscientists’ normalized to the occurrence of the word ‘biology’ in major world English language newspapers for the years 1985-2009.

**METHODS:** The LexisNexis Academic Database's power search function was used (to allow us to restrict our search to major world newspapers; for full list of searched newspapers, see appendix 1) to search for the word “neuroscience or neuroscientists” in English, year by year from 1985 through 2009. [The term neuroscientists returns results for both the singular and plural forms of the word.] We rejected terms such as brain, as preliminary searches indicated that they were more likely to deliver results related to brain diseases than interest in neuroscience *per se*, as well as more technical terms such as neuroessentialism which rarely appeared in the database. In order to test the degree to which the search terms “neuroscience or neuroscientists” acted as a proxy for the rise of neuroessentialist thinking in newspaper articles, we examined the content of the 20 least relevant articles (defined by fewest mentions of the search term) for each year, manually scoring them for their bearing on neuroessentialist thought. The results indicated that 74% of the least relevant articles dealt with issues that could readily be attributed to neuroessentialist thinking. Given that these were the *least* relevant articles retrieved by the database search, we interpret these data as suggesting that greater than 74% of the articles included in our analysis were directly relevant to the rise of neuroessentialism.

In order to investigate whether the increase in the use of the term “neuroscience or neuroscientists” was secondary to a general increase in science reporting in major world newspapers, we carried out a second search using as our search term “biology”. The data confirmed our hypothesis that science reporting in general increased over the time period being studied, with an observed 5.8-fold increase in the frequency of the term “biology” between 1985 and 2009. Normalizing the “neuroscience or neuroscientists” data to the “biology” data provided a measure of the relative rise of neuroessentialist thinking in the face of a generalized increase in science reporting.

Appendix 1: Major world newspapers searched were:

ABIX - Australasian Business Intelligence  
Belfast Telegraph  
Brisbane News  
BRW Abstracts (Australia)  
Business Day (South Africa)  
Countryman  
Daily News (New York)  
Daily Record & Sunday Mail  
Daily Telegraph and Sunday Telegraph (Sydney, Australia)  
Financial Mail (South Africa)  
Financial Post Investing  
Global News Wire  
Herald Sun/Sunday Herald Sun (Melbourne, Australia)  
Het Financieele Dagblad (English)  
Independent on Sunday  
Information Bank Abstracts  
International Herald Tribune  
Kiplinger Publications  
Korea Herald  
Korea Times  
Los Angeles Times (most recent 6 months)  
Moscow News  
Newsday (most recent 6 months)  
New Straits Times (Malaysia)  
Northern Territory News (Australia)  
South China Morning Post  
Sunday Times (South Africa)  
Sunday Tribune  
The Advertiser/Sunday Mail (Adelaide, South Australia)  
The Age (Melbourne, Australia)  
The Australian  
The Australian Financial Review Abstracts  
The Business  
The Business Times Singapore  
The Canberra Times  
The Courier Mail/The Sunday Mail (Australia)  
The Daily Mail and Mail on Sunday (London)  
The Daily Star and Sunday Star  
The Daily Telegraph (London)  
The Daily Yomiuri (Tokyo)  
The Dominion (Wellington)  
The Dominion Post (Wellington, New Zealand)  
The Express  
The Globe and Mail (Canada)  
The Guardian (London)  
The Herald (Glasgow)  
The Independent (London)  
The Irish Times  
The Japan Times

The Jerusalem Post  
The Jerusalem Report  
The Kalgoorlie Miner  
The Mercury/Sunday Tasmanian (Australia)  
The Mirror (The Daily Mirror and The Sunday Mirror)  
The Moscow Times  
The Nation (Thailand)  
The News of the World  
The New York Times  
The New York Times - Biographical Materials  
The New York Times - Government Biographical Materials  
The New Zealand Herald  
The Observer  
The Philadelphia Inquirer  
The Prague Post  
The Press (Christchurch, New Zealand)  
The Scotsman & Scotland on Sunday  
The Straits Times (Singapore)  
The Sun  
The Sunday Express  
The Sunday Telegraph (London)  
The Sunday Times (London)  
The Sydney Morning Herald (Australia)  
The Times (London)  
The Toronto Star  
The Toronto Sun  
The Washington Post  
The Washington Post Biographical Stories  
The Washington Times  
The Weekender (South Africa)  
The West Australian  
USA Today  
Wall Street Journal Abstracts  
Xtreme Information