The Brain in the Jar: Troubling the Truths of Discourses of Adolescent Brain Development

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Abstract

Ideas about adolescent brains and their development increasingly function as powerful truths in making sense of young people. And it is the knowledge practices of the neurosciences and evolutionary and developmental psychology that are deemed capable of producing what we have come to understand as the evidence on which policy, interventions and education should be built. In effect these discourses reduce young people to little more than a brain in a jar.

The paper examines how the evidence about adolescent brains - their volume, and the functioning and activity of different regions - from neuroscience and evolutionary and developmental psychology works as truth. What knowledge practices are used to produce this evidence, or are deemed capable of producing this evidence? What truth claims are able to attach to this evidence? What makes it true and why is it imagined as evidence of something that is true in policy, public and other research settings that are often far removed from where it was produced? I argue that the discourses of adolescent brain development disembody, reduce and simplify the complexities of these figures we know as adolescents. In effect they render the adolescent as a brain in a jar.

Keywords: Adolescent brain development, knowledge practices, evidence, embodiment
**Introduction**

Plum is soon to turn fourteen, and one evening she stands in front of a mirror with her school dress around her ankles, her body reflected naked and distressing in the glass. If her reflection is true then she has gone about in public like this – this thick black hair hugging her face like a sheenless scarf; these greasy cheeks with their evolving crop of scarlet lumps; this scurfy, hotly sunburned skin; these twin fleshy nubbins on her chest that are the worst things of all, worse than the downy hair that’s feathered between her legs, worse than the specks of blackness blocking her pores, worse even than the womanly hurdle that still awaits her, the prospect of which occurrence makes her seize into silence – and nobody has informed her of the fact that she is hideous (Hartnett 2009: 1).

This is how critically acclaimed and successful Australian author of prize winning young adult fiction Sonya Hartnett introduces us to Ariella Coyle (Plum). Plum is the main character in *Butterfly*, Hartnett’s most recent novel. Hartnett’s is a story of the embodied anguish, uncertainty and anxiety that characterises Plum’s emerging engagement with a world structured largely through the rationalities and irrationalities of adults that are, by degree, intimate and remote to her. As such it is a powerful means for exploring the embodied experiences of young people and the worlds that they inhabit.

Adriana Galvan (2006: 6885) and her colleagues, working in a vastly different register, have other ways of making sense of young people’s engagement with their lifeworld and the relations, practices and adults that populate and give shape to these lifeworlds: Adolescence has been characterized by risk-taking behaviors that can lead to fatal outcomes. This study examined the neurobiological development of neural systems implicated in reward-seeking behaviors. Thirty-seven participants (7–29 years of age) were scanned using event-related functional magnetic resonance imaging and a paradigm that parametrically manipulated reward values. The results show exaggerated accumbens activity, relative to prefrontal activity in adolescents, compared with children and adults, which appeared to be driven by different time courses of development for these regions…These findings suggest that maturing subcortical systems become disproportionately activated relative to later maturing
top–down control systems, biasing the adolescent’s action toward immediate over long-term gains.

This paper takes its purpose from the fact that it is the second of these two accounts that is likely to make a powerful appearance in contemporary policy, academic and community discussions about young people, their sexuality, their education, their use of alcohol and drugs, their mental health (see, for example, Catalyst 2005, DrinkWise Australia 2010, NSW Department of Education and Training 2010). Ideas about adolescent brains and their development increasingly function as powerful truths in making sense of young people. And it is the knowledge practices of the neurosciences and evolutionary and developmental psychology that are deemed capable of producing what we have come to understand as the evidence on which policy, interventions and education should be built. As Judith Bessant (2008: 348) argues, a critique of this evidence, the science that produces it, and the truth claims that attach to it matter because this knowledge ‘is being used to explain why young people are different enough to warrant special treatment, including their exclusion from activities that mark normal adult capacities like voting, drinking alcohol and driving cars, and why they need closer monitoring’.

My aim in what follows is not to argue that the evidence about adolescent brains - their volume, and the functioning and activity of different regions - from neuroscience and evolutionary and developmental psychology is wrong, false or untrue. Rather, I want to examine how it works as truth. What knowledge practices are used to produce this evidence, or are deemed capable of producing this evidence? What truth claims are able to attach to this evidence? My sense is that such rules of evidence exclude what me may learn about young people from the likes of Plum and her creator, and that in excluding what might be powerful (painful because of this power) truths such as these we severely limit how it is that we know young people. We reduce them, effectively, to being little more than a brain in a jar.¹

**Discourses of Adolescent Brain Development**

Susie Vanderlip (2004), an entrepreneurial child and adolescent behavioural counsellor, references a *Time* graphic/story in a posting titled, *What ticks inside a teenage brain?*, to suggest that: ‘If you thought it mostly hormones and feelings,
you’re close to being right…at least until their brains grow. Brain scans and research are confirming that the adolescent brain structures are still immature and account for much of the trouble they get into’. For Vanderlip this new evidence confirms not only our sense of what is happening in adolescents’ heads, but how these developments shape behaviours: ‘Of course, this has been the truth of human brain development for eons’. The Time story is a good space to witness the ways in which this science is popularised and the ways these popularised simulations influence public and policy thinking and debate about young people. On the Time magazine www site the story is accompanied by a photo image of a young teen boy’s head. Superimposed over this photo image is a simulation of the young male’s brain – a representation that creates a sense of what lies within this boy’s head. The image of the brain shows different regions of the brain in different colours. These colour coded regions are made to appear distinct and separate from each other.²

The image is titled Inside the Adolescent Brain. The text that accompanies the title outlines how the human brain has two ‘major developmental spurts’ – in the womb and in the period from childhood and through the teen years. The text claims that the brain ‘matures by fits and starts and in a sequence that moves from the back of the brain to the front’. So, starting at the back of the brain in this image the cerebellum is represented as a green area at the base of the brain. The text revealed here claims that new research suggests that this region undergoes dramatic change during adolescence, ‘increasing both the number of neurons and the complexity of the connections between them’. This area is ‘thought’ to support ‘activities of higher learning...and advanced social skills’. The amygdala is pictured as a red coloured egg shaped region that is located deep in the centre of the base of the brain. Teens, we are told, ‘tend to rely more heavily on the amygdala’. The text then says ‘this may explain why adolescents often react more impulsively than adults’. With the final region – the prefrontal cortex represented as a large, orange coloured section of the brain located front and centre – we arrive at the front of the brain just behind the forehead. The prefrontal cortex is described as the ‘CEO of the brain’. It is also called ‘the area of sober second thought’, and ‘is the last part of the brain to mature – which may be why teens get into so much trouble’.
This evidence from neuroscience is harnessed in particular ways to suit particular purposes in various settings and spaces concerned with explaining and understanding adolescents/young people. On the www site of DrinkWise Australia Andrew Rochford (MD) is interested in the latest neuroscience research on adolescent brain development. Drawing on the neuroscientific evidence about adolescence as a period of increased, significant and final brain development Rochford (2010) claims that this ‘development period is…vitally important and anything that interferes with this is obviously bad news’. During this time ‘the important areas of the brain involved in reasoning, planning, inhibition and emotion regulation are being developed’. As an ambassador for cultural change in relation to alcohol consumption Rochford, endorsing a DrinkWise campaign Kids and Alcohol Don’t Mix, argues that alcohol ‘disrupts brain development. Teenagers who drink alcohol risk their brains not reaching full capacity, which means they might never reach their full potential as an adult. It’s that simple!’ Importantly, these ‘neurological processes, that were originally designed to ensure human survival, are put off course by alcohol’.

As the new truths of computed, behavioural neuroscience circulate, are translated and popularised in a range of public, policy and academic spaces in which adolescent behaviour and psychology is the thing of interest, then the ways in which these representations of adolescent brain development are constructed are forgotten. The assumptions, the provisional, conjectural nature of any activity, any evidence fades from view, disappears in the particular hinterland in which this knowledge is produced and circulates (Law 2004). The following section explores elements of this hinterland.

The Brain in the Jar: Imaging and Evidence

Joseph Dumit’s (2004) Picturing Personhood: Brain Scans and Biomedical Identity is an account of his 3 years in the field in the Positron Emission Tomography (PET) community. Dumit’s ethnography provides a powerful insight into how communities of science work, how they establish the practices, processes and technologies capable of producing truths, and the ways in which computer enabled neuroscience allows certain forms of thinking, particular ways of conducting and reporting on experiments, and disallows others. PET is a computed tomography (CT), or computer mapping, technology that is used in scanning the brain and other organs. Put very simply PET
scans record traces of injected radioactive isotopes as they flow and disperse/degrade in various locations of the body. PET technology is, as Dumit (2004: 3-4) identifies, ‘an incredibly complex, expensive and deeply interdisciplinary set of techniques and technologies’ that requires many millions of dollars to be invested in machines, facilities and human and technological infrastructure.

His discussion has a primary focus on the ‘visual effect of PET brain images’ (Dumit 2004: 4). These brain images - Dumit calls them fluid signifiers - travel readily and are ‘easily made meaningful’. While a PET scan represents a ‘single slice of a particular person’s brain blood flow over a short period of time’, it can come to stand in for, at one level, a definite ‘type of human’ (schizophrenic, depressed, normal). The same image can also be marshalled, along with other resources/potentialities to ‘demonstrate the viability of PET as a neuroscience technique’, and to make claims about the ‘general significance of basic neuroscience research’ (Dumit 2004: 4, original emphasis) The power and fluidity of these signifiers is vital to winning a slice of limited grant monies, and for making claims to be listened to/consulted in relation to a whole range of medical, psychological and sociological problems – such as why adolescents do stupid things. Dumit’s (2004: 10-11) interest is in both the social life/biography of these images, and the virtual communities in which these images are produced and circulate. In these communities all kinds of relationships and connections emerge, exist and are managed between such things as ‘popular theories of person and science’; scientific ‘theorizing’; ‘laboratories and granting agencies’; ‘journals and publishing apparatuses’; and ‘machines, brains and persons’.

Dumit’s ethnography highlights the difficulties that accompany the production of PET images that claim to provide evidence of something that is happening somewhere in the brain, or when someone is doing something, or suffering from some condition, or when/if someone is a normal member of a particular population. Dumit (2004: 59-60) identifies four challenges that illustrate these difficulties. The first of these raises the issue of experimental design. In order to produce evidence of something an experiment (that can be repeated/refuted elsewhere) has to be designed and undertaken. Participants need to be chosen, and this process ‘requires delimiting the boundaries of “normal human”’. Inclusion and exclusion in/from the experiment is dependent on definitions of normality: ‘Is a chronic smoker or coffee drinker normal
enough? How about someone who had been found to have depression 10 years ago and has taken Prozac for 6 months – or someone whose brother is schizophrenic?’

When participants are identified as being able to be included on the basis of their normality, or their condition or disease status, they then need to do something in the experiment: a something that can provoke brain activity that can be captured and represented. Again, the nature and the character of these tests must be controlled for, and exclude a whole range of phenomena/variables that might muddy the image of brain activity, or confound the technology, or be beyond the imagination of the scientists. Not everything in the vast array of possibilities of human consciousness, emotions, behaviours can be tested for in these settings.

The second challenge that Dumit (2004: 59) identifies relates to the measurement of brain activity. PET scanning requires the preparation and injection of particular radioactive materials into the subject: materials whose trace can then (during their half-life in the body) be scanned. The PET scanner ‘must properly collect the data’ which is then algorithmically reconstructed by computers to produce a ‘three-dimensional map of activity, based on assumptions about the scanner and brain activity’. The dataset/map for each person/participant is known as a brainset. The third challenge relates to making data comparable: this challenge requires individual brainsets to be ‘transformed and normalized so that individual’s brain locations can be correlated with those of others’. These normalised brainsets can then be ‘combined and checked for statistical significance using subtraction, averaging, and other forms of data set manipulation’. This work produces what Dumit calls a collective group brainset – which, elsewhere, he discusses in terms of the circulation and use of PET scan images that claim to capture and represent such things as dementia, schizophrenia, normality.

The final challenge in/for the systems, processes and practices that produce PET brain images is to make comparable data presentable. As Dumit (2004: 59-60) describes this challenge it relates to the ways in which carefully considered and selected colours are made to substitute for numbers in datasets, and then ‘specific colored brainsets are selected to be produced and published’. In this process colouring transforms ‘numeric variations into a contour map, highlighting some differences at the expense of others’.
The selection of images for publication and circulation is, for Dumit, a particularly ‘troubling practice’ as it involves a ‘common, standard, and often encouraged practice of selecting extreme images’. These extreme images travel more easily into public and policy spaces where ‘new, less qualified labels are applied’.

Images, simulations and representations can produce powerful truths. Seeing, as we say, is believing. Donna Haraway’s (1991) Situated Knowledges is an influential essay that discusses the objectivity/subjectivity problem in feminist epistemology and science studies. Her discussion is important here because it speaks directly to the nature of the evidence and the truths produced by CT technologies that allow us to see a brain functioning, to capture and represent this functioning in ways that appear as un-mediated, un-manipulated by human values. In Haraway’s (1991: 188) problematising of vision the eye of an ‘ordinary primate like us can be endlessly enhanced by sonography systems, magnetic resonance imaging, artificial intelligence-linked graphic manipulation systems, scanning electron microscopes, satellite surveillance systems’. The possibility of seeing the brain-in-action that CT technologies allow is one part of a ‘technological feast’ that Haraway (1991: 191) suggests quickly ‘becomes unregulated gluttony’. In this sort of pigging-out on techno-science and its truths ‘all perspective gives way to infinitely mobile vision, which no longer seems just mythically about the god-trick of seeing everything from nowhere, but to have to put the myth into ordinary practice’. The ordinary practice here relates to the ways in which the images that we feast on travel into courts, into policy spaces, into discussions about young people, sex, drugs, drinking and rock ‘n’ roll: ‘And like the god-trick, this eye fucks the world to make techno-monsters’. To make brains in jars. For Haraway (1991: 190) this meditation on vision - in all it forms - suggests that the eyes ‘made available in modern technological sciences shatter any idea of passive vision; these prosthetic devices show us that all eyes, including our own organic ones, are active perceptual systems, building in translations and specific ways of seeing, that is, ways of life’.

So, Dumit and Haraway’s work allows us to see that none of these CT technologies enable a direct, un-mediated, un-manipulated, values (algorithmic, moral, scientific) neutral window into brain processes that may shape or explain diverse aspects of human behaviours and dispositions.
Conclusion

Alva Noë (2009) is a Professor of Philosophy at the University of California (Berkeley), and a member of the Institute of Cognitive and Brain Sciences. He positions his work against the wave of contemporary neuroscience orthodoxy that suggests that you (us), ‘your joys and your sorrows, your memories and your ambitions, your sense of identity and free will, are in fact no more that the behaviour of a vast assembly of nerve cells and their associated molecules (Francis Crick, cited in Noë 2009: 5). Noë (2009: 7) proposes that to make sense of human consciousness ‘we must look not inward, into the recesses of our insides’, but, rather, ‘we need to look to the ways in which each of us, as a whole animal, carries on the process of living in and with and in response to the world around us’. Or more pointedly: ‘You are not your brain. The brain, rather, is part of what you are’.

A number of points are central to Noë’s proposition that we are not our brains. First is his working definition of consciousness that tries to capture something about experience, where experience is understood as ‘encompassing thinking, feeling, and the fact that the world “shows up” for us in perception’. Showing up means that our mind doesn’t create our experience of the world through the workings of different regions of the brain. Rather, there are environments that we, as embodied, sentient beings encounter and shape and build relations in. For Noë this requires that we think differently about the relationship between, and meanings of, mind and brain. As Noë (2009: 9-10) points out, somewhat obviously, the brain is a ‘part of the body found in the head and connected up to a larger system known as the nervous system’. In this sense to have a brain ‘is to have a certain kind of bodily organ or part’. However, to have a mind, suggests Noë, is ‘to be conscious – that is, to have experience and to be capable of thought, feeling, planning etc’. But is the mind the brain? For Noë the brain is vital to mind, but mind is not reducible to brain: ‘Consciousness is not something the brain achieves on its own’. The experiences characteristic of humans (in all their similarity and diversity) requires a complex relationship between brains, bodies, environments. Consciousness, claims Noë, is ‘an achievement of the whole animal in its environmental context’. ‘I deny’, says Noë, ‘that you are your brain. But I don’t deny that you have a brain. And I certainly don’t deny that you have a mind’. Consciousness ‘requires more than a brain. Brains don’t have minds; people (and other animals) do’ (see also Clark 2008, Rose & Rose 2000).
We can argue, then, that the brain provides the architecture for consciousness, but it
doesn’t determine consciousness, reason, irrationality. These elements and
determinants of experience emerge from the functioning, operation, activity of an
embodied brain, but the character and nature and potential of consciousness are open,
mutable.

The simple, but powerful message here is that despite appearances, in spite of the
emergence of a new orthodoxy of adolescent development that is tied to ideas of
adolescent brain development, there is much debate and conjecture about the,
epistemological and theoretical possibilities for framing the relations been brains,
minds, experience and consciousness. And about the experimental science on which
many of these claims are based. In forgetting, by design or accident, these elements of
the hinterlands in which these truths are produced and circulate the discourses of
adolescent brain development disembody, reduce and simplify the complexities of
these figures we know as adolescents, as young people of the type that might be
represented by a figure such as Plum. In this sense there is much work to be done in
troubling the ways in which discourses of adolescent brain development function as
true in popular and policy spaces.

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1 There is little space to develop this metaphor but it is a trope that has a long history in the thinking/writing of the likes of Descartes, Roald Dahl, and science fiction and popular culture.
2 From the May 10, 2003 issue of *Time* magazine; posted online on Sunday, May 2, 2003, at http://www.time.com/time/graphics/0,30207,3,00.html