Paper 1.1 - Abstract- Myths and Reality: the uses and abuses of neuroscience in further education.

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Abstract

This study investigated the knowledge and use of educational neuroscience in a large Further Education (FE) college. The FE College, referred to as 'Jackson College' had four main campuses, delivering a range of courses from entry level up to level five. A small qualitative study based on a case study design was used and results were obtained through two collection methods. Firstly, two 'one to one' interviews were carried out with the College Principal and the Curriculum Principal; following this a focus group was held with five Learning Directors.

Results indicated that the knowledge of educational neuroscience was very limited and that at present within Jackson College there was no conscious effort to focus on neuroscience as a method of improving teaching and learning; suggesting that as a discipline it is unknown by the college. The results also show that neuromyths, identified in the OECD reports (2002 and 2007) and by the educational neuroscience community, are evident in the college. Some knowledge of 'Learning Styles' and 'left/right' brain learning was prevalent in the college and these ideas were discussed in relation to brain science with no indication that they could be neuromyths. Sharing the outcomes of the study has led to several possible innovations at the College:

1. A member of the college should have a role of responsibility for keeping up to date with developments in educational neuroscience;
2. The college should subscribe to two relevant peer-reviewed journals, one that is based in cognitive neuroscience and one that is based in education;
3. Key staff should attend conferences on education and cognitive neuroscience;
4. In partnership with a suitable university the college should develop a research centre or programme in educational neuroscience;
5. An expert in educational or cognitive neuroscience should be invited in as a guest speaker at the next CPD opportunity;
6. The college should include a critical introduction to educational neuroscience into their in-house teacher training programmes.

Introduction

The aim of this study was to investigate the current understanding and use of educational neuroscience in an FE college, called *Jackson College*. This included discovering if the neuromyths discussed in the OECD reports (2002 and 2007) were evident and incorporated into practice within the college. Examples of typical neuromyths in the OECD reports are:

- We only use of 10% of our brains.
- The right hemisphere of the brain is for emotion and creativity. The left hemisphere deals with logic and reasoning.
- The brain is only plastic for certain kinds of information during specific critical periods, with the first three years of a child's life being decisive for later development and success in life.

In light of the Education Endowment Foundation (EEF) proposed £6 million investment into educational neuroscience research it would appear the relatively new discipline is set to grow. However, is it likely or at all possible that findings from a brain scan can actually be applied as 'usable knowledge' in an educational domain (Clement and Lovat, 2012)? In recent times there has been a call for 'Neuroeducators' (Fischer, Goswami and Geake, 2010) and 'mutually informing' scholarly expertise (Hruby, 2012) to develop the discipline but has this filtered through to the educational community? These questions are at the heart of this paper which is focused on discovering the current synergy by investigation how teaching practitioners currently use information from educational neuroscience in their day to day teaching practice. This synergy between education and neuroscience will be critical for advancements to be made in the field and for neuroscience to have a positive impact on teaching and learning in schools and colleges in the future.

It would seem simple and plausible to make the connection between the brain and learning; a connection seemingly exploited by the educational community, and the potential of neuroscience was welcomed recently for the contribution it could make to teaching and learning (Purdy, 2008). Neuroscience has catapulted its way into public thinking in recent times and in simple terms can be called 'brain science', drawing upon knowledge from neurology, psychology, physiology and biology (Goswami, 2004). As a discipline for understanding learning it has the potential to help any practitioner in education or other associated areas. Education has a fundamental interest with the brain and to develop a greater understanding of the principle organ for learning (Diamond in the TLRP, 2007), which might afford more efficient and effective learning practices. Discoveries in 'educational neurology' could improve how education is designed and delivered; teaching and learning methods, classroom delivery, curriculum planning and also early intervention

programmes aimed at helping learners who struggle in a particular subject or area of cognition are some of the possible benefits (TLRP, 2007).

However, there is a need to be cautious when digesting the myriad claims based upon neuroscientific findings. Excitement should not overshadow or mis-interpret realistic findings. In relation to educational neuroscience one pitfall of this enthusiasm is the potential to alter teaching practice based on unproven claims. As Weisburg *et al*. (2008) have demonstrated a major problem for teaching practitioners has been in disentangling the claims made in the media about the benefits associated with neuroscience. For example, there may be some imaginative or sensational interpretation of causality in research in: *The Neural Basis of Romantic Love* (Bartels and Zeki, 2000), *The Neural Basis of Unconditional Love* (Beauregard *et al*., 2009) and *Neurobiology of Wisdom* (Jeste and Meeks, 2009). The media seem to popularise and capitalise upon such research (see Leake, 2009), possibly not always in the best interests of teaching and learning, or neuroscience.

Another important aspect that is not always considered when interpreting findings from educational neuroscience is the technology used. There are several techniques that can be employed to measure brain activity and in some cases more than one may be combined. Neuroimaging is based on changes to neural activity within the brain when taking part in cognitive tasks (Goswami, 2004) with Functional Magnetic Resonance Imaging (fMRI), Positron Emission Tomography (PET) and Electroencephalography (EEG) being popular techniques used. However, whichever technique is employed there may always be questions about conclusions drawn concerning detectable brain activity and inferences made about concepts such as love, hate, beauty, evil, logic and learning and other perceived wisdom.

It is important not to lose sight of just how complicated the brain is, how interconnected it is. The primary techniques that are used to tell us information are based on sophisticated software that measures brain activity in an indirect way in most cases, for example blood flow. The measurements are not fine, they are gross, looking at large areas of the brain and are based on averaged calculations above and beyond the norm to allow ‘conclusive’ statements to be made. There is also a delay in the timing of the mental adaptation for some of the techniques, meaning that results cannot explain what happens at the time of the mental events. Finally, it is not actually known what all the neurons are doing within the brain, although empirical estimates can be made through observation, often with crude or adventurous inferences. Whilst the argument might be that technology is improving and that it is only a matter of time before brain functioning is fully understood, caution is still needed when interpreting findings (Geake, 2009). A conflicting opinion to this is that knowing where something sits in the brain does not necessarily tell us anything useful about human behaviour (Varma and Schwartz, 2008; Tallis,

1999) and we should be wary of how neuroscience can guide practice and policy in education (Bruer, 1997).

The philosophical debate concerned with the nature of the human *being* (ontological understanding) cannot be overlooked when trying to appreciate how neuroscience functions as a panacea for some within an educational environment, for example, *Neuro Linguistic Programming* being the latest fad in some learning circles. This fact was not lost on Purdy and Morrison (2009) who use the philosophy of Wittgenstein to highlight how ascribing apparent certainties of human behaviour within brain science can run into numerous problems, largely based on the indeterminacy of human behaviour measured through brain activity. Their work adds to a long tradition of research around the Mind-Body debate; from *Catesian Dualism* by Rene Descartes (1637) to Gilbert Ryle's (1949) monist thesis, *The Ghost in the Machine* to Warner and Szubka's (1994) *Mind-body problem, a guide to the debate*. A simplistic interpretation of what this could mean is if there is a belief that human behaviour and consciousness cannot be fully explained by 'scientifically' measuring and analysing brain activity, then there is likely to be a degree of scepticism regarding neuroscientific findings. That is, when we peer into a brain we don't actually know what we are looking at. See also Churchland and Churchland's (1994) *Neuroscientist's Field Guide* on reductionism in this field and the problems between physical evidence of brain activity and inferences that might be made about human behaviour as a result.

Neuromyths and neuromythologies are terms that have been used to describe dubious claims about the brain and learning. The most damaging aspect of neuromyths may be the impact they are having on teaching practice in educational establishments. Howard-Jones *et al.* (2009:2) researched the neuroscience awareness of trainee teachers and concluded that 'in the absence of formal training, trainee teachers acquire their own ideas about brain function, many of which are potentially detrimental to their practice as teachers'. This was endorsed by Dekker *et al.* (2012) when researching the predictions and prevalence of misconceptions among teachers around neuromyths in education. The study was carried out with teachers in the United Kingdom and the Netherlands. One part to the study was an online survey with 32 statements, 15 of these were classified as neuromyths. Teachers agreed with 49% of the statements which were actually based on myths, which may indicate they believe in these myths. To illustrate, a selection of these myths were, for example:

Neuromyth 1: We only use of 10% of our brains.

Neuromyth 2: The right hemisphere of the brain is for emotion and creativity. The left hemisphere deals with logic and reasoning.

Neuromyth 3: The brain is only plastic for certain kinds of information during specific 'critical periods', with the first three years of a child's life being decisive for later development and success in life.

Neuromyth 4: Enriched environments enhance the brain's capacity for learning.

Neuromyth 5: There is a visual, auditory, kinetic and a haptic type of learning.

Neuromyth 6: Myths about bilingualism such as, two languages compete for resources in the brain, knowledge acquired in one language is not accessible in another language, or, the first language must be spoken well before the second language is learnt.

Neuromyth 7: That multi-tasking leads to greater efficiencies and productivity.

(adapted from: CERI (2013) *Neuromyths* Centre for Research and Innovation)

Educational neuroscience and its incumbent neuromyths make possible a criticism of some established theories in education which has been that some ideas, theories or models have merely satisfied a need; political, educational or institutional, to justify action and/or investment. For example, long standing ideas about teaching styles in Physical Education (PE), such as Mosston's (1966) and later Mosston and Ashworth's (1985) *Spectrum of Teaching Styles*, and Kolb's (1976) *Inventory of Learning Styles* (VAK: visual, audio, kinetic preferences for learning) developed further by Honey and Mumford (1982) in their *Activist, Theorist; Pragmatist and Reflector* model of learning preferences, and then Gardner's (1983) *Multiple Intelligences Theory*, all have more recently been doubted as constituting a 'full account' of teaching and learning processes for their apparent ineffectiveness, or at least promotion of a status quo in educational achievement over the last 25-35 years or longer (Coffield, *et al.*, 2004; Wiliam, 2009; Willingham, 2010).

Methodology and research design

By speaking with staff and senior managers responsible for implementing teaching and learning strategies in Jackson College, this study set out to investigate the current understanding and use of educational neuroscience. In short it was to find out what people knew about the discipline. Had they heard of educational neuroscience? Did they know about the philosophical debate? Did they know about neuromyths?

For these reasons a qualitative approach was fundamental to ascertaining their opinions regarding perceptions of neuroscience (Newby, 2010). Working within the interpretivist paradigm (Sparkes, 1992), participants' understandings could be set against their own social interaction and meanings, i.e. interpretation of the data was grounded in/guided by the research context. This approach differed from how medical science might carry out experiments in neuroscience, or how a sport and exercise scientist might use a positivistic, experimental model to investigate the cause and effect of a new intervention.

A case study design was used to collect data and allowed an in-depth investigation of a single case i.e. the understanding of educational neuroscience at Jackson College alone. A case study can be defined as an 'intense examination of the setting' (Bryman, 2012:67), so data collected from Jackson College meant the results are difficult to generalise to other populations, i.e. the findings from this study should not be generalised to other FE colleges (Bassey, 1999). However, as Yin (1994) argues a 'domain' (themes or concepts) may be identified to which some 'naturalistic' generalization might occur. Also that the aim of small scale case study research is to uncover practical truths within a given, if isolated, context (Giacobbi, Poczwardowski and Hager, 2005). Consequently, the findings from the Jackson College case study may stimulate future research across the sector from which more general trends might be identified.

Specific staff were asked to contribute to the study through purposive sampling (Cohen, Manion and Morrison, 2011) as they were required to have curriculum design knowledge and teaching and learning experience. The data was gathered using two main methods; interviews and a focus group. First, two semi-structured interviews were carried out with the college's senior managers, following an interview schedule (pre-set questions) that permitted some flexibility for respondents to talk more freely around issues, allowing the researcher to explore interesting viewpoints that may arise (Newby, 2010). To triangulate the data from the two interviews a focus group was carried out with five advanced practitioner teachers. Like the interviews, the focus group had the same basic schedule, again with some latitude to permit people to discuss tangents of interest sparked by them. In this manner, the focus group (as a data collection tool) was flowing, not overly restrictive and whilst staged by the researcher was, once underway, largely participant driven.

With informed consent, both the interviews and the focus group were recorded with MP3 audio devices; the focus group was recorded using a video camera with faces masked/anonymised by digital software PhotoShop devices. The data was transcribed and analysed simultaneously, by hand, in order to preserve the context and primacy of the data (Palmer and Griggs, 2010, Cohen, Manion and Morrison, 2011) in preference to using a computer programme such as NVIVO or NUDist when important contextual information and feel for meaning can be faded out through excessive thematic reduction (Crowley, Harre and Tagg, 2002).

Interview/focus group schedule

1) What do you understand of the term educational neuroscience?
2) Do you think our current teaching (and learning) practice is influenced by educational neuroscience?

3) Are any of the neuromyths identified in the OECD reports prevalent in Jackson College? (*Neuromyhts 1-7 above were shared for this question).

Anticipated supplemental questions; prompts and clarifiers

- Have you heard of the term 'brain science' in education?
- What do you understand by 'brain science' as a term or ideology?
- Has there been any teacher training or government initiatives based upon educational nueroscientific principles aimed at this college?
- Have you or, to the best of your knowledge, anyone else from the college been to any meetings or conferences on educational neuroscience?
- Currently is it part of the college's strategy for tutors to take students through learning styles VAK test? (Assessment of preferred learning style: visual, auditory or kinaesthetic learning).
- What do you feel is the benefit of the VAK test to teachers and students?
- Has the VAK test, as a pre-enrolment exercise, helped to guide students onto appropriate courses that sit them? Is there any local evidence for this?
- Do all colleges need the VAK test in place to meet OFSTED regulations?
- Have you heard of left/right brained learning?
- Has anyone in the college been to training on how to accommodate left/right brained learning?
- Would you be willing to implement a new strategy based on neuroscience or would you wait for government/OFSTED guidance first?
- Have you heard of 10% brain usage?
- Should teachers have a basic knowledge of the brain?

NB: These questions are just outlines/prompts for discussion and could be approached differently in the interviews and focus group, depending on the flow and direction of the conversation.

Neuromyths and mythology: what staff in Jackson College said about neuroscience within teaching and learning:

Data collection method I: Interviews: Andrew Bright (AB) and Charles Dent (CD): Pseudonyms of Senior Managers interviewed at Jackson College.

Data collection method II: Focus group: comprising five Advanced Practitioner Teachers at Jackson College.

Excerpts of primary data from the interviews and the focus group are presented in combination to build an overall picture of respondents' understanding of educational

neuroscience and the influence of neuromyths upon their beliefs about teaching and learning in practice and in theory.

Interviewer: Question (1)

What do you understand of the term educational neuroscience?

Andrew Bright: I have heard of it, but I probably could not tell you much more about it other than it is more about the relationship between psychology and education and the way the brain works and operates in terms of planning education and getting the best out of thought processes and education. But no I am not an expert.

Charles Dent: No, I have not really heard much about neuroscience. The term cognitive behaviour, I'm familiar with that kind of thing in education but I've not seen anything that comes through with the term 'neuroscience' in education circles.

Focus Group: Within the focus group the term neuroscience was again not well known by any of the advanced practitioners in the room.

A follow up question of 'What about the term brain science?' was then asked that initially gained no response, before one member of the group commented:

'Left side of the brain, right side of the brain' (Person A).

Followed by another member who commented:

'Yes I was going to say was it left or right side' (Person B).

Data/discussion inference:

As a new discipline it is evident that educational neuroscience is not yet understood as a way of understanding teaching and learning in the same way that more classical approaches such as psychology seem to be. This would make sense with the discipline in its infancy. However, the findings from the focus group would indicate that although the term neuroscience has not been heard of, surrounding topics have filtered into mainstream education, such as cognitive behaviour. This suggests that as a discipline the knowledge is minimal and that an understanding of what educational neuroscience involves is not evident within senior managers and teaching practitioners but terminologies around the brain and learning have made their way into the educational domain.

Interviewer: Question (2)

Do you think our current teaching (and learning) practice is influenced by educational neuroscience?

Andrew Bright: It possibly could have done at the teacher training level. I would expect now for anyone going through a teacher training programme it would now be an integral part of what they're learning. Whereas, certainly, when I did my teacher training, no it wasn't, I did not cover it in any shape or form. I would expect that it would be now and probably some of those who have recently come through that journey would be more familiar with it but I wouldn't be.

A follow up question was asked regarding if there had been any conferences that members of the college had been invited to or if any expert speakers had visited the college. The answer was 'No'. A third follow up question was asked regarding how in the future the college might develop knowledge about neuroscience to underpin teaching expertise…

> **Andrew Bright:** I think we are still working on refining it, but as you'll know we have a week's CPD at the end of term (Continuing Professional Development) and then we also have teacher training dates scattered throughout the year, some of them have specific purposes like business planning, curriculum planning and others are specifically around subject needs. Predominantly they should be around helping us develop the new thought processes around teaching and learning, so this is exactly the kind of thing that we could introduce in that CPD week…

The second Senior Manager also stated that as a discipline it has not been incorporated into the college's teaching practice but did offer an insight into how teaching and learning methods do spread throughout the college.

> **Charles Dent:** Our professional development team who support the teaching and learning infrastructure from a HR (Human Resource) perspective do research into what would benefit our teaching community in terms of courses, and they identify emerging teaching/learning strategies, or technologies and they embedded that into the training and development of our teachers. This is another mechanism to get our staff thinking about educational theory and practice.

A follow up question was asked concerning new research into neuroscience and if the research team would identify it, the answer was 'Yes'.

Data/discussion inference:

The data indicate that at Jackson College at present there has not been a conscious effort to focus on educational neuroscience as a method of improving teaching and learning. However, towards the recommendations by Geake (2009) who wants educators to have a greater influence to drive the discipline forward, there seems to be interest at Jackson College to develop new teaching and learning training ideas. Also, educational neuroscience could do more to improve its network and outward appeal to allow the filtering process into Jackson College to begin.

3) Interviewer: Question (3)

*Are any of the neuromyths identified in the OECD reports prevalent in Jackson College? (*Neuromyhts nos 1-7 above were shared on a list for this question).*

Responses related to learning styles.

Andrew Bright: Going back a good few years now, as part of the induction of young people on to courses, there were 3 or 4 prelim tests, so there were a few different learning styles surveys, questionnaire analysis, that were introduced into the joining procedures.

He continued…

Andrew Bright: Theoretically the teacher/lecturer would look at the make-up of the learning styles within their group and they would ensure that they are aware of that and therefore understand why they may or may not get responses to certain activities and ways of learning and then also that they can tailor through their schemes of work and lesson plans activities that will get the best out of the group of learners there.

Charles Dent: We've been working hard on this, this is about our initial advice and guidance and our screening of learners and actually identifying… [their learning preferences] …we use the VAK system, visual, audio and kinaesthetic analysis so that we can actually identify their preferred learning style, which actually, you know, common sense would say it links to, …does link to brain activity I'm sure.

He continued…

Charles Dent: We make our curriculum as diverse as we can to accommodate different learning needs for different learners. So we would make sure there are lots of interactive and hands on elements to the courses for learners who are of a kinaesthetic nature with a good mix of theory and a good mix of demonstration for those learners that were visual and audio.

Responses in relation to left/right brain learning.

Focus Group:

…And obviously it is a key belief in psychology readings and studies, about the left brain/right brain division (Person A).

…They have either got the very logical left brain or the creativity of the right brain and some people are extremely fortunate to have both (Person D).

…Yes the left right brain thing… it links with learning styles (Person B)

…Sometimes it has been linked to mind mapping…when you do a mind map you can actually draw things as well as write things and actually that is trying to develop both sides together, right and left sides together. That is how mind mapping as an activity can be a creative process (Person D).

…If you're looking at cognitive knowledge it would be through the mind mapping or through images… left brain would be more sequential, like a PowerPoint… (Person C).

…So they [students] are assessed for it in their induction pack, it's recorded, whether it is actually taken any further I don't know (Person E).

…We use it in context statements and things like that so we can assess groups of learners, like, he's a kinetic learner so he can do PE GCSE (Person A).

Data/discussion inference:

The results from the one to one interviews and the focus group indicate that neuromyths are prevalent in Jackson College. The two dominant myths are concerning learning styles and right/left brain dominance. The focus group was

asked if it is a college directive to use VAK learning styles assessments. Most members were in agreement that they are encouraged to use them, however one person did comment, *'it is something that we do because we have to do it'* (Person E). The duration of the focus group was 25 minutes with the topics of learning and learning styles left/right brain being discussed for 15 minutes i.e. the majority of the focus group time – even allowing for the initial quietness of people becoming prepared to speak in this research setting.

Discussion: neuromyths at Jackson College

The knowledge of educational neuroscience and neuromythologies revealed by the respondents can be viewed as polar opposites in the data. It is evident that knowledge about educational neuroscience as a discipline is almost non-existent but knowledge of neuromyths is evident, if not prevalent. The key point to raise here is that those involved in the study did not at any point state that what was being discussed was actually a neuromyth which suggests that this status in their beliefs was not known by them. In other words what appears to have become educational belief held by an individual was not recognised, pejoratively as neuromyth. Thus, the neuromyths seem to have entered into the college domain as a credible means for improving teaching and learning. This potentially has detrimental outcomes on teaching and learning practice within Jackson College and shows the ease with which neuromyths can sometimes appear convincing; neuro-facts.

This is a concern because not only does it diminish educational neuroscience as a discipline it could prevent teachers from a) being able to judge the value of a new intervention in the first instance, and b) trying out new techniques in fear that the technique will prove to be a misnomer – what knowledge might they draw upon to evaluate the new technique? It seems to be a negative self-perpetuation in what appears to be useful as a learning tool may indeed be, at best, a waste of time. As Geake (2008:130) succinctly points out, 'VAK might, if it has any effect at all, be actually harming the academic prospects of the children so inflicted'.

The over simplification that has led to the left/right brain learning phenomenon is a good example of neuromyths making their way into the public domain. It is thought the left/right brain neuromyth stemmed from some hemisphere dominance in some skills. An example is language processing which seems more left-lateralised, and face recognition more right-lateralised (Goswami, 2004). However, this does not mean that learning or in fact people can be categorised as left or right brain learners or people (OECD, 2007). If anything, research shows that both hemispheres work together in cognitive tasks and there is massive cross-hemisphere connections (Goswami, 2004).

Given the above simplification and the fact that left/right brain learning has been classified as a neuromyth by the scientific community for some years now (the first OECD report was published in 2002) it is surprising that the left/right brain neuromyth was prevalent in the data of this study. The respondents indicated that it is not used as a formal strategy (such as in induction packages) by the college but it is certainly still very much alive in practitioner thoughts and voiced in discussions.

The results also indicated that learning styles theory is heavily relied upon within the college. Coffield *et al*. (2004) conducted extensive and critical research about their use in teaching and learning, raising some doubts about their usefulness in certain settings, however respondents were not aware of these developments. However, a significant point in the data was that different learning styles were discussed in relation to brain science, suggesting that participants believe that learning styles are useful and based on scientific fact. Whilst learning styles are not the central focus of this paper it may be important to consider why participants link learning styles so easily with 'brain science' when recent research suggests this may not be the case; Goswami (2006), Purdy (2008) and Geake (2008) all giving explanations as to why learning styles and brain activity should be treated with extreme caution.

Conclusion

In closing, it may be claimed that both learning styles and left/right brain learning have no grounding from a neuroscience perspective, yet were known by the majority of participants within this study and discussed in relation to brain science, whereas the actual term 'educational neuroscience' is not known by them. The main reason for the knowledge of the myths and not the actual discipline could be due to the neuromyths being more accessible and an easily imagined explanation of what in actuality may be much more difficult to account for.

The results also indicate that too often, teaching initiatives may be too closely linked with ill-informed ideas about the brain and learning. On the issue of learning styles, it is clear that people may prefer to learn in different ways. Teachers may not need 'brain science' to understand that some students can be motivated one day and not the next, or enjoy one lesson and not another; good teachers seem to know this and manage their lessons in their own preferred way, regardless of whatever theory might be offered up to evaluate it. Consequently, as many of the 'neuromyths' identified by the OECD (2002 and 2007) are evident in the college we encourage further research into educational neuroscience and development of staff training at a practical level of application in Jackson College, in order that these unhelpful myths about the brain and learning might be usefully mitigated. A wider implication is for a greater responsibility to be placed on the dissemination of findings from

neuroscience into an educational domain. Results gathered in this study are comparable to Simmonds (2014) who explored how neuroscience is affecting education and learning using large-scale surveys which would suggest that the issues discussed here are not unique. With this in mind, the EEF may wish to spare some of the £6 million funding to build a better network of distribution into education of the myriad of neuroscientific research to be carried out over the coming years.

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