Education, Neuroscience and The Asymmetry Principle

1 INTRODUCTION

There has been a charge in recent years within educational discourse in particular to appeal to cognitive neuroscience to give scientific credibility to concepts and phenomena of interest to education. Broadly speaking, education appeals to neuroscience to provide a scientific basis for learning, thinking, understanding, emotions and intelligence, and all of the factors which may contribute to these phenomena. Educational policy and practice are becoming fairgrounds for neuroscientific input. Teacher training courses, particularly in the UK, (but similarly in the US and in Europe) are now likely to include at least some neuroscientific components.

The question is, therefore: is this a credible collaboration, or is it one which is akin to the behaviouristic models of education from the early 20th century from B.F. Skinner, or the constructivist models from Piaget and Vygotsky?

Over the course of this paper the author seeks to examine the philosophical credentials of neuroscience in general, and of so-called neuroeducation and brain-based learning in particular, to illuminate the credibility of the neuroscience-education collaboration. Is neuroscience likely to be the dawn of a new scientific age within education, or will be another conceptually flawed scientific model for the educational paradigm?

2 PRELIMINARY DEFINITIONS

2.1 WHAT IS NEUROSCIENCE?

It is particularly difficult in such a short paper to capture a satisfactory definition of a discipline as diverse as neuroscience. Nevertheless, a broad – admittedly vague – definition must be established for the bounds of this work. The author, however, wants to be entirely clear at this point, that no intentional disservice is intended to be committed against neuroscience with this preliminary definition.

Bennett and Hacker (2003, p. 2) suggest that ‘cognitive neuroscience operates across the boundary between two fields, neurophysiology and psychology’. More specifically, cognitive neuroscience will be examined in this paper, in particular to examine the role which it can (or cannot) play with reference to education. In one of the first major works of the cognitive neuroscience movement – *Cognitive Neuroscience: The Biology of the Mind* – one of the fathers of the movement, Michael Gazzaniga (along with two other cognitive neuroscientists, Richard Ivry and George Mangun) outline in the preface of the text that ‘Cognitive neuroscience is taking the scientific community by storm’ (Gazzaniga, Ivry and Mangun, 1998, p. xiii), and offer the following insight as to what cognitive neuroscience offers to the brain sciences in general:

> Scientists now realize that studying the mind’s complex processes – perception, language, attention, memory, control of movement, feelings, and consciousness itself – has become a task that is not only scientifically tractable, but is approachable by cognitive and neural means. The disciplines of cognitive psychology, behavioural neurology, and neuroscience now feed off each other, contributing a new view to the understanding of the mechanisms of the mind. This development has led to the emergence of the field of cognitive neuroscience.
>
> (p. xiii)

Notice first, the inter-changeability between the concept of ‘mind’ (an entity of no material substance) and ‘brain’ (a material, tangible object) borders on absurd. This view is steeped in mind-brain identity theory which, it has to be said, divides opinion from within neuroscientific circles. Nevertheless, Gazzaniga and his co-authors feel sufficiently satisfied – evident from the title of their book – to view cognitive neuroscience as the ‘biology of the mind’. This problem will not be examined in any detail in this work. Second, these authors seem to have attributed a range of abilities to the mind, such as ‘perception, language, attention, memory, control of movement, feelings, and consciousness itself’ and outline that an examination of the *brain* and its neurophysiology will lead to a more detailed understanding of how the *mind’s* processes work. For the moment, let it be clear that Gazzaniga et al. (1998) have given significant reason to question the philosophical credentials of neuroscience. Indeed, any science which is predicated on the belief that an examination of the neurophysiology of the brain will lead to a fuller understanding of the 'mind's processes' is due an extensive examination. Gazzaniga et al. (1998) set out to show that 'the brain enables the mind' (p. xiii). This was what these authors saw, at their time of writing, to be the aim of cognitive neuroscience. Much of that aim remains intact to this day.

Purves et al. (2013) offer the following more up-to-date definition of cognitive neuroscience:

> Cognitive neuroscience is a relatively new discipline that has arisen from the recent marriage of neuroscience, a biomedical field that has flourished both conceptually and technically during the past century, and cognitive science, a field of study rooted in the long-standing interest of natural philosophers and psychologists in understanding human mental processes. Consistent with these progenitors, research on cognitive neuroscience integrates investigations of brain structure and function, and seeks to measure cognitive abilities and behavior to understand how the human brain works at all levels.
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> (Purves et al., 2013, p. 1)

At first glance, it appears that most of the difficulties with the definition Gazzaniga et al. (1998) offered have been sufficiently well mastered in this more up-to-date text. Indeed, even on the concept of the mind, the authors note that the '*mind* is a notoriously difficult term to define' (Purves et al., 2013, p. 2). These authors continue:

> Cognitive neuroscience is defined by the work at the intersection of cognitive science and neuroscience. Thus, cognitive neuroscientists must have grounding in both these domains. They must be able to think about the cognitive processes that shape our behavior and the contents of our mental lives, and understand cognitive psychology and related fields. But they must also be able to relate those processes and theories to underlying brain function, which requires proficiency in the key findings and the tools of neuroscience. Cognitive neuroscience thus combines all the difficulties of measuring brain function with all the problems of trying to accurately assess cognition and behaviour, as well as the complexities of trying to link them together.
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> (p. 9)

Taking these two definitions together – Gazzaniga et al. (1998) and Purves et al. (2013) – it should be eminently clear that the intersection between cognitive processes and neurophysiological processes is the interest of the cognitive neuroscientist. In light of this definition, it also becomes clearer what the appeal of cognitive neuroscience might be for education: namely, to find a foothold in a deeper and more scientific understanding of the underlying precepts of the cognitive processes of interest to education, such as learning, thinking and understanding. This author asks: can cognitive neuroscience deliver on these promises in an educational context? This question will be examined throughout this paper. Indeed, as Bennett and Hacker (2003) observe, 'The logical or conceptual relations between the physiological and the psychological are problematic' (p. 2). This is the motivation for the critique of neuroscience in this work, particularly in relation to education.

Geake and Cooper (2003), suggest the following definition of *cognitive* neuroscience, set in the context of what should be of interest education:

> Cognitive neuroscience is a wide field embracing a rich variety of experimental paradigms and approaches, from the bimolecular to the behavioural. … Areas of experimental interest include vision, spatial cognition, audition and music, emotions, memory, motor function, language, and consciousness, most (if not all) of which can inform our understanding of cognitive behaviours relevant to education, for example, intelligence, learning, memory, motivation, literacy, creativity.
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> (pp. 8-9)

The appeal of neuroscience for education, therefore, appears to be that it purports to be capable of providing answers to some of education's most vexing questions surrounding learning, memory and intelligence. It is this apparent appeal for education, in truth, as opposed to a firm definition of neuroscience, which is the aspect of neuroscience which requires examination in this work.

To be entirely fair also, it is important to note that there are many neuroscientists and neurobiologists who are, indeed, careful with what they posit about the brain. However, it is the remit of this work to demonstrate that there remain too many cases where the neuroscientific doctrine is founded on *conceptual* errors. Moreover, being founded on an ignorance of simple philosophical precepts leads to rather glaring and troubling consequences about what is posited to be neuroscientifically possible. In relation to education, this work aims to show that the remit of neuroscience should be more carefully considered, and fundamentally restricted. Predicating educational reform on neuroscientific conceptual errors, surely, ought to be prevented.

2.2 WHAT IS BRAIN-BASED LEARNING?

Brain-based learning is a collection of learning 'theories' which purport to explain learning through developing a fuller understanding of the role the brain plays in learning. It is a study which calls on evidence from educationalists, cognitive psychologists and neuroscientists to support its claims. According to Gulpinar (2005), Brain-Based learning theory encompasses twelve main principles, listed as follows:

1. All learning engages the entire physiology;
2. The brain/mind is social;
3. The search for meaning is innate;
4. The search for meaning occurs through patterning;
5. Emotions are critical to patterning;
6. The brain/mind processes parts and whole simultaneously;
7. Learning involves both attention and peripheral perception;
8. Learning is both conscious and unconscious;
9. There are at least two approaches to memory (rote learning system, spatial/contextual/dynamic memory system);
10. Learning is developmental;
11. Complex learning is enhanced by challenge and inhibited by threat associated with helplessness and fatigue;
12. Each brain is uniquely organized.

(Gulpinar, 2005, pp.302-303)[1]

This definition provides a standard understanding of brain-based learning models; although alternative brain-based learning theories might differ slightly from others. Nevertheless, the attraction for appealing to brain-based learning models is apparent: there is a systematic attempt within brain-based learning theories to explain how learning occurs, and how best to teach on the basis of this explanation; claims

[1] Cited also, in the first instance in Caine & Caine (1991).

which are substantiated in evidence from mind/brain philosophy, Gestalt psychology, cognitive psychology and neuroscience.

Jensen (2008), suggests that keeping pace with the fast-moving nature of neuroscience and brain research in general is one of the challenges facing modern-day educationalists (p. xii). Rather worryingly, the same author suggests that modern-day education is founded on a new knowledge of the brain and its workings, which previous generations of educationalists weren't so fortunate to have. This, he suggests, is why embracing the brain-based learning movement is so important:

> Based on research from the disciplines of neuroscience, biology, and psychology, our understanding of the relationship between learning and the brain now encompasses the role of emotions, patterns, meaningfulness, environments, body rhythms, attitudes, stress, trauma, assessment, music, movement, gender, and enrichment. By integrating what we now know about the brain with standard educational practices, *Brain-Based Learning* suggests that schools can be transformed into complete learning organizations.
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> (Jensen, 2008, p. xii)

Perhaps these claims would be more credible if Jensen (2008) didn't go on to claim that 'we are all great natural learners' (p. xiii). Isn't it also deeply troubling that Jensen (2008) continues to set brain-based learning up as the savior to education:

> When students are provided with a learning environment that is optimal for learning, graduation rates increase, learning difficulties and discipline problems decrease, a love for learning flourishes, administrators focus on the real issues, and learning organizations thrive. In short, creating an organization around the way the **brain naturally learns** best may be the simplest and most critical educational reform ever initiated. In fact, of all the reforms, nothing provides a better return on your investment of time, energy, and money than developing a brain-based approach to learning.
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> (p. xiii, this author's bold-type)

If brain-based learning is adopted, attainment improves, problems disappear, and a 'love' for learning flourishes. The 'learning organization' is the aim, and the student will thrive in this environment which is founded on an appreciation of how the 'brain learns'. Money is saved, and our investment is safe. These are bold claims. Where is the evidence for them? It does not exist. Are these claims underpinned by coherent and credible science? This paper will show that they are not. There are neuroscientists, to their credit (Goswami (2006), Tallis (2010), Howard-Jones (2010), Rose (2013)), who seek to dispel so-called 'neuromyths' from finding their way into education and other disciplines, but too many ill-considered and philosophically weak arguments still remain.

In the above exert, this author has emphasized one point of particular interest: namely, the line 'brain naturally learns'. This emphasis will become clearer throughout the paper. For the moment, however, let it be clear that it is common practice for the brain-based learning movement to posit that that brain is the learning organ, and that learning environments, organizations and curricula should be shaped around this learning brain. Indeed, as Jensen (2008) notes, with reference to the brain, 'the vast complexity of our 'thinking organ' has left scholars short of an efficient explanation of how it works' (p. 2). So it is clear that the leaders in the field of brain-based learning take the brain to be the learning, thinking, understanding organ; the hub of cognitive and psychological phenomena. This claim seems intuitive, but the consequences of such seemingly innocent reasoning will be shown later to be profoundly problematic.

For the time being, however, let it be clear what brain-based learning has as its core aim. To quote Jensen (2008) one last time: 'Brain-based education considers how the brain learns best. The brain does not learn on demand by a school's rigid, inflexible schedule. It has its own rhythms.' (p. 4). This tenet of brain-based learning will be shown to be the work of science-fiction rather than science-fact. For too long now, neuroscience has provided a cover of credibility to brain-based learning, giving the impression that the concept of the learning, thinking brain is a modern-day magnificent scientific achievement. A quick search on the *Amazon.co.uk* website (which hardly constitutes research, but it does give a feel for how increasingly popular this field of brain-based learning is) will return over 1100 books on brain-based learning. These ideas have permeated the mainstream thinking within education. They are rife within educational discourse throughout the world. And they are all predicated on the belief that the best way to educate children is to consider how their 'brains learn best'.

2.3 THE ROYAL SOCIETY, BRAIN WAVES PROJECT (2011): PROMINENT NEUROSCIENTISTS ADD WEIGHT TO THE DEBATE

One of the most prominent supporters of the neuroscience-education collaboration was the endorsement put forward by the Royal Society in 2011, when the term 'neuroeducation' became commonplace as a sub-discipline in its own right. The project entitled, 'Brain Waves Module 2: Neuroscience: implications for education and lifelong learning', commissioned by the Royal Society urges that an increased level of neuroscientific training is necessary for beginning and current teachers, due to the relevance neuroscience has for education and its usefulness for attaining insights into how children learn.

Despite the efforts of The Royal Society to dispense with so-called 'neuromyths' and to warn that caution is required within the neuroscience-education collaboration, their report makes four major recommendations for education and teacher training:

1. Neuroscience should be used as a tool in educational policy;
2. Training and Continued Professional Development (CPD) should include a neuroscientific element in relation to relevant education issues, particularly for Special Educational Needs (SEN);
3. Neuroscience should inform adaptive learning technology;
4. Knowledge exchange should be increased.

Let it be clear in the process of critiquing these recommendations that this author does not seek to undermine the elements of The Royal Society's report which have addressed many of the intricate problems which have plagued neuroscientific discourse for many years. Indeed, other publications – such as Geake (2005), TLRP (2007), and Howard-Jones (2010) – set about making clear where neuroscience has gone wrong in the past, making clear that the neuromyths which have hindered neuroscience should be discarded in order for the discipline to be taken seriously. This, however, is where this author parts with The Royal Society (2011), and other such publications. Indeed, it is lamentable and puzzling in equal measure, why such efforts would be expended to recalibrate the boundaries of sense within neuroscience, only to make bold and unfounded assertions about its applicability to other disciplines such as education. If neuroscience is at a time of cautious optimism, (Geake, 2005, p.10; Goswami 2006; Royal Society 2011, p. v), then its adoption to education should be suspended. Indeed, given that the authors of The Royal Society (2011) report acknowledge that neuroscience presents 'opportunities as well as *challenges* for education' (p. v, this author's emphasis) and that the discipline of neuroscience is still relatively infantile in nature, insomuch that the authors 'urge caution in the rush to apply so-called brain-based methods, many of which do not yet have a sound basis in science' (p. v), it seems strange that this document ends with a recommendation that neuroscience should be used to inform educational policy, and that teachers should be trained in neuroscientific principles. As Rose observes, 'the claims of mainstream neuroeducation … have been oversold' (TES, 2013). This overhyped, self-attributed remit needs to be recalibrated, and the bounds of what is neuroscientifically possible within education need to be reset. The fact that The Royal Society (2011) have endorsed this project demonstrates the widespread belief within prominent research communities that the collaboration between neuroscience and education is one which is likely to work.

Bruer argued that any attempt to concatenate ideas from neuroscience and education was to be considered as a 'bridge too far,' going on to claim that, although the brain and discoveries about the brain should 'fascinate us,' we should however remain cautious (perhaps even pessimistic) about how useful neuroscience can be to educational practice:

> … we should be wary of claims that neuroscience has much to tell us about education, particularly in those claims derived from the neuroscience and education argument. The neuroscience and education argument attempts to link learning, particularly in early childhood learning, with what neuroscience has discovered about neural development and synaptic change. Neuroscience has discovered a great deal about neurons and synapses, but not nearly enough to guide educational practice. Currently, the span between brain and learning cannot support much of a load. Too many people marching in step across it could be dangerous.
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> (Bruer, 1997, p.15)

Before going on to examine in more detail the credentials of the collaboration between neuroscience and education, let it be clear that this author is acutely aware of the historical context surrounding neuroscience as a discipline. It is often contested that neuroscience is a 'fast-changing' discipline, to the extent that what might have held two or three years ago, may not be apt in the present moment. This work, however, contains no such temporal concerns. The criticisms leveled in what will follow are *conceptual* concerns, rather than empirical ones. Consequently, these conceptual concerns cannot be resolved by empirical evidence; they transcend the advancements in neuroscience however fast-changing the discipline might be. The author, therefore, has chosen a range of contributing references from *different* points in the neuroscientific timeline to demonstrate that these conceptual concerns have the tendency to resurface *despite* advancements in neuroscientific methods and techniques. What Bruer said in 1997, therefore, is equally apt today. Indeed, as this author has already cited, Rose (cited in TES 2013) has voiced similar concerns about the overhyped nature of the neuroeducation and brain-based educational models. More importantly, the conceptual concerns which are highlighted in this author's adoption of Bennett and Hacker (2003), are not resolved with neuroscientific advancements over time; they are resolved only with a more careful approach to how we speak about the brain, and by giving more careful consideration to the distinction between neurophysiological and psychological phenomena.

3 AN INFUSED INNER-OUTER RELATION: FIRST-PERSON/THIRD-PERSON ASYMMETRY

The remainder of this paper will be dedicated to philosophical elucidation and clarification of what is neuroscientifically possible within education. Thus far, the author has given an outline of what neuroscientists see as the definition of their study, and what educationalists, neuroeducationalists and brain-based learning theorists believe to be the points of common interest between neuroscience and education. The philosophical underpinnings of these reflections require a stern examination.

Neuroscientists talk in such a way which seems to connect 'inner' and 'outer' realms in a local, causal relation, as if they stand apart in separately analyzable states in which the inner activities cause the outer behaviours. This model seems intuitive and tempting to accept. The entire *raison d'être* of neuroscience and brain-based learning theories is, therefore, to give an insight into how learning, knowing, believing and so on, are predicates which begin in the inner, and manifest themselves – via a causal relation – in the outer. This author will demonstrate, however, that at the basis of this notion is a misunderstanding of how these intentional predicates are constructed, and governed by a *first-person/third-person asymmetry principle.*

3.1 THE ASYMMETRY PRINCIPLE OF PSYCHOLOGICAL PREDICATES

Educational predicates are governed by an 'asymmetry principle,' succinctly described by Harré and Tissaw:

> [I]n making a first-person statement I am making an avowal. I am expressing how it is with me, sincerely or insincerely. In making a third-person statement about somebody else's feelings I am describing that person's feelings correctly or incorrectly. In the first case I need no evidence. In the second case I must go on the signs I see or hear. These distinctions between the grammar of first-person expressive talk and third-person descriptive talk can be categorised as the asymmetry principle.
>
> (Harré and Tissaw, 2005, p. 190)

Also, Wisdom – a prominent Wittgensteinian (in fact, one of Wittgenstein's students) – suggests that the asymmetrical nature of how one ascribes psychological predicates to the first- and third- persons is not a matter for regret:

> The asymmetrical logic of statements about the mind is a feature of them without which they would not be statements about the mind, and that they have this feature is no more a subject suitable for regret than the fact that lines, if truly parallel don't meet.
>
> (Wisdom, 1967, p. 361)

So, the asymmetry principle in how psychological predicates are ascribed to the first and third persons is noticeable in the nature of each of these ascriptions: to the first-person (to oneself) *without* criteria, and to the third-person (someone else) *with* behavioural criteria, which are logically sound grounds for their ascription i.e. publically 'agreed' behavioural criteria. This is not a cause for regret; it is, in fact a feature of what makes these attributes psychological.

3.2 The symmetry principle for physical attributes

In contrast, the way in which physical attributes are ascribed to the first- and third-persons follows a *symmetry principle,* insomuch that it is done in the same way for oneself as it is for another. To say that someone is such-and-such a height, for example, is done with no distinction between the first- and third-person cases. There are no criteria for the third-person ascriptions of height that are different for the way in which one would ascribe a height to oneself. In this way, physical attributes follow the symmetry principle of first-person/third-person ascriptions.

3.3 Not a something, not a nothing either!

It is commonplace for neuroscientists and educationalists alike to fail to grasp this profound first-person/third-person asymmetry which characterises educational predicates, and mistakenly portray the neuroscientist as having a more profound direct access (via sophisticated imaging techniques) to a hidden inner realm whose contents, alas, must remain a matter of conjecture for the teacher.

This belief – which is rife within neuroscience as a discipline – manifests as a transgression from the mentalist mind-body dualism approach – captured in Cartesian dualism – to the materialist brain-body dualism approach. Eliminative materialism envisages that the neuroscientific technique – namely, neural imaging in its various forms – can reduce the constitutive uncertainty which surrounds psychological predicates such as learn, think and understand, under mind-body dualism. To be sure, as Glock (1996) observes, ‘it seems plausible that mental phenomena are inner causes of outward behaviour, and hence must be identical with neurophysiological phenomena, that is, brain-processes or -states’ (p. 177). Nevertheless, this does not permit the neuroscientist to claim that ‘psychological statements describe neurophysiological phenomena’ (ibid). In a similar manner, Tallis (2010), a practising neuroscientist (among other things), makes clear that the challenges which face modern-day materialist accounts of consciousness cannot be resolved by what he calls ‘neuroscientism’. Tallis, therefore, outlines that whatever case neuroscience can put forward, must be necessarily restricted (p. 3).

In a sense, the inherent difficulties with explaining concepts like consciousness, intentionality, perception, and psychological phenomena, are beyond resolution, through neuroscience, or otherwise.

The language used to describe psychological phenomena does not describe anything in relation to the brain. The psychological and the neurophysiological, therefore, are categorially distinct, and so psychological phenomena are not described, in any meaningful sense, under examination of neurophysiological processes or states.

Developing this further, and in keeping with Wittgenstein, it is clear that the proponents of neuroeducation and brain-based learning have rejected one flawed model for another equally flawed model. With reference to the exact nature of an 'inner guiding object,' Wittgenstein argues, 'It's not a Something, but not a Nothing either! The conclusion was only that a Nothing would render the same service as a Something about which nothing could be said' (Wittgenstein, 2009, p. 109e). It is not that, as a matter of fact the brain does not learn, think and understand, or that these things do not happen inside the brain, as opposed to the fact that these claims *do not make sense*; and the transgression on the bounds of sense begins in the failure to grasp the asymmetrical nature of the psychological predicates involved. In essence, we confuse the first-person use (a something), with the third-person use (a nothing) which gives rise to confusing explanations. In fact, the answer lies between these two extremes: 'the expression of a mental process is a *criterion* for that process; that is to say, it is part of the concept of a mental process … that it should have a characteristic manifestation' (Kenny, 2004, p. 49).

4 ESTABLISHING THE FIRST-PERSON/ THIRD PERSON CATEGORY ERROR

4.1 A DEFINITION OF A CATEGORY AND CATEGORY ERRORS

A category is a collection of objects, together with a collection of rules or predicates which govern these objects. A category error therefore, is the incoherent ascription of predicates or attributes to an object which cannot possibly have these predicates or attributes. Category errors tend to emanate from situations where language is used in a way which *does not make sense*. The error is therefore circumvented with an examination of the language, and the combination of the words that have been concatenated into the sentence in question.

4.2 THE ASYMMETRY PRINCIPLE FOR PSYCHOLOGICAL/EDUCATIONAL PREDICATES

Recall, the notion of first-person/third-person asymmetry entails an understanding that there is an oppositional-difference in the way we ascribe the attribute to the first-person (ourselves), in contrast with how we ascribe the same attribute to the third-person (someone else). So, for example, in this instance when we consider the predicate 'learn', we ascribe this predicate differently to ourselves as to another. Indeed, in claiming that *I have learnt* a concept I can make such a claim about myself without requiring an appeal to some sort of criterion. That is to say, classrooms are not full of children opening their books in astonishment when they realized that they got 10 out of 10 in a set of problems that they had no idea they had learnt. Such evidence is not required for the first-person to ascribe learning to himself. The predicate 'learn', therefore, is ascribed to oneself *without criteria.*

To talk, however, of *someone else* learning, is ascribed *with criteria*; perhaps some form of observation about their behaviours or actions, in accordance with some set of pre-determined criteria to outline success or failure i.e. 'agreement' with these criteria or otherwise. The predicate 'learn', therefore, is ascribed to oneself *without* criteria, but to another *with* criteria. In this way it follows the asymmetry principle. First-person, present tense use of psychological predicates are *avowals,* and are expressed either truthfully or non-truthfully about how things are with oneself. There is no scope for error in one's first-person ascriptions in the manner in which there are with one's third-person ascriptions. In this way, third-person ascriptions of the *same* predicates are *descriptions* of observable behaviours, and thus are expressed either correctly or incorrectly. The first-person and the third-person are, however – as Bennett and Hacker (2003) argued – inexorably linked. Indeed, should someone display an inability to ascribe learning, for example, to *another* in their third-person ascriptions, it is reasonable to assume that their first-person ascriptions of learning *to themselves* may also be misguided. The inner and the outer are entangled; never to be pulled apart in an attempt to understand one as separable from the other.

4.3 THE SYMMETRY PRINCIPLE FOR BRAIN ACTIVITY

On the other hand, the notion of first-person/third-person symmetry is the idea that the ability or attribute would be ascribed *in the same way* to the first person as to the third person. So, for example, the activity in a brain at any given time is governed by a first-person/third-person *symmetry*, since the observation of activity in the brain can be done for the first-person in the same way as for the third person (by observing neural images e.g. PET and fMRI scans), and consequently the ascription of brain activity to oneself is conducted *in the same way* as for another.

4.4 THE CATEGORY ERROR

Therefore, it is clear that psychological predicates – particularly the educational predicates 'learn,' 'understand,' 'think' – and brain activities are in *different categories*, on the basis of their first-/third-person symmetry/asymmetry distinctions; and any attempt to place psychological predicates *inside* the brain in place of (i.e. as if it were the same as) brain activity induces a category error. That is, the predicates 'learn,' 'think,' 'understand' cannot possibly be housed inside the brain since they do not have the appropriate construction, and are not governed by the same rules. This is the basis of the category error, inherent in 'brain-based learning theories' which purport to describe learning by taking the brain as the locus of predicates such as learning, thinking and understanding. It is a tempting and, indeed, a forgivable error to commit. Talk of the brain 'learning, thinking, understanding' is not as glaring a blunder as talk of 'sleeping' sticks. The combination of the words in the statements 'learning takes place in the brain' or 'here [**pointing to a neural image of the brain, for example**] is where the brain is learning' gives rise to what *looks like* sensible statements. We are, as Wittgenstein claims, 'bewitched' by our language.

4.5 NEURAL IMAGING: WHAT IT SHOWS

But neuroscientists may protest that the brain's ability to make connections while it (the brain) is thinking, to learn, to understand, or to be emotive are visible from PET or fMRI images of the brain which are a staple of media portrayals of neuroscience. Bennett and Hacker reject this notion:

> But this does not show that the brain is thinking, reflecting or ruminating; it shows that such-and-such parts of a person's cortex are active when the *person* is thinking, reflecting or ruminating. (What one sees on the scan is not the brain thinking – there is no such thing as a brain thinking – nor the person thinking – one can see that whenever one looks at someone sunk in thought, but not looking at a PET scan – but the computer-generated image of the excitement of cells in his brain that occurs *when* he is thinking.)

(Bennett and Hacker, 2003, pp. 83-84)

It suffices to say therefore that all that can be learnt from the most sophisticated neural imaging techniques such as PET and fMRI is that there is activity in certain areas of the brain which can be probabilistically correlated to certain behaviours *whilst* the living human being does them. And to emphasize once more, such correlations *do not show* that the brain learns, thinks or hypothesizes, as opposed to showing the activity in the brain whilst the human being whose brain it is, does these things. Any attempt to draw any further information from a neural scan results in confusion.

Glock (1996, p. 177) observes that Wittgenstein's philosophical psychology, particularly his later writings, does not permit the transgression from the 'mentalist' (mind/body dualism) view to the materialist (brain-body dualism) view. Despite the fact that the materialist view seems more plausible than the mentalist view – by virtue of the fact that it induces a physical entity (the brain) in place of some ethereal realm (the mind) – Wittgenstein, nevertheless dedicated some of his later writings to dispensing with anything more 'up-to-date'. The hope that the neuroscientific method (neural-imaging) can reduce the uncertainty which has plagued the 'hidden inner' realm is pre-emptively halted before it can gather any pace. As Glock (1996) concludes:

> … it seems plausible that mental phenomena are inner causes of outward behaviour, and must hence be identical with neurophysiological phenomena, that is, brain-processes or -states. However, even if one grants this causal conception of the mind, it does not follow that psychological statements describe neurophysiological phenomena. If Wittgenstein is right, first-person present tense psychological utterances are by-and-large not descriptions of anything, let alone the brain. Less controversially, what little I know about my brain is based on fallible evidence, but that I have certain sensations, intentions, beliefs, etc., is neither subject to error, ignorance or doubt, nor based on evidence or observation of any kind.

(p. 177)

There is clearly a category difference between the psychological and the neurophysiological, evident in the fact that – as Glock (1996) observes – the language used to talk about both realms is not interchangeable. Consider for example the following string of statements, used by Glock (1996, p. 178):

A1: I am in pain

A2: my C-fibres are firing

B: I can doubt whether my C-fibres are firing

Notice that the use of A2 in statement B leads to no apparent confusion. I can indeed doubt that my C-fibres are firing, since such an event is based on fallible evidence, which I may or may not be convinced by, of have knowledge of. However, Statement A1 cannot be readily substituted into statement B in place of A2, since it would then read:

B*: I can doubt that I am in pain,

which is clearly nonsense. What might it mean to doubt that one has such-and-such a pain? Even in cases of severe hypochondria, the person who claims to be in pain exhibits no doubt about their pain, regardless of its lack of substance. Their actions demonstrate a lack of doubt. The problem of substitutability gives rise to a difference of categories between psychological states (such as pain, learning, thinking, etc.) and brain states. Whatever is shown on the brain scan or neural image, therefore, cannot be logically connected to a psychological state.

To be clear, this does not amount to a denial that a properly functioning brain is a 'precondition for the possession of mental capacities' (Glock, 1996, p. 178). Moreover, the lack of logical connection between psychological states and brain states does not preclude that there exists a *correlation* between some mental phenomena and neurophysiological states. However, Wittgenstein's philosophy gives rise to the notion that there is, as a matter of fact, 'a universal parallelism between the mental and the physical' (ibid). Glock (1996) cites a series of propositions from Wittgenstein's *Zettel* which seem to capture this feeling, namely §608-9 and §611:

> No supposition seems to me more natural than that there is no process in the brain correlated with associating or with thinking; so that it would be impossible to read off thought-processes from brain-processes. I mean this: if I talk or write there is, I assume, a system of impulses going out from my brain and correlated with my spoken or written thoughts. But why should such a *system* continue further in the direction of the centre? Why should this order not proceed, so to speak, out of chaos?
>
> (*Zettel*, §608)

Wittgenstein, therefore concludes that our yearning for a causal picture between the psychological and the physiological should be abandoned:

> It is thus perfectly possible that certain psychological phenomena *cannot* be investigated physiologically, because physiologically nothing corresponds to them.
>
> (*Zettel*, §609)
>
> The prejudice in favour of physiological parallelism is a fruit of primitive interpretations of our concepts. For if one allows a causality between psychological phenomena which is not mediated physiologically, one thinks one is professing a belief in a gaseous mental entity.
>
> (*Zettel*, §611)

As a result of these realizations, the conclusion is that 'even where neurophysiological phenomena are, as a matter of empirical fact, correlated with mental phenomena, they are neither necessary nor sufficient for the latter' (Glock, 1996, p. 178). That is to say, even if brain-state A has, in the past, correlated to psychological state A*, this in no way suggests that being in brain-state A *always* means being in psychological state A*. One is in psychological state A* only when one is in that state. For example, the brain-state for being in pain does not mean that one is in pain. Rather, one is 'in pain' when one is in a state of pain, not in a state of 'brain-state pain'. Conversely, it is logically possible to be in a psychological state B, even if the neural image does not correlate. So, for example, one could be thinking that things are thus-and-so, even if the neural scan suggests a contradictory brain-state. It is therefore logically impossible to establish necessary or sufficient brain-states for psychological states; and this logical impossibility results from the categorial distinction between psychological phenomena and neurophysiological phenomena. The conclusion is, therefore that 'there is no conceptual connection between neurophysiological mechanisms and mental phenomena' (Glock, 1996, p. 179). Moreover, 'Neurophysiological concepts play no role in our explanation and application of mental terms: third-person uses of mental terms are based on behavioural criteria, first-person uses are not based on any criteria, let alone neurophysiological ones' (ibid).

5 CONCLUSION

This paper has examined the philosophical credentials of neuroscience in general, and by extension the impact of neuroscience on educational discourse, in the guise of neuroeducation and brain-based learning. Such primitive connections have been given extra clout in recent years, especially due to the overwhelmingly favourable contribution made by The Royal Society in 2011. Neuroeducation and brain-based learning, despite being in their infancy, have a scientific credibility which is sustained by leading thinkers in both cognitive neuroscience and education. The philosophical underpinnings of this collaborative project, therefore, are entitled to a rigorous examination.

This author has concluded that the connections between neuroscience and education are philosophically and conceptually weak, in the main due to the neuroscientific community being, in the large part, ignorant of the asymmetry principle. It has been argued that neuroscience has fallen prey to a materialist version of outdated Cartesian philosophy, by transcribing what used to be categorized as mind-body dualism onto a modern-day version of brain-body dualism. This author has put forward the case, in keeping with Wittgenstein, that the connections between the inner and the outer should be considered as an infusion rather than a separable dichotomy. As such, the asymmetry principle of ascription between the first- and third-persons can be accounted for. The commitment, however, of neuroscience and its educational derivations to flawed Cartesian philosophy gives rise to a profound conceptual error. This conceptual error in turn has become part of the collaborative project between neuroscience and education.

The overall conclusion, therefore, is fairly bleak with respect to the input which neuroscience can have on educational discourse. To be clear, it is not that neuroscience is rendered useless to education, as it is a realization that the neuroeducation and brain-based learning programmes are fundamentally restricted. Moreover, this author questions whether neuroscience and education ought to be considered as compatible. It is true that on the face of it, neuroscience and education seem to have common trends within each of their respective research programmes, to the point that the collaboration would seem intuitive. However, as this author has shown, the philosophical incompatibility is embedded into the work which has already been conducted collaboratively, and the pragmatic and practical connections are also far from clear.

This author concludes therefore that the neuroscience-education collaboration requires, at the very least, a rigorous philosophical examination, and remains entirely pessimistic that the inexorable complications which plague the collaboration currently are resolvable.

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