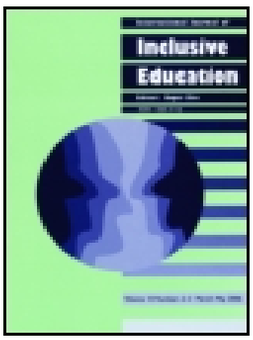

International Journal of Inclusive Education

ISSN: 1360-3116 (Print) 1464-5173 (Online) Journal homepage: http://www.tandfonline.com/loi/tied20

Educational inclusion and critical neuroscience: friends or foes?

Tom Billington

To cite this article: Tom Billington (2017): Educational inclusion and critical neuroscience: friends or foes?, International Journal of Inclusive Education, DOI: 10.1080/13603116.2017.1283717

To link to this article: http://dx.doi.org/10.1080/13603116.2017.1283717

INTERNATIONAL JOURNAL OF INCLUSIVE EDUCATION, 2017
http://dx.doi.org/10.1080/13603116.2017.1283717

Routledge
Taylor & Francis Group

OPEN ACCESS

Educational inclusion and critical neuroscience: friends or foes?

Tom Billington

School of Education, University of Sheffield, Sheffield, UK

ABSTRACT

Momentum is continuing to grow in the circulation of neuroscientific discourse, informing aspects of how we live but affecting too how we think about education and learning. Neurologically informed intrusions into education frequently align with psychology which has until now largely adopted a 'medical model', supporting policies and practices which ultimately invoke psychopathology and arguably render individual young people more vulnerable to various forms of social and educational exclusion. This paper urges caution in respect of understandings of educational neuroscience that focus on individual deficits and diagnoses. Rather it holds in mind the broader historical context for neuroscience and its implications for our understandings of what it is to be human in the twenty first century and thereafter for education and learning. Theoretical resources from critical and affective neuroscience but also critical educational psychology are brought together specifically to support the principles of inclusionist policies and practices in education.

ARTICLE HISTORY
Received 19 July 2016
Accepted 30 November 2016

KEYWORDS
Inclusive education; critical and affective neuroscience; critical educational psychology

The emergence of a 'neuro-' world

The twenty first century has been popularly referred to as the 'century of the brain', evidenced by major initiatives such as BRAIN in the United States (White House 2013), which was a Presidential focus on gaining an understanding of the human brain, and by the €1.19 billion Human Brain Project (2012) which is being funded by the European Union. The vast resources martialed in the pursuit of knowledge concerning our most mysterious organ suggest that we are approaching a moment in history when age-old philosophical questions about human mind could finally be resolved. Given the 'increasing asymmetries in funding between the neuro- and social sciences' (Kraus 2015, 101), it is presumably imagined that any answers will be provided by a particular kind of scientific endeavour (i.e. positivist). Neuroscience is being bankrolled by governments to provide these answers supported by an array of institutional shifts and networks (OECD 2002), for example, the Society for Neuroscience regularly boasts attendances of over 30,000 at its annual conference. This paper is a response to the extraordinary growth but is written specifically for researchers, policy-makers and practitioners who are committed primarily to the principles of educational and social inclusion.

While this is an exploratory theoretical paper, its motivation and methodology stems from consideration of both research and practice. The increasing significance of neurologically informed discourse in relation to human development and education has been apparent for some years when supervising research students and trainee psychologists and teachers at the University and also in the requests for advice and training received from schools and Education Authorities. Additional impetus for the paper, however, comes not only from an emerging literature in both affective and

CONTACT Tom Billington t.billington@sheffield.ac.uk

critical neuroscience but also from fieldwork experience, gained initially as a secondary teacher and subsequently for many years as a psychologist working at the boundaries of exclusion with schools, families and in the family courts (Billington 2000, 2006). Neuro-discourse has been on the increase in each of these settings.

Neuroscience introduced itself into education and educational psychology in accordance with a cognitivist paradigm and began to distill a knowledge about the brain, as it were, in order to educate the educators (Goswami 2004; Blakemore and Frith 2005). There have been special editions – *Journal of Philosophy of Education* (Cigman and Davis 2008), *Educational and Child Psychology* (Cole, Resing, and Gibbs 2016) – and new Journals too – *Educational Neuroscience*, *Mind, Brain & Education* – while claims are made in education training packages concerning the neurological basis for all learning and behaviour (e.g. Jensen 2008; Kelly 2016) together with a range of registered products and commercial teaching materials.

In the UK, the Royal Society, aware perhaps of both the opportunity and the concerns regarding the expansion of the new science, attempted to bring some order to the fast-emerging field of education and neuroscience, drew attention to some of the risks involved and made recommendations (*Brainwaves Module 2: Neuroscience – implications for education and lifelong learning*, Royal Society 2011). While there had been earlier reports linking education and neuroscience, for example, the *Blue Brain Project* (EPFL 2005), the *Brain Waves* reports were seminal in mapping out the potential future impact of neuroscience upon education. Interestingly, however, the core principle cited in the second *Brain Waves* report recommended that 'knowledge needs to go both ways' (RS 2011, 33), not just from neuroscience towards other disciplines but from those disciplines back into neuroscience. The authors extolled the virtues of finding a shared conceptual space, in particular, a 'common language and bridge between educators, psychologists and neuroscientists' (RS 2011, iii), and of a 'better knowledge exchange between scientists and practitioners' (RS 2011, 1). The ways in which this common language was to be achieved and in which language and ideas might flow the other way, from educational practitioners and policy-makers to neuroscience, were not explored, and although there have been attempts to mediate (Howard-Jones 2008; Mason 2009) there are likely to be many educators and social scientists who are wary of accepting an *a priori* biological or cognitivist brain discourse (Bruer 1997; Davis 2004).

Neuroscientific discourse is permeating many areas of social life and it can be argued that its widespread distribution is beginning to threaten the range of means by which we can represent or conceptualise 'human'. There is a power invested in neuro-knowledge which is infiltrating socio-cultural forms of expression and beginning to challenge any opposition. At its most extreme, it is becoming possible to conclude that other means of representing 'human', in spaces free from neurological discourse, are diminishing and that all counter-discourses will be de-stabilised. Resistance might almost seem futile in the face of an inevitable and determinist imperative that we are nothing but brains with the eventual consequence in the social sciences that 'the prefix neuro- has won its final battle … it has conquered critique itself' (De Vos and Pluth 2015, 22). It has been suggested that the ways in which neuroscientific discourse potentially undermines other forms of knowledge might constitute a wider social danger, for example, by restricting agency in the area of social justice with serious consequences for our understanding of educational inclusion. The power of neurologically informed accounts of the person could even be a 'threat to civic society' (De Vos 2016a).

Despite the growth of neuro-discourse, however, 'brain-based' approaches to learning are still struggling to gain widespread purchase in educational practice beyond the by now customary preface 'neuroscience tells us [this or that] … ' which is becoming a regular feature of service and practitioner training. I argue that any reluctance on the part of educators to accept such materials is well-founded since it is difficult so far to pinpoint individual 'discoveries' from neuroscientific research relating to learning, behaviour or education for which the underlying concept or principle has not already been articulated or established elsewhere in the history of human or social science, for example, in biology, psychology or sociology or indeed philosophy or educational research. Neuroscience in education currently seems merely to be corroborating or responding to extant discourse.

The power of its gaze on all forms of human difference, however, relating to learning, behaviour and special educational needs suggests that neuro-discourse is being circulated, not in any neutral way but on the basis of a politically sanctioned authority which allows it to insert a particular personality within an expanding sphere of influence (Rose and Abi-Rached 2013). One of the most significant challenges to the incorporation of neuroscience into education, however, comes from members of the neuroscientific community itself who have expressed concern about the mis-application of neuroscientific research (Rose 2006; Kirmayer 2012). In particular, some neuroscientists point to the massive leap which is necessary currently to extrapolate from the results of laboratory-based studies focused on one micro element of brain chemistry to, for example, effective practices in learning and teaching on a particular Monday morning in one busy junior school in Anytown (Johnston 2015; Kraus 2015). The chasm between, on the one hand, the conditions in which the research is performed and on the other hand, educational practice, makes it impossible to ensure that the scientific rigour and standards of proof achieved in laboratory conditions can withstand the journey to the context of busy schools, classrooms and messy social relationships (Howard-Jones 2011). The results of highly complex research studies are being squeezed into popular media accounts (Daily Mail 2014, 2014a) and there is a concern as to the ways in which neurological representations are being used to create and define 'human' based on results acquired in sterile experimental and ultimately asocial conditions. Such models of the human are beginning to impact political agendas outside the laboratory, 'Neuroscience is increasingly being called upon to build prescriptions about how to live' (Choudhury and Slaby 2012, 5) and are encouraging a scientistic approach to the social (Latour 1979).

The relationship between education and neuroscience is being negotiated (De Vos 2015) and this paper explores ways in which as educators we might either embrace or resist the theories or dominion of the neuro-world in education. Of course, any decision in this respect will not be one for educators alone to make since social science critique, including that directed at the neuro-phenomenon, will attract opposition, not least, political since 'Any vision of the brain is necessarily political' (Malabou 2008, 52).

While I have sympathy with the view that neuroscience potentially constitutes what might seem merely to be the latest re-incarnation, firstly of medicalised discourse in education (Furedi 2004) and secondly of an ideological rationalism, the 'dominant Western tradition that reveres cerebral learning' (Trowsdale and Hayhau 2015, 1022), I argue that whether as educators or psychologists we need to articulate our positions relating to any proposed 'flow of ideas' and assess what kind of common language with neuroscience is either possible or desirable. Uniquely, the paper combines theoretical resources from affective and critical neuroscience and also critical educational psychology in order to re-define the conceptual landscape but also to alert policy-makers and practitioners to potential threats being posed to educational inclusion.

Education and psychology

We could be forgiven for thinking that we have been here before since for over a century now educationalists and psychologists have enjoyed fluctuating relationships, at times mutually supportive, at other times tentative or even dismissive of the other. Educational (or school) psychology in practice can be regarded with deep suspicion by some educators, especially by those committed to inclusive practices. Any caution will be due, at least in part, to the history of educational (school) psychology theory and practice which, it could be argued, has contributed to processes in which generations of children and young people have been excluded from various arenas of mainstream educational life (Chitty 2007). This power and influence was achieved through the distribution of medicalised discourses of human difference which rely on explanations provided by psychopathology (Billington 1996).

Psychologists are not solely to blame for such practices, of course, especially given the shared history of psychology and education (Rose 1988). Institutional forms of both western education and

psychology were forged during the same period of human history and with the emergence of mass schooling have since frequently occupied the same social arenas. William James, for example, influenced both emerging institutional forms in the United States and taught many of the first generation of American psychologists and educationalists, including John Dewey whose instincts, whether as philosopher, psychologist or educationalist, were as a social reformer dedicated to a liberal, progressive education agenda (1897). Dewey took a particular kind of psychology into the classroom, one which demonstrated a democratic commitment (1916), emphasised a concern for moral and social issues and considered as important the experiences of individual child learners (1938). These approaches have continued to provide succour for many educators and psychologists, both researchers and practitioners. More controversially, Binet would perhaps have been horrified had he known that his work (psychological tests relating to particular constructions of learning and intelligence) would contribute to policies and practices which for decades would support the removal of young people from their schools on an industrial scale.

Both psychology and education in their institutional forms became absorbed by the 'modern', a project in which psychological science offered simultaneously both to individualise and to homogenise all human functioning as part of an underlying commitment to progress. In UK education such a project was embodied in the work of Cyril Burt whose ideas reinforced segregationist education policies and practices for much of the twentieth century by focusing on:

(1) a scientifically inadequate basis for conceptualising human intelligence
(2) a genetic hereditability as the single most important variable in human learning and development virtually to the exclusion of all others
(3) an intrinsically eugenicist approach which generated and supported what we can now see as racist, sexist and able-ist theories of the human being (Billington and Williams 2015).

Given the power of discourses relating to intelligence and hereditability and given also the ways in which they continue to justify many forms of educational and social exclusion, caution is understandable when contemporary governments are similarly seduced by the claims of a new science which promises finally to reveal simple biological 'truths' about learning, behaviour and education with 'neuro-' replacing or re-invigorating the old 'psycho-'.

The relationship between neuroscience and psychology is embryonic but it is likely that psychology will bolster its authority by offering itself as interlocutor between neuroscience and education especially since 'It is psychology that is mapped onto the brain, it is psychology that provides the pencils with which the brain is colored' (De Vos 2015, 25). The 'pencils' chosen to colour neuroscience, psychology and education, however, tend to be selected from the same palette of an experimental positivism responsible for many prevailing accounts of human difference which have been used ultimately to police the boundaries of difference and to sustain exclusive practices, social and educational.

Education and psychology share histories in which, to varying degrees, both have accepted medicalised discourses of the person, invariably in the form of psychopathologies, which have come to restrict the available ways of conceptualising and responding to forms of human difference in our schools and more specifically within special educational needs. Education and psychology have often worked together to propagate such approaches in a shared commitment to constructing assessments of young people which rely, for example, on unproblematic understandings of ability and normalcy (Goodley 2014). Yet it is nearly a century since a report into the place of psychological testing in education first urged caution, recognising that young people were being subjected to 'hasty and crude methods … the whole problem has proved far more intricate than was at the outset assumed … ' (Hadow 1924, 60). Nearly a century later, there is a danger that neuroscientific discourse is infiltrating education in order merely to reproduce in different guise the inner personality of theory and assessment practices already embedded in existing psychological discourse in education. Technological developments may be breathing new life into old practices and merely continue to locate deficit in

the form of inadequate and incomplete representations of individual young people. The utilisation of neuroscientific research and practice in education might well owe less to new scientific insights or 'facts' about learning or behaviour and more to issues of governmentality. Neither psychology nor education has ever been apolitical and the politics of inclusion needs to be vigilant in respect of the inclinations of the new science.

Education and affective neuroscience

'Neuro-' knows few boundaries and it is unsurprising, therefore, that there are counter neuro-discourses which themselves offer resistance to discriminatory practices in psychology and education which fuel the processes of social exclusion. There are neuroscientists who, for example, reject the kinds of incomplete versions of persons generated by reductionist discourses of deficits and who are attending to those more complex notions of human experience, emotions and personhoods previously evoked by James and Dewey:

> Insofar as behaviour arises from neural events and both cultural and genetic factors influence neural events, a comprehensive understanding of the nature of the human mind and behaviour is impoverished without a theoretical and empirical approach that incorporates these multiple levels of analysis. (Chiao and Cheon 2012, 290)

One such additional layer of analysis provided by neuroscientific research which has gained popular attention in recent years has focused on the emotionality of neural events. For decades, theories from cognitive psychology had been translated into educational policy and practice in ways which encouraged teachers and psychologists to consider thinking and learning as intrinsically linear, wholly rational and as hermetically sealed within isolated individuals. Some neuroscientists now see this model of cognition as inadequate, however, initially due to its inability to contemplate the complexity demanded by consideration of emotion. Antonio Damasio recognised 'the scientific neglect of emotion in the 20th. century' (2000, 39) and is one of many neuroscientists whose research focuses on the importance of emotion and feelings in the mental life of persons, asserting that experience is not only inseparable from other forms of cognitive activity but intrinsic to thinking itself, 'input into the brain generates an experience and, next, by using the experience so generated to form concepts … ' (Zeki 2007, 35).

Simultaneously in the social sciences, Gardner (1983) and Goleman (1995) were extending cognitivist conceptualisations of intelligence and learning, impacting upon educational policies and practices. Social and emotional aspects of learning became fashionable (DCSF 2007) and in the UK there followed other attempts to introduce nurture, well-being, therapeutic or mental health discourse into education (Boxall 2002; HM Treasury 2003; DoH 2015). Such trends have become subject to critique (Ecclestone and Hayes 2008) but the models of learning and intelligence which dominated cognitive psychology and education in the last century are being challenged by affective neuroscience, 'cognitive science is really a science of only part of the mind … it leaves emotion out. And minds without emotion are not really minds at all … ' (Le Doux 1999, 25).

Affective neuroscience has significant implications for both psychology and education since it can undermine the foundations of those Enlightenment sciences which had failed to generate experientially focused models of research and practice. With a few rare exceptions which are invariably consigned to the margins of educational practice (e.g. phenomenology, philosophy and psychoanalysis), the failure even to acknowledge experience had contributed to the de-ontologisation of the human and social sciences, as theory and research struggled to gain purchase on the 'essence of the experienced things' (De Kessel 2015, 11; also see Corcoran 2016). Damasio and other 'affective neuroscientists' have not only expanded conceptualisations of the cognitive to include emotion but have upset the consensus on the nature of the mind-body schism upon which rationalist human and psychological sciences had been based for 300 years

(Gallagher 2005) and have actually proposed a reversal of the causal link between thinking and feeling (Immordino-Yang and Damasio 2007).

The neuroscientist Joseph Le Doux conceptualised a model for the processes involved in thinking and feeling, arguing that our internal states are, in a primary way, provoked by external stimuli which trigger what he regards as emotional responses (1999, 164). Le Doux suggests firstly that the world outside affects our inner world in a primary way and secondly that multiple possibilities are then created for the inter-connectedness and interpenetration of our thinking and feeling within – in a vast and complex re-configuration of the cognitive. Notwithstanding the conviction of the research, however, let alone the impressive technological resources involved in neuroscientific research, there is a danger that the knowledge of educators will once again be usurped (Mintz and Wyse 2015) for what teacher would not already have known that a child's learning and behaviour in the classroom are affected by a whole host of external factors? What teacher would not have known that the performance of any child (or adult for that matter) is affected by the way they are feeling in relation to their particular social, cultural or economic circumstances?

Challenges have emerged from within neuroscience to the notion of a mechanistic cognitivism which fails to acknowledge emotion, and these ideas de-stabilise the linear, determinist models of mind and behaviour which have continued to pervade research and practice in education and educational psychology. Discourses of feeling and thinking being generated by affective neuroscience seem helpfully to tolerate a dynamic relationality in the phenomena of persons and these complex representations are creating a space for a more ontologically literate model of the human which could refute the mechanistic cognitivist- and rationalist-saturated vocabulary used to support expedient anti-inclusionist practices in education (Corcoran 2009).

While affective neuroscience has been developing theories which challenge dominant discourses of thinking, learning and intelligence, critical neuroscience takes a further step beyond positivist assumptions in order to preserve and generate other alternative resources for the ways in which we can think and talk about persons. Critical neuroscience lifts the neurological or psychological veil to reveal the latest political challenge posed to social and education inclusion.

Critical neuroscience: supporting inclusive practice

Of mind, brains and bodies

> 'Mind is a process not a thing … ' (Damasio 2004, 183).

It has been argued elsewhere that psychology's success during the last century was achieved through the development of a range of technological products for market consumption (in the form of assessment batteries), the purpose of which had been to make populations and persons more manageable, inserting government into their lives through the creation and application of statistical algorithms (Billington 1996). Contemporary neuroscience, however, is being constructed upon new technologies of which previous generations of psychologists and scientists but before that philosophers and scholars could scarcely have dreamt. It is these technologies which promise, finally, to reveal the mind … or perhaps not, since neuroscience has not actually located mind, just brains, the visceral goo of flesh and matter.

There is invariably a slippage between mind and brain in populist neuro-discourse and the terms can become synonymous. A study of brains takes us logically only to biological studies of the three-pound organ inside the head, of course, while mind has yet to be located so conveniently, ' … mind may need the brain but it is not reducible to it' (Rose 2012, 57). Mind continues to elude modern neuroscience existing as it does beyond the physiological parameters of brain, and thus continues to trouble the contours of positivist scientific practices and procedures, itself not a new concept (Ryle 1949). A dissatisfaction with a purely rationalist scientific study of persons has caused some neuroscientists to look outside their discipline, for example, Antonio Damasio writes of his own

recourse to the seventeenth-century philosopher whose hypotheses, if acted upon, might yet lead to a very different kind of scientific study of the human:

> Spinoza's insight … mind and body are parallel and mutually correlated processes, mimicking each other at every crossroad, as two faces of the same thing … his insight was revolutionary for its time but it had no impact on science … . (Damasio 2004, 217)

Damasio does not conclude that a scientific examination of brains is futile but recognised that Spinoza and, centuries later, William James too, had a vision of a science of the human which could not be captured within a too tightly constrained notion of brain functioning, 'Psychology is the science of mental life, both of its phenomena and their *conditions* … the faculty does not exist absolutely, but works under *conditions* … ' (James 1890, 1–3).

The particular 'conditions' considered by James to be crucial when attempting to comprehend mental life demand a sensitivity both to environmental and social variables which cannot be replicated within the laboratory. Perhaps the European Human Brain project foresaw the limitations of laboratory-based experimental studies when applied to what are intrinsically interactional spaces when it opted controversially for a computational rather than an experimental research model (Dumit 2015). It is the Jamesian 'conditions' for brain/body functioning which are considered by some neuroscientists to present confounding variables when contemplating the developing brain and indeed its relationship with the mind; 'the brain is not the sole producer of the mind but [is] a relational organ that mediates the interaction between the organism and its complementary environment' (Fuchs 2012, 341). Without dwelling on the implicit hierarchy of knowledge within their position, the Royal Society too hinted at this complex possibility within the project of neuroscience, 'A neuroscience perspective recognizes that each person constitutes an intricate system operating at neural, cognitive and social levels with multiple interactions taking place between processes and levels' (RS 2011, 8).

Representations of brains are thus changing and increasingly it is not only their corporeal but their dynamic and relational qualities which are enabling understandings of the ways in which brains both influence and are influenced by a whole range of environmental circumstances, 'non-neural factors have an influence on neural factors and vice-versa, since the system in question is brain-body-environment' (Gallagher 2012, 91). Such properties make it problematic to contain the study of brains in isolation and the sheer volume of variables both inside the body and beyond the skin make it difficult to apply reductionist conclusions about either brains or their capacities for learning in intrinsically relational contexts, for example, in school classrooms. The Enlightenment experimental model, while highly successful in the laboratory, can fail to take into account the complex relationship between the brain and its 'conditions' due to a 'Methodological reductionism … [which] always risks losing sight of the crucial phenomena to be explained' (Kirmayer and Gold 2012, 309). This problem was perhaps again identified by the *Human Brain Project* in its acknowledgment of the difficulties when attempting to 'bridge the enormous gap between microscopic and macroscopic neuroscientific evidence (such as from single-cell and fMRI studies)' (Haueis and Slaby 2015, 119). The neurobiologist, Steven Rose, hints at the methodological problems which arise should the spectacular results achieved in the laboratory be applied simplistically or inappropriately to social worlds, 'the genome is a linear and stable sequence, the brain a dynamic structure organized in three dimensions of space and one of time' (Rose 2012, 55).

While the Royal Society again suggested a more complex link between our biological and social lives, 'genes can be turned on and off by environmental factors such as diet, exposure to toxins and social interaction' (2011, 2), some popular neuro-discourses seem merely to revert to older attempts to garner knowledge about the brain and Rose (2006) and others (Davis 2004) illuminate simple errors that arise when neuro-discourses rely on a biological essentialism (e.g. 'we are our brains'), apply simplistic evolutionary mantra ('survival of the fittest') or generate accounts which owe more to early nineteenth-century phrenology (reductionist modular accounts of brain functioning). The kind of science necessary to identify microscopic neural elements will not necessarily work when

directed at whole brains or persons since the multi-dimensional nature of persons gives them '… properties that are not present in their components' (Kirmayer and Gold 2012, 312).

A critical neuroscience, therefore, begins to open up spaces in which as teachers and educators we can retain our own ontologically informed authority in understanding and supporting young people in their learning. Teachers possess expertise in teaching and learning but also many years' commitment and experience of sharing their lives with young people in classrooms, experience which has a value beyond the scope of predominant forms of educational or psychological evaluation. Teachers (and psychologists) spend their lives neither with brains nor with neural properties but with persons.

Learning

Arguably, psychology has continued to make serious (and scientific) errors when intruding into education by permitting confusions to occur between specific categories and the life of the person (Hacking 1975; 1995) and critical neuroscientists are alerting us to similar possibilities within the application of neuroscientific thinking, 'the brain cannot stand in for the person' (Kirmayer and Gold 2012, 315). There is a need in education, therefore, to maintain the distinction between neuroscientific (or indeed psychological) discourse and the individual young persons with whom we work; 'scientific analysis and explanation must respect the ontology of their objects, which is something that must be taken into account in the conceptual framework used to study them' (Reynaert 2015, 63).

It is schools, homes and communities which provide the Jamesian 'conditions' within which brains or, rather, young persons live and grow. Damasio, Le Doux and other affective (Panksepp 1998) or neuroesthetic neuroscientists (Zeki 2007) do not easily side-step the importance of such 'conditions' nor too do accounts generated within other sub-fields, for example, in neuropsychoanalysis (Solms and Panksepp 2012) or phenomenological neuroscience (Prtevi 2009; Rowlands 2010). Common to each of the above is the generating of neuro-discourses which acknowledge not only the complexity of the 'conditions' for mental life but also the irreducibility of persons to brain. These positions again open up spaces in which as educators we can engage with young persons and their learning on the basis of a potential change which can be achieved, not by focusing either on the brains or any purported deficits but by insistently altering or constructing the 'conditions' in which the young person is expected to function and learn (Gergen 2009). The thesis here, therefore, goes beyond acknowledging that brain development and learning are linked to environmental factors. Rather, it exposes the complexity of the processes inherent in learning, and more boldly proposes that changes to the social environment could in effect lead to neurological change; 'changing the social world … may change the brain … ' (Kirmayer 2012, 379). This is clearly a more radical and political step which would challenge simplistic attempts to locate deficits solely in individual persons.

While educators may not have articulated learning processes in precisely this way in relation to brain functioning, once again, the underlying principle would come as no surprise to many classroom teachers. The most effective way of achieving long-term gains in learning and behaviour for all young persons is to ensure that the conditions for learning are in place, for example: the positive relationships between teachers and the young people; the expectations and commitment of school staff; the fabric and the organisational structures within the school; the relevance of the curriculum; the shared values; but outside the school, the coherence, vibrancy and hopes of the local community.

Just as affective neuroscience could be seen to provide resources to support inclusionist positions it provides other helpful discourses relating to a dynamic process model of learning. The concept of brain plasticity, for example (Rees, Booth, and Jones 2016), focuses on the brain's dynamic properties for adaptation and change and in so doing challenges a straightforward biological determinism (Kraus 2015). Discourses of plasticity challenge portrayals of brains as possessing fixed, innate characteristics which are pre-determined to follow an inevitable path in the psychological life-course from birth, characteristics which we might be invited to conclude are necessarily resistant to

significant change; 'neuroplasticity allows the brain to continuously take account of the environment' (RS 2011, 2).

While there will be serious neurological traumas affecting some individuals (Satanario 2016), neuro-discourses circulating around brain plasticity offer a more dynamic approach to the conceptualisation of learning by demanding that brain development for the vast majority is considered as an interactive process which is responsive to particular environmental conditions and human experience. The messy interplay which occurs between individuals and their social circumstances, the 'hybrid ontology of nature and culture' (Raikhel 2012, 229), opens a space in which, again, as educators we need not be paralysed but can be emboldened to act, not by replicating deficit or other partial accounts of individuals, but again by focusing on the 'conditions' necessary for young people to achieve learning and change in complex social circumstances.

Brain plasticity, 'connectivity' and 'co-operativity' are all potentially progressive discourses found in neuroscience literature which challenge linear Enlightenment models of causation and change and they support educators in attempts to hold on to more complex, dynamic models of learning, for example, 'learning involves the strengthening of synaptic connections between neurons … cells that fire together, wire together … ' (Le Doux 1999, 213). Learning is again here being conceptualised as dynamic and relational, re-affirming possibilities based not on a model of mono-linear causation, but on highly sophisticated processes which provide a 'long-term potentiation … co-operativity between … pathways … ' (Le Doux 1999, 217). Such discourses provide dynamic, relational and interactive accounts of the brain and its potential for learning but crucially they also demand representations which are inherently social; 'The human brain is fundamentally a social brain … ' (Slaby and Choudhury 2012, 34).

While these neurologically informed discursive resources can lead to critical positions, however, we already possess centuries of evidence to support the notion of process-oriented, social models of learning. The importance to learning of environmental, relational or specifically social circumstances has been recognised after James and Dewey by psychology (e.g. Vygotsky 1978; Bruner 1986; Dweck 2006; Burman 2008) and education (e.g. Freire 1972; Lingard, Nixon, and Ranson 2008; Slee 2010; Allan and Harwood 2013; Daniels et al. 2013). If the conclusion again is that neuroscience is not actually saying anything fundamentally new, what is happening when it is being inserted into educational discourse?

Neurotechnology: brain imaging and the pursuit of normalcy

Neuroscience gains its authority not just through its adherence to a particular kind of preferred scientific activity but because of its appeal to market forces and their thirst for technological innovation. A new age of digital and computerised technologies is opening up new vistas in which micro-elements of our brains and bodies can be observed, for the first time inside the skin – computerised axial tomography (CAT scans), positron emission tomography (PET scans) and functional magnetic resonance imaging (fMRI) – which can sometimes be reduced to glossy magazine images claiming to reveal the normative infant, adolescent, ADHD or autistic brain or even the brain of a normative abused or neglected infant. Process, complexity or messy environmental confounding variables are notoriously difficult to capture or replicate, not just within clinic- or laboratory-based experimental studies but in still photographs and are overlooked by the shorthand demanded by the popular snapshot representation. Thus the question arises as to what exactly are we being encouraged to see and conclude when looking at such images?

The actual science on offer in brain images may not only be misleading but could be in danger of crudely repeating old mistakes, 'An uncritical use of new imaging technology may open the door to a new kind of old fashioned phrenology … ' (Bao and Pöppel 2012, 2144). A critical neuroscience argues that simplistic imaging accounts, while feeding media frenzy and public fascination, can ignore the ways in which scans can show, not a category, but a brain which works differently, solves problems in unusual ways or which uses particular areas of the brain differently (Timimi, Gardner,

and McCabe 2010). Importantly, there would often seem to be a lack of proof as to whether any neurological differences observed are temporary or permanent, or whether they are a cause or an effect of, for example, a particular behaviour or environmental circumstance.

The images of brains in popular culture are not actual brains; they are representations, and as such they are texts which have been produced and which can be read for meaning in much the same way as this paper and thus subject to certain principles for reading and interpretation. Popular images of brains are representations which are the products, not just of a scientific investigation, but of a creative partnership in which algorithms of brain functioning are transformed into media or even artistic artefacts. Even before any critique of the scientific content, therefore, it is necessary to scrutinise the technologies and techniques used to create particular representations of brains which are just that – mere 'images … [which are] consciously selected to enhance the textual argument' (Dumit 2012, 219).

Critiques suggest that there are problems at every step of the process when producing brain images and that they potentially reveal more about the structures, systems or people producing the research than about the intended experimental subject, 'during the design stage, the basic terms of human nature are always built into the experiment' (Dumit 2012, 204). It is not just the fault-line between actual brains and the means by which those brains are represented that provides a space in which ideas about the human can be inserted, for the experiment itself will have been constructed upon ideas shaped not by any neutral science but by the cultural, economic and political discourses securing its authoritative voice. A danger for educational inclusion inherent in an uncritical appreciation of brain images is that it will merely enhance the processes and procedures of psychopathologisation; 'the textual manipulation of imaging texts, if without challenge, can permit an otherwise untheorized collapse from scan to diagnosis … ' (Dumit 2012, 221).

The tendency of the technology is towards normalcy and therefore to 'reveal' the disordered brain, to create models of persons in the form of categories and according to a notion of the ideal human which is just as much a cultural project as a scientific one. Neuroscientists and psychologists find themselves once more influencing policies and practices by creating definitions of normal which, rather than science, constitute 'a physiological and a social judgment' (Dumit 2012, 200). There are concerns in any studies which attempt to find 'normal' whenever in the sampling they fail to take into account, for example, 'such characteristics as age, ethnicity, handedness, culture (refugee status), sexuality, familial histories, past head trauma, and medical history [which] are all still unknown confounders … ' (Dumit 2012, 201). Dumit concludes that many neuroscientific studies are fatally compromised since

> there are so many different definitions of normal, of who could be included as a normal control, and how explicitly their attributes should be noted, attempts to standardize a database have so far failed. (Dumit 2012, 201)

Increasingly, it seems possible that neuroscience will merely lead to the 'same old', generating new technologies in pursuit of a new 'normal'; it is possible that neuroscience and education might ignore the opportunity to focus on the benefits of diversity and aspire instead to the eugenicist dream of unearthing perhaps just a few fortunate 'supernormals who have no probable pathology' (Dumit 2012, 200) and upon whom we can build some kind of utopian/dystopian future. While such practices in pursuit of 'normal' would continue to prosper, the number of pathologies would continue to expand likewise with boundaries as ever, arbitrarily and ill-defined with potentially serious consequences (Hyman 2010), 'Formalizing a new diagnosis … increases the occurrence of … diagnosis and thus contributes to creating an epidemic' (Kutchins and Kirk 1997).

Neuroscience and any conjecture in respect of 'normal', therefore, needs to be performed not just by neuroscientists but by social scientists and not least, I argue here, by those who will be at the receiving end of such theories and diagnoses and who are at risk of exclusion.

Final thoughts

> 17th and eighteenth century science indeed *was* an instrument of liberation and enlightenment. It does not follow that science is bound to *remain* such an instrument. There is nothing inherent in science or in any other ideology that makes it *essentially* liberating. (Feyerabend 1981, 157–158)

The impact of a century of exclusion in education cannot be calculated because persons cannot be calculated while the value of human qualities such as dignity, respect and courage in the face of oppression is opaque to a positivist science. As educators, therefore, we might be well-advised to sustain our focus on the value of our own work with young people, the subjectivities and mind (i.e. as process) which lie beyond any scan. It would be a serious educational, psychological and indeed serious scientific error were we to ignore the void that exists between compelling images of electrical activity in the brain and the actual experience of persons which remain much less accessible to any form of neurological or psychological reductionism; 'there is an abyss between knowledge and experience which cannot be bridged scientifically' (Damasio 2000, 308).

We need to be mindful of the doubtful scientific credentials of any claims made in education which rely on a neuroscience which, ' … lets us down. Somehow, bursts of electricity in the wetware of the brain don't seem adequate to the exquisitely structured mind that I, and you, have … ' (Tallis 2008, 158). This is not to conclude that neuroscience does not have anything to contribute to education, just that any claims need to be viewed through a critical lens.

While this paper is itself vulnerable to the accusation that it propagates neuroscientific discourse, I argue that it offers a contribution to the flow of ideas between education and neuroscience and challenges positivist assumptions about the nature of their epistemological relationship. A critical approach might even lead to better science; 'From a science studies perspective, it makes sense to argue that critical practice is constitutive of neuroscientific research – a sign of excellence and a distinctive feature/gesture' (Kraus 2015, 100).

The stakes are high, however, since neuroscience is constructing a very particular view of what it is to be human and there are potential social consequences, specifically here in relation to education, psychology and educational inclusion, should we accept a model of the human which has been created either in the laboratory or under a microscope. There is an ethical imperative in our work with young people who are at risk of some form of exclusion, whether educational or social, in schools or in the care system, that we resist the underlying discursive shift from 'having a brain to being a brain' (De Vos 2016b, 2). As educators, therefore, we need to:

(1) subject to rigorous critique educational interventions which claim an evidence base in neuroscience
(2) ensure that those critiques address the 'politics implicit in scientific practices' (Slaby and Choudhury 2012, 31) and
(3) use such critiques to resist those inclinations and practices within neuroscience which would create new forms of educational exclusion.

The technological potentials of neuroscience suggest a relentless burrowing to the centre of the 'human'. While to some this may seem like a fantastic and exciting adventure, critical neuroscience sounds a note of caution, not least in respect of the kinds of representations of the human that will be constructed in the future. Meanwhile in the short term, there are signs that the application of neuroscience in education risks constructing new politicised visions of normalcy and pathology. We have over a hundred years of experience in education to know that such a project could, if unfettered, lead to a new century of oppression and social exclusion.

Notes on contributor

Tom Billington is Professor of Educational and Child Psychology in the School of Education at the University of Sheffield where he is also Co-Director of the Centre for Critical Psychology and Education. This is a growing community of researchers and practitioners who work at the interface between Education and Psychology including, for example, in critical disability studies, global mental health and critical educational (school) psychology practice. Tom has supervised well over 50 successful doctoral students and his most well-known publications include two single-authored books, *Separating, Losing and Excluding Children* (2000) and *Working with Children* (2006). He is a Fellow of the British Psychological Society (BPS) and has either been a member of or chaired BPS working groups in autism and child protection. Tom continues to be a practising psychologist in the family courts and remains committed to challenging oppressive forms of research and practice across Psychology and Education.

References

Allan, J., and J. Harwood. 2013. "Medicus Interruptus in the Behavior of Children in Disadvantaged Contexts in Scotland." *British Journal of Sociology of Education* 35 (3): 413–431. doi:10.1080/01425692.2013.776933.

Bao, Y., and E. Pöppel. 2012. "Anthropological Universals and Cultural Specifics: Conceptual and Methodological Challenges in Cultural Neuroscience". *Neuroscience & Biobehavioral Reviews* 36 (9): 2143–2146. doi:10.10.16/j.neubiorev.2012.06.008.

Billington, T. 1996. "Pathologizing Children: Psychology in Education and Acts of Government." In *Psychology Discourse Practice: Regulation and Resistance*, edited by E. Burman, G. Aitken, P. Alldred, R. Allwood, T. Billington, B. Goldberg, A.J. Gordo Lopez, C. Heenan, D. Marks, and S. Warner, 37–54. London: Taylor & Francis.

Billington, T. 2000. *Separating, Losing and Excluding Children: Narratives of Difference*. London: Routledge Falmer.

Billington, T. 2006. *Working with Children: Assessment, Representation and Intervention*. London: Sage.

Billington, T., and A. Williams. 2015. "Education and Psychology: Change at Last?" In *Handbook of Critical Psychology*, edited by I. Parker, 231–239. London: Sage.

Blakemore, S. J., and U. Frith. 2005. "The Learning Brain: Lessons for Education: A Precis." *Developmental Science* 8 (6): 459–465. doi:10.1111/j.1467-7687.2005.00434.x.

Boxall, M. 2002. *Nurture Groups in Schools: Principles and Practices*. London: Paul Chapman.

Bruer, J. T. 1997. "Education and the Brain: A Bridge Too Far." *Educational Researcher* 26: 4–16. http://www.jstor.org/stable/1176301.

Bruner, J. S. 1986. *Actual Minds: Possible Worlds*. Cambridge, MA: Harvard University Press.

Burman, E. 2008. *Deconstructing Developmental Psychology*. 2nd ed. Hove: Routledge.

Chiao, J. Y., and B. Cheon. 2012. "Cultural Neuroscience as Critical Neuroscience in Practice." In *Critical Neuroscience: A Handbook of the Social and Cultural Aspects of Neuroscience*, edited by S. Choudhury and J. Slaby, 287–304. Chichester: Wiley-Blackwell.

Chitty, C. 2007. *Eugenics, Race and Intelligence in Education*. London: Continuum.

Choudhury, S., and J. Slaby. 2012. *Critical Neuroscience: A Handbook of the Social and Cultural Aspects of Neuroscience*. Chichester: Wiley-Blackwell.

Cigman, R., and A. Davis. 2008. "Special Issue: New Philosophies of Learning." *Journal of Philosophy of Education* 42 (3–4): 349–707.

Cole, R., W. Resing, and S. Gibbs. 2016. "Special Issue: Neuroscience and Educational Psychology." *Educational and Child Psychology* 33 (1): 1–132.

Corcoran, T.D. 2009. "Second Nature". *British Journal of Social Psychology* 48 (2): 375–388. doi:10.1348/014466608X349513.

Corcoran, T. 2016. "Ontological Constructionism." In *Critical Educational Psychology*, edited by A. Williams, T. Billington, D. Goodley, and T. Corcoran, 26–33. Oxford: Wiley Blackwell/BPS Books.

Daily Mail. 2014. http://www.dailymail.co.uk/health/article-2731093/What-causes-autism-Scientists-discover-people-condition-brain-connections.html accessed 26th. May 2016.

Daily Mail. 2014a. http://www.dailymail.co.uk/health/article-2756747/Doctors-soon-diagnose-ADHD-children-brain-scan.html accessed 26th. May 2016.

Damasio, A. 2000. *The Feeling of What Happens: Body, Emotion and the Making of Consciousness*. London: Vintage.

Damasio, A. 2004. *Looking for Spinoza*. London: Vintage.

Daniels, H., A. Edwards, Y. Engestrom, T. Gallagher, and S. R. Ludvigsen. 2013. *Activity Theory in Practice: Promoting Learning Across Boundaries and Agencies*. London: Routledge.

Davis, A. 2004. "The Credentials of Brain-based Learning." *Journal of Philosophy of Education* 38 (1): 21–36. doi:10.1111/j.0309-8249.2004.00361.x/epdf.

DCSF. 2007. *Social and Emotional Aspects of Learning for Secondary Schools: Tools for Monitoring, Profiling and Education*. Nottingham: DCSF.

De Kessel, M. 2015. "The Brain: A Nostalgic Dream: Some Notes on Neuroscience and the Problem of Modern Knowledge." In *Neuroscience and Critique: Exploring the Limits of the Neurological Turn*, edited by J. De Vos and R. Pluth, 11–19. London: Routledge.
De Vos, J. 2015. "What Is Critique in the Era of the Neurosciences?" In *Neuroscience and Critique: Exploring the Limits of the Neurological Turn*, edited by J. De Vos and R. Pluth, 22–40. London: Routledge.
De Vos, J. 2016a. "Personal Communication. Book Launch Event." University of Manchester Institute of Education. 16 May.
De Vos, J. 2016b. *The Metamorphoses of the Brain – Neurologization and Its Discontents*. London: Palgrave Macmillan.
De Vos, J., and R. Pluth. 2015. *Neuroscience and Critique: Exploring the Limits of the Neurological Turn*. London: Routledge.
Dewey, J. 1897. "My Pedagogic Creed." *The School Journal* LIV (3): 77–80. http://infed.org/mobi/john-dewey-my-pedagogical-creed/ Accessed 14 June 2015.
Dewey, J. 1916. *Democracy and Education: An Introduction to the Philosophy of Education*. New York: The Macmillan Company.
Dewey, J. 1938. *Experience and Education*. New York: Touchstone.
DoH. 2015. *Future in Mind: Promoting, Protecting and Improving Our Children and Young People's Mental Health and Well-being*. London: Department for Health and NHS England.
Dumit, J. 2012. "Critically Producing Brain Images of Mind." In *Critical Neuroscience: A Handbook of the Social and Cultural Aspects of Neuroscience*, edited by S. Choudhury and J. Slaby, 195–226. Chichester: Wiley-Blackwell.
Dumit, J. 2015. "The Fragile Unity of Neuroscience." In *Neuroscience and Critique: Exploring the Limits of the Neurological Turn*, edited by J. De Vos and R. Pluth, 223–227. London: Routledge.
Dweck, C. 2006. *The New Psychology of Success*. New York: Random House.
Ecclestone, K., and D. Hayes. 2008. *The Dangerous Rise of Therapeutic Education*. London: Routledge.
EPFL. 2005. *Blue Brain Project*. Lausanne: Ecole polytechnique federale de Lausanne.
Feyerabend, P. 1981. "How to Defend Society Against Science." In *Scientific Revolutions*, edited by I. Hacking, 151–161. Oxford: Oxford University Press.
Freire, P. 1972. *Pedagogy of the Oppressed*. Harmondsworth: Penguin.
Fuchs, T. 2012. "Are Mental Illnesses Diseases of the Brain?" In *Critical Neuroscience: A Handbook of the Social and Cultural Aspects of Neuroscience*, edited by S. Choudhury and J. Slaby, 331–344. Chichester: Wiley-Blackwell.
Furedi, F. 2004. "Reflections on the Medicalization of Social Experience." *British Journal of Guidance and Counselling* 32: 413–415. http://www.tandfonline.com/doi/abs/10.1080/03069880410001723611.
Gallagher, S. 2005. *How the Body Shapes the Mind*. Oxford: Oxford University Press.
Gallagher, S. 2012. "Scanning the Lifeworld: Toward a Critical Neuroscience." In *Critical Neuroscience: A Handbook of the Social and Cultural Aspects of Neuroscience*, edited by S. Choudhury, and J. Slaby, 85–110. Chichester: Wiley-Blackwell.
Gardner, H. 1983. *Frames of Mind: The Theory of Multiple Intelligence*. New York: Basic Books.
Gergen, K. J. 2009. *Relational Being*. New York: Oxford University Press.
Goleman, D. 1995. *Emotional Intelligence*. New York: Bantam Books.
Goodley, D. 2014. *Dis/Ability Studies: Theorising Disablism and Ableism*. London: Routledge.
Goswami, U. 2004. "Neuroscience and Education." *British Journal of Educational Psychology*. 74 (1): 1–14. doi:10.1348/000709904322848798.
Hacking, I. 1975. *The Emergence of Probability*. Cambridge: Cambridge University Press.
Hacking, I. 1995. *Rewriting the Soul: Multiple Personality and the Sciences of Memory*. Princeton, NJ: Princeton University Press.
Hadow, W. H. 1924. *Report of the Consultative Committee on Psychological Tests of Educable Capacity*. London: HMSO.
Haueis, P., and J. Slaby. 2015. "Brain in the Shell: Assessing the Stakes and the Transformative Potential of the Human Brain Project." In *Neuroscience and Critique: Exploring the Limits of the Neurological Turn*, edited by J. De Vos, and R. Pluth, 117–138. London: Routledge.
Howard-Jones, P. A. 2008. "Philosophical Challenges for Researchers at the Interface Between Neuroscience and Education." *Journal of Philosophy of Education* 42 (3–4): 361–380. http://onlinelibrary.wiley.com.eresources.shef.ac.uk/doi/10.1111/j.1467-9752.2008.00649.x/epdf.
Howard-Jones, P. A. 2011. "From Brain Scan to Lesson Plan." *The Psychologist* 24 (2): 110–113.
Human Brain Project. 2012. "The Human Brain Project: A Report to the European Commission. Co-ordinator: Henry Markram." HBP-PS Consortium. April, 1–107.
Hyman, S. E. 2010. "The Diagnosis of Mental Disorders: The Problem of Reification." *Annual Review of Clinical Psychology* 6: 155–179. doi:10.1146/annurev.clinpsy.3.022806.091532.
Immordino-Yang, M. H., and A. R. Damasio. 2007. "We Feel, Therefore We Learn: The Relevance of Affective and Social Neuroscience to Education." *Mind, Brain and Education* 1 (1): 3–10.
James, W. 1890. *Principles of Psychology*. Vols. 1 & 2. Mineola, NY: Dover.

Jensen, E. 2008. *Brain-based Learning: The New Paradigm of Teaching*. 2nd ed. Thousand Oaks, CA: Corwin Press.
Johnston, A. 2015. "A Confusion of a Weak Reductionist: Responses to Some Criticisms of My Materialism". In *Neuroscience and Critique: Exploring the Limits of the Neurological Turn*, edited by J. De Vos and R. Pluth, 141–168. London: Routledge.
Kelly, J. 2016. "Whole Brain Learning and Teaching: An Introduction for Learners of All Ages, Parents and Teachers. Transforming Futures Vol 1." CreateSpace Independent Publishing Platform.
Kirmayer, L. 2012. "The Future of Critical Neuroscience." In *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, edited by S. Choudhury and J. Slaby, 367–384. Chichester: Wiley-Blackwell.
Kirmayer, L., and I. Gold. 2012. "Re-socializing Psychiatry: Critical Neuroscience and the Limits of Reductionism." In *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, edited by S. Choudhury and J. Slaby, 307–330. Chichester: Wiley-Blackwell.
Kraus, C. 2015. "What Is the Feminist Critique of Neuroscience? A Call for Dissensus Studies" In *Neuroscience and Critique: Exploring the Limits of the Neurological Turn*, edited by J. De Vos and R. Pluth, 100–114. London: Routledge.
Kutchins, H., and S. Kirk. 1997. *Making Us Crazy: DSM the Psychiatric Bible and the Creation of Mental Disorders*. New York: The Free Press.
Latour, B. 1979. *Laboratory Life: The Social Construction of Scientific Facts*. Los Angeles: Sage.
Le Doux, J. 1999. *The Emotional Brain*. London: Phoenix.
Lingard, B., J. Nixon, and S. Ranson. 2008. *Transforming Learning in Schools and Communities*. New York: Continuum.
Malabou, C. 2008. *What Should We Do with Our Brain?* Foreword by Marc Jeanerod, Translated by Sebastian Rand. New York: Fordham University Press.
Mason, L. 2009. "Bridging Neuroscience and Education: A Two-way Path Is Possible." *Cortex* 45 (4): 548–549. doi:10.1016/j.cortex.2008.06.003.
Mintz, J., and D. Wyse. 2015. "Inclusive Pedagogy and Knowledge in Special Education: Addressing the Tension." *International Journal of Inclusive Education* 19 (11): 1161–1171. doi:10.1080/13603116.2015.1044203.
OECD. 2002. *Understanding the Brain: Towards a New Learning Science*. Paris: Organization for Economic Development.
Panksepp, J. 1998. *Affective Neuroscience: The Foundation of Human and Animal Emotions*. Oxford: Oxford University Press.
Prtevi, J. 2009. *Political Affect: Connecting the Social and the Somatic*. Minneapolis: University of Minnesota Press.
Raikhel, E. 2012. "Radical Reductions: Neurophysiology, Politics and Personhood in Russian Addiction Medicine." In *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, edited by S. Choudhury, and J. Slaby, 227–252. Chichester: Wiley-Blackwell.
Rees, P., R. Booth and A. Jones 2016. "The Emergence of Neuroscientific Evidence on Brain Plasticity: Implications for Educational Psychologists". In R. Cole, W. Resing and S. Gibbs (eds.) (2016). Special Issue: Neuroscience and Educational Psychology. *Educational and Child Psychology* 33 (1): 8–19. Leicester: The British Psychological Society.
Reynaert, P. 2015. "Neuroscientific Dystopia: Does Naturalism Commit a Category Mistake?" In *Neuroscience and Critique: Exploring the Limits of the Neurological Turn*, edited by J. De Vos, and R. Pluth, 62–76. London: Routledge.
Rose, N. 1988. *Governing the Soul: The Shaping of the Private Self*. London: Routledge.
Rose, S. 2006. *The 21st. Century Brain: Explaining, Mending and Manipulating the Mind*. London: Vintage.
Rose, S. 2012. "The Need for a Critical Neuroscience: From Neuroideology to Neurotechnology." In *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, edited by S. Choudhury, and J. Slaby, 53–66. Chichester: Wiley-Blackwell.
Rose, N., and J. M. Abi-Rached. 2013. *Neuro: The New Brain Sciences and the Management of Mind*. Princeton, NJ: Princeton University Press.
Rowlands, M. 2010. *The New Science of Mind: From Extended Mind to Embodied Phenomenology*. Cambridge: The MIT Press.
Royal Society. 2011. *Brainwaves Module 2: Neuroscience – Implications for Education and Lifelong Learning*. London: The Royal Society.
Ryle, G. 1949. *The Concept of Mind*. London: Penguin.
Satanario, S. 2016. "The 'Late Effects' of Paediatric Brain Tumours and the Implications for Educational Settings". In R. Cole, W. Resing, and S. Gibbs (eds.) Special Issue: Neuroscience and Educational Psychology. *Educational and Child Psychology* 33 (1): 20–33. Leicester: The British Psychological Society.
Slaby, J., and S. Choudhury. 2012. "Proposal for a Critical Neuroscience." In *Critical Neuroscience: A Handbook of the Social and Cultural Aspects of Neuroscience*, edited by S. Choudhury, and J. Slaby, 29–52. Chichester: Wiley-Blackwell.
Slee, R. 2010. *The Irregular School: Exclusion, Schooling and Inclusive Education*. Abingdon: Routledge.

Solms, M., and J. Panksepp 2012. "The 'Id' Knows More Than the 'ego' Admits: Neuropsychoanalytic and Primal Consciousness Perspectives on the Interface Between Affective and Cognitive Neuroscience". *Brain Sciences* 2 (2): 147–175. DOI:10.3390/brainsci2020147.

Tallis, R. 2008. *The Kingdom of Infinite Space: A Fantastical Journey Around Your Head*. London: Atlantic Books.

Timimi, S., N. Gardner, and B. McCabe. 2010. *The Myth of Autism: Medicalizing Men's and Boys' Social and Emotional Competence*. Basingstoke: Palgrave Macmillan.

Treasury, H. M. 2003. *Every Child Matters*. London: HMSO.

Trowsdale, J. and R. Hayhau 2015. "Psycho-physical Theories, Practice and Embodied Learning for Young People with Learning Difficulties." *International Journal of Inclusive Education* 19 (10): 1022–1036. DOI:10.1080/13603116.2015.1031832.

Vygotsky, L. 1978. *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.

White House. 2013. "The Brain Initiative: Brain Research Through Advancing Innovative Technologies". https://www.whitehouse.gov/BRAIN accessed 12th. March.

Zeki, S. 2007. *The Splendours and Miseries of the Brain: Love, Creativity and the Quest for Human Happiness*. Chichester: Wiley Blackwell.