



I think if we're talking about policy and reasons for doing things, and if we're appealing to scientific evidence rather than what people feel or the latest poll, it's incumbent upon people who make those arguments to present honest arguments.

— John Bruer, PBS *Frontline* interview

My brain, it's my second favorite organ.

— Woody Allen

THE SURLY YEARS: BRAIN DEVELOPMENT IN ADOLESCENCE (AND BEFORE)

A discussion of recent popular reports on the science of brain development during both the "early" and the "teenage" years.

PART I: THE EARLY YEARS

In Which The Fully Cooked Brain Comes To The Rescue of Toddlers Everywhere!

Globalization has brought massive and rapid transformation not only in the areas of technology, economy, and politics, but in work and family life as well.¹ Many child advocates have proclaimed for decades that these socioeconomic changes have left more families & children vulnerable to despair and destitution than at any time in North American history.² According to this perspective, while an elite few benefit from an unprecedented increase in wealth and social opportunities, a growing underclass is spiraling into a maelstrom of poverty, disintegrating communities, and crime.³ As a consequence, the daily reality for fully half our children under the age of three⁴ involves exposure to conditions known to be harmful to their growth and development: inadequate health care, poor diet & physical exercise, neglect, abuse, and domestic violence – to mention just a few.

Before 1994, attempts to stir public sympathy for the plight of such children met with, at best, moderate but short-lived success: no detailed scientific analysis (and there were many), no impassioned warning of dire consequences down the road (and there were many), held public attention long enough to effect significant change in public policy or to loosen public purse strings. In fact, as Angus Reid points out, when the downturn in the economy during the 1990s forced government spending to make hard decisions, child & family welfare wasn't much of a priority: "Its hard to be romantic about the fact that more than 21% of Canadian children – 1.4 million of them – were living in poverty in 1993, *before* many governments started cutting back."⁵

Compare this social cause (which I will refer to as "child development"⁶) with contemporaneous campaigns of the past forty years to reduce other social harms – for example, the crusades to make the use of seatbelts mandatory, to stop impaired driving, to reduce smoking in public spaces, and to protect the environment. In terms of its potential scale of harm to society, "child development" exceeds or matches any of these.⁷ In terms of valid scientific and statistical research supporting its claims, "child development" again exceeds or matches them all. However, in terms of new⁸ social

¹ As an introduction to the meaning and significance of "globalization", I recommend Thomas L. Friedman's *The Lexus and the Olive Tree* (Toronto: Random House, 1999/2000) and – for its impact on Canadian society in particular – Angus Reid's *Shakedown: How the New Economy Is Changing Our Lives* (Toronto: Doubleday Canada, 1996).

² See, for example, Mel Hurtig, *Pay The Rent Or Feed The Kids* (McClelland & Stewart, Toronto, 1999).

³ Because of the nature of this agency, we should be scrupulous in asserting what we honestly and reasonably know about crime. In this respect, we cannot support the child advocates' position that crime is an increasing danger in the lives of children. While crime trends are notoriously hard to identify, there is no evidence that crime – particularly *youth* crime – is increasing as globalization transforms our social institutions, despite media and public perception to the contrary. In fact, there is much more compelling evidence that youth crime (both non-violent and violent) has been declining over the past twenty to thirty years. [I refer the reader to the longitudinal analyses provided by *Statistics Canada* and the U.S. Federal Bureau of Investigation's *Uniform Crime Reports for the United States, 1964-1999*. Indeed, crime – like smoking, alcohol consumption, and drug use – are nearly half what they were when I was a teenager. For example, according to the *Center for Disease Control and Prevention* ("*Youth Risk Behavior Trends*"): teen alcohol use today is about 19%, compared to 50% in 1979; and marijuana use is 7% compared to 14% in 1979. See also: Bernard Schissel, *Blaming Children* (Halifax: Fernwood Publishing, 1997) for a history & analysis of youth crime in Canada.]

⁴ As calculated in 1993 by the American *National Educational Goals Panel* (see: www.negp.gov/page1-3.htm) [NEGP is an independent executive branch agency of the U.S. federal government charged with monitoring national and state progress toward the National Education Goals.]

⁵ Angus Reid, *op. cit.*, p. 247. The extent of the cutback in Ontario is perfectly reflected in the experience of our own agency over the ten years between 1993 and 2002. The Canadian Department of Finance's *Economic and Fiscal Update 2003, Annex #1* reports that social income security was slashed from 16% to less than 12% of GDP during the 1990s (from: *Honouring Our Promises: Meeting the Challenge to End Child and Family Poverty*, Report Card 2003).

⁶ To signify all those conditions and factors known to harm the physical and mental development of children (i.e., poverty, abuse, poor health services, poor nutrition & exercise, isolation, neglect, domestic violence, etc., etc.).

⁷ With the possible exception of "environmental awareness" – an argument could be made that if we don't protect the environment, there won't be much use in trying to protect anything else because there will be nothing to protect. However, the scale of harm for the other causes seems smaller than that of "child development": the social cost of child abuse, neglect, deprivation, etc. is an incalculably high mix of death, injury, mental illnesses, criminal incarceration, hospitalization, and economic loss.

⁸ I say "new" social policies because I am not claiming that there are no such policies related to child development. On the contrary, a considerable part of the public purse is directed towards care and protection of children, including mandatory services for education, health, and child welfare. However, the point is that these policies were by and large developed in the first half of the twentieth century: they do not adequately reflect the current economic, political, and technological reality. Our commitment of resources to our children's development has fallen out-of-step with changing needs.

policies aimed at ending or mitigating the harm, “no measurable progress”⁹ has been made. These days we more or less happily “buckle up”, pick a “designated driver”, “butt out”, and “reduce, reuse, recycle”¹⁰ – or if we don’t, we at least understand that we *should*. And this is more than just a change in attitude: all of these efforts have been supported by changes in public policy and legal



enforcement of regulations. However, there has been no parallel improvement in our outlook on the harms that threaten our children’s development or investment in resources to redress them.¹¹ So silent have we been as a society that both the American *Center For Policy Alternatives* and the *Carnegie Corporation* call it a “quiet crisis”.¹²

Well, it was quiet until 1994 when the *Carnegie Corporation* published *Starting Points: Meeting the Needs of Our Youngest Children*, a report from its Task Force on Meeting the Needs of Young Children. For some very specific reasons that, with the benefit

of hindsight, we can readily identify, this report caught the media’s attention in a big way.

Starting Points is a 150 page document outlining the scientific research supporting the child advocates’ concerns about the various threats to children during the prenatal, perinatal, and postnatal stages of development (stages commonly referred to as “zero to three”). Fully 148 of its pages are nothing more than a rehash of the known medical, public health, environmental, and social perils facing vulnerable infants. The remaining 2 pages, however, have been hailed as “stunningly new”, “powerful”, “revolutionary” – even “breathtaking” (Madeleine Nash, “How A Child’s Brain Develops”, *Time Magazine*, February 1997).

What was so different about these pages? The short answer is that they provided a brief summary of the *neuroscientific* picture of how an infant’s brain development might be affected by experience and rearing – the first time this had been done in the context of a call for social reform of child care.¹³ It was *this* picture that caught media attention and eventually catapulted early child development to the forefront of the social policy agenda.¹⁴

⁹ This is the conclusion reached by the 1993 United Nations Economic and Social Council as it considered Canada’s performance in fighting poverty (see Hurtig, *op. cit.*). In general, it is equally true of the other harms threatening our children’s development.

¹⁰ It’s hard for my daughter to imagine how different daily life was for me when I was a six-year-old kid, but I will always have fond memories – my mother, three sheets to the wind, speeding through garbage piles in the street as my brother and I bounced on the back seat of our ‘53 Chevy like it was a trampoline, stirring up blue currents in the thick haze of my dad’s chain smoking frenzy. Well, maybe my memory isn’t a hundred percent: if this wasn’t me, it must have been someone just like me.

¹¹ Obviously, I am taking a rather broad brush to an issue that is significantly complicated when one thinks about the details. Not *all* harms threatening child development have gone unappreciated or ignored. In particular, our consciousness of domestic violence has increased markedly – as have police and court responses to it and social resources dedicated to it (e.g., shelters, education, & counseling programs). However, even with this matter, one wonders whether the motivation behind such improvements had more to do with an organized women’s movement (and the push to give *women* more political power and protections) than with worry about its effect on child development. [Certainly, the latter reinforces the former. But it’s hard to imagine things going the other way around. The history of domestic violence awareness clearly shows concern for child welfare is more of an afterthought.]

In addition, there have been periodic attempts to address the needs of children at risk. In Canada, *Brighter Futures* [1992] – our response to UNICEF’s *World Summit for Children* [1990] – permitted many community agencies to develop programs for preschool children (for example, the Community Action Programs for Children (CAPC)).

¹² See www.cpa.org/cpa/index.cfm and www.carnegie.org respectively. The *Center for Policy Alternatives* (CPA) “is the nation’s leading nonpartisan progressive public policy organization serving state legislators. CPA strengthens the capacity of state legislators to lead and achieve progressive change. Founded in 1975, CPA is a 501(c)(3) nonprofit organization, supported by foundations, unions, corporations and individuals.” The *Carnegie Corporation* is a philanthropic organization that “... was created by Andrew Carnegie in 1911 to promote the advancement and diffusion of knowledge and understanding. The last of Carnegie’s endowments, it is the only one of the various Carnegie agencies to be established as a grant-making foundation ... it has three major programs, one of which is *Education and Healthy Development of Children and Youth*. Within that are four areas of concentration: early childhood and early grades, young adolescents, science education, and education reform.”

¹³ Just as an interesting historical note, the *Carnegie* Task Force did not prepare its *Starting Points* report because it wanted to herald new *neuroscientific* findings about child brain development. Rather, it was interested in formulating policy recommendations for the zero to three age range because it saw these years as the most neglected *socially* – in the sense that there were no formal organized institutions (like preschools, day care centers, and public schools) charged with monitoring and meeting the needs of this group.

¹⁴ To give an idea of the impact of *Starting Points*, it was the direct inspiration for both Rob Reiner’s *I Am Your Child* foundation [see: www.iamyourchild.org] and for President Clinton’s White House Conference on Early Childhood Development and Learning: What New Research on the Brain Tells Us About Our Youngest Children (17 April 1997). These efforts led to a variety of state-sponsored early childhood development projects – including California’s Proposition 10, a cigarette tax that generates \$700 million annually for early years investment.

In Canada, *Starting Points* led to the *National Children’s Agenda* [1997], *The Early Years Study: Reversing the Real Brain Drain* [McCain & Mustard, 1999] and to the creation of the *Early Childhood Development Project* – a national and provincial program funding new programs for early childhood development. As the *Hamilton Early Years Reporting Project* [www.city.hamilton.on.ca/phcs/Research/Docs/EY_Pamphlet_1.pdf] explains:

The goal of the *Early Childhood Development Initiative* is to ensure young people can fulfill their potential to be healthy, safe and secure, ready to learn, and socially engaged and responsible. Under the agreement, the federal government will transfer \$2.2 billion over five years to provinces and territories to improve and expand their early childhood development programs and services. Provincial and territorial governments have agreed to use this funding to:

- promote healthy pregnancy, birth and infancy
- improve parenting and family supports
- strengthen early childhood development, learning and care
- strengthen community supports

The *Ontario Early Years Plan* is an investment in programs and services (\$114 million in 2001-2002, \$153 million in 2002-2003) that support young children and their families. The plan builds on existing partnerships, programs and services to benefit all parents with children age 0-6. Established by the Ontario government in 2001, the *Early Years Challenge Fund* was created to help communities develop successful early years projects. The Challenge Fund provides up to \$30 million annually to community-based projects, and matches community contributions to support innovative projects that meet the needs of children and families.

Still, there was an urgency to the media's and child advocates' reaction that was vastly out of proportion to the actual message contained in these two pages of *Starting Points*. The full force of this urgency was expressed by the actor Rob Reiner, founder of the *I Am Your Child* foundation, in his plea to the 1997 National Governor's Association:

We now know through science that the first three years of life is the most critical time period. It is the time period when the brain develops at a greater rate than any time during the course of a person's life. ... But by age 10 your brain is cooked and there's nothing much you can do.

Your brain is "cooked"¹⁵ by age 10 and there's nothing much you can do? Reiner elaborated this fear in his keynote address to a White House Conference devoted to this concern:

If we want to have a real significant impact, not only on children's success in school and later on in life, healthy relationships, but also an impact on reduction in crime, teen pregnancy, drug abuse, child abuse, welfare, homelessness, and a variety of other social ills, we are going to have to address the first three years of life. There is no getting around it. All roads lead to Rome.

In one form or another, it is this sense of urgency – i.e., that we *must* somehow develop, nourish, enrich, improve, or enhance our child's brain *before the door closes at age three* (or six or ten, depending upon the current reading of the brain evidence) or he'll end up stupid, abusive, homeless, criminal, or worse – that is at the heart of the child advocates' remarkable success in getting early childhood development to the top of the social policy agenda (or, at least, further up than it has ever been before).

But where did this urgency come from? And is there any truth to it?

Certainly there is nothing much in the original *Starting Points* summary that justifies either a "sky-is-falling-down" (i.e., "pay attention to this or we'll end up with more crime, violence, and homelessness") or an "aha!-we-have-seen-the-light-at-last" (i.e., "the truth is finally revealed") reaction. That document outlined five fairly modest claims, all of which had been in general circulation for at least ten to fifteen years¹⁶, namely:

- the brain's development between the prenatal period and the first year of life was more extensive than previously thought;
- brain development is more susceptible to early environmental influences than previously thought;
- early environmental influences on the brain are long-lasting;
- early environmental influences affect the way that the brain is "hard-wired"; and
- early stress has been proven to have a negative impact on brain function.¹⁷

¹⁵ From an actor who gained fame playing the role of "Meathead", one has to wonder whether the use of this image is a cleverly planned rhetorical ploy or just a delicious but unconscious coincidence.

¹⁶ During the 1980s, a series of popular articles presented the "new" brain science in a variety of parenting magazines, newspapers, and general audience books, for example: *Children Today*, "The Infant: Ready and Able to Learn" (1985); *Parent's Magazine*, "Brainpower! You Can Make Smarter Babies" (1986); Healy, *Your Child's Growing Mind* (1987); and the *Chicago Tribune's* series by Ron Kotulak, (1993).

¹⁷ These five points are taken from: Sarah Moughy, *Frontline* [www.pbs.org].

In large part, the message of this research is that brain development is far more dependent on *environmental* or *experiential* influences (particularly in an organism's early years) than was previously believed – the previous belief being that brain development was *genetically* determined. As Rima Shore says in the Executive Summary to *Rethinking the Brain* (a policy document used in the White House Conference): "Only 15 years ago, neuroscientists assumed that by the time babies are born, the structure of their brains is genetically determined. They did not recognize that the experiences that fill a baby's first days, months, and years have such a decisive impact on the architecture of their brains, or on the nature and extent of their adult capacities." [Families and Work Institute, 1997]¹⁸

... *the Myth of the First Three Years* ...

The interpretation of the *value of brain research* to the child advocates' cause has unfortunately polarized into two opposing camps – which for the sake of convenience I will call the Enthusiasts and the Restrained.¹⁹ The Enthusiasts (among whom we can count such influential people as Rob Reiner, Rima Shore²⁰, Ron Kotulak²¹, and Fraser Mustard²²) believe, amongst other things, that the scientific evidence emerging from the most recent generation of brain research firmly establishes that the early experiences of the child determine its adult capacities in a *nontrivial* way.²³ They also believe

¹⁸ Whether one sees the message of this research as "new" depends entirely on one's frame of reference. Certainly, to a narrow mechanistic tradition within modern science, it *is* a bit of a surprise – that tradition favored genetics as the mechanism for brain development. However, there are several other traditions with different perspectives ... For example, I was raised in a sub-culture that believed strongly in *experience* – especially *early* experience – as the key determinant of such development. Working on this belief, my mother, a woman with only a grade eight education, read the entire works of Shakespeare out loud while carrying me in her womb. The theory was that I would thereby become well-educated and "good with my head". While carrying my younger brother, mom was heavily into home repair & improvement, so she read a lot of *Popular Mechanics* and *Mechanix Illustrated* – consequently, my brother was destined to become "good with his hands". [The family joke is that, having raised two energetic boys, by the time my sister was expected, mom was too exhausted to do anything but flip through the pages of the *Sear's* catalogue.]

¹⁹ Of course, there aren't such "camps" in reality: interpretation of neuroscientific research spreads across a broad spectrum of opinions. I am only using the image of divided camps to compare and contrast the two opposing ends of this spectrum. It's merely a rhetorical device intended to magnify positions so possible consequences of small differences can be seen a little more clearly.

²⁰ Early education author, particularly *Rethinking the Brain* (1997).

²¹ Author of *Inside the Brain: Revolutionary Discoveries of How the Mind Works* (1996).

²² Co-author, with the Hon. Margaret McCain, of the *Early Years Study: Reversing the Real Brain Drain* (1999) – the Canadian response to *Starting Points*. Dr. Mustard is a noted Canadian hematologist and founding President of the *Canadian Institute for Advanced Research* and leader of the *Founders' Network*. For more information see his biography posted at: <http://www.founders.net/fn/bios.nsf/cl/fn-bios-1?opendocument>.

²³ This is not to imply that the Restrained position is *trivial*! I say "*nontrivial*" because there is indeed a commonsensical way in which later capacities depend upon earlier experiences – no one could cogently argue against this truism. However, the Enthusiasts' position goes well beyond the commonsense interpretation, as is revealed in Reiner's worry that the brain is "cooked" by age ten and "there's nothing much you can do". The *Early Years Study* (*op. cit.*) puts it this way: "Early experiences have a **decisive impact** on the architecture of the brain, and on the nature and extent of

that this research has found the “smoking gun” – i.e., the *causal mechanism* for society’s problems (whether crime, teen pregnancy, drug abuse, child abuse, welfare, homelessness, or a variety of other social ills), and it happens to be brain development in the early years. Finally, they believe that brain research holds the key to effective interventions and solutions to our social problems – i.e., that it is able to inform and guide social policies of child development.

In contrast, the Restrained (represented by experts like John Bruer²⁴, Jack Shonkoff²⁵, William Greenough²⁶, Kurt Fischer²⁷, and Jerome Kagan²⁸) are simply not convinced that the current state of neuroscientific research & evidence justifies the conclusions reached by the Enthusiasts. They are *scientifically cautious* – or, if you like, *conservative*. This *brain* research & evidence might one day (in the *distant* future) support such claims, but not now. Accordingly, they believe that adult capacities depend as much upon developmental experiences extending through adolescence and upon chronic environmental circumstances as they do upon experiences in the early years of development. They also believe that there are *multiple causal mechanisms* at work in creating society’s various problems (e.g., poverty, abuse, drugs) – and not all of these are appropriately laid at the feet of brain development in the early years. Finally, they believe that the key to informing and guiding social policies is indeed found in scientific research – *but the scientific research of cognitive and behavioral psychology, sociology, anthropology, economics, and epidemiology, not just (or even primarily) neuroscience*.

It’s important to be clear, that the issue that divides these two camps is simply *the current value of brain research to the child development agenda*. It is not the value of the child development agenda itself: on this there is far less disagreement – although, differences in perspective inevitably lead to important divergences in *how* this agenda should be realized, divergences in when & where scarce social resources should be applied to support child development.

It seems an unavoidable aspect of the human condition that whenever experts disagree, there is pressure to broaden the original small arena of discord into greater and greater fields of battle – to magnify the dire consequences and questionable motives of the opposition’s

adult capacities.” (emphasis in original – tellingly, this quotation was taken from the *Rethinking the Brain* policy document cited above, *not from any original brain research*)

It’s ironic, but despite the fact that they present their position as “new thinking”, the Enthusiasts believe *exactly* the same thing about the brain that the earlier *genetic* interpretation believed – i.e., that at a certain point the brain is “developed” (it’s architecture and functions are “hard-wired”) and from that point on interaction with the world doesn’t make much of a difference to it (trauma excepted). These positions differ only in the timing of the congealing and in the mechanisms that lead to it.

²⁴ The author of *The Myth of the First Three Years* (1999) and the president of the James S. McDonnell Foundation (a primary funder of brain research in the USA).

²⁵ Professor of child development at Brandeis University and author of *From Neurons to Neighborhoods*.

²⁶ Swanlund Professor of Psychology, Psychiatry, and Cell and Structural Biology and director of the Center for Advanced Study at the University of Illinois. Greenough is also the scientist responsible for introducing the distinction between “experience-expectant” and “experience-dependent” brain processes [see earlier footnote].

²⁷ Charles Bigelow Professor of Education and Human Development and director of the Mind, Brain, & Education Program at the Harvard Graduate School of Education.

²⁸ Daniel and Amy Starch Professor of Psychology at Harvard.

position, until the “enemy” is cast entirely beyond the pale. Freud called this the “narcissism of minor differences”.²⁹ And the issue of brain research in child development is no exception. Regrettably, both the general public and professionals who must develop practical programs based on such research get caught in the ensuing dust cloud of expert conflict.

I should, therefore, make it clear from the outset that I do not sit on the fence in reporting on this disagreement: after immersing myself in the arguments and counter-arguments, I have decided my allegiance is with the Restrained camp. Whether this is because they are more convincing in their logic & rhetoric, or because their position better suits my personal temperament & values – well, you can decide for yourself.³⁰ I do like to think, however, that I have not been blinded by the kind of narcissism alluded to above – I still agree with 90% of what the Enthusiasts have to say about the importance of the child development agenda. It is only the link between this agenda and the messages emerging from neuroscientific research that I find questionable.

With these two clarifications in mind, let’s look at the rift between the Enthusiastic and Restrained positions on the messages of brain science.

According to John Bruer³¹, the claims of the Enthusiastic camp are supported by the weaving together of three “neurobiological strands” from the neuroscientific literature. Each of these strands represents a significant (but not particularly “revolutionary”) finding of recent research. When they are knitted together – *by belief in a more*

²⁹ Originally in “The Taboo of Virginity” (1917): “... it is precisely the minor differences in people who are otherwise alike that form the basis of feelings of strangeness and hostility between them. It would be tempting to pursue this idea and to derive from this ‘narcissism of minor differences’ the hostility which in every human relation we see fighting successfully against feelings of fellowship and overpowering the commandment that all men should love one another.” His most famous reference to it was in *Civilization and its Discontents* (1930).

³⁰ Actually, I’d like to thank Fraser Mustard for knocking me off the fence. Several years ago I attended a community presentation where he was summarizing his *Early Years Study*. At the beginning of the presentation, he held up John Bruer’s book and urged his audience not to read it. In his opinion, *The Myth of the First Three Years* was both shoddy, inaccurate scholarship *and* motivated by American neo-conservative, regressive political values. It was worse than a waste of time – Bruer had got it all wrong!

Probably, that moment as he waved Bruer’s book over our heads was not a highlight in Dr. Mustard’s otherwise distinguished career – at least, I hope it wasn’t. None of us is immune to crippling gaffs. [My colleagues will, no doubt, recall my own “pie-hole” faux pas!] In any event, it had the opposite effect on me than was intended – I’ve generally believed that the way to deal with error is to *confront* it, not *avoid* it. I was intrigued that maybe there was something in Dr. Bruer’s book that Dr. Mustard didn’t want us to see. It turns out – in my opinion anyway – that I was right: *The Myth of the First Three Years* is anything but shoddy and inaccurate, and Bruer is *if anything* a strong *liberal* advocate for children. [In one of those ironic twists of history, the Early Years advocates are now being branded as neo-conservative reactionaries themselves! Their emphasis on the simplistic panacea of “good mothering” (reading, singing, playing) is seen as a covert strategy to blame mothers while ignoring systemic social conditions like poverty and social class. Personally, I can’t see either Bruer or Mustard as neo-conservative – both strike me as extremely liberal. I think the name-calling stems from the narcissism of minor differences, not from any real political agenda.]

³¹ Anything I report here is based on his book *The Myth of the First Three Years* (1999) – and he says it much better than I can.

fundamental organizing principle (which I will explain shortly) – they create a compelling picture of human development that Bruer calls the Myth of the First Three Years. These three strands are:

- i) **Synaptic Exuberance & Pruning** – Humans are born with all the brain cells (called *neurons*) they will ever have³² – although these neurons are not in a mature state: they will eventually develop a variety of complex internal structures (a process called *differentiation*³³), more connections or *synapses* with other neurons (a process called *synaptogenesis* or *synaptic proliferation*), and a conductive sheath called *myelin* (a process called *myelination*). Shortly after birth, our neurons undergo a period of rapid synaptogenesis which proceeds most intensely for the next three years, until it finally subsides when we are about ten years old. At the same time, our synaptic connections are also being *pruned* – i.e., many of these new connections are unmade as the brain gets rid of unused ones.³⁴

From this strand of evidence, some Enthusiasts draw several questionable conclusions, for example:

1. *The more synapses we have, the more intelligent we are (i.e., more synapses = more brainpower).* As one Enthusiast puts it: “The evidence indicates that the more connections you have, the smarter you are.”³⁵ But as Bruer points out: “Whatever the relation is between synapses and brainpower, it is not a simple one.” After all, each of us apparently has far more synapses when we are pre-teens than adults – and no one would argue that we are more intelligent at 7 than we are

³² The traditional understanding is that the formation of our cortical neurons is complete four months before actual birth. Recent research, however, has shown that *neurogenesis* (i.e., the formation of new brain cells) does happen in adults, but only in that part of our brain called the hippocampus (a part of the limbic system thought to be involved in memory).

³³ Dozens of different types of neurons will develop. Differentiation involves: *size* (neurons will vary from 4 microns to 100 microns in width of cell body); *extension* of cell processes (some will have single extensions – others double or multiple ones); and *direction* (some will be directed to sensory input, some to motor control, others will communicate between these two).

³⁴ For example, at birth we have approximately the same *synaptic density* as we do as adults. Synaptogenesis increases this density so that by the time the brain is 1 to 2 years old, it is 50% higher than it is in adults. When it reaches its peak volume (at about 7 years old), it is approximately 36% higher than it is in adults. During puberty, pruning will cut the density back to its original value. [One must keep several things in mind when considering this evidence: (1) the human brain is incredibly complex – different parts develop at different rates and on different schedules (e.g., the visual cortex reaches a level 60% higher than adults within the first year of life and reduces to adult levels by about 11 years of age); (2) the brain samples used to determine these figures (based on the work of Peter Huttenlocher *et al.* at the University of Chicago) are very small (approximately 50 brains – of which only 4 were adolescent, and these showed marked variation); and (3) some of the evidence comes indirectly from a limited PET (positron emission tomography) scan of 29 epileptic (and medicated) children (in these studies, by Chugani, Mazziotta, & Phelps, “glucose metabolism” was taken to represent synaptic density). As Bruer says: “A PET study showing when brain areas come on-line metabolically, or a neuroanatomical study that shows when synaptic densities increase, does not speak to when, or even whether, parents might be able to train brain areas. The simple fact is that although we know these events occur, we do not know what they mean for child development or to what extent, if at all, environmental and parental stimulation affects these events.” (82)]

³⁵ Ron Kotulak, *Inside the Brain, op. cit.*

at 27 or 37 or 47: “... by any measure one cares to use, adults are more intelligent, have more highly flexible behaviors, and show capacities to learn subject matter and reasoning skills that we do not see in infants, toddlers, and 3-year-olds ... the late adolescent and early adult periods of rapid synaptic loss do not result in a drop in brainpower.” [Bruer, 1999] Also, the research shows conclusively that “too many” connections are just as problematic as “too few” – it appears that certain conditions (e.g., fragile-X syndrome) express abnormally high synaptic density, and this condition negatively affects intelligence every bit as much as abnormally low synaptic density (e.g., Down’s syndrome).³⁶ If there is any conclusion we are justified in making, it is that there might be an “optimal” level of synaptic density (i.e., one that is neither too low nor too high) – but, as yet, we have no idea of what processes aid our brains in achieving this level. Genetics is still as good a guess as anything.³⁷

2. Another standard maxim within the Enthusiastic camp is the assertion that *early environmental stimulation causes synapses to form*. As Hilary Clinton puts it in *It Takes A Village*: “... with proper stimulation brain synapses will form at a rapid pace, reaching adult levels by the age of two and far surpassing them in the next several years.” Proper stimulation? Well, that would be “... someone talking to, singing to, reading to or playing with the infant or toddler.” [Education Commission of the United States, Policy Brief, 1996] Again, Bruer reads the evidence differently: “... the research suggests that genetic and developmental programs, not environmental input, control early synapse formation.” Significant parts of the synaptic exuberance begin *before* the child is born – a condition where environmental stimulation cannot cause synapse formation. In addition, experiments with rhesus monkeys have shown that the synaptic density of both animals raised in *enriched* and *deprived* stimulation environments are exactly the same as those raised in a normal environment.³⁸ An interpretation that is more consistent with the research data posits that the causal arrow is exactly the reverse of what the Enthusiasts believe – i.e., *genetically determined synaptic proliferation is a precondition for the possibility of certain experiences* (e.g., sight, hearing, language, etc.), *not a result of such experience*. In effect, as Bruer puts it, we must wait until certain capacities come “on-line” (by way of synaptic proliferation) before we can have the experiences associated with them. [In this scenario, pruning – i.e., synaptic loss – is understood as a necessary part of the process of building brain capacity, not as a threat to intelligence. In the words of one of the scientist who first studied it: “... the

³⁶ Summing up some of the brain research on adolescence (which we will look at in the next Part), Barbara Strauch notes: “No one, of course, is saying that more synapses make people smarter. Science doesn’t know that.” (cited below)

³⁷ One might reasonably expect that, *if synaptic density was fundamental to increased intelligence, then adult brains would be significantly more dense (in the good sense) than infant brains*. But they aren’t. Synaptic density returns to approximately the same value as before the exuberance/pruning process.

³⁸ Bruer describes these experiments in detail in his book. While the visually deprived monkeys did have fewer neurons in their brains going to the visual area than normal-sighted monkeys, nonetheless “there were no significant differences in synaptic densities between the blind and sighted monkeys. The rate and extent of synapse formation was the same in blind and sighted animals of the same age.” The same result was found with monkeys in an intensive visual environment: “Contrary to the experimenters’ expectations, despite all the extra stimulation, the synaptic densities of the preterm, highly stimulated monkeys were no different than those of the full-term, normally stimulated control monkeys.”

elimination of contacts may be as selective and as constructive towards the final function of the visually altered neuron as the formation of specific synaptic contacts.” (Lunde, Booth, & Lunde, 1977)]

3. Finally, there is the conclusion that *the period of rapid synapse formation is the time during which basic learning skills are “hard-wired”*. From this, it follows that the early years are our last best chance to build better brains for our children. This is the “cooked” brain that Rob Reiner warns us about. As journalist Joan Beck puts it: “... the brain grows most rapidly [in the first three years] then becomes hard-wired into an organ of thinking.”³⁹ Of course, this conclusion is both contrary to our experience and counterintuitive. As Bruer points out using an analysis of neuroscientific memory experiments, the ability to perform a certain function (e.g., delay gratification – which, in turn, depends upon representational memory – or use language) first comes “on-line” at exactly the time that synaptic proliferation peaks in the area of the brain associated with it [see above]. However, the ability (which we could also call a “skill”) *continues to improve* during both the pruning period that follows the proliferation peak and during the plateau period when synaptic density falls to its adult level. Most abilities or skills show an upward progress *beginning after the period in which they are believed – by the Enthusiasts – to have been hard-wired*. But if they truly are hard-wired, how can this be so? Being hard-wired, by definition, means that they have achieved their highest (end) capacity. So, now we can see why the Enthusiast position is both contrary to experience and counterintuitive – our skills & abilities grow long into adulthood and get better with practice. So, in some important sense, the brain cannot be hard-wired so early. As Bruer says: “The circuitry we need to do these things is not complete, hard-wired, or permanently fixed during early development. It is not limited to the time when synapses form most rapidly.”

Okay, okay, concede the Enthusiasts (well, perhaps only those closest to the fence), maybe sensory stimulation (reading, singing, playing, etc.) doesn’t “cause” synapses to form *per se* – but surely it strengthens some synapses, thereby ensuring that they survive into adulthood! Surely, this understanding isn’t counterintuitive – it’s just commonsense. We must do all this reading and singing to save synapses from elimination⁴⁰ – to form “pathways”. Journalist Ron Kotulak explains this “interesting interpretation”: “As pruning accelerates in the second decade of life, those synapses that have been reinforced by virtue of repeated experience tend to become permanent; the synapses that were not used often enough in the early years tend to be eliminated. In this way, experiences – positive or negative – that young children have in the first years of life influence how their brains will be wired as adults.” (*Inside the Brain, op. cit.*) [This is the “use ‘em or lose ‘em!” warning. By some means, “use” marks a synapse as “important”, while “lack of use” condemns it to the ash heap.] Bruer’s response: “Superficially, this strategy makes sense, but there is no neuroscientific evidence to support it ... neuroscientists have little idea how experience before puberty affects either the timing or the extent of synaptic pruning ... neuroscientists do not know, for monkeys or humans, whether early experience increases or decreases synaptic densities or synaptic numbers after puberty. They do not know if prior training and education affect either loss or retention of synapses at puberty. They do not know what kinds of synapses – excitatory versus inhibitory – are selectively

pruned. Nor do they know whether animals with greater densities in adulthood ... are necessarily more intelligent and developed ... This synaptic preservation strategy, despite its initial, intuitive plausibility, does not make much neuroscientific sense. Any plausibility it has derives from our desire to understand the mind and intelligence in terms of synaptic numbers and densities. A neural accounting approach gives us a concrete, quantitative measure for something that we otherwise find abstract and mysterious.”

At this point, let me highlight one of the crucial differences between the Enthusiastic and the Restrained positions, based on the preceding analysis: *For the former, only the experience and environmental stimulation of the early years truly matter in the development of the brain. In contrast, the latter see that period as just the beginning of a long developmental and maturational process* (as we shall see, lasting well into the third decade of life at the very least – and perhaps longer) *during which experience and environmental stimulation continue to play a decisive role in our lives*. [Now let’s move on to the second neurobiological strand in the Myth of the First Three Years ...]

- ii) **Critical Windows** – Although the *synaptic preservation strategy* doesn’t have support in the brain research literature, it is clear that *for the brain to develop normally, it must have certain kinds of experience at certain times*. This time-dependent experience is vital for the selective elimination of synapses and the development of distinct capacities, behaviors, or skills (e.g., sight, hearing, language, etc.): “If during the critical period for a trait an animal has experiences that are normal for its species, the animal will develop the trait normally. If during the critical period for a trait an animal has abnormal, species-atypical experiences, it will develop the trait abnormally. If the environment is sufficiently abnormal, the animal may not acquire the trait at all.” [Bruer, 1999]

Critical periods make evolutionary sense because they allow incredibly *complex* nervous systems to develop by combining genetics and experience. If all our brain connections (synapses) were determined genetically (i.e., “hard-wired” from birth), the DNA coding would have to be massively larger than it is (after all, we have billions of neurons and trillions of synapses but only a few thousand genes) – or our brains would have to be massively smaller. Conversely, if all our brain connections were determined by experience (environmental stimulation), there would be no consistent, dependable, or shared human traits (because each structure would be the only one of its kind). Instead, brain development is a combination of these two processes: genes lay down general structures, while experience fine tunes them. In this way, humans share broad capacities (behaviors & skills), but each individual expresses or realizes these broad capacities in different, unique ways. [Think of snowflakes: the chemical properties of water (which are shared by all water molecules) “hard-wire” snowflake structure to be a consistent six-sided hexagonal; however, environmental variations in temperature, air currents, humidity, and floating particulates cause each flake to be unique in its details. Brains are like big snowflakes: they share exactly the same structure, but no two are identical. As John Denver sang, “As different as we are, we’re all the same.”]

How do critical periods work? To grossly simplify the process, our genetic programming supplies an overabundance of synapses (as was described above as *exuberance*). Stimulation (or experience) creates a competitive situation in which these synapses vie for a limited supply of nutrients – the more active a synapse is, the more nutrient

³⁹ *Chicago Tribune*, 24 April, 1994.

⁴⁰ To be fair, Enthusiasts were encouraged in this interpretation by one of the scientists doing the PET scan research – Harry Chugani.

it gets. So, active synapses flourish, and inactive ones wither – this is the *pruning* process (also referred to above).

Hey! Isn't this suspiciously like the "use 'em or lose 'em" *synaptic preservation strategy* criticized in the previous section? Yes, but it's important to understand what the difference is - otherwise, one falls victim to the same misinterpretation of the research data as the Enthusiasts. To start with, there is no evidence that capacities that depend upon critical-window processes get better "hard-wiring" by intensifying their use (e.g., by reading more or singing or hearing classical music played rather than rock⁴¹) in an effort to save synapses from the pruning shears.⁴² Rather, these critical-window capacities develop in response to a type of "brain plasticity" (i.e., brain change caused by environmental stimulation rather than genetic programming) that William Greenough calls "*experience-expectant*" – that is, the brain is (genetically) designed to expect certain experiences or stimuli from the normal or typical environment that the organism inhabits and grows within. As long as the child is exposed to these *normal* environmental experiences, the brain will develop the associated capacity (using the pruning process).

This is not to say that intensifying the stimulation related to certain activities will have no effect at all on the child's brain. It will. In fact, it will significantly increase a child's *proficiency* in a skill or behavior (assuming that the brain capacity for that skill or behavior has come "on-line" as explained above) - *but not in the sense that it will improve the hard-wiring for life*.⁴³ This kind of skill development depends upon another kind of brain plasticity that Greenough calls "*experience-dependent*". *Experience-dependent* plasticity allows the brain to learn from (i.e., to acquire skills and behaviors pertinent to) each individual organism's unique environment, in contrast to capacities shared with all members of the species. Unlike *experience-expectant* plasticity, this kind *does* depend upon growing new synapses or on increasing the efficiency of existing synapses, not on pruning. Also unlike *experience-expectant* plasticity, the *experience-*

dependent kind does not have a critical window: it functions through one's entire life – so it is always possible to learn new skills or to improve existing ones (just as it is always possible that such skills get rusty or lost from lack of use⁴⁴).

In humans, an example of an *experience-expectant* capacity is language – a capacity that is shared by all members of the species. [Bruer claims that all *experience-expectant* capacities share one feature: "They all deal with very basic traits, traits necessary for survival and reproductive success – recognizing the mother, mating, seeing, language, and social-emotional development ..."] By contrast, examples of *experience-dependent* skills, related to language, might be "speaking English" or "reading" or even "writing". These latter capacities are not shared by all humans but are specific to limited, quickly changing environments.⁴⁵

The Enthusiasts make the mistake of confusing *experience-dependent* plasticity with *experience-expectant* plasticity. The result is the misguided belief that there are critical windows for learning things like reading, writing, music appreciation, mathematics, chess, etc. – things that are part of our historical, cultural, sub-cultural, or individual experience, rather than species-wide experience. If we don't reach the child within this window of opportunity, his or her ability to achieve these skills will be lost forever – or, at least, diminished in a way that contributes to a host of social ills (from homelessness to criminality). To the contrary, the Restrained find no justification for this interpretation of the neuroscientific literature.

Unfortunately, the Enthusiastic response to Restrained caution has been to exaggerate the conclusions reached by the latter (again, I think the motivation for this is simply the narcissism of minor differences). Fraser Mustard huffs that "... the [Restrained] authors imply that programs for early years development are unimportant for the development of the competence and coping skills for most of the population ..."⁴⁶ Contrary to this characterization, however, the

⁴¹ Although I think there is general agreement and a vast scientific literature showing that hip hop, heavy metal, and polka music are so abnormal that they actually cause considerable brain damage.

⁴² Using the same brain research on the visual system of kittens and monkeys as the Enthusiasts, Bruer convincingly shows that it is not the *amount* of stimulation that supports the pruning process in critical-window development but the *pattern* of stimulation: "This leads neuroscientists to an important, but not widely appreciated, conclusion: when it comes to critical periods, if the visual system is our best example, the *amount* of neural activity is less important than the *pattern* of neural activity in causing synapses and axons to reorganize ... These experiments provide no support for the popular belief that during a critical period more stimulation is necessarily better than less."

⁴³ For example, research shows that children with mothers who have professional careers develop bigger vocabularies. Why? Because these mothers speak more often – and with a wider variety of words – to their children. Are these mothers "hard-wiring" their children differently than non-professional mothers? No. Vocabulary acquisition is a function of *exposure* to words, not to hard-wiring during a critical window. Exposure *at any age* increases a person's vocabulary. Jerome Kagan sums up the crucial issue dividing the two camps this way: "Infants who are tickled, played with, talked to, and smiled at are more alert, more vocal, and laugh more fully and frequently than infants who missed these pleasurable experiences. No one disputes that infant experiences have influence. What is controversial is the fixity of those first profiles. The proponents of connectedness [i.e., the Enthusiasts] believe that some of these early expectations and emotional reactions will be neither transformed nor eliminated by subsequent events. *That* is the debatable claim." (from his *Three Seductive Ideas*, 1998)

⁴⁴ If such skills were hard-wired early in life, as the Enthusiasts claim, it is difficult to see how they could either be improved or lost.

⁴⁵ That is, environments (either historically or geographically delimited) that do not persist long enough to foster *genetic* adaptation. So "quickly" is a relative term – in terms of evolutionary change, it could be as much as several hundred or even thousands of years.

⁴⁶ Mustard, *Does Early Childhood Matter for Human Development and Health?* (<http://www.founders.net/fn/papers.nsf/0/50205524b17e693e852569b4006045aa?OpenDocument>). For the record, I've read Bruer's writings and interviews extensively and with great concentration – *and nowhere can I find any implication that he thinks early years education is "unimportant"*. In a way, this kind of reaction to the Restrained caution shows a strange consistency in the thought of the Enthusiasts: they (and I know I shouldn't lump them all together so easily) tend to make the same unwarranted leap from "evidence" to "conclusion" when interpreting the Restrained criticisms as they do when interpreting the neuroscientific data. Something gets added between the former and the latter.

Mustard goes on to complete the above quotation by stating that his critics "[reject] the finding from a broader synthesis of knowledge that if a society wishes to reduce the inequalities in health (physical and mental) and literacy, significant attention must be given to the factors influencing early child development in all sectors of society." Well, no they don't. Their point is that many scientific studies and fields lead to exactly the conclusion Mustard would have us make – *just not "brain science"*. [I'm not exactly sure why the Enthusiasts misconstrue rejection of one small part of their evidence as rejection of their entire position. I suspect, however, that it has something to do with the importance of brain research garnering attention and status for the child advocates' cause. Without it, they would be back to the "quiet crisis" days of the 1980s and early 1990s.]

Restrained position, is *most definitely not* that children should not be taught cultural skills (like literacy, music, and math) early. Of course they should! But they should be taught these skills early because we want our children (all of them) to be proficient & accomplished – *not because their brains will be deficient if we don't*. The Restrained position is *positive* – they say: let's invest in educating children simply because we want them to have the maximum in learning experiences so they can lead more fulfilled and productive lives, both in the future *and* now. It is also a *hopeful* position – they contend: even if a child does not receive training in a skill early, there is no scientific (or empirical) evidence that says he or she can't develop the skill later in life. In contrast, the Enthusiastic position is *negative* – they say: let's invest in educating children early because *if we don't, bad (and expensive) things are going to happen* - "If parents and policymakers don't pay attention to the conditions under which this delicate process takes place, we will all suffer the consequences...." (Madeleine Nash, *Time Magazine*, *op. cit.*). It is also a *bleak* position – they say: if a child does not receive training in a skill early, he or she will have missed golden opportunities and end up condemned to a diminished life.⁴⁷ As a *Newsweek* article put it: "Children whose neural circuits are not stimulated before kindergarten are never going to be what they could have been." (19 February 1996)⁴⁸

Once again I'm getting ahead of the argument I want to make, so let's move on to the third neurobiological strand of the Myth of the First Three Years ...

- iii) ***Enriched (or Complex) Environments Increase Synaptic Density*** – Of course, this strand also builds on the Enthusiasts' supporting belief that *the more synapses we have, the more intelligent we are* (see above). According to one version of the Enthusiastic position: "Early experiences can have a dramatic impact on this brain-wiring process, causing the final number of synapses in the brain to increase or decrease by as much as 25%."⁴⁹ The hypothesis is simple: complex or highly stimulating environments

⁴⁷ One of the Enthusiasts' favorite metaphors to convince us of this diminishment is the "accent". Children that learn a second language early in life learn also to speak that language without an accent (and they do so whether they are "bathed" in language, as is the custom in our culture, or largely ignored, as is the tradition in other cultures [See: Steven Pinker, *The Language Instinct* (1994)]). If a person picks it up later, however, there is almost invariably some degree of accent [only about 5% of adult learners of a second language can speak without a noticeable accent]. Of course, older learners can achieve remarkable proficiency in most other aspects of the language (vocabulary, thinking in it, and possibly even grammar [actually grammar appears to have a critical window, but it's one that lasts up to 15 or 16 years], etc.), but the presence of an accent is supposed to signify a diminishment of capacity. So we are led to conclude that all types of learning must complete themselves within the early years' windows of opportunity – or else they will suffer the equivalent of an accent. [My speculation is that accent has more to do with "hearing"/"speech" (i.e., phonology) – a human, species-wide capacity that is established through critical-window processing within the first six months after birth – than it has to do with learning a specific language's vocabulary and semantics.]

⁴⁸ "The evidence is in," said Portia Kennel of *Ounce of Prevention*. "Scientists have looked at the first years of life, this is the basic building block of time that will determine the success or failure of children later in life." (Reported on CNN website: www.cnn.com/HEALTH/9606/15/nfm/brain.conference/)

⁴⁹ *Starting Smart* document published on the Ounce of Prevention Fund website: www.bcm.tmc.edu/civitas/links/ounce.html.

produce complex, smarter brains; whereas simple, under-stimulating environments produce uncomplicated, not-so-smart brains.

Again, most of the neuroscientific support for this interpretation comes from laboratory work with rats – where, indeed, such brain density differentiation *is* found. However, Bruer points out three scientific caveats: (1) The environments specified as "enriched" in these experiments are – in the opinion of one of the leading scientists studying rat brain density (i.e., William Greenough) – close approximations of the rat's *natural* (non-laboratory) habitat. In effect, then, we are not seeing the impact of enrichment in the sense that the Enthusiasts apply it to human development.⁵⁰ (2) The neural density increase was not uniform across the rat's brain – it occurred only in certain areas (primarily related to vision), and not at all in others. Consequently, it would be imprudent to conclude that human brains increase uniformly (or in areas other than those analogous to rat vision). (3) The stimulation experiments were performed on "weanling" rats – i.e., those equivalent in maturity to later childhood and adolescence in humans, not those equivalent to infancy or the first three years of human life.⁵¹

All of these caveats aside, however, it does seem well established that, as a general principle, synaptic density increases in response to stimulation. The problem is the interpretation of this fact. Once again, the Enthusiasts seem to be misconstruing the time-limited *experience-expectant* process as the *experience-dependent* one. When this happens, they reach the erroneous conclusion that stimulation must occur at an early period for synaptic density to increase. In reality, synaptic density can be increased at any age, young or old.⁵² [To my mind, this is just another way of saying that the human brain is capable of *learning* at any age – and, indeed, there are lots of reasons to believe that we become much more sophisticated and flexible learners well past the period of adolescence.]

Bruer is quick to point out, however, that the research is *not* saying that there is no difference between young and old brains – only that such difference is not in the ability to generate synapses in response to environmental stimulation. Instead, the difference lies in the physical capacity to nourish brain cells. New synapses need chemical replenishment and blood vessels to support them. The brain's ability

⁵⁰ Laboratory enrichment seems to simply establish a "normal" condition for rats – it doesn't show the impact of real (i.e., greater than normal) stimulation, which is, after all, the interest of the Enthusiasts.

⁵¹ As we shall see, this confirms neuroscientific findings on the teen brain.

⁵² If it's not clear in all this babble about synapses and neurons, let me try to state the issue another way ... There seem to be two mechanisms that increase synaptic density:

- (1) A process called "exuberance" that prepares the brain to expect input (stimulation) from the environment at certain time periods in a person's development so that broad human capacities can be hard-wired (e.g., vision, hearing, language). This is called *experience-expectant* plasticity and it does not require or respond to enriched environments. And
- (2) a process of "learning" that responds to input (stimulation) at any time so that specific and unique human behaviors/skills can be "soft-wired". This is called *experience-dependent* plasticity and it *does* respond to enriched environments (e.g., increased stimuli, practice, etc.).

The Enthusiasts confuse these two different types of plasticity.

to supply these support structures diminishes with age – long before its ability to generate new synapses diminishes.⁵³

These three themes (exuberance/pruning, critical windows, & enriched environments), then, form the mutually supporting parts of the Enthusiasts' story about why the early years are the most important period in human development. As we have seen, however, this conclusion relies more on interpretation than substance. Still, to be fair to the Enthusiasts, we can add a fourth neurobiological strand to their position. [Bruer doesn't address this trend in the neuroscientific literature, I suspect, because he does not see that it is misinterpreted in its implications by the Enthusiasts – and therefore it does not contribute in a misleading way to the underpinning Myth. I simply mention it because I want to give a more complete picture of the brain research as it is used by the child advocates.] The fourth strand shows that ...

- iv) ***Over-stimulation of the HPA system (hypothalamus-pituitary-adrenal axis) in infancy/childhood permanently affects the ability to handle stress*** – When we are threatened, scared, or surprised, our HPA system releases the steroid *cortisol* (or *hydrocortisone*) into the bloodstream. In turn, cortisol increases blood pressure and activates the body's immune system – putting the body into a state of heightened alert and preparedness. Too much or too long an exposure to cortisol makes the body vulnerable to what are called *stress-related* diseases. Persistent over-stimulation of the HPA system (such as what happens to babies raised in environments with chronic neglect, abuse, threat, extreme isolation, or social deprivation) causes the hypothalamus to permanently set the regulatory rate of cortisol to a higher-than-normal level – in effect keeping the body in a state of constant alertness and making it more anxious, impulsive, & aggressive and less attentive, patient, & sociable. The result can be adults with a variety of mental and physical problems, including depression, vulnerability to drug abuse, antisocial behavior, and learning disabilities.⁵⁴

No one seriously contests or denies the conclusion of this line of research – i.e., that chronically abusive environments have deleterious effects (possibly permanent – but not necessarily irremediable) on the human brain. However, there are a couple of reasons why it is not terribly supportive of the Early Year's thesis:

First, many people who suffer the effects of abusive environments do so at later periods in their lives (this is particularly so for children who are victims of sexual and physical abuse). There is no evidence to conclude that earlier abuse is more consequential than later abuse. If anything, the amount and severity of stress-related damage correlates most consistently with "length" of abuse, not with "when" the abuse happened. It appears from the research that we are vulnerable to the impact of abuse at any age. Enthusiasts will have to establish that *timing* of abuse is a critical factor – and that has not yet been made evident.

⁵³ There is even a body of neuroscientific evidence that shows that the brain's ability to increase its synaptic density is limited by its ability to create & maintain these support structures. Increased complexity seems to produce diminishing returns as the brain reaches an optimal synaptic density. If this is true, then all stimulation beyond the optimal level will not have the desired effect of increasing intelligence.

⁵⁴ See for example: McCain & Mustard (2002), *The Early Years Study Three Years Later*.

Second, the unfortunate experience of children in Romanian orphanages during the collapse of the Soviet Union points us in a slightly different direction than the Early Years' Enthusiasts would have us go. In their own summations of the Romanian tragedy, Enthusiasts⁵⁵ point out that children who are adopted *early* have better outcomes than those who are adopted late. However, this is confirmation that *length* of abuse is the key factor, not *timing*. If timing were key, would we not see some strong correlation between long-term damage and early exposure to it?⁵⁶ Indeed, Michael Rutter reports in his study of 111 Romanian children adopted (when they were under 2 years of age) in Britain that they had improved their cognitive functioning to normal levels by the time they were 4. His conclusion: "Severe (de)privation does not necessarily lead to irreversible problems in psychological functioning. This evidence indicates that recovery from a deprived background is possible with the right level of subsequent care. These findings challenge the strict 'deprivation hypothesis' view that early negative experiences (in terms of attachment) will lead to poor psychological health in later life."⁵⁷

... from neuroscience to revolutionary parenting and social policy ...

From the Restrained perspective, there is little doubt that the work being done in neuroscience is fascinating and that it is opening new horizons for our understanding of *brain* function and *brain* development in the early years. The link, however, between this research and our broader understanding of human behavior (as manifest in such areas as education, parenting, therapy, and social policy) remains highly speculative. Still in its own "early years", neuroscience is not yet the magical microscope that can bring the material underpinnings of human conduct into sharp causal focus: with its exploratory and disjointed areas & methods of investigation, it is less like a microscope and more like a Rorschach blotter – i.e., a collection of vaguely suggestive shapes in which the observer sees whatever he wants to see. No doubt, the ink spots are converging, but a solid, three-dimensional picture remains a distant goal.

Out of this fuzzy nebula of growing research, the Enthusiasts have indeed conjured a "new" direction for child development and education: such is their "revolutionary"⁵⁸ insight that it is the "early years" that are the key to solving society's chronic problems, from homelessness to crime, from mental illness to drug addiction. Still, one might reasonably expect that such a rich source of revolutionary work would yield a host of other novel, unexpected, and startling discoveries about how we should now raise our children. After all, the point of a revolution is that it turns everything on its head. Indeed, one of the hallmark effects of scientific investigation is its *counterintuitive* nature: it suspends "common sense" in favor of the uncommon and the "unnatural".⁵⁹ But is this what we actually find?

⁵⁵ For example, both Mustard and Treffer in their articles cited above.

⁵⁶ That is, we would expect to see that children that were abused early would suffer long-term consequences and that remediation would be *less* effective with them.

⁵⁷ Rutter, M. & The ERA study team (1998), "Developmental catch-up, and deficit, following adoption after severe global early privation", *Journal of Child Psychiatry*, v. 39/4.

⁵⁸ In an article entitled "Does Early Childhood Matter for Human Development and Health?" (wwwFOUNDERS.net/fn/papers.nsf/0/50205524bf7e693e852569b4006045aa?OpenDocument), Dr. Mustard compares the Enthusiast literature (*Starting Points*, *Rethinking the Brain*, etc.) to the scientific revolution brought about by Galileo and Newton.

⁵⁹ See Lewis Wolpert's *The Unnatural Nature of Science* (1993): "... science is not just about accounting for the 'unfamiliar' in terms of the familiar.

When we peek behind the curtain of the Early Years Insight, do we see a brave new world? Let's take a quick peek ...

Looking first at the area of parenting, according to one Enthusiast – Kathy Oliver, Ohio State University, Family & Consumer Sciences – “Research in brain development and school readiness suggests the following 10 guidelines ...”⁶⁰

- Be warm, loving, and responsive.
- Respond to the child's cues and clues.
- Talk, read, and sing to your child.
- Establish routines and rituals.
- Encourage safe exploration and play.
- Make TV watching selective.
- Use discipline as an opportunity to teach.
- Recognize that each child is unique.
- Choose quality child care and stay involved.
- Take care of yourself.
- Reach out and get some help.

Well, these are 11 (Ms. Oliver's seems to have thrown in an extra guideline for good measure⁶¹) reasonably helpful suggestions; however, we can say three things about them ... First, they don't stray very far from common sense. There is nothing particularly novel or revolutionary about them.⁶² Fraser Mustard himself sums up the “nothing-new-here” nature of brain research in this way: “The new evidence is a celebration of what good ‘mothering’ has done for

Quite the contrary: *science often explains the familiar in terms of the unfamiliar.*”

⁶⁰ See: ohioline.osu.edu/hyg-fact/5000/5318.html. I chose these guidelines because they are fairly representative of numerous other sites and articles that “translate” brain research into guidelines for action. These guidelines seem to have originated in the *I Am Your Child* campaign document entitled *The First Years Last Forever* (although it is not clear that this document identified them as originating in neuroscience research).

⁶¹ Just as a point of interest, it's the last guideline (“Reach out and get some help”) that Oliver adds to the original list. About this guideline she notes: “The new brain research informs us of the uppermost importance of the relationship between caregiver and child in the first years of life, and affords us a wonderful opportunity to enrich the lives of our children and help them realize their full potential. The first years truly last forever.”

⁶² Actually, you can see the common sense nature of these guidelines better if you simply reverse them:

- Be cold, uncaring, and unresponsive.
- Ignore your child's cues and clues.
- Raise your child in silence.
- Be unpredictable and chaotic in your child care “routines”.
- Expose your child to unnecessary risks.
- Allow your child to watch whatever TV she wants, whenever she wants.
- Punish your child randomly and without purpose.
- Ignore your child's unique needs and abilities.
- Pick low quality, cheap day care and never check up on it.
- Let yourself go (both physically and emotionally).
- Never ask anyone for help.

There is hardly a “guideline” here that doesn't make a normal (or typical) parent cringe in disbelief. So, it's fair to ask, “What exactly is the new information that the original guidelines are supposed to contain?” Where's the beef? As neuroscientist Steve Petersen remarked tongue-in-cheek, the scientific evidence best supports this advice to parents: “Don't raise your child in a closet, starve them, or hit them on the head with a frying pan.” [quoted by Malcolm Gladwell in “Baby Steps: Do the first three years of life determine how we'll turn out?”, *The New Yorker*, 10 January 2000]

centuries. Parents have always known that babies and young children need good nutrition, stimulation, love and responsive care.” [McCain & Mustard, 1999]⁶³ Second, none of these guidelines come *directly* from research in brain development. Instead, they are, as we have seen demonstrated above, *interpretations* of what such research could possibly mean - interpretations by child advocates and other scientific professionals, not by neuroscientists. Finally, to the extent that these guidelines *have* scientific corroboration (and most of them do), such corroboration comes from disciplines such as psychology, sociology, and anthropology, not so much from neuroscience.

The situation is similar when we turn from parenting to social policy. Brain research really hasn't revolutionized this area either – despite the Enthusiasts' claim that it has. According to Jack Shonkoff,⁶⁴ a pediatrician at Brandeis University and chairman of a panel at the National Research Council that studied how brain research could be translated into public policy: “There's a gross misunderstanding on the part of the general public about how much recent brain work is ready for prime time in terms of applications to education and social service programs.” Similarly, William Greenough warns: “The results of neuroscience research cannot be translated into policy by itself. We have many sources of information regarding brain and behavioral development and learning. The best context for policy development is a team of individuals that collectively has expertise in child and adolescent development (especially developmental psychology), education, medicine (e.g., child psychiatry) and neuroscience. Working together to interpret the research and formulate policies that reflect the fullest possible knowledge of the development process, reasoned and valid policies can be proposed.” And so too does Kurt Fischer: “Ultimately neuroscience research will contribute enormously to our knowledge about raising and educating children, but right now we know too little to build public policy or advice on brain findings. In contrast to neuroscience, cognitive science and developmental science are more mature, making enormous contributions to knowledge in the last 50 years. Much policy and advice can be based on that research, but neuroscience is too young to provide such specific guidance.”⁶⁵

To the Restrained, there is no denying the “revolutionary” nature of the new neuroscience: it is indeed turning previous beliefs about brain development on their head. However, this is a revolution *within* neuroscience and not within our broader understanding of human behavior. At best, the Enthusiasts seem to be claiming that the

⁶³ Testimony that science just confirms what parents have always known comes from both sides of the American political spectrum. Laura Bush states: “If you have children, then like President Bush and me, you were probably not surprised to learn that science now confirms some of the hunches that parents have had for generations.” [White House Summit on Early Childhood Cognitive Development, 26 July 2001]

⁶⁴ All quotes in this paragraph are from the *Frontline* interviews by Sarah Moughty (*op. cit.*).

⁶⁵ Addressing the issue of educational policy, Bruer writes: “However, there is nothing new in this [Enthusiastic] critique of traditional education. It is based on a cognitive and constructivist model of learning that is firmly rooted in more than 30 years of psychological research. Whatever scientific evidence we have for or against the efficacy of such educational approaches can be found in any current textbook on educational psychology. None of the evidence comes from brain research. It comes from cognitive and developmental psychology; from the behavioral, not the biological, sciences; from our scientific understanding of the mind, not from our scientific understanding of the brain.” [from *In Search of ... Brain-Based Education*, 1999, Phi Delta Kappa International, www.pdkintl.org/kappan/kbr9905.htm]

revolution in neuroscience is nothing more than a long-awaited confirmation of what other scientific disciplines have been saying for years (and mothers have known for centuries). In terms of practice and intervention, however, what's new? Where is there even one new parenting or policy prescription – above and beyond the highly questionable admonition that we must knead and season the child's brain before it becomes fully cooked – for how we should raise our kids?

If the Restrained position is true, then, what explains the Enthusiasts' enthrallment with brain research? Both John Bruer and Jerome Kagan offer possible answers ...

For Bruer, it is all a matter of marketing⁶⁶: neuroscience is simply an effective way to package and sell the child advocates' cause. It has succeeded where past attempts failed. In reality, the "message" of the child advocates (i.e., that the Early Years are the most important because they determine adult characteristics and outcomes and are the root of a host of social ills) is not new – it goes back decades, probably even longer. However, it wasn't until it was dressed up in neuroscience garb that it attracted a lot of attention and support. And it got this attention and support because it spoke in a language that men in particular found appealing: "... brain development was of interest to both men and women. Talking about the brain's 'hard-wiring' and soldering synapses presented a mechanistic image that appealed to men, an image they could use to frame issues in early child development that previously had been of overwhelming concern only to women." Brain science permitted the child advocates to bridge the unfair divide between the "soft" and the "hard" sciences: "... brain science has always had a seductive appeal for educators. Brain science appears to give hard biological data and explanations that, for some reason, we find more compelling than the 'soft' data that come from psychological science."⁶⁷ Quoting Ed Zigler, Director of the *Bush Center in Child Development and Social Policy* at Yale, in *Education Week*, Bruer notes: "If you tell decision makers or parents, 'Your child will have a better brain if you do this or that,' then that seems to have a more seductive appeal than anything we educators can say."

The impact of this prejudice is typified in the work of Daniel Treffler, an economist at the *University of Toronto* and the *Canadian Institute for Advanced Research*. Treffler is convinced that the need to invest in people when they are young is more than just a value or an appealing ideal: *it is a "fact"*, ascertained by "research". Of course, this fact was not established by the sciences or research in which he is an acknowledged expert (i.e., economics and statistics). He calls the Early Years myth a fact *now*, but: "I wouldn't have said that ten years ago. At that time, when faced with studies that purported to demonstrate a direct link between early childhood interventions and the long-term economic performance of individuals, I was interested but not convinced. At that time there were just too many parts of the puzzle missing for the statistician in me to be moved. Put simply, it's not easy to prove that something that happens to a person in childhood is the cause of something else that happens when the

person is much older. There are just too many other factors that could have come into play during the intervening years." So, how did he become convinced? Well: "It was only the scientific discoveries of recent years that convinced me of the direct link between early childhood experiences and outcomes in adulthood. There has been a real outpouring of research at the molecular and cellular levels relating early environmental stimuli to biological processes in adulthood, **so now a causal mechanism can be demonstrated**. Of all the areas of research, three might be of particular interest for our purposes: brain 'plasticity', the HPA axis (or stress system), and serotonin metabolism." [emphasis added⁶⁸]

For Kagan, the appeal of brain research has less to do with marketing (i.e., winning over support from men and other "hard" science groupies) and more to do with class politics. From his perspective,⁶⁹ the vision informing the Early Years myth is firmly rooted in the historical and sociological experiences of the American middle class. It has less to do with cold, hard scientific truth and more to do with the passionate dissemination of a particular value set. The language and cachet of neuroscience simply permit a *moral* argument espousing middle-class values & practices to be disguised and delivered as *objective fact* to other classes and alternative family lifestyles (e.g., poor families, single-parent families, ethnic minorities, or immigrant families).

The proximate social cause for this need to proselytize alternative practices is the large number of children that have been turning up at school doorsteps unready to learn.⁷⁰ Increasing numbers of such children have spawned a "school readiness" crisis⁷¹: "Some have no knowledge of the alphabet; some have never been read a bedtime story. Many of these children have great difficulty learning to read, and those who fail to acquire reading skill by the fourth grade are at risk for becoming adolescent delinquents."⁷² Many are hungry and ill-clothed. Many are unsupervised, tired, or neglected.⁷³ The plight of such children tugs at both political ends of the heartstrings of our middle-class society: first, it violates the middle-class sentimentality about children and the moral obligation that flows from such emotion; and, second, it represents an intolerable drain on

We have too much evidence about the remarkable ability of humans to change and learn from experience at virtually every age to conclude that the early childhood years are necessarily more important than other years.

- Donald Bailey, *Critical Thinking About Critical Periods*, 2001

⁶⁶ Although, to be fair, he never puts it quite so crassly.

⁶⁷ This quote is from the *In Search of ...* article *op. cit.* It seems that psychology, sociology, and economics do indeed suffer from what the historian of science Peter Medawar called Physics Envy.

⁶⁸ All quotes in this paragraph are from Daniel Treffler's *Looking Backward: How Childhood Experiences Impact a Nation's Wealth* (2004).

⁶⁹ Again, I bear total responsibility for any distortion of Kagan's position that my following summary of his argument makes.

⁷⁰ Our public schools are, of course, the bastion and cauldron of middle-class life. They are the middle-class yardstick against which all children's lives *must* by law be measured. [I'm not meaning to imply that this is a bad thing. I was not raised in a middle-class family, but I well realize the value that assimilating to that class through the education system has been to my personal life.]

⁷¹ This crisis is so evident that it now has a formalized political platform in the USA called *No Child Left Behind*. And, yes, in case you haven't made the connection, it is indeed just one aspect of the "quiet crisis" mentioned above.

⁷² Jerome Kagan, *Three Seductive Ideas* (Cambridge: Harvard University Press, 1998).

⁷³ See Mel Hurtig, *op. cit.* – and consider the growing number of "breakfast clubs" and clothing exchanges that have been set up in our public schools over the past two decades.

social/fiscal resources (in terms of both short-term costs, such as intensive remedial programs, and long-term economic burdens, such as increased crime and loss of job & tax-contribution potential).

But what can the middle class do about this crisis? Diverting tax dollars to address the real underlying causes (e.g., poverty and globalization) doesn't seem feasible given: (a) the growing diminishment of middle-class economic power;⁷⁴ and (b) the impending need to invest fiscal resources in the needs of an aging population – a trend that will see health and retirement social security needs trump child-focused needs like education and daycare. What is needed is a less fiscally onerous strategy: "It is considerably more expensive to improve the quality of housing, education, and health of the approximately one million children living in poverty in America today than to urge their mothers to kiss, talk to, and play with them more consistently." (Kagan, 1998)

Still, it's a touch unseemly to foist middle-class standards on families with different economic resources or alternative values when our primary motivation is simply *efficiency & thrift* – and, as Kagan points out, it won't work anyway, for a couple of reasons: First, such a strategy flies in the face of other fundamental middle-class values, particularly *tolerance* and *diversity*. It's difficult in an urbanized, cosmopolitan, multi-ethnic, rights-based society to force our preferences on others in any self-conscious fashion. Second, moral suasion requires some kind of compliance based on guilt and/or shame. Families raised on alternative values simply do not measure themselves by the same moral standards and, therefore, cannot (or will not) feel guilty or shamed for non-compliance with middle-class practices. Even those families that might share or aspire to middle-class values – e.g., poor or alternative lifestyle families – are most often too oppressed, stressed, or depressed to respond to mainstream guilt-tripping with anything other than anger or fatalism. Besides: "... the decision to generate shame or guilt implies that poor mothers are morally flawed. Most middle-class adults are understandably reluctant to blame these victims by suggesting that they did not care enough about their children's welfare." (Kagan, 1998)

Thankfully, a nod to neuroscience allows the middle class to preserve the inexpensive strategy for fixing social ills while escaping the horns of the moral dilemma: "Hence, a preferred, and more benign,

⁷⁴ It's helpful to flesh out exactly what the decline of middle-class power looks like. Consider the following economic facts (from the USA but generally applicable to Canada as well):

- The average *household* (i.e., combined income all family members) income *adjusted for inflation* of the middle quintile (i.e., middle 20% of the population) remained roughly constant from 1973 to 1993 – however, this was only possible because of a massive increase in the number of working mothers and increases in overtime hours across the board. [Of course, this means a reduction in time and energy spent on child care and supervision.] This trend was caused not by an increase in taxes, but by a decrease in real wages (tax levels remained constant during this period).
- There has been a massive transfer of wealth from both the lower social classes and the middle classes to the upper 20% of households. In 1977 the top quintile earned 4 times the amount of the bottom quintile. By 1990 it increased to 7 times. During the same period, the middle class transferred an annual amount of \$4,500 USD per household to the rich; and the poor lost 13% of their real income.

[Facts taken from: Frank & Cook, *The Winner-Take-All Society* (1995) and Cassidy, "Who Killed The Middle Class", *New Yorker* (October 1995).]

approach acknowledges that poor mothers love their children but do not know the basic facts of human development. If they were aware of the importance of playing with, talking to, and reading to their children, they would implement these rituals at once. In order to make this message more urgent, educators have exploited the current prestige of the neurosciences and told parents that the first two years of life are a critical period in infant development; if parents do not provide proper stimulation during this time, their children will be harmed permanently." (Kagan, 1998)

... so what?! ...

Of course, it's possible that some observers of this struggle between the Enthusiasts and the Restrained might (in a *devil's-advocate-ends-justifies-the-means* sort of mood) ask: "So what?! What's so bad about the Myth if it accomplishes the purpose of getting attention paid to a critical time of life and an area of human development that deserves social resources (especially in a political climate the promises to divert more resources to the aging population)?"

Two reasons:

First, there is the simple fact that our social policies ought to be based either on (a) sound scientific research & expertise or on (b) clearly defined social values – *not on values masquerading as neutral scientific knowledge*. Such a conflation does a disservice to both science and our values: it undermines the credibility of the former by bending it to political ends and implies that the latter lack sufficient justification to stand alone.

The truth of the matter seems clearly to be that early childhood intervention works to accomplish a host of positive long-term outcomes – everything from increased academic achievement (literacy, higher grade average, higher graduation rates) & increased employability to a reduced risk for social ills such as criminality and mental illness. This type of intervention is especially important and effective with children that are economically and socially disadvantaged. However, it works⁷⁵ *not because it wires the brain*

⁷⁵ Of course, not everyone is convinced that early childhood intervention truly lives up to its promises. Scientific opinion ranges from highly skeptical to ardently supportive. [Personally, I lean closer to the supportive side.] Speaking for the skeptics, Vanderbilt University's Dale Farran concludes: "Reviewing work related to intervention for children from disadvantaged backgrounds over this past decade is somewhat disheartening. A great deal of money was spent on programs which have not been shown to be more effective than doing nothing at all" [from "Another Decade of Intervention for Children Who Are Low Income or Disabled: What Do We Know Now", in Shonkoff & Miesels (eds.), *Handbook of Early Childhood Intervention*.] Opposing this conclusion is Steven Barnett, a professor of Education Economics and Public Policy and Director of the National Institute for Early Education Research (NIEER) at Rutgers University and one of the principal analysts of the American *Head Start* program. Barnett has persuasively answered the critics' concerns that programs like *Head Start* show a definite "fade-out" of benefits as the participating children age. [See, for example, nieer.org/resources/research/BattleHeadStart.pdf.]

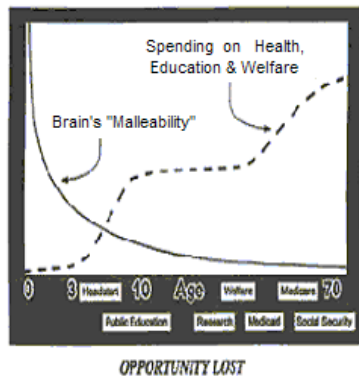
Despite the fact that it concentrates primarily on academic benefits, I find Barnett's work interesting because he admits that there is one key area in which "fade-out" *does* happen – i.e., in IQ scores. In every other area, *Head Start* shows effective long-term benefits (e.g., achievement test scores, grade retention, special education, and high school graduation). In effect, Barnett is revealing a useful distinction – between biological state (IQ) and behavior (academic performance). My point is that *if the Enthusiasts position is correct (i.e., early intervention improves the hard-wiring of the brain), would we not then expect to see a definite retention of IQ as the child ages?* Behavior (academic performance) might be influenced by a variety of social factors, so we wouldn't be surprised if it

more efficiently, but because it affords these disadvantaged children access to the kinds of middle-class resources, opportunities, and experiences that they would not otherwise have. We ought to have the political courage to commit to *providing* this access for all our disadvantaged children, rather than to avoiding the financial cost of such access by morally urging middle-class conformity in the guise of neuroscience on disadvantaged families.

Second, the deterministic model of brain development that underpins the Enthusiasts' Myth has potentially damaging consequences for vulnerable populations – consequences that some political jurisdictions are already implementing. Fueled by economic research on the benefits of early childhood intervention, another Myth has taken flight in our political imagination – i.e., the Myth of the Saved Three Dollars.⁷⁶ In essence, this Myth states that for every *one* dollar invested in early childhood intervention, *three* dollars are saved (in the future) because of the reduction in child protection, mental health disorders, addictions, and criminality. Unlike the Myth of the First Three Years, however, this Myth is substantially true: *early intervention does indeed reduce the rates of many social ills* (as Trefler, *op. cit.*, confirms in his economic analysis). However, when looked at through the lens of the Myth of the First Three Years, an inevitable distortion happens: if the brain is fully cooked by three (or six or ten), then what possible good can intervention do past that point? Why not take the money invested in such programs and divert

Diagram 1: Opportunity Lost?

THE MISMATCH BETWEEN OPPORTUNITY AND INVESTMENT



it to where it will have the greatest impact? Once again, it is John Bruer who gives voice to the concern: "If we take the Myth to heart, it seems to follow that if we can't help children by age 3, then we can't help them at all. Critical periods, windows slamming shut, loss of neural plasticity, and cooked brains draw attention to the quiet crisis, but they do so at a price. A strong and beguiling neural-environmental determinist argument for the critical importance of the first three years weakens the policy case for supporting programs and interventions to

faded over time. But biological hard-wiring shouldn't fade – that, after all, is what IQ is supposed to index.

⁷⁶ First formulated by the economists Jacques Van der Gaag, & Jee-Peng Tan from a 1988 analysis of nutrition programs in Bolivia, it has frequently inflated to six and even seven dollars (for example, see the *Every Child Matters Education Fund* information). Proponents of early childhood intervention have learned that accounting arguments carry more weight with government funders than appeals to improved welfare or moral obligation.

assist older children and citizens. Why provide literacy and education programs in prisons? Why recruit individuals with low intelligence into the armed forces? It's too late to help them."⁷⁷

A typical projection of how social resources are misspent, based on the Myth of the First Three Years, is presented in Diagram 1 [Opportunity Lost?].⁷⁸ In effect, the Myth advocates that the Spending line should match the Brain Malleability line, thereby saving millions of dollars that are now being wasted on ineffective help.

PART 2: THE SURLY YEARS

In Which The Un-Cooked Brain Comes To The Rescue of Teenagers Everywhere?

No one ever thought that what was changing (in teenagers) could be driven by, or be a reflection of, the basic changing structure of the brain. That is very, very new.

- Tomas Paus *et al*, *Science* (1999)

The neuroscience world was dropped on its dogmatic head just a few years ago by reports that the adult brain, which in this case includes adolescents, continues to produce a regular stream of new neurons ... neuroscientists have been finding that the brain continues to change – it is plastic – throughout life ...

- Barbara Strauch, *The Primal Teen* (2003)

When I was a boy of fourteen, my father was so ignorant I could hardly stand to have the old man around. But when I got to be twenty-one, I was astonished at how much the old man had learned in seven years.

- Mark Twain

Sometimes, now, I find it just feels good to think.

- Eric (aged 17)⁷⁹

Whatever the differences in interpretation or philosophy between the Enthusiastic and the Restrained positions, the continuing advancement in neuroscience research seems to have settled the issue conclusively in favor of the Restrained. Indeed, the Enthusiastic Early Years advocates appear to have gotten the story of the brain wrong:⁸⁰ it isn't fully cooked by three or six or even by 10 or 12.

⁷⁷ McCain & Mustard mention the savings that can be had from early intervention in their *Early Years Study* – i.e., the Ypsilanti/High Scope program is estimated to save seven dollars for every dollar invested (as an example of potential savings). To their credit, however, McCain & Mustard do not make specific recommendations about reallocation of resources away from other child services (as they put it, the system should not "[rob] Peter to pay Paul"). They believe that decreases in system expenses will be realized over time, but that immediate investments should come from other government sectors (unspecified).

⁷⁸ Taken from Fraser Mustard's article: "Brain Development, Competence and Coping Skills" at www.founders.net (date unknown).

⁷⁹ Quoted in Barbara Strauch, *The Primal Teen; What the New Discoveries About the Teenage Brain Tell Us About Our Kids* (Toronto: Random House, 2003).

⁸⁰ Of course, given my belief that the Enthusiastic argument is informed more by a value set (and a particular, deterministic model of human development) than by dispassionate interpretation of scientific evidence, I doubt that any true Enthusiasts will understand the new research on teenaged brains as in any way invalidating their position. I look forward to hearing the explanation as to how the new research actually proves the early years' myth to be true. [To be fair, most Enthusiasts – as the following quotation indicates – seem to be rethinking their position.]

Doomed Before Kindergarten? ... As an early interventionist, concentrating on children 0-3 years of age, we have been taught about the importance of the early years of life. The plasticity of the brain, and its ability to learn is at a rate unmatched at any other time of life. Now, some information points to the fact that the brain continues to be able to expand and is better at it than previously believed. The teen years may present a second window of opportunity.⁸¹

Central to the new brain research is the work of Dr. Jay Giedd, chief of brain imaging in the child psychiatry branch of the *National Institute of Mental Health*. Using magnetic image resonance (MRI), Giedd has studied the brain activity of more than 1,800 children and teenagers.⁸² The results of his work are a serious challenge to the Early Years' myth: "... most scientists working in this area today think that the changes taking place in the brain during adolescence are so profound, they may rival early childhood as a critical period of development."⁸³

*Before the imaging studies by Giedd and his collaborators at UCLA, Harvard, the Montreal Neurological Institute and a dozen other institutions, most scientists believed the brain was largely a finished product by the time a child reached 12 ... Some theorists concluded from this that the idea of adolescence was an artificial construct, a phenomenon invented in the post-Industrial Revolution years. Giedd's scanning studies proved what every parent of a teenager knows: not only is the brain of the adolescent far from mature, but both gray and white matter undergo extensive structural changes well past puberty.*⁸⁴

So, what exactly is going on in the brains of those previously believed to be fully ~~cooked~~ developed? Here's a snapshot of the various processes and changes (but you won't see the big picture until you put them all together).⁸⁵

⁸¹ Julie Loe, www.pediatricservices.com/prof/prof-25.htm.

⁸² His initial interest was in studying brain functioning in kids with ADHD and autism, but he expanded his research to "normal" kids because he needed a credible control.

⁸³ Barbara Strauch, *op. cit.*

⁸⁴ Claudia Wallis, "What Makes Teens Tick", *Time Magazine*, 10 May 2004. There is, of course, a certain paradox in the claim that "every parent of a teenager knows", given that McCain & Mustard earlier claimed that parents have known for centuries exactly the opposite (i.e., that mothering is vital because the brain stops developing after the early years). What exactly is it that we are to believe that parents know? [Actually, what I find most interesting is that both sides of this matter find it helpful to appeal to the "common sense" experience of parents while simultaneously claiming that their insights are based solidly on "science" (which exists because common sense is notoriously incomplete and limited – and often quite wrong about how things work). Clearly, parental knowledge (as contradictory as that may be) carries impressive weight and authority in our culture.]

⁸⁵ The information below is a compilation from: Strauch (*op. cit.*); Wallis (*op. cit.*); American Bar Association, "Adolescence, Brain Development and Legal Culpability", ABA Juvenile Justice Center (January 2004, www.abanet.org); Ronald Dahl, "Beyond Raging Hormones: The Tinderbox in the Teenage Brain", *Cerebrum: The Dana Forum on Brain Science*, v. 5, #3, Summer 2003; transcript from CNN's *Your Health* – "Brain Development During Adolescent Years; Protecting the Brain During Formative Years is Paramount; MRI Allows Insight Into Mind", aired February 17, 2001 - 3:30 p.m. ET – interview with Jay Giedd, Elizabeth Sowell, Paul Thompson, Deborah Yurgelun-Todd, and Susan Bookheimer; Sarah Spinks, "Adolescent Brains are Works in Progress", *Frontline*, aired 31 January 2002.

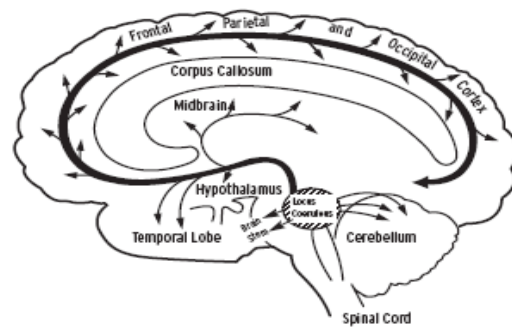
• ... *exuberance & pruning* ...

"For years it was thought that the teenage brain was finished, cooked. Most of the truly important human brain development, scientists believed, was over by the first three years of life." [Strauch, 2003] Recent⁸⁶ neuroscience is showing, however, that *synaptogenesis* (or, as described earlier, *exuberance*) carries on through the teen years in waves and in different substructures of the brain. One scientist (Harvard's Kurt Fischer) provides evidence that exuberance is periodic and frequent in our brain's development: at 4, 8, and 11 weeks; at 4, 8, and 12 months; and at 2, 4, 7, 11, 15, and 19 years.

Following each fit of exuberance, of course, is a period of *pruning*: "The period of pruning, in which the brain actually loses gray matter, is as important for brain development as is the period of growth. For instance, even though the brain of a teenager between 13 and 18 is maturing, they are losing 1 percent of their gray matter every year." [Spinks]⁸⁷

In effect, then, *the very same brain processes that were so vital to the Enthusiasts' case for early intervention (before the windows of opportunity close forever) are at work in the teenage brain.*

Diagram 2: Brain Anatomy



• ... *the prefrontal cortex (the brain's "bark")...*

"The prefrontal cortex sits just behind the forehead. It is particularly interesting to scientists because it acts as the CEO of the brain, controlling planning, working memory, organization, and modulating mood. As the prefrontal cortex matures, teenagers can reason better, develop more control over impulses and make judgments better. In fact, this part of the brain has been dubbed 'the area of sober second thought.' ... The fact that this area was still growing surprised the scientists. Although they knew that the brain of a baby grew by over-producing synapses, or connections, they had not known that there was a second period of over-production." [Spinks, 2002]

⁸⁶ Again, "recent" is a contentious term: some scientists contend that the research showing teen brain development goes back a couple of decades. One group seems to see the work of Giedd as astonishingly new, while another group sees it as simply confirmation of what has been shown in earlier studies.

⁸⁷ Exuberance & pruning, you will recall, is the mechanism by which the brain prepares new capacities – in which, as Bruer pictured it, a new capacity (most likely with survival implications and evolutionary selection) comes "online".

The prefrontal cortex is the brain area that experiences the largest and longest period of exuberance & pruning. Besides the capacities mentioned above, it is also believed to be instrumental in the processing of social, emotional, and intellectual information – in effect, it permits the uniquely human ability to create and interpret “context”.

The general purpose of the prefrontal cortex is *inhibition* and *consequential thinking*; it is designed to control lower brain impulses. [In Paul MacLean’s “triune brain theory”, human evolution involves the development of three brains, with each successive ‘brain’ functions to control or modify the impulses of its predecessor. The ‘brains’ are: (i) our *reptilian* brain (brain stem/cerebellum – Lizard Brain) which operationalizes survival processes like breathing, movement, digestion, aggression, flight, etc.; (ii) our *limbic* brain (Monkey Brain) which operationalizes emotions, bonding, playing, etc.; and the *neocortex* (Human Brain) which operationalizes creativity, language, and associational thinking.] From this perspective, brain development is progressive inhibition. One major consequence of this reduced inhibition is increased risk taking – one of the hallmarks of adolescent behavior (and directly pertinent to our field of youth criminal activity).

- ... *the caudate nucleus (the little thing with a “tail”)...*

Part of our limbic system (specifically, the *basal ganglia*), the *caudate* is one of the first structures to undergo and complete the teenage exuberance & pruning. In general, its pruning is completed by the time we are 13 – and the result is a 20% reduction in synaptic connections from its peak number. The caudate governs unconscious mechanistic motor movements (things like piano playing, bike riding, etc.); it locks in motor skills as part of the learning process and “acts like a secretary to the prefrontal cortex by helping it prioritize information.” [Wallis, 2004]

- ... *the cerebellum (the “little brain”) ...*

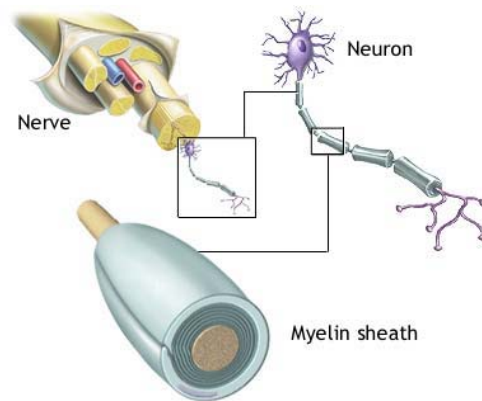
Located at the top of the neck (and considered part of MacLean’s *reptilian* brain), the cerebellum is one of the least heritable parts of the brain – i.e., it shows least variation attributable to genetics and most variation in response to the experience of the environment. It is one of the last parts of the brain to complete the pruning process – well after the prefrontal cortex. It is instrumental in recognizing social cues (so it is prominent in such things as autism, Asperger’s Syndrome, and getting jokes). Interestingly, it is also one of the most sexually dimorphic parts of the brain – i.e., it is bigger in males.⁸⁸

- ... *white matter: myelinization ...*

Myelinization of the neurons (as discussed previously) is a necessary part of a brain cell’s development. The white, fatty myelin sheath that forms around the cell’s axons (a) provides structure & nutrition, (b) carts away unused or dead dendrites & neurons, and (c) furnishes the insulation necessary for increased efficiency in processing electrical signals. Still growing in the teen years, despite the Early Years’ claim to the opposite, myelin grows 100% during adolescence. This growth is mainly in the *cingulate gyrus* (the “girdled circle” that is part of the limbic system and is involved in emotions, shifting of attention, cognitive flexibility, and cooperation) and the *hippocampus* (the “horsy sea-monster” that helps create new memories and integrate emotions

with memories). [Just to balance the scales, the hippocampus develops faster in females.]

Diagram 3: Myelin⁸⁹



- ... *the corpus callosum (the “unfeeling body”) ...*

The corpus callosum is the bundle of nerve fibers that connects the left and right hemispheres of the neocortex. It is, therefore, instrumental in integrating and coordinating information from different brain areas. Research is now confirming that it is not fully developed until adolescence, when the myelinization process is completed. It is linked to the *parietal cortex* (i.e., brain “wall” that is considered to be our logic center). [Again, this area tends to develop more fully in female⁹⁰ brains.]

- ... *the amygdala (the brain’s “almond”) ...*

The *amygdala* is an almond shaped knot in the middle of the brain (part of the limbic system) involved in fight, flight, anger, fear, and other emotions). Neuroscience is now showing that adolescents rely on this area of the brain more than the *prefrontal cortex* (i.e., the area used by adults) to sort out or interpret emotions. One consequence of this displacement is the frequent mislabeling of emotions (adolescents, for example, have difficulty distinguishing between worry and aggression or between fear and hate). Developmentally, then, emotional recognition slows down during the teen years and only returns to normal speed around 18, when exuberance & pruning fine tune the prefrontal cortex.

- ... *neurotransmitters: glutamate, dopamine, serotonin ...*

As well as structural development in the teen brain, there is also considerable change in chemical activity, particularly in those chemicals responsible for communication between brain cells (*neurotransmitters*). For example: *Glutamate*, which is an *excitatory*

⁸⁹ From A.D.A.M., www.adam.com.

⁹⁰ In many places in brain research, the “male” and “female” brains are differentiated. This differentiation is to be understood in the statistical sense, not as a stereotype. Most human brains share features of both the male and female brain; very few are highly differentiated. So, it’s quite possible that a given male could have a predominantly “female” brain, and vice versa. All the research shows is that *on average* males are more likely to have a “male” brain and *on average* females are more likely to have a “female” brain. [Think of it like “height” – the average male is taller than the average female, but many females are taller than some males.] See: Simon Baron-Cohen, *The Essential Difference: Male and Female brains and the Truth About Autism* (New York: Basic Books, 2003).

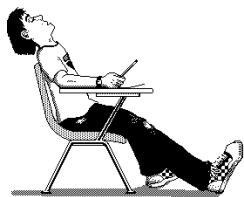
⁸⁸ This is probably due to the fact that hunting (from an evolutionary perspective) in the human species requires both heightened physical coordination and heightened social coordination (both of which the cerebellum is involved in).

neurotransmitter (i.e., it causes synapses to fire), declines from a 7:1 ratio to 4:1 during adolescence (indicating a general “calming” of the brain and, therefore, less impulsiveness as the teen gets older). *Dopamine*, which is a *modulator* (i.e., it alters, converts, and harmonizes synapse communication), increases in early adolescence and then decreases dramatically in later adolescence. Too high or too low a level of dopamine interferes with proper modulation. Dopamine is also involved in the brain’s *pleasure/reward* system (e.g., we are *rewarded* with hedonic feeling both for *survival activity* – things like sex, risk, independence – and also *saliency* and *error detection* – dopamine increases in the presence of something new so that we may sort out whether it’s a threat or not). *Serotonin*, which is an *inhibitor* (i.e., it reduces the likelihood of a synapse firing and thereby calms the brain), is believed to decline during the onset of adolescence – resulting in more impulsive, risky, and moody behavior.

• ... *hormones: estrogens and androgens & others* ...

Other chemicals are involved in adolescent brain development besides the neurotransmitters. Primarily, these are *hormones* (chemicals that “urge”). Puberty was once thought to have started with the increase in the sex hormones *estrogen* and *androgen* (the principal androgen is called *testosterone*). Now, however, it is thought to start with changes in brain development: i.e., the *hypothalamus* (the part that “lies below the inner chamber” of the brain and that is responsible for regulating body temperature, breathing, and blood pressure, etc.) signals the *pituitary gland* (the pea-sized “phlegm secretor” and master gland of the endocrine system) to start producing hormones. In turn, these hormones sculpt the massive body and brain changes we define as puberty. Originally, these sex hormones were thought to work mostly on the hypothalamus, but neuroscience is now showing their influence all over the brain: in the cortex, cerebellum (movement & cognition), amygdala (emotions), as well as the hippocampus (memory).

Chief amongst the non-sex hormones that show a dramatic increase in adolescence is *melatonin* (the “black” hue). Produced by the *pineal gland* (the “pine cone”), melatonin induces sleep, driving the adolescents need for more sleep up as much as two extra hours per day. [The adolescent sleep pattern is a well-understood phenomenon. Conjectures about the survival value of such a pattern include: (a) the need for sleep processes to fine-tune the massive body and brain changes taking place at that stage of development; (b) the shift of sleep/wake cycle to afford the hunting/gathering tribe greater defenses during the night; and (c) the reduction of adult/adolescent conflict as the latter gains in strength and seeks sexual access without the need to challenge or compete with the former.



... so ...

The gist of the neuroscience snapshot above is that brain development does *not* end with the Early Years: it continues in significant ways all through adolescence (and, some maintain, even into much later adult years). The brain’s reliance on environmental input to complete this development is as crucial at thirteen as it is at three – and the capacities that come online during adolescence are as vital to our survival and well-being as those that come online in the first few years of life. If this is true, can we expect government investment in a *Surly Years Study*? Shouldn’t we be advocating for Surly Years Centers and a *Surly Years Challenge Fund*, before the window of opportunity closes and the brain is cooked for good? Shouldn’t

we be identifying the long-term negative consequences (e.g., hospitalization, incarceration, lost employment potential, addiction) of ignoring the “real brain drain”? Even Dan Quayle understands that “a mind is a terrible thing to lose”.

Of course, since hindsight is 20/20, it’s now easy to see that adolescence is indeed a *developmental* stage of human growth not just for the body, but for the brain as well. It’s a bit puzzling how we could have once believed that the massive changes taking place throughout the body and its vital organs would not also affect our most vital and most complicated organ.

I think Kagan provides the most compelling account of why we have historically wanted to see the brain as fully hard-wired in its early years. His explanation goes something like this ...

In the 18th-century shift from an agricultural-rural economy to an industrial-urban one, the role and significance of women and children changed radically. In essence, children lost their economic value as *laborers* but assumed a new economic value as *investments* (a family’s fortune could be improved by having children educated to assume more prestigious and lucrative occupations in an increasingly mobile and fluid class society). They also became objects of sentiment and pleasure as their value shifted from a present-focus to a future-focus. Concomitantly, women were freed from their economic role as *helpmates* on the farm (or craft enterprise) to become *mistresses of the domestic sphere* – and their chief responsibility became the nurturing and educating of the family’s investment in its future (i.e., its children).

Social mobility, however, represents *both* opportunity *and* threat: a family’s investment could as easily lead to ruin as to improvement & security. The result is a new form of social and economic anxiety. Consequently, protective beliefs will inevitably arise to mitigate such anxiety by providing suggestions for action and control. A constellation of such beliefs began to grow around the new roles of women and children. As Kagan puts it: “The popular notion that certain parental behaviors guaranteed the development of character traits necessary for a successful future, and therefore protected the family against a descent in status, rationalized ritual practices that swept some of the worry away. But this idea meant that the complementary hypothesis must also be true: If mothers did not nurture their infants properly, their children would be vulnerable to a dull mind, a wild spirit, and a downward spiral. Thus, it was morally incumbent on parents to implement the best rearing practices as early as possible.” [Kagan, 1998]

In Kagan’s view, it is this social anxiety that gave birth to what he calls “infant determinism”⁹¹ – i.e., the idea that the experiences of the

⁹¹ To be clear, we can compare “infant” determinism (i.e., the idea that the adult is determined by the experiences of infancy) with “genetic” determinism (i.e., the adult is determined by genes), “astrological” determinism (i.e., the adult is determined by stellar configurations at birth), “cultural” determinism (i.e., the adult is determined by social or cultural forces), or “theological” determinism (i.e., the adult is determined by the will of a god). It was William Wordsworth who gave lyrical form to infant determinism in his 1802 poem “My Heart Leaps Up When I Behold”:

So was it when my life began;
So is it now I am a man;
So be it when I shall grow old,
Or let me die!
The Child is father of the Man ...

However, I suspect the idea existed in folklore long before the changes identified by Kagan. Certainly, prior to the 18th Century, the Jesuits had a

infant determine the capacities and destiny of the adult. In one form or another, this myth re-emerges with each generation. The Early Years hypothesis is simply the latest version.⁹²

The new findings on adolescent brain development put the lie to infant determinism by showing that our brains are far more malleable and receptive to environmental influence, and for a much longer period, than the Early Years Enthusiasts would have us believe. However, there is an important point to be made here: the message of the new research is not that *infant determinism* should be replaced with *developmental determinism* (as if the basic approach is correct, but we just need to stretch it out a little longer); rather, the message is that we need an alternative to determinism itself if we are going to gain a better understanding of brain development and brain functioning in humans.

There is a (perhaps valid) perception in our social experience that the teenage years are tumultuous – a time of risk, rebellion, and raunch. As long as we have had written records, there have been complaints about the rowdiness of youth. As far back as the 8th Century BCE, the Greek poet Hesiod observed:

I see no hope for the future of our people if they are dependent on frivolous youth of today, for certainly all youth are reckless beyond words... When I was young, we were taught to be discreet and respectful of elders, but the present youth are exceedingly disrespectful and impatient of restraint.

And it was no better three hundred years later when Plato lamented that:

Youth today love luxury; they have bad manners, contempt for authority; they allow disrespect for elders and love chatter in place of exercise. They are tyrants, not the servants of their households. They no longer rise when elders enter the room. They contradict their parents, chatter before company, gobble up dainties at the table, cross their legs, and tyrannize their teachers.



It's tempting to look at the new neuroscience research and believe we now have the causal mechanism that explains this turbulence. However, this is the same mistake as that made by the Early Years Enthusiasts. Again, what we need is a more Restrained approach. As John Bruer points out: "This simple, popular, newsweekly-magazine idea that adolescents are difficult because their frontal lobes aren't mature is one we should be very cautious of. Yes, there are

principle for which they were well known – i.e., "Give me the boy until he is seven and I will give you the man."

⁹² The incarnation of infant determinism immediately preceding Early Years is called Attachment Theory. [See Kagan, 1998, for an excellent critique of the scientific merit of this theory.]

adolescents that are hard to get along with. There are adults that are hard to get along with for the same reason. Presumably, the adults have mature frontal areas. There are very young children who seem to have no problem with this. Very immature brain structure, yet results in very sophisticated behavior. So this notion there's going to be some easy connection between counting synapses or measuring white matter and the kinds of behaviors people display or we want them to display is one we're going to have to do a lot more work on before it's science." [Spinks, 2002]

We get a much more charitable view of adolescence when we take a cross-cultural perspective. In societies that are smaller, less industrialized, less socially complex, and more structured, the cataclysms of adolescence are virtually non-existent. We know from other areas of science (sociology, social psychology, anthropology, etc.) that there are undoubtedly huge environmental elements that contribute to adolescent behavior: the stresses & pressures of a long and complex transition from childhood to adulthood, the social disjunction between adolescent and adult experience, and the evolving changes in work and family life, to mention just a few. In our societies (i.e., the Western, industrialized ones), each generation of adolescents face unique situations and challenges – ones that the adult generation cannot prepare them for. If we want to "explain" adolescent behavior, then, we need to look to these social factors every bit as much as (and probably *more* than) we look to the neuroscience.⁹³

- Terry Henry

⁹³ As an example, I reported above on the adolescent's relative inability to distinguish certain emotional states (the section on the amygdala). As it turns out, however, this conclusion was based on a neuroscience experiment that showed subjects **black & white** pictures of faces expressing emotions. When a different researcher repeated the experiments with **color** pictures, the difference between adult and adolescent perception disappeared! The explanation? Adolescents today have a different social experience in de-coding black & white images – such images have shown a significant *cultural* transformation: they are far less prevalent now than they were for adults growing up. When the images are presented in a cultural form (in this case, color) that is relevant and meaningful to adolescents, they perceive in a manner virtually identical with adults. The conclusion, then, that adolescents are less able to distinguish emotions may not be warranted. [See, David Dobbs, "Fact or Phrenology?", *Scientific American Mind*, v. 16, #1, 2005.]