# The Politics of Logic in Early Childhood Research: A Case of the Brain, Hard Facts, Trees and Rhizomes

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## Abstract

*This paper engages with questions of logic and its politics to explore how those of us in early childhood education can become critical consumers of 'brain research'. The research truths we use to construct classroom practices decide the meanings of our actions, thoughts and feelings and our interactions with children. Following Foucault (1980), I see these truths as intimately connected with power and its effects on us.*

The truths of 'brain research' have inundated early childhood education at an extraordinary pace in recent years and the recent 'Learning Brain Down Under Expo' in South Australia which attracted over 700 educators offers us a timely opportunity to critically reflect on it and its effects. My critical reflections use the politics of logic contrasting the 'tree-like' logic of linear causality and rhizomatic logic (Delueze and Guattari 1987) to point to key questions that I hope other early childhood educators can use to critically reflect on the truths of 'brain research' and its meanings and effects in early childhood education.

## Beginnings: the blush and the finger paint

*I have two clear memories of my first year at primary school. The first I call 'stinging blushes', the second, 'talking into the finger paint'. In 'stinging blushes' Miss George, my first year teacher, is teaching my class the alphabet. Miss George is perched on a chair at the front of the class holding a card on which there is a capital 'A', a lower case 'a' and a picture of a rosy red apple. We are sat on the floor in rows. I am in the second row next to my cousin Sandra. Miss George asks the class if anyone knows what letter of the alphabet she is holding. I am pretty certain is it 'A' and so I confer with Sandra, who agrees with me. I feel excited that I know the answer. But, before*

*Sandra and I have finished talking about 'A' and the fact that my dad's name, which was Alan, starts with 'A', Miss George booms my name, ordering me to stand in front of the class. I hear how 'bad' I am for talking out of turn and I am reminded that we only speak when a teacher asks us to. I feel the sting of a ruler hitting my calf as she talks to me and the sting of deep pink blush of humiliation envelop my face as Miss George insist I tell the class what Sandra and I had been saying. I was a quick learner and for the remainder of my primary school years I rarely spoke unless the teacher asked me to and I regularly blushed when I was called to talk in front of a group.*

*My other memory of Miss George's class was the first day we did finger painting. It was sometime after my learning 'A' day. I do remember feeling that I didn't want to do finger paint, my stomach churning and suddenly its contents arriving in the midst of the finger paint. This time Miss George chastised me in front of the class for not speaking. If I felt unwell I must tell her. Yet, with hindsight, maybe I did speak – clearly and into the finger paint.*

*Some years later, as a kindergarten teaching student, my first year supervisor wrote that I was very intuitive in my work with shy and quiet children but that I would have to learn to be less shy at group time and more assertive about the 'children who talked' without my permission. She also commended me on how well my finger painting experiences had gone.*

My shyness at speaking to groups of people has lessoned and it no longer constantly brings stinging blushes of humiliation with it. But I have wondered what would have been different in my early years of schooling and my life now if Miss George had been exposed to the implications of research in the neurosciences for early childhood curricula that pervade many contemporary early childhood texts. For instance:

- Given that brain development and thus later cognitive development is aided by curriculum that encourages young children to be active, to question and to construct their own understandings and meanings (see Puckett, Marshall and Davis 1999) what might I have achieved in my life now if Miss George had allowed Sandra and I to figure out what 'A' meant in our lives?
- Or, given that young children's brains process information best when it is presented in 'wholes' and when children can make sense of it in their own time and way (see Puckett et al. 1999), would I have struggled less with writing this paper if Miss George had taken a more holistic approach to us learning the 'alphabet'?
- Maybe, if Miss George had understood that positive, nurturing environments are important to healthy brain growth (Catherwood 1999) I would have been more assertive with 'children who talked' at group time.

- And if Miss George had realised that stressful environments cause us to produce a hormone (cortisol) that can reduce brain cells and neural connections (Dockett 2000) would I have been spared my 'stinging blushes' and would Miss George have been spared my 'talking into the fingerpaint'?

What are the effects on me now of how Miss George stimulated my neural pathways in that first year of primary school? If, as many argue (e.g. McCain and Mustard 1999, Thompson 2001, National Research Council and Institute of Medicine 2000), how our neural pathways form in these early years can influence later development in areas such as our capacity to learn, control emotions and be disease free, what have I lost and gained intellectually, emotionally and physically from how Miss George constructed teaching and learning in that first year of my primary school? What has it meant for how I control feelings of humiliation and anger? What arouses blushes that 'sting' and uncontrollable 'talking' now and, more importantly, how is Miss George implicated?

## Miss George and her effects: or the place of linear causality in our lives

To answer these questions requires a particular form of logic. It requires the 'tree-like' logic of linear causality. The tree's linear structure – from roots through the trunk to the branches – is a metaphor of the fixed, determining and linear logic that explains things in terms of cause-and-effect relationships. At its most simple, linear logic is expressed in the formula 'A+B=C'. For example, consider Nunley's explanation of the relationships between brain development, learning and stress:

> Stress is more than just uncomfortable, it's dangerous to the mind and body. In addition to increasing health problems, chronic stress causes problems with our memory systems, blood pressure, problem-solving skills, and thought processes in that decision-making region of the brain known as the pre-frontal cortex … Be careful in the classroom. (Nunley 2004a)

That explanation relies on linear logic with fixed and final results: stress causes various 'brain' problems. Similarly, from the World Bank we see an even starker, cause-and-effect statement about stress and early brain development.

> Early stress can have a negative impact on brain development. (World Bank 2002)

The brain development and education literature is littered with linear causality and it rests, like traditional science and most western philosophical thinking, on linear causality or what I call 'tree logic' to explain relationships between one event (a synapse in specific area of the brain) and another event (a deep pink blush).

In practice, of course, contemporary cause-and-effect formulae are far more complex, as Thompson (2002) illustrated with the following formula:

$$CI95\%M+t(\Omega=0.5\ df=n-1)\ [SD/\sqrt{n}]$$
$$=.35\pm2.447\ [.108/\sqrt{7}]$$
$$=.35\pm.10$$

That formula is a way to test 'effect sizes' in relationships between phenomena. Traditional scientific researchers investigate the world using methods with high effect sizes, which enable these researchers to say that their research results are valid 'beyond a reasonable doubt'. This confidence in its results gives traditional scientific research a high status not only among scientists but also in society generally. Its high status is reflected in its hegemony in educational research and policy making in many 'western' countries, especially the USA. For example, the No Child Left Behind policy – enacted in the USA in 2001 – gives billions of dollars of federal funds to educational programs and strategies that are based on scientific research evidence (Fueur, Towne and Shavelson 2002).

## The experiment, the longitudinal study and degrees of confidence

A 'tool of choice' for traditional scientific researchers wanting to establish cause and effect is the experimental study, especially randomised studies. Randomised experiments continue to be hegemonic in neuroscience where experiments on the rat, the cat and the chicken have been particularly important in efforts to establish causative relationships between the brain and specific behaviours (e.g. Patin, Vincent, Lordi and Caston 2004, Latsari, Antonopoulos, Dori, Chiotelli and Dinopoulos 2004). Leading the way was Hubel's and Wiesel's Nobel-prize-winning work on why sight could not readily be restored to children who were born with congenital cateracts and later had them removed (McCain and Mustard 1999) that demonstrated the importance of critical periods in the development of the brain from their work on cats in 1970. As Mandernach explained:

> The development of vision in the cat depended on the animal receiving visual stimulation during a 'window of time'. The kitten's eyelids were sewn shut so that no visual stimulation was received for a period of time. When the eyelids were opened, the physical structure of the eye was normal but the cat was 'blind'. The brain cells allocated to vision

> were nonfunctional for vision since they had not been used during the window of opportunity. They had either been appropriated for other systems or were lost. (Mandernach 1999)

Hubel later argued that

> Early deprivation of social interaction, such as contacts with a mother, may lead to mental disturbances that have their counterparts in actual structural abnormalities in the brain. (Hubel cited in McCain and Mustard 1999, p. 34)

Recent technologies that have allowed the brain and its activities to be studied in new ways have produced an 'explosion' of new knowledge about the brain (McCain and Mustard 1999). But a glance through key applied brain research journals such as *Cognitive Brain Research* and *Developmental Brain Research* shows that this explosion still relies significantly on the rat (e.g. Latsari et al. 2004, Patin et al. 2004, Peiffer, Rosen and Fitch 2004), the cat and the chick (e.g. Nicotra, Cicirata and Martinez 2004) for the 'hard facts' and causative logic. It is the hard facts about the brains of the rat, the cat and the chick that have made their ways into developmental psychology and early childhood education through the work of people such as McCain and Mustard (1999). McCain and Mustard prepared a highly influential report for the Ontario government in the late 1990s that drew in large part on understandings from within neuroscience to argue that the early years and investment in them was more critical than investment in the later years of schooling. Commentaries such as Nash's using this report are common:

> Deprived of a stimulating environment, a child's brain suffers. Researchers at Baylor College of Medicine, for example, have found that children who don't play much or are rarely touched develop brains 20% to 30% smaller than normal for their age. Laboratory animals provide another provocative parallel. Not only do young rats reared in toy-strewn cages exhibit more complex behavior than rats confined to sterile, uninteresting boxes, researchers at the University of Illinois at Urbana-Champaign have found, but the brains of these rats contain as many as 25% more synapses per neuron. Rich experiences, in other words, really do produce rich brains. (Nash 1997, p. 49)

These ideas born of 'hard facts' and 'tree logic' about rats and toys have moved rapidly into web sites and magazines geared to parents of young babies such as the online parent magazine *Baby Talk*:

> Babies who have more sensory experiences are able to develop more brainpower. Dr. Frederick Goodwin who is the director of the National Institute of Mental Health participated in some of this research. His conclusion? 'You can't make a 70 IQ person into a 120 IQ person, but you can change their IQ measure in different ways, perhaps as much as 20 points up or down, based on their environment.' In essence, an infant born with a 100 IQ can either become an 80 IQ or a 120 IQ by his fourth birthday, based on the poverty or enrichment of his experience base! (Quigg 2002)

'Hard facts' about neuroscience that use 'tree logic' to establish the importance of the early years (such as those cited by Quigg 2002, Nash 1997 and McCain and Mustard 1999) regularly circulate in the professional early childhood educational literature. They offer seductive facts and logic for early childhood educators emphasising the importance of early stimulation and positive, nurturing relationships for healthy growth and development (e.g. see Thompson 2001). At last 'science' proves that early childhood education is important, and many researchers have deeply 'desired' that proof from science for over a century (see Bloch 1992).

Early childhood educators' and researchers' century-old desire to legitimise their pedagogies using hard scientific data continues. The certainties of new truth about the child, such as those generated in the neurosciences (often referred to as 'the brain research') (see National Research Council and Institute of Medicine 2000) are widely claimed to prove that the early years are significant to later development (see Thompson 2001, Fleer 2002) in areas such as our capacity to learn, control emotions and be disease free (McCain and Mustard 1999, Thompson 1999, National Research Council and Institute of Medicine 2000). More specifically, neuroscience is seen as the source of hard, scientific data that supports the view that early experiences, including nutritional and emotional experiences, stimulate brain activity and influence how neural pathways develop. The ideas have considerable currency and authority, and are promulgated by key international institutions such as the World Bank (e.g. World Bank 2002).

Yet, amongst the certainties of traditional scientific educational research and its logic of linear causality another form of logic unsettles its certain explanations and shoots questions of change, complexity and heterogeneity to the fore. It is rhizomatic logic. Rhizomatic logic brings new questions and issues forth about what we can say for certainty about what causes us; it replaces certain 'hard facts' with shifting and multiple truths. It is a logic connected deeply to exploring the politics of knowledge and their effects that grow in a specific field of inquiry, such as neuroscience or early childhood education. With this logic new questions about my blush and Miss George

arrive and with this logic new questions about brain research in early childhood education emerge.

## Rhizomatic logic and its challenges

In contrast to the tree, the rhizome – a metaphor of 'lateral' logic – implies a world that is dynamic, ever-changing and always 'becoming' in a never-ending process. Instead of me being 'caused' in some way by Miss George and my primary classroom, lateral logic implies I am dynamic and ever changing in ways that resist cause-and-effect logic. This 'becoming' is not the becoming of a child developing towards a successful and completed adult that is the subject of child development texts (see Silin 1995). Instead, it is a process of ever shifting and shaping the self in ways that means I am/we are never 'finished'.

Rhizoanalysis builds from the philosophical and cultural theories of Gilles Delueze and Feliz Guattari (1987). They used the contrast between rhizome (e.g. ginger, iris, agapanthus) and tree as a metaphor of the contrast between two forms of logic. The tree's linear structure – from roots through the trunk to the branches – is a metaphor of the fixed, determining and linear logic that explains things in terms of cause-and-effect relationships. This we have discussed in considerable detail to date. The rhizome's contrasting 'lateral' structure – a collection of mutually dependent 'roots' and 'shoots' – is a metaphor of a dynamic, flexible and 'lateral' logic that encompasses change, complexity and heterogeneity.

A rhizome is never finished; it is always 'becoming' through crossovers between offshoots, through expansions of one form of growth into another and through the death and decomposition of outdated elements. Thus, rhizoanalysis explains things in terms of a dynamic, ever-changing 'becoming', rather than a fixed and finished 'being'; and a particular rhizoanalysis – e.g. our identities, for instance, as public speakers – is never fixed and final, but is always becoming. One meaning about who we are expands into another, some meanings become outdated and new meanings shoot forth. 'Rhizomatic' logic is associated with poststructuralist ideas because Delueze and Guattari sought to move beyond a (linear, universal) logic that produces stable and universal truths of the social world, towards a (lateral, local) logic that produces shifting and multiple truths (MacNaughton 2003).

The truth of Miss George and my blushes is still becoming and there is not one truth to be found. There are only shifting and multiple truths and effects to be found. From a 'rhizomatic' perspective, we can never 'be' in a fixed and final way; instead, we are always 'becoming who we are' as fashions, expectations, experiences, values, beliefs, opportunities and desires associated with who we are as gendered, racialised, classed

beings change over time and between cultures and geographies. From a 'rhizomatic' perspective, the development of young children requires more complex explanations than the cause-and-effect relationships between, for example, brain-compatible teaching and children's behaviour.

The 'lateral' logic of rhizoanalysis challenges linear causality, highlighting how relationships and meanings link in complex and shifting ways in our 'becoming'. For example, a rhizoanalysis of young children's identities as learners would show how those identities overlap with cognition that, in turn, overlaps with cultural experiences that, in turn, overlaps with parents' expectations, that, in turn, overlaps with their age that, in turn, overlaps with their experiences of early childhood settings that, in turn, overlaps with geographical location that, in turn, overlaps with national identities that, in turn, overlaps with history that, in turn, shifts over time (Mansfield 2000). And so on, and so on. If identities grow rhizomatically this implies our ways of researching with children need also to be rhizomatic – overlapping, multi-focal and shifting with time (MacNaughton 2003, Smith 2003).

Rhizoanalysis challenges the idea that one moment in a child's life (such as a deep blush) is caused by, say, her stage of child development or by her gender, or by her teacher or by what another child did or said. Instead, it highlights the complex and shifting links between for instance, gender, cognition, class, 'race', and how these links shoot in unpredictable ways into a particular moment in a child's life (MacNaughton 2003, Smith 2003). For example, it highlights how those links overlap with understandings of gender held by adults who work with the child; peers' gender practices; and the presence and absence of gender in the 'text' (the stories, songs, teacher talk, child talk, rituals, routines, etc.) that is the early childhood setting.

Rhizomatic logic generates tensions for research that uses 'tree logic' to explain us and for educational statements and strategies based on them. I focus in what follows on three of those tensions and the questions that they bring to me about Miss George, my stinging blush and the brain research in early childhood education.

### Tension 1: It is not about us in all our changeability

Traditional scientific research was developed to investigate the natural/physical world, not the cultural/social world(s) of diverse, complex and changeable people. Science cannot predict us as easily as it can the natural/physical world, because it cannot control us as easily, as Berliner explains:

> Doing science and implementing scientific findings are so difficult in education because humans in schools are embedded in complex and changing networks of social interaction. The participants in those

> networks have variable power to affect each other from day to day, and the ordinary events of life (a sick child, a messy divorce, a passionate love affair, migraine headaches, hot flashes, a birthday party, alcohol abuse, a new principal, a new child in the classroom, rain that keeps the children from a recess outside the school building) … limit the generalizability of educational research findings. Compared to designing bridges and circuits or splitting either atoms or genes, the science to help change schools and classrooms is harder to do because context cannot be controlled. (2002, p. 18)

So, whilst linear causality can probably explain relationships between rats and toys it is much more complex to pick out what causes us to be the ways we are as learners or as adults. Using rhizomatic logic, what caused me to blush one day in Miss George's class could have the very next day caused me to laugh and what effects these moments had on my ability to speak in front of groups could depend on how my parents were in front of groups of people, how Sandra my cousin talked to me later in the day or what Miss George said and did on another day. It could be linked to the fact that I was a girl and not a boy growing up in 1950s white, rural Australia or to innumerable complex social facts and contexts that produced me as a learner in that moment. Its relationship to me may have ended.

It is immensely tempting for those of us who work in early childhood education to embrace an argument that says what happens, for instance, in the first three years of life shapes later life because then the case for early childhood education is made. But, there is a paradox in the 'tree-like' logic that claims what happens in our brain during the first three years of life determines us. It can be used to argue for increased investment in early childhood programs but it can also be used to argue that there is no point investing in children and services for them after the first years of life. Consider this story from Corrie (2000) about Dorji:

> Dorji was born into a very poor family in a remote mountain village in Nepal. As he was an infant, he was strapped to his mother's back all day as she worked in the field, and as a toddler he was cared for by his five-year-old sister in their small hut. There was no running water and hygiene was poor. Food was scarce, the children were malnourished and suffered debilitating illnesses with no medication. Dorji had no access to commercial toys or books, and paper was a rare luxury in the village. When he was five he went to work in the fields to contribute to his family's survival. He left home when he was 10 to work away from the security of his family and his village. (Corrie 2000, p. 6)

And now consider Corrie's (2000) comments on Dorji's story:

> his deprived upbringing should have resulted in unused synapses in his brain being pruned, meaning that his 'window of opportunity' to learn would be 'lost forever' … how do the experts explain the fact that today Dorji is a well-qualified and highly skilled theatre nurse who can converse in four languages. Dorji learnt to read and write when he was a teenager, managed his nursing studies with ease, and now makes an invaluable contribution to the health care of his country in a busy hospital in Kathmandu. (Corrie 2000, p. 7)

Corrie is not a neuroscientist, and neither am I, but I find her questions worth considering.

- How do we explain the 'late bloomer'?
- How do we argue for investment in lifelong learning if the early years matter so much?
- What do we do about learners whose environments are 'deprived' in their early years? And who decides what is deprived?

I am rhizomatic. I change from moment to moment and day to day. To choose one part of my life as determining over another is misguided and potentially dangerous. To blame Miss George for who I am becoming or to single out my early years as determining me for ever after is to ignore all that I have changed and continue to change since them. That my early years have been part of who I am I do not deny, but that they have finally determined me in a simple cause and effect way I question. I am still a work in progress with many twists and turns yet to come. I also suspect that how I progress and how Dorji progresses will be different because we are different – culturally, linguistically and in other ways I cannot see. Our differences bring me to the second tension rhizomatic logic produces for traditional linear cause and effect logic and for traditional scientific researchers, such as neuroscientists or early childhood researchers attempting to prove how the brain matters in our lives.

### Tension 2: It is not about us in all our diversity

Traditional scientific research relies on construct validity (Laosa 1991). Yet we know that research on early childhood has persistently failed tests of construct validity by relying on ethnocentric measures of child outcomes to establish causal effects and by overgeneralising to the wider population from them (MacNaughton 2003). Jorgenson's comments on the 'learning windows' and the brain raise the same serious issues about construct validity in 'brain research' when its findings are generalised to the wider population:

> Our sweeping acceptance of such learning windows can be traced back to a single scientific study (Chugani, Phelps and Mazziota 1987) conducted with 29 epileptic children ranging in age from between five days and 15 years. The popular notion of critical learning periods for children (often cited as those aged four to ten years old) 'is an instance where neuroscientists have speculated about the implications of their work for education and where educators have uncritically embraced that speculation' (Bruer 1999, p. 653). A number of studies make the leap from the limited finding on the windows of opportunity with language acquisition to broad assumptions about optimal time frames for cognitive development in general (Miller 1998, South West Educational Development Laboratory 1998). (Jorgenson 2003, p. 366)

Jorgenson (2003) draws me to ask questions such as:

- Where has this piece of neuroscience come from?
- What groups of people or animals was it done with?
- How generalisable is it to the groups of people I work with?
- Who is suggesting it can be generalised and with what degree of confidence?
- Is their confidence justified?

These questions speak to traditional scientific validity and to the belief that you can speak with confidence if you objectively control for and respond to diversity by reducing its effects. However, the confidence to generalise from one specific study on one specific group of rats, chicks or people is something that few 'brain' researchers have. Statements in recent articles in the journals *Cognitive Brain Research* and *Developmental Brain Research* are peppered with provisional statements about research results and with conclusions that that emphasise the need for further research before anything can be said with certainty (e.g. Smits-Englesmen, Westenberg and Duysen 2003, Peiffer, Rosen and Fitch 2004, Batty and Taylor 2003). Yet, much of the early childhood literature on the brain research mutes the provisionality that our diversity creates for us as researchers (see Bruer 1999a).

Rhizomatic logic challenges the idea that research about us can be anything other than provisional. It is impossible to objectively control for diversity or to reduce its effects because it endlessly infuses our social world. Efforts to explain diversity, control for it or fix its effects are always partial and temporary. Diversity brings with it ambiguities to be mapped and remapped rather than certainties to be discovered. So, just as one neuroscientist discovers for certain that one set of synapses cause

behaviour in one group of chicks or children with epilepsy we find that another challenges it by researching a different group of chicks or children. Bruer emphasises this in his discussion of critical periods in Chugani, Phelps and Mazziota (1987), concluding that 'there is no neuroscientific evidence to support this belief. And where there is no scientific evidence, there is no scientific fact' (Bruer 1999b).

Diversity in languages, cultures, genders, sexualities, geographies, economies and abilities are us. Logic that cannot embrace, engage and map this diversity produces simplistic and mistaken application of research, such as neuroscientific research, to create what Jorgenson called a 'scam' (2003, p. 364) and what Bruer called 'brain myths' rather than 'brain facts'. He forcefully argued that these myths are dangerous to teaching. Bruer again:

> Sousa tells of an experienced fifth-grade teacher who was upset when a mother asked the teacher what she was doing to take advantage of her daughter's windows of opportunity before they closed. Unfortunately, according to Sousa, the teacher was unaware of the windows-of-opportunity research.
>
> This well-established neuroscientific 'finding' about a sensitive period for learning originated in the popular press and in advocacy documents. It is an instance where neuroscientists have speculated about the implications of their work for education and where educators have uncritically embraced that speculation. Presenting speculation as fact poses a greater threat to the public's confidence in teachers and schools than does Sousa's fifth-grade teacher. (Bruer 1999b, p. 648)

Our changeability and our diversity combines with what statisticians call our 'noisiness' or our complexity to produce my third tension in using cause and effect logic to make sense of us.

### Tension 3: It does not like our 'noisiness' (our complexity)

Early childhood researchers are attempting in various longitudinal studies (Australian Institute of Family Studies 2002, Schweinhart 2000, NICHD Early Child Care Research Network 1999, Wylie, Thompson and Lythe 2001) to develop sophisticated statistical formulae that can explain us in cause-and-effect terms that are 'beyond reasonable doubt' and applicable universally. The drive for universal explanations requires them to eliminate the effects of human diversity and complexity. Early childhood researchers who conducted a longitudinal study on child outcomes in New Zealand explain:

> In statistical terms, human society and individual experiences are 'noisy' environments. An experiment in the hard sciences can limit the number of factors involved, and show that these factors between them explain a large proportion, even 90 percent or more, of the variance of the results. Statistical analyses of the social data can usually account for a great deal less than this. (Wylie, Thompson and Lythe 2001, p. 11)

The focus on our noisiness and cause-and-effect logic in educational circles is especially notable as we leave the twentieth century and enter the twenty-first. For many scientists, the last century was marked by the indeterminacy of their explanations of the world. We now know that the linear, cause-and-effect determinacy that marked Newton's universe was not so universal after all. In the twentieth century, scientists developed ideas summarised as relativity, chaos theory, catastrophe theory and complexity theory to explain areas of the universe that cause-and-effect logic could not. In parallel developments in the social sciences, sociologists found that the cause-and-effect logic of such approaches as functionalism, structuralism and systems theory were inadequate explanations of the complex, shifting and self-organising phenomena of societies and cultures. Social scientists who continued to use traditional scientific methods to study people's relationships with their circumstances have had to take account of an increasing array of 'variables' affecting the development of these relationships. The results have been that their explanations have been so complex – and contingent – that they could predict outcomes in only a relatively small number of situations.

To establish that Miss George had any effect in my life is so complex as to present an impossible task. There are so many factors that have been involved in my life that have led to me being who I am today from my later education, my friends, my family, my work choices and contexts through to my gender, my class, my race, and so on and so on. They each have left and continue to leave a noisy and shifting imprint on me. Where are my early years in this imprint? How could you screen out the noise to show its imprint?

Rhizomatic logic disrupts the possibility that our 'noisiness' can ever be controlled and that the logic of linear causality is helpful to us in making sense of who we are becoming. Instead, it embraces complexity and chaos and attempts to find ways to map it. It reminds us to ask questions of ourselves as researchers and of brain research such as:

- How do we see our complexity?
- What noise do we screen out of early childhood research or its interpretation because it is too complex to include it?

- What 'noise' affects your research?
- How will you listen for this noise and assess its influence in your research?

These questions are not the only questions that rhizomatic logic raises for researchers and they are not simple questions to explore that will bring forward quick or easy answers. To research using rhizomatic logic is challenging because efforts to grapple with changeability, diversity and complexity in our lives bring with them moments in which the impossibilities of capturing anything for certain can be overwhelming and dispiriting. Alongside this, it takes considerable time and effort to become familiar with the difficult theories needed to imagine and practice research in ways that can honour changeability, assume diversity and engage with complexity. It is risky and challenging to begin researching with these ideas as it means charting research journeys that are in themselves likely to be changeable, diverse and complex. For those just beginning to do this work in early childhood education, the challenges are considerable. There is no well-worn path for us to follow. This means our steps are likely to be small, and they may falter at times. Taking these steps, however, offers us choices and brings us possibilities to remake research agendas in the field that can offer helpful policy and pedagogical insights into our complexity, diversity and changeability.

## Final reflections: bringing rhizomatic logic to early childhood education and the brain

In early childhood education we are in danger of choosing brain research and reinforcing the hegemony of traditional scientific research in the field, because it strips back the meaning of what we do and its justifications to simple cause-and-effect statements – sound bites for politicians – about, for instance, brain formation and its effects in later life. The meaning of early childhood education and its research is more complex and chaotic than that. Its meanings are diverse, changing and complex and children are diverse, changing and complex. I see early childhood education as about children's rights now. I see early childhood research as a site at which to transform inequitable relations of gender, 'race', class, sexuality, ability and age. This is not an easy task nor it is one for which there simple roadmaps showing routes to certain destinations. It is a task replete with complex ethical choices, unpredictable twists and turns and never-ending possibilities. It requires research theories and strategies that recognise this and I am wary of theories that offer simple roadmaps to certain destinations and ignore the complex, the unpredictable and the unknowable. For it is within these that possibilities to do things differently arise.

I have mentioned the seductiveness and allure of researching to establish 'beyond reasonable doubt' that early childhood matters; but I have also discussed the tensions

that are emerging around such research and its reliance on tree logic – tensions that cast doubt on its viability and pour cold water on the allure of its cause-and-effect logic. I believe that we need research and forms of logic that engage our changeability and assume our diversity and that work with it and the diverse voices it produces, rather than dismissing it as 'noise'. Such research has only just begun in early childhood education (e.g. MacNaughton 2003, Smith 2003).

As the brain has become 'commercialised', questions of the brain have become big policy and big business but they are also part of the everyday business of early childhood studies. The everyday language, ethics, routines, rituals, practices, expectations, ideas, documents and invocations of quality in early childhood services are formed through and motivated by very particular understandings of children and how best to educate them. Over time some of this knowledge has settled so firmly into the fabric of early childhood studies that its familiarity makes it just seem 'right', 'best' and 'ethical'.

Before the 'brain research' settles into such a position I know I will be asking the following questions of its various and varying iterations, its advocates and the educational programs and strategies they propose:

- How does your research/program strategy honour our changeability?
- How does your research/program strategy assume our diversity?
- How does your research/program strategy engage with our complexity?

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