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Proposal for a Critical Neuroscience

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Critical Neuroscience: Towards an Undisciplined Ethos for Critique

We outline the perspective of 'critical neuroscience': a stance of critique pertaining to neuroscientific methods, practices, concepts, discursive effects, formative backstories and societal impacts. Critical neuroscience brings together work from various disciplines with the aim to engage neuroscience practitioners as well as decision-makers, stakeholders and the public, bringing them to adopt a critical stance towards the entirety of the 'Neuro complex' in its present guise, including its broader impacts on scholarship, academia and wider society. This text is a programmatic outline which traces major lines of influence and theoretical backgrounds. It is an invitation to neuroscientists and critical scholars from different fields to engage in collaborative reflection on the present and future of human neuroscience in its dynamic socio-cultural surroundings. The chapter is a moderately revised and updated version of the foundational chapter 1 of our volume *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience* (Chichester: Wiley-Blackwell 2012).[1]

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The label 'critical neuroscience' captures a productive tension. The title represents the need to respond to the impressive and at times troublesome surge of the neurosciences, without either celebrating them uncritically or condemning them wholesale. 'Critical' alludes, on the one hand, to the notion of 'crisis', understood—in the classical Greek, predominantly medical sense of the term—as an important juncture and point of intervention, and relatedly, to a task similar to that proposed by Kant in *The Conflict of the Faculties* (rather than in his more famous 'Critiques'), where he defends a space of unconstrained inquiry freed from the continual pressures put on scientific knowing by the vagaries of government and the political sphere at large (Kant 1992). In Kant's perspective, this opens up a space for inquiry that is itself inherently and self-consciously political, insofar as no allegiances to any pre-established orders of power will detract from reason's—and by the same token, free citizen's—self-determination. Fending off the multifarious forces that threaten to shrink or impede this unconstrained public sphere remains a perpetual task, one that gets specifically vexing when some of the toxic constraints imposed upon it are issued by institutional science itself. That is, when scientists—or, more often, their institutional advocates, sponsors, pundits—resort to dogmatism, positional authority or blatant self-promotion. On the other hand, the concept of 'critique' raises important associations with Frankfurt School critical theory. While critical neuroscience does not directly adhere to a 'Frankfurt School programme', nor to the rather swift identification of most work in natural science with positivism espoused by early critical theory, it does share with it a spirit of historico-political mission. This mission chiefly revolves around the persuasion that scientific inquiry into human reality tends to mobilise specific values and often works in the service of interests that often come to shape construals of nature or 'naturalness'. These notions of nature or of what counts as natural, whether referring to constructs of gender, emotion, mental disorder, normal brain development or other key human traits or capacities, require unpacking. Without reflective scrutiny, they can appear as inevitable givens, universal and below history, and are often seen as a form of 'normative facticity', presumably imposing specific demands on us and our conduct in everyday life (Hartmann 2012).

In the following, we will spell out how our proposal for a critical neuroscience is not motivated by the aim to undermine the epistemological validity of neuroscience or debunk its motives, nor is it simply an opportunity to establish yet another neuro-prefixed discipline. Situated between neuroscience and the human sciences, critical neuroscience uses an historical sensibility to analyse the claim that we are in the throes of a 'neuro-revolution' since the beginning of the Decade of the Brain in 1990. It investigates sociologically the

motivations and the implications of the turn to the *neuro-* in disciplines and practices ranging from psychiatry and anthropology to educational policy, and it examines ethnographically the operationalisation of various categories in the laboratory. Investigating the historical and cultural contingencies of these neuroscientific categories, critical neuroscience aims to analyse the ways in which, and conditions through which, behaviours and categories of people are 'neuro-naturalised'. It also traces how putative 'brain facts' are appropriated in various domains in society, starting with medicalised contexts of the West, but also with an eye to cross-national comparative analysis to understand the production and circulation of neuroscientific knowledge globally. Maintaining close engagement with neuroscience is on the one hand crucial for building accurately informed analyses of the societal implications of neuroscience, whilst on the other hand, providing a connection, a reflexive interface, through which historical, anthropological, philosophical and sociological analysis can feed back into research practice and provide critical as well as creative potential for experimental research in the laboratory.[2]

In attempting to build up a picture of what critique might look like for this project, we avail ourselves of a number of disciplines and sensibilities that can contribute as resources for critique. Our goal is to render critique amenable to a number of diverse disciplines and scholarly outlooks. This versatile set of tools can contribute to reviving a critical spirit while also broadening the neuroscientist's gaze. That being said, we do not intend to outline a fully fledged programme or recipe for critique. Instead, we will sketch building blocks for a mode of engagement, an ethos, that aims to raise awareness of the factors that come together to stabilise scientific worldviews that create the impression of their inevitability.

To bear relevance outside the narrow scholarly sphere, such an endeavour requires a self-reflexive hermeneutics that is necessarily multi-dimensional, even 'undisciplined'. The result, we envisage, will not so much be an unpacking of the black boxes of the neurosciences as an assemblage of resources that ultimately widens the ontological landscape of the diverse and varied behavioural and social phenomena under study. It is the plurality—reflecting the complexity of behaviour as well as the many contingencies of neuroscience—of elements of this landscape that gives rise to the solidity of a claim, the 'realness' of a fact. Contextualising neuroscientific objects of inquiry—whether the 'neural basis' of addiction, depression, sociality, lying or adolescent behaviours—can, in this way, demonstrate how such findings, whilst capturing an aspect of behaviour in the world, are also held in place by a vast number of contributing factors, co-produced by a collection of circumstances, social interests and institutions (Hacking 1999; Young 1995). These circumstances

and interests are often quite systematically ignored in neuro-discourse (see, e.g. Heinemann and Heinemann 2010; Weisberg et al. 2008).

However, we propose that critical neuroscience should not stop at description and complexification. Indeed, we share a sense of uneasiness, repeatedly voiced within the field of Science and Technology Studies (STS) in particular (Anderson 2009; Cooter and Stein 2010; Forman 2010; Mirowski 2011) about depoliticalisation of scholarship in the face of the increasing commercialisation of academia. In line with a broader cultural tendency favouring voluntarist conceptions of the 'entrepreneurial self', centred around ideas of 'resources' and personal 'capital' (social, emotional, 'mental'), there is a notable correspondence, sometimes quite open, sometimes in the form of less obvious complicities, between scholarly discourse and economic imperatives and normative schemas.[3] We share the conviction that a more radical and openly political positioning is needed in face of these trends. In the first instance, it is important to reinvigorate a sense of the impact that broader social, political and economic dynamics have on the very shape of academic and scientific culture.

Assemblage: The Thickening of Brain-Based Phenomena

Bruno Latour, in his essay about critique and its effect of *weakening* scientific facts, appeals to his critically oriented readers to 'suspend the blow of the [critical] hammer' and calls for a renewal of a realist attitude oriented to matters of concern, rather than matters of fact (Latour 2004). Matters of concern are those around which the human world revolves: they enthral, involve, challenge us to embrace or oppose them—matters of concern are focal points in practices, discourses, disputes. Critical neuroscience shares this constructive spirit, the 'stubbornly realist attitude' and the focus on what matters in relation to scientific practices (Rouse 2002). Critical neuroscience embraces the added dimension that enters the scene with the focus on matters of concern: values, conflicting moral and political outlooks and evaluative perspectives, changes in the attribution of relevance pertaining to a given phenomenon or scientific result, often contested among affected parties. There is no layer of scientifically accessible reality that is beyond or beneath this messy entanglement with concerns, values, interests and the conflicts between such rivalling evaluative outlooks. With this orientation, critical neuroscience specifically emphasises the politics implicit in scientific practices (see Rouse 1996; Haraway 1997).

However, while Latour and other champions of the by now fashionable anti-critique stance deem themselves non-dogmatic and quasi-democratic in giving a voice to participants in practices—both human and non-human—in the process of assembling their formations and collectives (instead of silencing the actors behind grand-scale theoretical assumptions), they relinquish too much. An overly celebratory or idly metaphysical gabbling too easily results from the sidelining of any non-local invocation of the social, the economic or the political. By contrast, our proposal for critical neuroscience calls for a less detached attitude on the part of the critical investigator, a more active engagement and, at times, a more confrontational response in cases of violation of scientific standards (Fine 2010; Jordan-Young 2010), strategies of ignorance (McGoey 2009), imperialistic export of Western assumptions to non-Western contexts (Watters 2010) or the political use of preliminary data (Choudhury et al. 2010). Such responses need to be supported by attempts to identify and render explicit more subtle biases and frames of evaluation: the specific organisation of public attention, patterns of distribution of affective energies, collectively sustained valuations and schemes of judgement that are instituted in subtle but pervasive ways in both scientific and popular discourses, in representations of scientific results, but also in spheres of public understanding at some distance from the practice of research. Notions such as the neural basis of adolescent risk taking, hard-wired sex differences, molecularised understandings of mental illnesses, or narratives about behavioural and emotive tendencies universally present in humans and 'set in stone' by evolution are cases in point. Some of these narrative patterns solidify to form what Judith Butler has called 'frames'—powerful yet unnoticed ways in which perception, knowledge and normative judgement are tacitly pre-organised so that some conceptualisations and evaluations are made likely while others are ruled out a priori (Butler 2009). Critique here has the task of working against deeply engrained habits of perception, thought and judgement, against pervasive orders of the sensual and the sensible, in order to enable and actively promote alternative framings of matters of concern.

What we envisage as the practice of critique, therefore, may well start with the critical yet constructive activity of assembling (Latour 2004, 246). Building on Latour's understanding of the term, 'assembling' in our usage refers to the collection of material from multiple sources and perspectives in order to enrich scientific conceptualisation as well as the broader intellectual horizon in which problems and issues are framed for empirical investigation and interpretation. Objects of neuroscientific investigation can, as a result, be situated in the full fabric of meaningful relations—while this very fabric is itself placed under scrutiny and has to be kept open for contestation. The

social situatedness, cultural meanings and various interests of affected groups all package the ontological landscape of neurocognitive phenomena. This view holds that what we see in the brain is at any time held in place by a rich web of factors within the epistemic culture (Knorr-Cetina 1999; Young 1995), and in the ambient society, which in turn mobilises these findings beyond the laboratory. Insights from multiple disciplines can bring to light the internalised scientific ideals, or 'epistemic virtues' (Daston and Galison 2007) that direct the formulation of neuroscientific findings—the filtering of information, the criteria for, and goal of, objectivity and the operationalisation of chosen aspects of the lifeworld. This encompassing embeddedness of neuroscience's objects of study is now increasingly acknowledged in various so-called *biosocial* research perspectives, which treat what formerly were thought of as separate biological and social dimensions as inextricable (see Meloni et al. 2016; Meloni 2014).

To illustrate this by way of an example, let us briefly venture into the case of addiction and addiction research. Addiction is increasingly understood as a disease of the brain, in which addictive substances cause malfunction of the frontal regulation of the limbic system, thus 'hijack[ing] the brain's reward system' (Leshner 2001) and potentially even altering gene expression (Kuhar 2010). The goal of these brain-centred approaches to addiction is to locate candidate molecular mechanisms that can lead to effective new treatments (Hyman and Malenka 2001). While these studies have yielded some notable findings, addiction is far more than (and different from) a mere change in brain chemistry. 'Addiction' denotes a family of conditions that are inextricably tied up with social environments, drug markets and cultural triggers (Campbell 2010), and depend on collectively developed and sustained habits and also upon institutional practices that emerge in response, as a feedback, to the original phenomenon—through classificatory looping as described by Ian Hacking (1999).

Approaching addiction using an ecological systems view, through multiple epistemic cultures, would mean to re-inscribe and integrate these multiple causal factors. Such an approach examines the linkages across levels of description using various methodologies and includes recording the cultural phenomenology of addictive behaviours. Additionally, it attends to the political economy of addiction and the effects of industry on concepts of addiction. And it strives to include the perspectives of those most directly concerned so as to work towards emancipatory and empowering strategies in facing the challenges that addiction poses. Taken together, this integrative approach will yield an explanandum much richer than any of the narrow construals developed exclusively from a single scientific or medical

perspective. Clearly both registers—social and biological—are necessary to assemble a richer and also sufficiently dynamic understanding of addiction. The more relevant questions for a critical neuroscience to work out will be how to overcome the gap between social and neural, how to develop conceptual vocabularies and frameworks that overcome this distinction and how to empirically study phenomena like addiction with a view of the *situated* brain and nervous system and including the personal perspective and experience of those concerned.[4]

How Does the Social Get Under the Skin?

Ethnographic work by Margaret Lock has provided powerful evidence for the need to collapse conventional dichotomies between the 'inside' and 'outside' of the human body. Her seminal study of the experience and physiological characteristics of menopause among Japanese and American women led her to the concept of 'local biologies', a useful way to denote her finding that social context and culture can refashion human biology (Lock 1993; Lock and Kaufert 2001; Lock and Nguyen 2010, ch. 4). Lock found that the cultural differences in menopause/konenki ran deep, manifesting on biological, psychological and social levels. She argued that the different experiences of hot flushes were not simply due to differences in cultural expectations in relation to the body, but down to the biological effects of culturally determined behaviours such as diet. This finding challenges the tendency in biological science to draw boundaries at the skin, and demonstrates instead the ongoing dialectic between biology and culture. Laurence Kirmayer has extended these ideas to the brain and behaviour through his concept of 'cultural biology', which understands culture as a biological category in the sense that human beings have evolved a 'biological preparedness to acquire culture … through various forms of learning and … neural machinery' (Kirmayer 2006, 130). Lock and Kirmayer's concepts of 'local biologies' and 'cultural biologies', respectively, capture a notion of central importance to critical neuroscience: biology and culture are mutually constraining and dynamically co-constitutive, such that they are each conditions of the other's determination and development.

Explanations that situate brain and cognitive function within the social and cultural environment of the person are, in fact, increasingly encouraged within psychiatry and neuroscience. Calls for interdisciplinary research that lead to integrative explanations are certainly heard within psychiatry as a route to developing multi-level theories of disease and their aetiologies (Kendler 2008). Advances in epigenetics have been especially influential in fuelling

major shifts in scientific thinking about the linkages between the body and its environment, between soma and society. Research on epigenetics has begun to reveal how interactions between the genome and the environment over the course of development lead to structural changes in the methylation patterns of DNA that regulate cellular function. There is compelling evidence, for example, that early parenting experiences and social adversity alter the regulation of stress response systems for the life of the organism (Meaney and Szyf 2005). Such studies provide biological evidence that lived experience, developmental histories, dynamic interactions and cultural contexts are all fundamentally bound up with biological processes as 'low level' as gene expression.

In parallel to these developments in genomics, social and cultural neuroscience have become the most rapidly developing areas of cognitive neuroscience. These research fields posit that the human brain is fundamentally a social brain, adapted for social learning, interaction and the transmission of culture (Frith and Frith 2010; Rizzolatti and Craighero 2004). Moreover, its structural malleability is understood to be experience dependent and long lasting. Evidence of genomic and neural plasticity thus forces scientists to rethink the primacy given to biophysical levels of explanations and challenges us to destabilise the dichotomy of nature/culture and instead address the fundamental interaction of mind, body and society.

This concept of the situated brain brings up a number of possibilities and challenges for critical neuroscience. First of all, it requires the critic to act as a *bricoleur*, collecting data at a number of different levels, layering phenomena, such as menopause or addiction, with these different strands of inquiry that ultimately serve to enrich one another in their explanatory value. Secondly, the emerging discourses of 'interaction' require critical analysis by sociologists and anthropologists of science. How exactly are aspects of social life, culture and individual difference incorporated into scientific observations and methodologies? Furthermore, when the environment and biology are each assigned roles in the development of pathologies such as schizophrenia or antisocial behaviour, how are the social and cultural realms made concretely relevant or rendered visible in medical explanations? How might the more complex ontologies of mental disorders that result from these integrative explanations bring about new ethical and political challenges by opening up new spaces of intervention or creating new 'at risk' populations (Pickersgill 2009; Rose 2010; Singh and Rose 2009)?

Situating the brain and behaviour in social and cultural contexts also underscores the importance of examining recursive loops between neurobiological and social/cultural processes such as the way in which explanatory

theories of illness and behaviour interact with the physiological processes involved. This 'bio-looping' as discussed by Ian Hacking and others refers to the ways that both culture and local biologies can transform one another, exerting their influence on the way we understand ourselves, the way we experience mental and bodily phenomena and the way that this in turn shapes the corresponding biological processes (see Choudhury and Slaby 2012; Seligman, *this volume*). We return to these issues later in a discussion of what critical neuroscience can do for neuroscience itself.

Re-invoking the Social in Studies of Neuroscience

Openly politicised forms of critique are no longer much in evidence, be it in STS or more broadly, and may not currently seem very workable. Prevalent, for example, in science studies and cultural studies are approaches that appear to trade in critical engagement for an aestheticisation of scientific practices, stopping short of penetrating into manifestly pathological developments. One reason for this may be the increasing professionalisation and differentiation of various metascientific approaches over the past 40 or so years: are practitioners no longer 'allowed' to operate on a broader, holistic level of social understanding that transcends clearly circumscribed local expertise?[5] It is likely that certain intellectual as well as political and economic developments support some of this academic quietism (Forman 2010).

In opposition to these tendencies, critical neuroscience strives to regain room for scrutiny, in reckoning with perspective-bound and interest-specific constraints that belie, in some contexts at least, objectivist aspirations of neuroscience and of those enthusiastic about its applicability in everyday life. Certainly, the gathering of context in many cases may end up laying bare the economic and political imperatives that sustain particular styles of thought from 'screening and intervening' to 'essential differences' (Abi-Rached and Rose 2010; Fine 2010; Jordan-Young 2010). It may also end up shedding light on the ways in which the very concepts and categories that produce new kinds of responsibility towards the 'natural' make-up of our minds are—knowingly or unknowingly—themselves shot through with our projections, and give rise to 'facts', worldviews and policies that may collude with social and political orders (Hartmann 2012; Malabou 2008). This is well illustrated by Cordelia Fine's study *Delusions of Gender*. Fine, trained both as a cognitive neuroscientist and a science journalist, rigorously analyses neuroscience experiments, their results and their interpretations among media exegetes, that purport to show hard-wired differences in behaviour between men and

women. She demonstrates with much technical insight how biases creep into the assumptions involved in experimental paradigms, and how cultural stereotypes are reified by 'brain facts', amounting to a form of neurosexism (Fine 2010; cf. Jordan-Young 2010).

As variously indicated above, critical neuroscience puts particular emphasis on the social. It is important not to take 'the social' as a static, homogenous formation, but rather to work with this notion as a variable proxy for the complex associations between scientists, laboratories, media, agencies, governments and other constituencies. Scientific knowledge as such can be viewed as embodied in material alliances or what Rouse, alluding to Wartenburg's conception of socially distributed power, has called 'epistemic alignments' (Rouse 1996; Wartenburg 1990). Effective knowledge only exists in concrete material-practical interactions between people, things, instruments, agencies and policies, and thus cannot be understood in abstraction from 'the various kinds of resistance posed by anomalies, inconsistencies, disagreements and inadequacies of skill, technique, and resources' (Rouse 1996, 194).

While no grand-scale invocations of 'social factors' can substitute for precise analyses of particular interactions and alignments between social actors and material actants, it is important to keep the bigger picture in view. It is here that we diverge from the localism of actor-network theory and the STS mainstream: epistemic and political alliances, as well as cognitive and affective frames and interpretive schemes instituted by them, often operative through media representations or discursive practices that begin in local settings and are subsequently broadened, all contribute to a structure of secondary objectivity or 'second nature'. These processes of solidification can easily escape the purview of science and its commentators because of the incremental nature and slow timescales of change and because of the authoritative nature of the finished product: established, official, institutional knowledge—that which gets variously coded in prevailing discursive formations and is disseminated via official channels of institutional PR and leading media.

The 'social' needs to be viewed not as an assumed explanatory factor but as the result of various micro- and meso-level operations and alignments between a wealth of actors, tools, quasi-objects and agencies. In turn, the social re-emerges as a potential explanatory resource, for example, in the mobilisation and distribution of attention, of concern and relevance and in the workings of tacit schemes of interpretation and normative judgement (Butler 2009). In light of this, it is not enough to merely point to ontological hybridisation or celebrate one's having superseded modernist dualisms (Latour 2005). Neither does it suffice, for our purpose, to merely neutrally chart cartographies of 'emergent forms of life'—such as biological citizenship and neurochemical

selfhood—nor simply to leave it upon others to 'judge' these developments (Rose 2007, 259).[6]

While such descriptive endeavours provide important staging for subsequent analysis, it is crucial to penetrate beneath the surface of emerging practices, relations and styles into the dynamics of power that may shape or stabilise surface phenomena, facilitate or hinder effective alliances or actions. It is important to reckon with pathological developments and render explicit interest-driven biases, hegemonic schemes of judging, templates of knowing and classifying, dangerous blind spots in interpretations, unquestioned narrative patterns and various unholy material alliances.[7] For example, the neoliberal mobilisation of human resources in the name of employability, flexibility and 'soft skills' has found a new space to take shape among neuroscientists performing the naturalisation of social/economic categories, and increasingly biologised notions of personhood, human experience and the good life (cf. Malabou 2008). Subjectivity is parsed from the outset into economic categories and becomes a type of bio-economic 'capital' that is in turn used to sort people into kinds, construct risk profiles and suggest enrolment in enhancement programmes (Fricke and Choudhury 2011).[8]

In light of this, we argue that critical neuroscience must ask hard questions about conceptual and normative assumptions and strategic alliances and work towards re-opening contestations and restaging alternative interpretations and evaluations.[9]

Structural Pathologies in Science and Society

The activity of assemblage, in our sense of the term, is thus an inherently political one. It allows the critic to identify what Axel Honneth has called 'social pathologies of reason' (Honneth 2009, ch. 2)[10]: defects or malfunctions in social systems, practices and institutions—malfunctions that come into view against the background of a normative understanding of society and the purposes of functioning institutions. In the case example of addiction, described earlier, one might come to reckon with diverging perspectives from medical professionals, pharmaceutical companies, health administrators, social workers, governments and political parties, the education sector, newly constituted 'risk populations' and certainly 'the addicts' themselves. However, 'addict'—and similarly, other kind terms in use in neuroscientific research—must be seen as a category that is co-produced through dominant classifications, styles of thought and cultural practices. Incisive analysis of the interactions which make possible these neurological categories give ground

for active assertions about what is at stake, in the case of 'brain overclaim' or tangible corporate influences on scientific practice.

For example, as Laurence Kirmayer and Ian Gold (2012) argue, there is a trend in mainstream Western psychiatry to employ increasingly narrow construals of mental suffering that neglect the situatedness of patients in distorted social environments and direct the focus away from cultural embeddedness—including politically problematic societal arrangements—towards assumed 'neurological underpinnings' of illness, agency and personhood. Ignoring the social and cultural contexts of phenomena under investigation can render neuroscientific research complicit with problematic developments in the medical sector, despite the best intentions of many individual practitioners. Scientists are not usually trained to be very sensitive to the subtleties of, and social conflicts within, political and institutional environments. This can lead to distorted interpretations of experimental results—with very real consequences in the lives and treatment choices of patients. Continuing the above example of addiction research, a narrowly neuroscientific understanding of substance addiction might lead to the neglect of the conditions that stabilise addictive behaviour and thus encourage forms of practice and treatment less conducive to the well-being of those affected than those that become available through a more complex understanding of the condition. Moreover, such narrow explanations fail to acknowledge the role of politics, social engineering and economic pressures in addiction and other forms of human suffering.

Intensified media representation coupled with audiences increasingly trained, through continuous exposure, to be receptive to easy-to-digest narratives of self-objectification contributes to the distorted images of the person—as lacking in free will, possessing skewed decision-making powers, being driven instead by automatised emotions and thus as not genuinely responsible for their acts (while simultaneously making them responsible for 'managing' their brains). Media reporting in this manner can lead to a climate of opinion that singles out sensationalistic themes, often ideologically laden, and pushes towards simplified, technocratic solutions to social problems. Critical neuroscience aims to function as an informed voice opposing those distorted images. Importantly, Fine's critique of neurosexism mentioned earlier is made particularly strong by her close engagement with the experimental design and statistics as well as her skill to write compellingly for a broader audience. Given that the flawed findings she critiques have travelled into the popular cultural script of male/female differences, critical writing for a public audience is a vital skill of immense value within the toolbox of critical neuroscience.

Whose Norms? Expertise, Participation and Contestation

The goal to scrutinise and lay bare scientific conventions that are taken for granted, tacit knowledge, vested interests at work in neuroscience research or their impacts on people, opens up complex questions about norms. In order to identify social pathologies or general 'system malfunctions', any critical endeavour inevitably operates in a normative space, reflecting particular assumptions about the conditions for both social organisation and individual well-being. Theorists cannot remain neutral but have to stake their particular political orientation—but it is crucial to see that there is no alternative to a necessarily partial, situated, specifically committed stance in the midst of the practices and developments under study. There is no neutral vantage point, no 'god's eye view' (Rouse 1996; Haraway 1997). What we deem 'pathological' at a given juncture depends on a contrast with nontrivial ideas of a non-pathological alternative. Where individual subjects are concerned, this calls for the articulation of a situated, conceptually thick orientation towards an image of the good life. Accordingly, no version of a critical neuroscience can simply impose a set of normative standards or values. The critic's task rather is to render the implicit norms of a given social domain or lifeworld segment explicit, point to possible tensions between different normative outlooks and, where necessary, measure institutional realities against the normative assumptions that legitimate them, yet without recourse to a fictional vantage point of neutrality above the fray of situated practice. This raises questions of power, the constructions of expertise, the social distribution of knowledge, and the possibilities for participation in decision-making processes—questions that have to be confronted from within the practical domains in which they arise, and by all those whose well-being, flourishing and political agency is concretely at stake.

The last few years have seen a steep increase in numerous forms of popularisation of neuroscience. Driven by various parties, including neuroscientists, funding agencies and the media, public engagement in neuroscience has emerged in the form of outreach projects, popular science writing and—not least—as interactive neuroscience exhibitions geared towards a range of audiences, with the aim of informing and engaging the lay citizen. If critical neuroscience advocates informed participation in the scientific process, then it will need to confront questions about representation, expertise and agency of citizens, particularly in information societies characterised by a more demanding and active citizenry (Beck 1997). There is no doubt that efforts to

'democratise' scientific processes this way pose difficulties. With hindsight, earlier optimism about the potential of a renewed politicisation of society around issues of science and technology seems to have been premature (Kerr and Cunningham-Burley 2000).[11] Rather than an emerging 'sub politics' (Beck 1997)—grass root political engagement that responds to hazards of scientific and technological development—we increasingly witness restricted expert circles monopolising the negotiation and regulation of relevant issues (cf. Mirowski 2011).

One way for critical neuroscience to attempt to establish (or challenge) normative conceptions—themselves always necessarily under reflexive scrutiny—is by creating a discursive space for debate both in professional and practical domains about the categories and applications of neuroscience, and about related social issues such as the organisation of labour, conception of health and disease, goals and practices in parenting and education, issues about law and punishment, technological self-optimisation and much more. In order to make this move however, it needs to probe critically at ways in which the choices and views of the public are regulated, particularly amidst the growing clamour for 'neurotalk' in public spheres (Illes et al. 2010). Expert counselling and state-run programmes of screening and risk assessment (Rose 2010) and the instant professional take-up of ethical concerns into an institutionalised 'neuroethics' (de Vries 2007) increasingly occupy the space for public engagement. In what ways might the space for 'science in society' or 'neuroethics' experts, as well as the domains of psychiatrists, doctors and educators (connected to government, funders or companies), act as intermediaries in aligning public opinions with scientific agendas, ratifying or legitimating neuroscientific research programmes? Who can legitimately make knowable what the 'public' wants or thinks about neuroscience and its applications? How can participatory approaches avoid opening up new forms of stratification?

With such problems in mind, critical neuroscience aspires to open up discursive spaces that facilitate debate among practitioners, 'stakeholders' and lay citizens about the goals, concerns, and normative standards that society wants its science to pursue or live up to: where the work of the critic involves not merely encouraging the accessible promotion of new ideas from neuroscience, but invites plural viewpoints and promulgates a degree of critical rigour through provocation—that is, by illuminating blind spots and by questioning assumptions. It is vital that public neuroscientists conceive of audiences not as listeners or viewers but as potential speakers. It is at these sites of contestation that specific normative issues surrounding scientific matters of concern can emerge and take shape. This process pushes science beyond reliable knowl-

edge—subject only to validation within its own disciplinary context—to the production of 'socially robust knowledge'; that is, knowledge tested for validity both outside and inside the lab, developed through the involvement of socially distributed experts including those from different disciplinary and experiential backgrounds within and outside of academia (Nowotny 2003). While the embeddedness in society and the iterative process of open contestation may render this knowledge more robust, the means of such forms of polycentric knowledge production in neuroscience must be carefully worked out (Jasanoff 2003).

A model of 'public' neuroscience such as this faces challenges within the changing structure of the university and changes in the organisation and funding of professional research. Both are increasingly oriented towards a corporate, neoliberal management model (Giroux 2007; Mirowski 2011). How can critical neuroscience reach its goals in a system that places its values on outcomes and efficiency, that increasingly fosters commercialisable or applied research and encourages corporate influences in the form of sponsorship, company spin-offs, profitable patents and institutional joint ventures?

There are trends pulling neuroscience in different directions, certainly not all negative. The ambivalence of the situation can be illustrated by reference to 'interdisciplinarity' (a term that has become a powerful buzzword, notably in neuroscience). Successful integration of distinct perspectives and methodological approaches can lead to unforeseen benefits and novel insights. However, genuine inter-, trans- and post-disciplinary research is constantly forced to acknowledge, and to work with, tensions between ontological and epistemological frameworks, and is thus necessarily slow, compared to conventional single-discipline research processes.[12] In order to enable a reflexive ethos, and to keep open a space for critical inquiry in a context that favours 'outcomes' in terms of revenues and commodities, critical neuroscience will need to continue discussing structural transformations, and challenging the increasing dominance of market orientation in academia.

What Difference Can Critique Make to Neuroscience?

The metaphor of the *looping journey*—of that which is taken to be a 'brain fact'—can help to operationalise critique, opening up possibilities for thickening, or assembling, a given, brain-based phenomenon. Whether we focus on the neural basis of addiction, depression, adolescence, culture, gender,

morality or violence, the journey can be traced using multiple methodologies, from the point of a theme's entry into—and treatment in—the lab, through various technical and knowledge practices, to the interaction with the media and policy, to its reception by the public. What we mean by a 'brain fact' is not a thing-in-itself, but a specifically conceptualised phenomenon or 'local resistance' that emerges from the collective practices and directed cognition of neuroscientists working in a community at a given time and in a given context (see Choudhury et al. 2009).[13]

With this in mind, it is important to ask what difference do second-order observations of laboratory conditions, communities of scientists and historical and cultural contingencies make to neuroscientists themselves, whose goal is to develop and test paradigms that ultimately contribute to mapping social, cultural or perceptual processes on particular brain regions. Critical neuroscience renews the possibility for critical commentators to be engaged with, rather than estranged from, laboratory science. Functioning through the collaboration of work from multiple methodologies, it aims to find entry points for social theory, ethnography, philosophy and history of science, in the laboratory. In the following, we put forward ways in which the latter fields can play a contributory role in both the *practice* of neuroscience in the lab and in the ways in which neuroscience is constellated into broader socio-cultural formations and practices beyond the lab.

From educational initiatives for junior-level researchers to the development of collaborative working groups investigating behavioural phenomena from different disciplinary perspectives, critical neuroscience explores whether an ethos of reflexivity can, through interdisciplinary training, be inscribed into experimental practice. The aim here is not to conduct a purer or 'better' neuroscience. Instead, reflective practice includes social and historical contextualisation and cross-cultural comparison of behavioural phenomena, within neuroscience. Examining these contingencies will generate alternative possibilities for findings in neuroscience, which on the one hand opens up interesting empirical questions for neuroscientists, and on the other hand, functions as a form of critique from within.

How should we conceive of the relationship between first-order (descriptions of brain and behaviour) and second-order (descriptions of neuroscientists observing behaviour) observations (Choudhury et al. 2009; Roepstorff 2004; Fitzgerald and Callard 2015)? We believe engagement between these socio-cultural and historical studies and experimental neuroscience can be constructive in a number of ways:

(1) Demonstration of alternative possibilities of results of neuroscience experiments by modifying technical parameters or comparing and re(de) fining categories[14];
(2) Exploring routes to empirically investigate social and cultural phenomena without assuming universal neural mechanisms from the outset;
(3) Enriching behavioural theories by allowing for pluralistic viewpoints and methodologies to result in layered explanations of complex phenomena;
(4) Examining the subtle relationship and feedback loops between popular opinion or ideologies about the brain and findings in neuroscience.

Such goals can only be realistically achieved through collaborative work. Working groups, as initiated since the emergence of critical neuroscience, consist of the following.

Sociologists of science who observe communities of scientists and capture the thought styles that govern their cognition in studying the particular phenomenon in the lab (Fleck 1935/1979). Fleck described the 'tenacity' of systems of thought that govern scientific practices and explanatory styles, and that ultimately give rise to what from then on will count as fact. What solidifies a local resistance into a recognised 'fact'? By studying the journey of a phenomenon in and around the neuroscience lab, we can study how the methods, concepts and theories involved in the development of a fact of neuroscience may be culturally conditioned; in addition we can identify the refractory effects of the thought collective that sustain it and the wider culture in which it functions (cf. Dumit 2004, 2012). Neuroscientists are working at a time of unprecedented politicisation through the commercialisation of research (Wise 2006), and sociological analysis can highlight the pressures that commercial, pharmaceutical, and military interests place on neuroscience (Healy 2004; Moreno 2006). Moreover, sociologists can begin to draw cross-national comparisons of the social structures of neuroscience. Comparing the international contexts of trends in neuroscience research and its representation will help to spell out the logic of the neuro-industry, that is, the institutional, historical, political and ideological planes in which the rapid developments, the allure and the influence on cultural formulations and other academic disciplines take place, over and above the events within neuroscience per se (cf. Rose and Abi-Rached 2013).

Philosophy contributes the analysis of central phenomena under investigation (and their different, often competing, conceptualisations), for example, emotions or moral decisions. It also serves to clarify the content and status of notions such as determinism, reductionism, specificity and consilience—concepts that have been floated in neuroscience and its critiques for a while, and

require sharpening. Often, these and other concepts play key roles in what Hartmann (2012) calls the 'hidden hermeneutics' of the neurosciences: structural narratives that practitioners routinely employ as they describe their objects of investigation and construct interpretations of data, but that are rarely reflected upon explicitly. Ideas about 'cerebral subjectivity' (Vidal 2009) or the ubiquitous but often vague appeals to evolutionary theory are good examples (Richardson 2007); similarly the hype around the notion of cerebral plasticity (Malabou 2008), or heart-warming yet factually shallow stories about empathy, affective contagion and the social brain (Young 2012).

The task here is to elucidate a specific meta level: ascending from the manifest contents of theories, explanatory frameworks and core concepts in current neuroscience to the analysis of latent assumptions and formative backgrounds, such as the implicit construal of the brain as the stable ontological foundation of both personal traits and social and cultural phenomena (Slaby and Gallagher 2015), or the complicity of neuroscience-backed construals of human subjectivity with capital-driven appropriations of health, self-care or the 'neo-social' optimisation of human conduct (Slaby 2015). Philosophy might also contribute to enriching the description of phenomena under study through phenomenological investigations, for instance, by performing what has been called 'front-loaded phenomenology' (Gallagher 2003; Gallagher and Zahavi 2008; Ratcliffe 2008).[15]

Cognitive neuroscientists contribute to technical and conceptual analysis of research processes, including methodological assessments. What are the potentials and limits of specific methodologies or tools, such as fMRI and the associated statistical methods, and to what extent are these clear or made clear in different venues (Logothetis 2008; Vul et al. 2009; Gonzalez-Castillo et al. 2012; Miller et al. 2012; Stelzer et al. 2014)? Here, we have obviously seen a massive increase in the level of critical awareness and readiness to confront these issues within neuroscience over recent years.[16] Much work remains to be done, however. For instance, how are cultural, psychological, functional and genetic models of cognitive phenomena mapped onto each other (Turner 2012)? Which principles shall guide the determination of significance in neuroanatomy, that is, what standards to apply in parsing the brain into 'regions' (Haueis 2014)? Once a phenomenon enters the neuroscience lab, how do scientists break down the phenomenon into constituents that they are able to study within the constraints of their methodology (Dumit 2004, 2012)? What efforts are involved in setting up experimental apparatuses and stabilising the phenomena under study? How are the results analysed and evaluated in comparison to other data from different experiments? How can data—

quantitative and qualitative—from social science and humanities disciplines be brought to bear on the neurobiological results?

Cultural or medical anthropologists will draw on ethnographic field work to develop cross-cultural comparisons of behavioural phenomena or symptoms and experimental paradigms (tasks, questionnaires) that have largely been studied on—or standardised using—particular groups of subjects deemed to represent the 'norm' (Henrich et al. 2010).[17] Critical neuroscience draws on medical anthropology to supplement findings of neural correlates with phenomenological insights, biographical accounts of the person and the *meaning*—that is, the social, cultural, moral or spiritual significances—of behavioural phenomena, including mental illness and interventions (Cohn 2012). Critical neuroscience resonates with cultural psychiatry, in emphasising that the allegedly most 'fundamental' level, using neuroscience in its current form, is not necessarily the most appropriate either for explaining or intervening in psychopathology. While neuroscientists and medical practitioners increasingly invoke the use of neuroscience in psychiatric nosology and clinical practice (Hyman 2007; Insel and Quirion 2005), critical neuroscience works towards ways to understand how 'meaning and mechanism' intersect via the brain (Choudhury and Kirmayer 2009; Seligman and Kirmayer 2008).

The biosocial subfields of social and cultural neuroscience have indeed begun to investigate how aspects of cultural background may influence cognition, such as the expression and regulation of emotions and understanding of others (Chiao et al. 2008; Zhu et al. 2007). As this area of neuroscience burgeons, critical neuroscience aspires to contribute to the conceptualisation of culture in experimental design and interpretation, to explore how environmental factors, including cultural practices, habits and understandings, interact with the development of structure and function of the healthy nervous system in such a way that several vocabularies of description—social, cultural, psychological and biological—can coexist (Kirmayer 2006; Lock and Nguyen 2010).

Historians of science trace historical trajectories of the conceptual construals, models and modelling practices, interpretive contexts and experimental set-ups common to contemporary neuroscience (Foucault 1973; Hacking 2002; Young 1995; Borck 2012). Historical analysis can thus show how particular problems such as the criminal brain, post-traumatic stress disorder, the risky teen or the empathic female become questions for the neurosciences, and how particular methodologies are valued over others as allegedly more objective. Critical neuroscience will yield important insights from the history of concepts, modelling practices and the various trajectories of objects of scientific inquiry, to understand how technologies, political and moral contexts converge to give rise to

diagnostic categories, how aspects of the self have come to be objectified and considered in certain contexts as clearly reducible to the brain (Vidal 2009) and how scientific objectivity itself developed—and changed significantly—as an epistemic virtue (Daston and Galison 2007). *Longue durée* analysis can additionally serve to interrogate the air of radical departure that surrounds much of the rhetoric around neuroscience (Borck and Hagner 2001). Unpacking these histories will help scholars and researchers gain distance from the inflated, spectacular and brain-centric rhetoric which parts of the neuro-industry seem to dictate (Casper 2014; Stadler 2012, 2014); at the same time, historians of science are well equipped to also come to critical terms with the broader significance of the neuro-turn, including its more indirect but no less pervasive impacts on scholarship and academic work at large (Cooter and Stein 2013).

Conclusion

We have sketched a broad picture of a critical neuroscience that probes the extent to which claims *about* neuroscience do in fact match neuroscience's real world effects. Our approach sets out to analyse the allure and functions of the *neuro* in the broader scheme of intellectual and political contexts including the rise in recent years, of a new (neuro) 'biologism' in many academic disciplines and popular culture at large. Our aim is to contribute these observations from the human sciences to neuroscience so as to demonstrate the contingencies of neuroscientific findings and to open up new experimental and interpretive possibilities.

Assembling and broadening ontological landscapes of behavioural phenomena requires researchers to move beyond the nature-nurture distinction when conceptualising phenomena such as addiction, adolescence, autism or depression. Instead, critical neuroscience will work with concepts such as 'cultural biology' and 'local biology' which bring to the fore the co-constitutive relationship between the brain and its context.[18] The 'endorphin-challenged alcoholic', the 'neurological adolescent' or the 'female brain' is richly situated and sustained in habitats made up of interactions between institutional, cultural and neuronal infrastructures. Such a framework poses intellectual challenges to cognitive and clinical neuroscience—challenges that must be taken up, especially as the notion of neuroplasticity or the field of cultural neuroscience open up potential to investigate brain-environment interactions. We emphasise the need to rethink the conception and location of these borderlines at the skull or the skin in a way that troubles the arbitrary distinctions and moves beyond biological determinism and social constructionism

(cf. Fitzgerald and Callard 2015; Pitts-Taylor 2016). If fMRI can show that cultural upbringing modulates brain activity or new biotechnologies permit us to tinker with the brain and cognition, it is apt for neuroscience to acknowledge that human brains are represented in terms of cultural categories and that brains also do 'cultural work' in distinguishing what is natural, who is healthy, different, normal, rational (Lock and Nguyen 2010).

In general, then, work collected under the umbrella of 'critical neuroscience' undertakes explorations of the discursive space that is opened up once the outworn distinctions and dualisms are surpassed, and once constructive interaction between practitioners from different methodological universes is enabled. The critical ethos we invoke, therefore, is not one that rejects but one that aims to elicit change: both in how significant phenomena are explored within neuroscience, and in how the social implications of neuroscience are analysed. The conceptual changes involved in studying the situated brain in its context, the pedagogical initiatives that bring multiple traditions of scholarship into contact and the calls for contestation in neuroscience funding and application, all disturb boundaries—between the brain and its environment, between disciplinary vocabularies and methodologies, and between science and society. These interruptions will provoke us to imagine the brain in different terms and to probe its functions in alternative ways. Such changes—towards which we sense an increasing openness among neuroscientists and social scientists alike—will open up potential for a more realistic picture of the function of neuroscience in society while simultaneously commenting on the broader socio-political changes in contemporary societies that impact its developments, for better or for worse.

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Notes

1. Updated and extended version of Chapter 1 in *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, 2011, Wiley. We reproduce the material here with kind permission of the publisher, Wiley-Blackwell.
2. The more descriptive portions of this agenda overlap in part with the careful and competent work that Nikolas Rose and Joelle Abi-Rached have done in their seminal study *Neuro: The New Brain Sciences and the Management of the Mind* (Princeton UP 2013).

3. How these postmodernist tendencies might have rendered explanations that invoke 'social influences' less common and less valued in STS is helpfully discussed by Forman (2010).
4. This goal would take as a premise that the brain and nervous system are nested in the body and environment from the outset and that their functions can only be understood in terms of the social and cultural environment (Choudhury and Gold 2011). For the more general background to this perspective, see Protevi (2009).
5. This might be one reason why critique of scientific and medical malpractice and corporate influence has recently been more a business of journalists, popular writers and non-academic intellectuals than of professional STS practitioners (recent examples: Fine 2010; Greenberg 2010; Watters 2010).
6. We refer here to the puzzlingly moderate final remarks in Nikolas Rose's *The Politics of Life Itself* (and echoed again throughout Rose and Abi-Rached 2013). Rose's proclamation of neutrality at the end of that work is surprising in face of the many blatantly critique-worthy developments he had charted so rigorously throughout his book.
7. Here critical neuroscience preserves what could be called historical solidarity with the project of critical theory: the similarity lies in the attempt to move beyond sporadic interventions towards a theoretically integrated account of an assumed system of normative assumptions, interpretive patterns and material conditions that jointly stabilise, on the scale of society or significant segments of it, a tacitly pathological status quo. The term 'theory' in critical theory is no accident (Geuss 1981; Honneth 2009).
8. Take for example the UK Foresight Project's definition of 'well-being': 'Mental well-being, […], is a dynamic state that refers to an individual's ability to develop their potential, work productively and creatively, build strong and positive relationships with others and contribute to their community' (Beddington et al. 2008, 1057).
9. Besides Cooter and Stein's (2010) refreshingly explicit political positioning, we have been inspired by the rigorous critical and scholarly stance of historical of economics Philip Mirowski. Especially his paradigm historiography of cybernetic's influence on contemporary economics (2002) would deserve a separate discussion, as there is much overlap with the formative developments that have led to the present-day shape and impacts of the neuro-cognitive sciences.
10. We take up Honneth's notion in a rather loose manner, divorcing it from the specific context of a theory of rationality implicit in approaches to 'critique' from a Frankfurt School perspective.
11. The most optimistic voice in this area has been German sociologist Ulrich Beck (see, e.g. Beck 1997).

12. Since we first wrote this chapter, Des Fitzgerald and Felicity Callard have done excellent work on the prospects and pitfalls as well as conceptual and practical backgrounds of interdisciplinary cooperation between neuroscience and the humanities and social sciences. They also helpfully focus on the issue of experimentation (see Fitzgerald and Callard 2015).
13. We use the notion of a 'brain fact' analogously to Ludwik Fleck's conceptualisation of a scientific fact in his seminal study *Genesis and Development of a Scientific Fact* (see Fleck 1935/1979). On the looping journeys of scientific facts in the context of neuroscience see also Dumit (2004).
14. This is an example of how neuroscience itself can be used to subvert its own assumptions and demonstrate the contingencies of categories and methodologies it employs, a move we have called 'experimental irony'. Margulies (2012) illustrates the power of this strategy of critique 'from inside' through a review of the famous study by Bennett et al. (2009) that used a dead Atlantic salmon in an fMRI scanner to highlight the high possibility of red herrings in brain imaging research.
15. Of course, philosophy—as a specialised domain of *philosophy of science*—also contributes directly to the methodological reflection, analysis and critique of neuroscientific research practice (see, e.g. Klein 2010; Haueis 2014).
16. This is one of the areas where the situation has changed to a notable extent since we first articulated the programme of critical neuroscience, and since the first version of this chapter was published in 2012. In this respect, then, we have seen a considerable gain in self-reflective awareness as part of neuroscience's professional outlook. It is much harder to get methodologically suspect studies published these days then it was, say, 10 or 15 years ago, although many problems still remain. Stelzer et al. (2014) review a lot of the work that has been published around and after the time our first critical neuroscience publications were written.
17. In their landmark comparative article, Henrich et al. (2010) use the acronym WEIRD to denote the White, Educated, Industrialised, Rich and Democratic societies that behavioural science researchers take to be 'standard subjects', in spite of the considerable heterogeneity across populations taken to be groups, and in spite of the fact that so called WEIRD populations are frequently *unusual* or *outliers.*
18. Besides the increasingly prevalent understanding of 'biosociality' as a fertile perspective in various fields (Meloni et al. 2016), we also consider the more critical perspective of 'biocapital' as highly relevant here. Where the concept of biosociality operates on a fairly broad and neutral plane, 'biocapital' hints at the quite direct—and often problematic—*economic* appropriation of biological materials, biological knowledge and biology-informed ethical outlooks (see Sunder Rajan 2006; Cooper 2008).

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