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# Brains, Maps and the New Territory of Psychology

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**ABSTRACT.** The past decade has seen growing interest in the use of functional brain imaging methods in research. The range of conditions and behaviours studied using these methods has also been expanding. These developments have changed the profile of subfields in both psychology and neuroscience. While these events have been critiqued as reductionist moves, I argue that they can better be characterized as productive processes. Such a characterization makes visible the expansion and reorganization of the object of study and of domains of investigation; it highlights new relations with other disciplines and institutions, and it problematizes the subsequent increased social visibility. A reflexive approach to mapping practices is proposed to help functional imaging research address issues of methodological isolation and accountability.

**KEY WORDS:** brain mapping, history of functional imaging, neuroethics, reductionism, reflexivity

## All in the Brain

The argument that 'it is all in the brain' hardly raises an eyebrow anymore. Almost every month, a new area for this process or a network for that behaviour are found and reported widely. Indeed, in the course of the Decade of the Brain, the idea of a biological basis to the mind became rooted in both popular and scientific discourse. Some announcements about the biological basis of some traits may still occasionally surprise or shock. A recent report claims to have found the biological substrates to racial attitudes (Phelps et al., 2000). How could such complex cultural attitudes be related to brain tissue and blood flow? A group of subjects were scanned while viewing black and white faces, and activity was measured in their amygdala (a structure involved in emotional learning and fear). The level of activity corresponded to the subjects' results on tests of 'racial evaluation' taken before the scans. This study was published in a mainstream American scientific journal. No outcry ensued. Exactly how to measure this trait may be debatable, but that fear of the Other is hardwired into our brains is an idea

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that can be entertained. It is also an idea that seems not only to carry the agenda of a new style of psychological research, but also to hold the promise of improved social relations. If the biological mechanisms of fear can be identified, they can perhaps also be (biologically, pharmacologically) modulated.

Which is not to say that the methodology of brain mapping has not been debated, both within and outside the research community. Figures such as Jerry Fodor and Tom Wolfe have written on the shortcomings on this approach. Wolfe (1997) worries about the demise of notions like culture, self and soul, as a result of scientists peering into our brains, made transparent through imaging technologies. Fodor (1999) insists on the importance of asking questions about the mind, beyond seeing particular areas of the brain lighting up in relation to particular tasks. Indeed, a commonly heard line of argument when discussing brain mapping consists in denouncing the reductionist potential of brain maps, and pointing to the limitations of scans. Such a critique is not without interest, but it may miss important social and scientific aspects of this new trend. A critique of these maps that highlights their complexity and the way they are productive (not only reductive) may do a better job of contextualizing this new stream of research.

### **The Function of Maps**

What is it that these maps *do* do, and why is this valued? What purpose are these maps of the brain made to serve? The answer is based on a simple principle and complex technicalities. In a phrase: maps link the life of the mind and the space of the brain.

The development of brain mapping has marked an important shift in the practice of experiments in some areas of psychology and neuroscience. By using scanning experiments, phenomena that had been studied using behavioural measures came to be studied using brain-based, and, more specifically, anatomical, measures. Rather than a focus on processes of mind in time, brain mapping redirected attention to patterns in the space of the brain (Beaulieu, 2002). These changes in the focus of experiments are detailed in *Images of Mind*, by Posner and Raichle (1997), two pioneers of the method in the late 1980s. Many of the objections to this approach are formulated in the responses of an issue of *Behavioral and Brain Sciences* in which a précis of this book was presented.<sup>1</sup>

These localizations have grown in sophistication in the course of the last decade. An increasingly complex set of features of the mind can be mapped onto the brain. Life experiences, the impact of environment and of learning, have all been studied in mapping experiments. Maps have been produced contrasting how language is localized in early and late bilinguals. The superior spatial memory of London taxi drivers, who must learn the city

centre's many roads by heart in order to be accredited, has also been mapped as biologically different. Besides changing the ways many psychologists and neuroscientists work, maps have been at the centre of new kinds of arguments about nature and nurture. Mapping, it is important to note, does not ignore social or environmental aspects; rather, it recasts these aspects in biological terms. The experiment on racism described at the beginning of this article is a clear example of how even a concept steeped in cultural determinants like racism can be translated as a reaction in the brain. These maps link social, psychological and environmental factors to the biological structure of the brain.

Mapping can be said to reconfigure the nature/nurture debate. It is not only nature that counts; nurture also counts, but only once translated into a measurable activation in the brain. Biologization of mind in brain mapping takes the social or the environmental rather seriously. It renders it as a feature of a map. In the popular magazine *Newsweek*, the fate of deprived Romanian orphans was prominently compared to that of normal children through a pair of PET scans, the images standing in for the impact of emotional neglect as measured in the brains of the orphans (Begley, 1997). In this case, lack of nurture was shown as a biological feature.

More recently, brain maps have further shaped the way the nature/nurture question is being posed. A study of twins' brains (Thompson et al., 2001) has linked brain scanning with genetic variation. This study also correlated cortical structure and IQ test scores in relation to genetic influence. What is happening in this instance is not the refusal to accord importance to non-biological aspects of psychological function, but, rather, a complex translation of phenomena into measurements of the brain. By measuring the volumes of parts of the brain and correlating these to degrees of genetic similarity (through the well-known strategy of comparing monozygotic and fraternal twins), the variations in volumes can be attributed to genetic or environmental factors. This particular study further suggested a possible mechanism to explain hereditary factors in IQ scores: volumes of grey matter were strongly genetically determined, and could in turn be related to the scores obtained by subjects.

Differences in measurements of intelligence, differences in degrees of kinship and differences in environment and experience could all be compared in this study, because they were translated into features of voxels, the digital units that make up brain scans and serve to calculate volumes and levels of metabolic activity. To accuse brain mapping of reductionism is to miss the ways in which it powerfully redefines concepts like behaviour, nurture, culture and environment. The relational role of the map is therefore to link context, mind and brain. This is one of the ways in which the impact of maps is best analysed as productive of new relations, rather than condemned as reductionist.

## The Space of the Body

The focus of brain mapping on space and anatomy has further consequences for the future of psychology and neuroscience. The reach of mapping extends into notions of the self, in the sense of one's potential and of one's biography. As these notions are mapped in the space of the brain, they also enter brain-based systems. The primary system that deals with the body is of course the bio-medical institution. Once they are linked to the brain, what were previously mental functions become bio-medical conditions. This is therefore another significant way in which these maps are productive: neuroscience and psychology can link their work to medical endeavours, including genetics and pharmacology. Through working with brain maps, a common territory (literally) is created in which these various disciplines can work.

This link makes clear two related points. First, it highlights why brain mapping has become connected to detecting disease. Books like Rita Carter's *Mapping the Mind* (1998) show just how powerful the mapping metaphor is becoming. This book's recent paperback edition, while in a smaller format, still retains many of its attractive illustrations and dramatic images of active brains. Page after page shows pairs of colourful brains juxtaposed. The visible difference between these brains makes the strong visual argument that there is a difference to be seen between murderous and peaceful brains, male and female thought patterns, or conscious and oblivious states of mind (Dumit, 2004). Once conditions are identified in the brain, the clinical logic says that we should be able to distinguish pathological from normal cases. Yet normality in psychology (especially in social and cognitive psychology) has traditionally been conceived in very different terms than in clinical science. These differences explain some of the discomfort voiced by psychologists about the extrapolations being made on the basis of their work (e.g. about the possibility of 'testing' for dyslexia or 'false memories').

Whereas psychologists speak of 'the brain', a notion supported by the tendency to do group studies in brain mapping and to average scans from several subjects, recovering individual differences is becoming an increasingly important goal, as brain mapping and bio-medical endeavours become aligned. The possibility of gathering meaningful data about individual subjects may thus partly explain the success of fMRI studies in contrast to PET, which require averaging. Brain maps therefore re-articulate the tension between the search for universals of cognitive neuroscience and the attention paid to individual variations in the study of genetics (Plomin & Kosslyn, 2001) or clinical science. This marked challenge to traditional notions of 'normality' is especially bold when brain maps are constituted through databases of scans and electronic atlases (Beaulieu, 2001).

Second, this mode of reporting experiments lines up brain scanning

technology with other biomedical scanners like x-rays, the archetypal diagnostic tool. Researchers working in brain mapping commonly report that they are asked whether they can extend their work to provide diagnostic tests to detect the conditions they have been investigating. Once we have the map, we should be able to use it to navigate!

It is also important to note that while anatomical notions have underpinned these studies in the first decade or so of this new stream, the grounds on which brain and behaviour are being connected are developing in two directions. Brains and behaviour are being linked at the molecular level, with either genetic inclinations (e.g. in the twin study described above) or possible pharmacological implications (as in studies that consider neurotransmitters as crucial factors) (Cummings, 2000; Jetty, Charney, & Goddard, 2001). A second significant trend is to favour mathematization and modelling as means to translate cognitive processes and neuroscientific notions into a common language (see McIntosh, Fitzpatrick, & Friston, 2001).

## **The Body Politic**

Maps, however, are also the stuff of politics. To accurately map the coastline was a potential act of treason not many centuries ago. Indeed, maps are still potent objects involved in systems of power, and maps of the brain are no different. Brain mapping is therefore also productive of new demands on researchers. As psychology and neuroscience tackle highly symbolic areas, like consciousness, (false) memory, subjectivity and the neural basis of social relations, they must expect related levels of social concern. Similarly, as cognitive neuroscience increasingly uses mapping to portray its results in terms of the human brain, it enters the bio-medical realm. Consequently, it ceases to be a relatively isolated academic discipline; increased visibility leads to greater public support, but also to greater public scrutiny. The interventions of Fodor and Wolfe discussed earlier are thus noteworthy because their assessment of brain mapping methodology were published in a mainstream print medium. With cognitive neuroscience's recent growth in 'relevance' comes increased responsibility. Much like the genetics community and its project to map genes, neuroscience faces a pan-European initiative to examine its ethical, legal and social aspects (ELSA). A symposium sponsored by the Wenner-Gren and European Science Foundations was held in Stockholm in September 2001, and aimed to reflect on the issues raised by these recent developments in neuroscience. An American call to develop 'neuroethics' has also been made.<sup>2</sup> The new stream of social cognitive neuroscience aims to relate brain mechanisms to traditional concerns of social psychology, and is therefore dealing with clearly socially significant issues (see Cacioppo et al., 2002).

Brain maps, and especially fMRI methodologies, are at the heart of this type of research. New funding initiatives have been launched amid defensive statements and acknowledgements that ‘social cognitive neuroscience is big science and it’s at the leading edge. . . . That may frighten some who might worry that it will take us down the road of biological reductionism’ (Azar, 2002). Given the points discussed above, a reflexive approach to the context and content of this research might be more effective in debating the acceptability of this endeavour, and lead to a fruitful debate, beyond accusations and denials of biological reductionism.

Such a reflexive approach addresses two important kinds of considerations. First, in terms of contents, it leads to the acknowledgement that the objects of psychology and neuroscience are changing, not simply, straightforwardly, improving. It also implies a modest stance with regards to the possibilities of brain mapping—a stance that enables researchers to consider what is shut out by the dominant paradigms in mapping experiments, and how the methodology might be enriched (Jack & Roepstorff, 2002; Roepstorff 2002).

Second, in relation to the context of this work, there have been some indications that researchers are taking note of the social import of their activities (Phelps, 2001). More than lip service is needed, however, since researchers who understand where and how their research is socially and culturally located may be better able to delineate their responsibilities as producers of knowledge, and their social accountability. This offers a third alternative to the problem of social responsibility of researchers—one that seems both more practical and ethical than either denying any responsibility for what happens to one’s research, or else taking on all possible repercussions of one’s work. This should of course not be considered as the sole individual responsibility of researchers. Institutions and funding agencies may also need to support this increased awareness, by stimulating ongoing (rather than post-hoc) communication between brain mapping researchers and anthropologists, sociologists and ethicists who are experts in these issues.

Maps are indeed productive: they connect the study of cognition with everyday life, psychology with the body, and scientific research with institutions of care. These new relations and the opportunities they create may constitute the true impact of mapping, and these are arguably of much greater significance than the theoretical objections of reductionism.

## Notes

1. See main text and critical responses in Posner and Raichle (1995).
2. The Dana Foundation, Stanford University and the University of California, San Francisco, sponsored a conference entitled ‘Neuroethics: Mapping the Field’. See conference website and conference reader, [http://scbe.stanford.edu/neuroethics\\_conference.html](http://scbe.stanford.edu/neuroethics_conference.html).

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