Ethical issues in Educational Neuroscience: Raising Children in a Brave New World

Zachary Stein[1]
Harvard University Graduate School of Education
Developmental Testing Service

Bruno della Chiesa
Harvard University Graduate School of Education
Organization for Economic Cooperation and Development

Christina Hinton
Harvard University Graduate School of Education
United Nations Educational, Scientific, and Cultural Organization

Kurt W. Fischer
Harvard University Graduate School of Education

Stein, Z., della Chiesa, B. Hinton, C., Fischer, K.W. (forthcoming, 2010). Ethical issues in Educational Neuroscience: Raising Children in a Brave New World. *Oxford Handbook of Neuroethics*. (Illes & Sahakian, eds.) Oxford University Press.

[1] stein.zak@gmail.com

A growing international movement, called educational neuroscience (or mind, brain, and education), aims to inform educational research, policy, and practice with neuroscience and cognitive science research. Usable knowledge from this field is already making important contributions to the field of education. However, this new field is also likely to radically alter our understanding of learning and schools. The research brings a powerful capability to directly intervene in children's biological makeup, stirring ethical questions about the very nature of child rearing, and the role of education in this process.

We argue that there is a key distinction between *raising children* and *designing children*, and that the ethical application of neuroscience research to education critically depends upon ensuring that we are *raising* children. Designing children involves altering dispositions and behaviors by use of mainly physical means while adopting 3rd person perspectives and instrumental attitudes. Some current practices surrounding psychopharmacology in schools fit this description. Raising children, on the other hand, is a process in which dispositions and behaviors are altered mainly through the use of shared languages and values while adopting 1st and 2nd person perspectives and cooperative attitudes. We argue that designing children is ethically unacceptable, invoking Kant's categorical imperative and human rights issues, and we present a few case studies to highlight important ethical issues. We hope to provoke others to consider emerging ethical issues in mind, brain, and education, and to take preemptive action to protect children's right to participate in their own development.

Facing New Educational Frontiers

From Adderall to zip drives, scientific and technological advances are transforming every aspect of schooling. People increasingly discuss learning and behavioral problems in biological terms, and psychopharmacology is a ubiquitous presence in American Schools. Computer

technologies are transforming the nature of teaching and learning, and many adolescents are performing multiple tasks across multiple platforms at the same time for a large part of the school day. While there are major differences in these trends depending on national and cultural contexts, the nature of education is undergoing profound change everywhere on the planet, bringing new challenges for human beings and their brains. The future of education and the future of neuroscience are linked (OECD 2007a). This paper addresses some of the ethical issues likely to be encountered as our societies move into new educational frontiers where neuroscience and education intertwine.

Educational neuroscience (or the broader field of mind, brain and education) is an emerging polycentric transdisciplinary movement (Fischer et al. 2007; Fischer, Goswami, and Geake in press; Koizumi 1999) aimed at helping to reform educational research, practice, and policy in light of brain research and cognitive science. The first section below briefly looks at this field and two of its important organizations. Generally, the field is shaped by concerns about the nature of usable knowledge, especially concerns about what constitutes a valid application of neuroscience in an educational context. The limits of neuroscience methods and the complexity of relations between research and practice take center stage in debates about how the field can move forward responsibly.

However, as the second section makes clear, a host of ethical issues pervade the field. These ethical issues range from the equitable distribution of benefits to the privacy rights of people studied in research and the sensitivity of conducting research in schools. We focus on a central issue in the third section -- the distinction between two general types of educational interventions informed by neuroscience, *designing children* versus *raising children*.

We explicate the meaning of this distinction and ground it in several case-study scenarios in section four. These scenarios envision educational reforms that might follow in the wake of advances in understanding the biological bases of ethical behaviors. Some approaches aim to physiologically alter a child's brain with the goal of correcting an organic dysfunction or

creating a desirable ability or characteristic—that is *designing children* so that they behave the way the designer wants. Other approaches provide children with a variety of educational and social contexts, informed by probabilistic neuropsychological profiles—that is *raising children* to be ethical. Critical differences between these two types of approaches hinge on issues of basic justice and fairness—the manner with which a child's right to autonomy is respected and fostered or overridden and denied.

The future of education and its relation to neuroscience revolve around the way knowledge is put to use with those most affected by it. The central issue is how education systems and families intervene in children's lives. Educational applications of neuroscience that favor designing children over raising them are unacceptable in so far as they change behavior through *coercion* as opposed to *persuasion*. Such educational interventions run the risk of creating individuals who are incapable of assuming authorship for their own life. We share Habermas' (2003) worry that the careless use of biomedical advances may undermine the organismic conditions that allow for ethical self-understanding and responsible agency. When mature individuals do a retrospective review of their lives, they ought to be capable of taking responsibility for their own lives. This possibility is denied to someone who has been made into who they are by irrevocable instrumental interventions into their biological makeup. All children have a right to participate in their own development, as stated in the Convention on the Rights of the Child: "Parties shall assure to the child who is capable of forming his or her own views the right to express those views freely in all matters affecting the child, the view of the child being given due weight in accordance with the age and maturity of the child" (United Nations 1989, article 12). Educational institutions and societies more generally need to take preemptive action to ensure that children exercise this right in the wake of biotechnologies that allow adults to directly intervene in children's neurobiology.

Educational Neuroscience—A Growing Global Movement

Education is emerging as one of the central concerns for humanity in the 21st Century. The most pressing global challenges—from climate change to terrorism to economic globalization—all hinge upon quality education. Mounting evidence points toward the efficacy of education in international development, economic growth, and social equity (OECD 2009). Access to education is a central civil rights issue, along with access to basic life-sustaining necessities such as food and shelter (*ibid*; Obama 2008). International communities of political and business elites are beginning to see what devoted educators have always known—that the future of civilization hinges upon the ability to educate coming generations (Coulombe et al. 2004; OECD 2007b; OECD 2009).2

Although education is now recognized as important for the present and future, it still lacks an essential foundation for quality that is pervasive in other industries: Education has little research and development (Fischer 2009; Hinton and Fischer 2008). As a result, *there is not a clear science of education*. As demands for high quality education proliferate around the globe the need for a science of education looms large—and many are beginning to look to brain research and cognitive and affective science for help in establishing this science of education.

The emerging field of *educational neuroscience* is as much a response to pervasive social need as it is an outgrowth of progress in the relevant sciences. As a result, the field is

---

[2] While this attitude is universally adopted on paper, the degree to which governments and business communities are truly committed to having a highly educated population is debatable (Bourdieu and Passerson 1964/1990). Some argue that there may be some resistance to education systems that are too successful because they might breed social changes considered dangerous by dominant elites who are keen to reproduce the current social structures (della Chiesa 2008; della Chiesa and Christoph 2009; OECD 2007c).

dynamic, heterogeneous, and contested, as a wide variety of stakeholders maneuver for influence. Responsible brain and cognitive scientists and open-minded educational leaders stand in stark contrast to entrepreneurs spinning off biomedical technologies and snake-oil salesmen selling so-called "brain-based pedagogy." Several international organizations and initiatives have emerged to give shape to these burgeoning and widespread efforts to build a science of education. Of particular note are the International Mind, Brain, and Education Society (IMBES) and the Brain Research and Learning Sciences project at the Organization for Economic Cooperation and Development's (OECD) Center for Education Research and Innovation (CERI) (OECD 2007a).

These initiatives serve an important dual role. On the one hand, they function to facilitate the growth of educational neuroscience. IMBES launched the journal *Mind, Brain, and Education* in 2007 to encourage and disseminate research and best practices. IMBES also coordinates a set of research school collaborations (Hinton and Fischer 2008) as part of growing efforts to bridge theory and practice in a rigorous, sustainable manner. Leading educators, neuroscientists, and cognitive scientists attend biennial IMBES conferences to build the field and to draw positive public attention to the field's important aspects and prospects. Moreover, in conjunction with these efforts, a group of major universities—including Harvard University, the University of Texas, and Cambridge University—now offer degrees in mind, brain, and education or educational neuroscience, as well as workshops for educators and scientists who want to learn about and contribute to connecting mind, brain, and education

At the same time, a pressing need to combat market forces and misinformation has these organizations issuing warnings concerning misapplications, neuromyths, and overzealous bridge-building from basic research to classroom practice. In this capacity they serve to focus the attention of researchers, practitioners, and the public on the limits of brain and cognitive science methods and knowledge. They issue a call for humility and caution, and a call for the

kind of concerted transdisciplinary efforts needed to build usable knowledge in the field (della Chiesa, Christoph, and Hinton 2009; Fischer 2009; Koizumi 1999).

Valid usable knowledge stands in contrast to prevalent neuromyths (OECD 2002; OECD 2007a). For example, several popular educational products claim that neuroscientific evidence demonstrates that infants' development and intelligence is enhanced by exposure to stimuli such as paintings, classical music, or flash cards. Others claim that certain types of physical exercise and movement (such as specific regimens of finger maneuvers) stimulate brain health and increase memory and academic performance. Still others make claims that individuals can be classified in terms of their hemispheric dominance ("left brain" people and "right brain" people), for which they sell diagnostics and related educational interventions. The research claims for these products are totally fallacious. The products are merely *marketed* using the language of neuroscience because using brain images and neuroscience terms makes people more likely to believe the ideas (McCabe and Castel 2008; Weisberg et al. 2008).There are many plausible explanations for the effects of neuroscience claims on marketing, including that the Western world is dominated by a positivistic/scientistic mindset that preferentially accepts material explanations and that the media promotes neuroscience as innovative and fashionable. Regardless of the underlying cause, as Dewey (1929) saw decades ago, people will flock to anything claiming a "scientific seal of approval" as long as a true science of education is absent.

One more subtle example of brain science being misapplied to education concerns the issue of "critical periods"—phases of brain development that are seen as narrow windows of opportunity for the acquisition of key skills, such as learning a second language. Inappropriate claims are made about the *narrowness* and *criticalness* of the periods (Neville and Bruer 2001), with some suggesting that if a person misses a small window of opportunity his or her chance to acquire the skill is gone forever. The issue exemplifies the kind of oversimplified moves from research to practice that need to be avoided. In order to avoid misunderstandings, careful scientists ban the phrase "critical period" when it comes to teachable/learnable knowledge and

skills in formal education contexts, and replace it with the phrase “sensitive period”, which suggests a much broader time-line flexibility (OECD 2002; OECD 2007a). Unfortunately, the media is not always this careful, leading to a quick proliferation of misconceptions (della Chiesa 1993, 2008; Bourdieu 1998).

A common problem is that these kinds of claims do not recognize the limits of cognitive neuroscience methods. Most studies to date neglect or ignore individual differences, treat the pervasive variability and diversity of human behavior as error or noise, and use samples that do not represent the full range of human beings. When research focuses on variability and diversity, learning and development display individual differences and variability everywhere (Fischer and Bidell 2006; Mascolo and Fischer, in press; Rose and Dalton 2009) — even more so when researchers consider groups that are not highly educated in industrialized Western societies (Henrich, Heine and Norenzayan, in press). Researchers making claims about the *narrowness* and *criticalness* of phases of brain development and how these are related to optimal educational environments need to stop assuming that all people are the same. When research conclusions are to be connected to educational practice and policy, researchers need to consider the relation of their samples to the whole population. They need to analyse variability when they attempt to move from description to prescription. The lack of research and development about educational practice creates major difficulties in connecting research on learning and development with practice and policy (della Chiesa, Christoph and Hinton 2009; Fischer 2009; Hinton and Fischer 2008).

These calls for caution are calls for *epistemic responsibility*. What do we really know? What does research demonstrate that is clearly relevant for educational practice? Is a given practice truly based on valid research? To make valuable advances in the coming decades, the field of educational neuroscience will require principles for quality control that are widely agreed upon and forged at the interface of research and practice. IMBES and OECD/CERI have made

this problem explicit and called for innovative collaboration between researchers, teachers, and others in fostering the co-construction of valid usable knowledge for education.

In addition to ethical issues concerning the limits of scientific methods and the need to more directly connect research with practice, major ethical issues are emerging that reach into the very fabric of human society and culture (Spitzer 2004; Koizumi 2007). IMBES and OECD/CERI have called for *ethical responsibility* in research and practice, and in the remainder of this paper we propose a key ethical distinction for grounding discourse about responsibility in educational neuroscience.

Contextualizing Ethics in Educational Neuroscience

Right now all across the planet, researchers and educators are working to bring advances from neuroscience and cognitive science into educational research, policy, and practice. Educational neuroscience (or mind, brain, and education) has a wide range of applications, from psychopharmacology to brain-based pedagogy; from the search for biomarkers of risk and disability (Goswami 2009; Singh and Rose 2009) to programs focusing on the importance of health, stress reduction, and sleep (Golombek and Cardinali 2008). Of course, some of the issues facing educational neuroscience are not new. There is a long history of discourse about the ethical issues involved with educational research (Lagemann 2000, 2008).

Here are a few important examples of classic ethical issues that carry over to educational neuroscience:

(1) In a study using quasi-experimental designs in classrooms or schools, a neuroscientific intervention is hypothesized to benefit those exposed to it. If it is effective, it will leave the control group potentially educationally disadvantaged, an unjust situation for the students involved.

(2) Researchers conspire with publishing houses and school leaders to roll out new practices based on neuroscientific educational research, thus *unilaterally* affecting the lives of students and teachers, precluding their involvement in deciding how they will be educated.

(3) The benefits of new research-based practices are inequitably and unfairly distributed among those who stand to benefit3.

(4) Diagnostic categories developed by neuroscience researchers come to function as labels used to stereotype individuals, typically damaging the school culture in which they are used and the emotional lives of those labeled.

This list could be extended. Educational neuroscience inherits these kinds of classic ethical issues from educational research, but the power of brain research and cognitive science intensifies many of them (such as 3 and 4) while also creating radically new ones.

The radically new ethical issues raised by educational neuroscience, such as changing a child's brain through surgery or pharmacology, or changing genes to create a "better" child, have important overlaps with issues in related fields. Bioethics (Singer and Kuhse 2000; Glannon 2007) and neuroethics (Marcus 2002; Illes 2005) offer insights into some of the issues raised by educational neuroscience. There are also important connections to medical ethics (Beauchamp and Childress 2008) and the ethics of human enhancement (Savulescu and Bostrom 2009).

However, education is distinct from medicine and related biomedical practices in both its ends and its means. Education is concerned with, among other things, the transmission of

---

[3] This is a long-standing issue in education. Some countries continue to maintain policies that are explicitly inequitable despite OECD's PISA studies clearly showing since 2001 that inequity in education, on top of being ethically questionable, is also inefficient in terms of overall education outcomes (OECD 2007b, 2007c). Moreover, these policies could create a social time bomb that could eventually explode in conflict and disrupt political stability (della Chiesa and Christoph 2009).

cultural values and skills (Dewey 1916). The philosophy of education addresses normative questions that do not arise in the same way in the context of medical practice and public health. Questions about which skills and cultural practices are worth instilling in the next generation have implications for the kinds of societies people want to live in and the general shape of a life worth living. These questions transcend but include those about how to insure that individuals are physically healthy or how to extend life or improve human well being and achievement.

Clearly relevant are issues about psychopharmacology and the violations of privacy that are likely to accompany emerging brain imaging technologies. Issues surrounding the ethics of human enhancement are just beginning to take shape, but already concerns about the proliferation and side effects of cognitive-enhancement technologies have significant implications for educational neuroscience.

Importantly, there are central issues for which ethicists already have relevant concepts and frameworks, for example, those concerning social justice and reform. Concerns about the fair distribution of benefits loom large and are relevant for sanitation or vaccination as well as educational neuroscience. Educational applications of the brain and cognitive sciences serve a wide range of social functions and create a unique problem-space for questions of distributive justice, responsible reform, and social transformation (Cremin 1976; Dewey 1916; Rawls 1968). Education is a basic social good that sustains group life. Broad changes to education are everyone's concern. We will argue that they play a central role in an important distinction about how parents and scientists shape their children.

Sheridan, Zinchenko, and Gardner (2005) and Fischer, Goswami, and Geake (in press) point out the unique problems that arise at the interface of neuroethics and education. The complexity of knowledge production in the field and the possibilities for misuse demand attention from experts devoted and trained to think through new issues. They suggest that the new role of "neuroeducator" is needed—a person explicitly devoted to bridging the gaps

between neuroscience and education responsibly. This is an example of the kinds of institutional innovations and policy recommendations on the horizon.

In impending policy debates, concerns about the distribution of benefits and the shape of future institutions are necessarily preceded by concerns about what is really beneficial for growing, learning human beings. What can be drawn from new neuroscientific knowledge that is *good* for children and society? Generally, these kinds of everyday moral judgments should play an important role in legislation and the formation of democratic will (Habermas 1996). When neuroscience creates radically new possibilities, people do not even know how to think about what is at stake. Can a line be drawn between *treatment* and *enhancement* for possible uses of brain science that look like human engineering or "cosmetic psychopharmacology" (Wolpe 2002; Marcus 2002)? Will wielding the power of the neurosciences lead down dubious paths, away from humanity and towards something else? These kinds of dystopian visions4 are valuable in drawing attention to important moral issues that are still difficult to define.

We propose a fundamental ethical distinction that is crucial for addressing the ethical implications of advances in educational neuroscience (or mind, brain, and education). In contrast to most prior arguments, this distinction concerns different ways of intervening in children's lives. It is less about what humanity is becoming as neuroscience begins to change people and more about the kinds of interpersonal interactions that people are willing or unwilling

---

[4] Aldous Huxley's *Brave New World* (1932/2010) is obviously relevant. Huxley wrote to George Orwell on October 21, 1949: "...the world's leaders will discover that infant conditioning and narco-hypnosis are more efficient, as instruments of government, than clubs and prisons, and that the lust for power can be just as completely satisfied by suggesting people into loving their servitude as by flogging them and kicking them into obedience". Beyond Huxley's well-known warnings, the dystopian tradition (up to the "cyberpunk" movement in the 1980's and 90's) has dealt often with ethical issues which revolve around the fundamental question "What does it mean to be human?" This direction culminated with the visionary work of Philip K. Dick (1963/2002, 1968/2007).

to condone. Framing the problems this way brings much needed clarity and insight to the ethical problems facing educational neuroscience.

The Difference between *Designing Children* and *Raising Children*

Aristotle (2002), the first ethologist to study the human species, outlined the various basic practices and attitudes that constitute our everyday lives. He showed that there is a difference between the *theoretical* and the *practical*, between the *ethical* and the *political*, and between *healing*, *breeding*, and *building*. To this day, in everyday life, people routinely mark off these kinds of differences between, for example, attitudes toward the organic nature of plants and animals versus attitudes toward the inorganic, social, and political products made by human beings. Most would agree that people *cultivate* living things, a process involving a respect for the inherent dynamics of their auto-regulated nature, while we *build* artifacts, a process involving the strategic planning of fitting means to an end. Sellars (2006) and Habermas (1987) argue for the importance of these kinds of basic common-sense distinctions, and suggest that the background knowledge forming people's shared life-world grounds mutual understanding and shared orientations.

Drawing a line between the practices of *building/designing* and *cultivating/raising* has high face validity as well. It marks a deep-seated distinction between two modes of production, invoking two distinct semantic networks of meanings (Habermas 2007). Recent debates over genetically engineered agricultural products often revolve around this basic distinction.

Of course, when the "products" are people, as opposed to plants, the distinction is much weightier. Institutions and relationships have always shaped lives, thus "producing" certain types of people as opposed to others. The question of *how* a life is shaped, by what actions and methods, and in light of which attitudes, is an essential question for education and child-rearing. Typically, educational methods are characterized as akin to cultivation; the fostering or

growing—in short, the *raising* of children—is the standard conception of the process of education (broadly construed, including not only schools but a wide range of learning environments). This definition contains a sense of respect for the internal regulative processes of individuals. Cultivation entails *working with* the unfolding of an already self-directed life. Raising a child is a process of co-constructing goals and shared values alongside the inculcation of skills and practices. Communication, compromise, and relationships of mutual expectation are essential, as are the mutual understanding of social norms and the dynamics of authority. Educational processes—the raising and cultivating of the next generation—depend upon actions, methods, situations, and attitudes that rely heavily on 1st and 2nd person perspectives and on the use of language and (at least some) cooperation. We offer reasons to those we educate, seeking to convince and persuade them of what is in their interest—ideally, raising a child involves shaping behavior through the garnering of consent.

For most of history the main alternative to this view was a conception of education as coercive *training* (Cremin 1976; Lagemann 2000, 2008). But even training, if it is to be effective, still requires a respect for the limits and internal dynamics of the life being shaped, involving issues such as motivation and differential individual capacities. However, the birth of psychological science, and especially the rise of behaviorism, brought with it the idea that education is akin to building or engineering—in short, over a century ago some social scientists began to favor the prospect of *designing* children (Pavlov 1927; Skinner 1938). As the metaphor implies, the internal dynamics and growth processes themselves are taken as an object of manipulation. This is *working on* the life being shaped, as opposed to *working with* it. The life is made to fit ends specified by the designer, as opposed to being shaped toward ends that fit it.

Designing children is a process in which an instrumental intervention changes behaviors, dispositions, and capabilities, affecting processes and mechanisms that change who the children will become. These are actions that rely mainly on 3rd person perspectives, which (in principle) need to make no use of relationships built on communication, compromise, or mutual

expectation. The unilateral *construction* of future generations has long been the dream of social engineers. One example is the crude wedding of IQ testing with overly simple notions of genetic heritability, which led to eugenics, including the sterilization of thousands of people in post-bellum America (Gould 1981). Thankfully, such flagrant violations of human rights have been widely condemned—state sanctioned eugenics programs are nearly universally opposed. But what has not changed is the basic idea that future generations might be shaped strategically by means of instrumentally targeted interventions that change their biological nature.

Critically, this distinction between raising children and designing them is not simply a distinction between physical and non-physical intervention. All educational processes have an effect on student's brains. Instead, the distinction concerns the structure of the educational relationship in question—how the elders intervene in children's lives. The line is drawn between relationships that respect the child's (limited and burgeoning) autonomy and those that override the child's nascent autonomy in the interest of goals to be imposed upon the child.

In the raising of a child the relationship has a dialogical structure of relative reciprocity, established in light of the child's input and an awareness of how the child's goals, capabilities, and dispositions do or do not fit with the surrounding norms and expectations of the educational environment. The child *participates* in the shaping of her life, and knows she is doing so.

In the design of a child the relationship has a monological structure of non-reciprocal imposition, established in light of the designer's goals for the child without input from the child or consideration/awareness of the child's goals. The child does *not* participate in shaping her life, but is acted on from the outside. The child experiences behavioral and dispositional changes imposed by processes beyond her control, with results she is not involved in producing.

The distinction focuses on the way people intervene in children's lives. The distinction actually establishes a continuum applicable in the analysis of any educational relationship. As it happens, many biologically focused interventions tend toward design. They make it possible to

get results—to change behavior as desired—without establishing the kinds of relationships typically associated with the raising of children.

For example, psychopharmacology allows people, in principle, to change the behaviors of children without the establishment of shared goals or a situation of mutual understanding. As biochemical knowledge increases, the effectiveness of pharmacological interventions is also increasing. In some current situations brain imagining technology can similarly be used to target special populations for invasive sub-cranial interventions, such as neural implants for mediating behavior or emotions in people. As biomedical advances begin to address cognitive functions such as memory, situations will emerge where parents choose to bestow a 'competitive advantage' on their child by purchasing biomedical enhancement packages.

The feasibility of these various scenarios is not the point. Regardless of the specific advances, brain and cognitive sciences will increasingly give schools and parents choices in shaping their children's lives. As opportunities to design children become increasingly available, defending the value of raising them becomes a necessity—if human beings decide that design is to be avoided.

What Is the Trouble with Design?

Most people seem to have an intuitive moral aversion to the idea of designing children (Glover 2006). Still, we need to clarify and explicate what is troublesome about treating children this way. Explicating the ethical issues will provide the beginnings of a moral framework for facing the future of educational neuroscience.

The difference between designing children and raising them retrofits loosely Kant's (1785/2008, 1788/1996) famous articulation of the categorical imperative—that one should treat others always as an end in themselves and never as a mere means to an end. This basic insight at the heart of Kant's deontology has been enriched by recent theorists (Habermas 1990;

Rawls 1968; Scanlon 1998; Sellars 2006) and rearticulated in terms of communicative rationality. Acceptable interactions are those in which all people who are possibly affected agree to—or could be reasonably expected to agree to—the norms being followed. In the ideal interaction the norms that govern it are co-constructed. We should agree on how we want to interact with one another.

But of course we often cannot ask a child how she or he wants to be treated—perhaps because s/he is too young to understand what is at stake. Then we must act on the child's behalf, which means we must act in light of a reasonable belief that our action would be justified in the child's eyes (were she or he granted full knowledge of the situation). This principle does not rule out disagreement and conflict; it merely suggests that disagreements over actions and norms should be *reasonable* and *considered* ones. That is, we are obliged *not* to act towards a child in a way that disregards her considered acceptance of our actions. We are also obliged *not* to act towards a child such that our actions would be, by our own estimation, inevitably unjustifiable to the child. Perhaps no rational person would agree to being treated that way.

These are some of the kinds of considerations that bear on the ethical dimensions of educational neuroscience, and the related prospect of designing children. Thinking in these terms, it is unacceptable to instrumentally intervene in the life of another—to work *on* them as opposed to *with* them. Actions carried out by engaging mainly 3rd person perspectives are not performed with a concern for the potential agreement of those affected. Only taking the role of others or talking to them—engaging 1st and 2nd person perspectives—allows for the assumption that we are acting with shared interests in mind. Some of the ethical concerns facing educational neuroscience arise from the fact that biomedical technologies make it possible for authorities to change behavior without dealing with mutually understood norms and goals. The ideal, of course, would be for to work jointly to co-construct norms and goals.

In the United States, some schools require the administration of psychopharmacological agents such as Ritalin5 to students with certain behavioral profiles. One danger of these policies is that little is known about the effects of long-term usage or of drug administration early in childhood. More is at stake, however, than the potential physical risk (although this is not a trivial issue). Mandated prescriptions establish an educational process in which the failure to meet specific behavioral expectations is thought to warrant a physical intervention aimed at changing the brain chemistry of the child—the strategic alteration of the child's dispositions, regardless of the child's (or her parent's) dissent. Most educationally relevant 'disabilities,' such as ADHD (attention deficit hyperactivity disorder) and dyslexia, arise at the interface of individual differences and the normative expectations from the school environment. The status of ADHD and dyslexia as diseases caused by organic dysfunction is questionable (Diller 1996; Rose and Dalton 2009). At the very least, locating the problem in the child's brain alone is a flagrant oversimplification. Thus, the mandated prescription of Ritalin is *not* equivalent to a medical intervention; it is a response to a child's failure to comply with norms and expectations, not merely an attempt to regulate a dysfunctional physiological system. The goal seems to be to change behavior and dispositions, not to heal the brain or body.

It is worth noting that mandating prescriptions is different from issuing punishments, even physical punishments. Punishments, as inappropriate and ineffective as they may be in some cases, are typically issued with a communicative intent: They are meant to teach a lesson. Even if a child changes her behavior simply so as not to get punished again, she has made a *choice* in light of an understanding of the norms in play (whether she agrees with them or not). The forced administration of psychotropic substances, on the other hand, changes behavior in a different way. It goes *around* the judgment and choice of the child, changing her

---

[5] It is important to note that, internationally, the use of drugs such as Ritalin varies greatly. The Italian government, for example, first banned Ritalin. That move was again authorized in Italy April 8, 2007, as a consequence of a law ("legge n. 49/2006", known as "legge Fini-Giovanardi"), applied from December 30, 2005.

behavioral dispositions by acting on mechanisms 'behind the scenes,' as it were. So the child can be designed to behave, regardless of her consent—regardless even of her understanding of the expectations and norms in question. The outcome of this design process is a system of norms that is insensitive to dissent and that literally relies on its ability to design children who will conform.

Also, the mandated prescription of psychotropic agents to children in educational contexts significantly differs from situations in which adults freely choose to undertake comparable treatments in order to relieve symptoms such as depression or PTSD (Post-Traumatic Stress Disorder). In the first case, an individual's brain-chemistry is strategically changed by authorities in order to alter behaviors deemed undesirable by those authorities. In the other, an individual chooses to change her own brain chemistry with help from authorities (doctors) in order to relieve symptoms that she deems undesirable. The structure of the relations and actions here are strikingly dissimilar. Surprisingly, the implications of this difference are often overlooked in neuroethical discussions of psychopharmacology (Levy 2007). The risks, harms, and benefits that may accompany psychopharmacological treatments administered to consenting adults raise important ethical issues (and they become even more complex with issues of strategic self-enhancement or 'cosmetic psychopharmacology'). But in a way, these debates about the future of the mental health care system deflect attention from the key point—a simple focus on the way people act toward their children.

The objection against mandating the prescription of psychotropic agents stems not from issues of physical risk or changing the brains of future generations. These issues require empirical evidence, with consequent ethical implications; but the jury is out. The objection is that prescribing such drugs is unfair, that it is unjust to treat children this way. There is no need to engage in quasi-metaphysical debate about what is natural or unnatural or to stir up fears of a post-human future in which the overuse of psychopharmacology has radically altered our species-specific behaviors. Prior to those issues, examining the dynamics of the relationships in

question is enough to clarify that certain uses of biomedical technologies for educational purposes are unacceptable. It is unethical to design children.

Issues of Identity Formation. Another way to frame these issues of justice and fairness is to consider the impact on the formation of identity in people who have been designed by an authority. Again, this shifts the argument away from unproductive debates towards a hard look at the *relationships* being built around neuroscience-based biomedical interventions. Habermas (2003) and others (Glover 2006; Fukuyama 2002) have raised concerns about the unprecedented intergenerational dynamics that could result from certain kinds of biotechnologies in educational contexts. Parents have always affected their children, and teachers affect their students. People establish their identities in close relationships within cultural contexts. The preferences and values embodied in the relationships and cultures thus shape the lives of future generations. In this dynamic process of individuation through socialization, an individual *negotiate*s her identity in relation to the desires of significant elders and broad cultural patterns. However, when authorities use biomedical technologies to affect the outcome of identity formation, a child's ability to negotiate her own identity can be lost, as the preferences of parents or prevalent cultural norms are literally *built* into her biology. Will science provide the capacity for one generation to strategically and irreversibly alter the biological substrate of another?

Having the sense that one's identity has been *imposed* rather than negotiated can lead to an inability to claim authorship for one's own life. The result is loss of autonomy and undercutting of responsibility and agency. This loss would have dramatic consequences for societies as well as individuals. Consider, for example, how we could structure a criminal justice system in a society where citizens did not feel a sense of personal responsibility. Before neuroscientific interventions, many contexts in which children form their identities have been dysfunctional or unjust – for example, situations in which children are forced into certain roles

(such as child soldiers) or denied a reasonable range of opportunities. Parents or cultures that severely constrain the choices during their children's identity formation are seen as repressive. All children have 'the right to an open future,' in which they can act autonomously and responsibly (Feinberg 1992) and a right to participate in their own development (United Nations 1989). Some types of biomedical advances make possible more radical methods for *imposing* parental or cultural preferences onto children. As the technology advances, the impacts will become increasingly predictable and effective. For example, parents and schools may soon choose to use biomedical technologies to enhance working memory, mathematical/ spatial intelligence, emotional self-regulation, or talent at sports.

Imagine a high school culture in which key characteristics of the nascent identities of the young adults have been chosen for them—built into them, as it were— and they have full awareness of this fact. They've been designed and they know it. What would it be like for them to work through the problems that typically face adolescents? What would it mean to 'find a voice of one's own' or even to 'consider career options' when one's basic capabilities and dispositions were chosen by others? How would close friendships and first romances be understood in light of knowledge that the qualities of one's emotional life are the result of technical biomedical interventions made by authority figures? These are disturbing questions, arising from the unjust use of newly wrought powers stemming from neuroscience.

Injustice is the pejorative of choice here because these children have been denied their *right* to an open future, denied the right to negotiate their identities. Designing children denies them the possibility of autonomous identity formation. Yes, there are other issues, such as empirical questions about unpredictable side effects of interventions, but the fundamental starting point is the social relationships established by designing children instead of raising them. In the next section two brief case studies clarify and elaborate this way of thinking about ethical issues in educational neuroscience.

Case studies on neuroscience and the future of moral education. In recent years there have been major advances in our understanding of the biological underpinnings of key aspects of moral judgment and ethical behavior (Gazzaniga 2006; Zelazo et al. 2010). Neuroscientists are beginning to understand the biological basis of ethical judgment, and have discovered a candidate mechanism for the neurological substrate of empathy, which involves mirror neurons that mimic the experience of others (Gallese 2003; Ganoczy 2008; Roth 2003, 2009; Spitzer 2004). These kinds of advances are likely to continue, and they are already leading some to suggest possible educational implications and applications.

The goal of this section is to look at two case studies concerning the future of moral education, a future radically affected by advances in the brain and cognitive sciences. After presentation of the two cases we will discuss them in light of the distinctions and terms introduced earlier. This exercise will elaborate how the difference between designing children and raising them involves treating them unjustly versus justly; it is not merely about whether biological interventions are used or not. There is not space to tackle all the issues raised by each scenario. Instead, this final section serves to open up possibilities and raise awareness. It is a conclusion that serves to raise more questions.

These case studies are models of possible futures, models that distort features of interest and frame critical properties for discussion. The focus on morality and moral education is purposeful and non-trivial. Other possible futures that deserve consideration include brain-science-informed strategies for altering memory and attention. Moral education is, and probably should be, controversial, with or without brain-based approaches in the mix, because it aims to foster the growth of personal character, not just academic skills. Thus, these scenarios may give even the staunchest proponent of psychopharmacology in schools cause for pause. Usable knowledge about the biological substrates associated with moral dispositions, judgments, and action is immanent (it is fast becoming a major focus of research; Greene and Haidt 2002; Immordino-Yang et al. 2009). This knowledge, like all knowledge, will bring power in its wake.

Specifically, it will bring the power to intervene in the biology of individuals with the goal of changing basic aspects of their moral lives.

David and Maggie: Maggie got pregnant at a young age and found it hard to change her lifestyle in a responsible way. David was born premature after spending 7 months in a womb that was often saturated with drugs and other toxins. At the age of 4 David is kicked out of preschool, and becomes almost impossible for Maggie to control. By the age of 8 David has already acted violently toward other children on many occasions and expresses ideas and beliefs about himself and others that his teachers describe as "frightening." In order to avoid expulsion from yet another school Maggie enrolls David in a new treatment program advertised (and mandated in some school districts) for children with problematic histories of antisocial behavior. The program joins advances in brain-imaging technology with psychopharmacology to "improve basic moral functions" such as empathy, positive emotion, and docility. After two months of treatment David's behavior begins to change. For the first time he tells his mother he is sorry for how he acted, explains that he used to always feel "out of control," and expresses thankfulness for the treatment he is receiving. After 2 years David, now 10 years old, is succeeding in school and no longer gets negative attention from teachers. However, for a class assignment in social studies, David writes a paper that prompts a teacher-parent conference. In this paper he suggests that everybody should get treatment like he does to "make them behave," that the world would be better if "kids with broken brains had them fixed" and argues further that "Criminals probably just have broken brains." Maggie is concerned and talks to David about these beliefs. He says he is confused about why some kids can "be good without pills," and wonders if she would "still love him if he stopped taking his."

Paula and Rick: Rick is the principal of Westbrook Prep, one the premier private college preparatory schools in the Northeastern United States, boasting competitive admissions and a challenging curriculum. Paula is a 16 year old, described as bright, sociable, and promising. But after two years at Westbrook Paula begins to falter. She explains to her guidance counselor that she feels her friends are "fake" and that her parents only care about whether or not she gets into the right college. She says she thinks there is "more to life than where you go to college," and says she thinks about dropping out to "start trying to help people, like at a soup kitchen or something." That week, a cheating scandal erupts at Westbrook. Six high-profile seniors are implicated, one a star football

player. Rick's attempts to control the situation involve a community assembly, including parents, teachers, and students, where he reiterates the code of ethics at Westbrook, but expresses leniency and forgiveness toward the students caught cheating. At this point Paula erupts indignantly in front of the whole community, yelling about the "hypocrisy" of the school and "how fake everyone is." The outburst puts Paula at odds with her parents, her friends, and Principal Rick. Her behavior changes as a result. She is increasingly isolated from her peers. Her teachers begin to describe her as defiant. Twice more she openly speaks out against the school's culture. Her grades plummet. Rick meets with Paula's parents, explains that she is becoming a major distraction, and hands them a pamphlet for a company that uses advances in brain-imaging technology and psychopharmacology to "improve basic moral functions" such as empathy, positive emotion, and docility. One week later Paula is taken in for treatment, despite her complaints and wishes to transfer schools. Her parents explain that they have "invested in her education at Westbrook" and want her to "succeed at fitting in." Paula's lack of compliance changes the treatment modality and a series of high-doses are administered during her first several visits. Over the next 6 weeks, Paula's attitudes change drastically. She meets with Rick and expresses remorse for her prior transgressions, thanks him for intervening, explaining that her "life's true purpose should have always been to succeed at Westbrook and get into Yale."

These two cases have many similarities. They both involve young people who are struggling to fit in and succeed in school, and who have, as a result, been placed in a treatment program that utilizes biomedical interventions aimed at altering their moral dispositions. Both David and Paula embrace their new dispositions and express some gratitude for undergoing the treatment. In both cases the intervention is a "success." However, many people are left feeling uneasy about the stories. The case of David and Maggie exemplifies in many respects how advances in biomedical technologies can contribute to the careful *raising* of a child. And yet, there are lingering and complex concerns about the identity-formation of a child whose brain has been so radically and instrumentally changed by his caregivers. The case of Paula and Rick is more openly problematic and exemplifies our deepest concerns about the possibilities of

designing children. In this case, both the reasons for the intervention and its supposed "success" must be questioned.

As noted earlier, the distinction between raising children and designing them does not mark the difference between biomedical and non-biomedical interventions. Before his treatment, David is, arguably, incapable of being raised because he is not consistently able to share in the experience and goals of others and is insensitive to linguistic-emotional persuasion. Maggie cannot control him and his teachers find his ideas frightening. Moreover, these behavioral dispositions continue over the long term, making it clear that the difficulties are not a transient phase. The circumstances surrounding his birth suggest that his central nervous system may not provide the conditions for communicative relationships that form the groundwork for early childhood socialization. The treatment is an attempt to get him "up to" normal, and to make certain basic capabilities—such as self-control—available to him. Despite the need for proxy consent, the biomedical intervention is in line with goals valued by reasonable people: David would want this for himself if he could decide such things—the intervention provides a boon to his autonomy and facilitates the formation of relationships where he can build his identity. One can argue that it is a fair thing to do to David, in his best interests. Children like David are one reason that our fears about designing children should not be used to radically constrain research and development efforts.

But of course there are trade-offs. For the purpose of our argument, risks and long-term physical side effects are not at issue (although they would be very real concerns in cases like this). The issue is that David will come to understand himself differently from other children. He knows that who he is, how he acts, and what he thinks are all, somehow, the result of the treatment his Mom and teachers have arranged for him to receive. Thankfully, in this case, he is surrounded by caregivers who are concerned about his welfare and identity as well as the reasonableness of his views about himself and others. His worldview has been affected; he has positioned himself and partitioned the world in terms of unique ideas that are at the core of his

identity. His concerns about his love-worthiness are important and poignant. As David matures these concerns may deepen. As his awareness of the treatment-dependency of his accomplishments increases, he may question the authenticity of his relations and identity. In this case, if the sensitivity and communicativeness of his caregivers remains intact, David may navigate this complex mode of identity formation with success, but there are real, potentially difficult issues for him and his family and teachers to navigate.

There is less reason for optimism regarding the case of Paula and Rick. The episodes and behaviors that prompt treatment for Paula are not suggestive of long-term dispositions or deep-seated biological dysfunctions. She is open, communicative, capable of relationships (she is actually longing for them), and reflective about who she is and what she values. Her outbursts are, in fact, an expression of certain *reasonable* grievances with her surrounding culture. The problem resides at the *interface* of her emerging identity and the values of her parents and school. The problem is not merely between Paula's ears, but it is co-located in the culture. Moreover, the situation should be handled as a reasonable disagreement and an opportunity for communicative exchange, not as evidence of a brain abnormality best treated with drugs. The deepest dangers of design reside in this kind of possibility, that disagreements can become cast as biological dysfunctions and that coercive biomedical interventions can be used to insulate cultural norms from criticism.

Thus, the big issue here is that it is *unjust* for Rick and Paula's parents to exercise their authority in this way and oversee her forced compliance to a biomedical treatment. They choose to design her instead of working to raise her. This is an unacceptable response to Paula's dissent because it does not adequately engage her perspective. Instead of embracing dialogue and a willingness to more flexibly co-construct educational goals, the specific values of the school are literally built into her. The biomedical intervention is not guided by uncontroversial goals because it is, in fact, *reasonable* to disagree about educational values and the shape of the good life. Rick and her parents, in effect, override Paula's right to negotiate her identity by

denying her right to *choose* the values she wants to live by. Her post-treatment espousal of new values is disturbing because she appears to be merely a mouthpiece; she has lost her unique voice.

There is more to say about these case studies. In these stories, an industry has been built around advances in usable knowledge about the brain's moral circuitry. Both Maggie and Rick utilize the services of a company specializing in biomedical technologies that "improve basic moral functions." There are many issues that need to be discussed, with this paper providing only a starting point for dialogue, focusing on a likely future educationally oriented medical-industrial complex. Other central worries include inaccurate and questionable mass-media dissemination (Bourdieu and Passeron 1990) and simplistic popularization of educational neuroscience (Hinton and Fischer 2008; OECD 2007a). The goal of this discussion has simply been to discuss possible futures in terms of the ways we should intervene in children's lives. The distinction between designing children and raising them discloses central features of the new and complex intergenerational relationships that will become possible in the coming decades.

Conclusion: Enthusiasm and Ethics

Educational neuroscience (or mind, brain, and education) is gaining in momentum and is beginning to produce usable knowledge with profound implications. Enthusiasm is growing that a true science of learning is on the horizon. But there are liabilities surrounding the use in educational and family contexts of approaches inspired by brain science and biomedical technologies. *Epistemological responsibility* is needed, as the complexities of bridging research and practice are confronted. What can brain scans really tell us? What do we really know? These are legitimate questions, but at the core of neuroethics is the question of *ethical responsibilities*—specifically, how we ought to intervene in children's lives. The key issue is:

What are acceptable or unacceptable relationships for adults to have with the children who depend on them? Our distinction—between designing children and raising them—helps draw attention to what really matters: the lives of children and the kinds of relationships they have with adults. Some of the relationships made possible by educational neuroscience are unacceptable ethically and should be avoided. In relationships of design, 3rd person perspectives dominate, and the voice and autonomy of the child are neglected. Fortunately educational neuroscience can also enable relationships with powerful positive possibilities, better ways of raising children instead of designing them. In these relationships people use the best knowledge about mind and brain in the service of children's welfare, sensitive to individual differences, values, and goals.

References

Aristotle (2002). *Nicomachean ethics* (R. Crisp, Trans.). (Cambridge UK: Cambridge University Press)

Beauchamp, T. and Childress, J. (2008). *Principles of biomedical ethics*. (Oxford UK: Oxford University Press)

Bourdieu, P. (1998). *On television*. (New York: New Press)

Bourdieu, P. and Passeron, J.-C. (1990). *Reproduction in Education, Society and Culture* (Theory, Culture, and Society series). (Newbury Park CA: Sage)

Coulombe, S., Tremblay, J.-F. and Marchand, S. (2004). *International adult literacy survey: Literacy scores, human capital, and growth across fourteen OECD countries*. (Statistics Canada, Ottawa)

Cremin, L. (1976). *Public education*. (New York: Basic Books)

della Chiesa, B. (1993). Ein knappes Ja: die Franzosen und die Verträge von Maastricht, in H. Rust (ed.) *Europa-Kampagnen: Dynamik öffentlicher Meinungsbildung in Dänemark, Frankreich und der Schweiz,* pp.101-146. (Vienna: Facultas wuv Universitätsverlag)

della Chiesa, B. (2008). Introduction, in P. Léna and B. Ajchenbaum-Boffety (ed.) *Education, sciences cognitives et neurosciences.* Sous l'égide de l'Académie des Sciences, pp.7-20. (Paris : Presses Universitaires de France)

della Chiesa, B. and Christoph, V. (2009). Neurociencia y docentes: Crónica de un encuentro. *Cuadernos de pedagogía, Madrid*, **386**, 92-96

della Chiesa, B., Christoph, V. and Hinton, C. (2009). **How Many Brains Does It Take to Build a New Light: Knowledge Management Challenges of a Transdisciplinary Project**. *Mind, Brain, and Education*, **3**, **17-26**

Dewey, J. (1916). *Democracy and education*. (New York: The Macmillan Company)

Dewey, J. (1929). *The sources of a science of education*. (New York: Liveright)

Dick, P.K. (1963/2002). *The simulacra*. (NewYork: Vintage)

Dick, P.K. (1968/2007). *Do androids dream of electric sheep?* (reprinted as *Blade Runner*, New York: Del Rey)

Diller, L. H. (1996). The run on Ritalin: Attention deficit disorder and stimulant treatment in the 1990s. *Hastings Center Report,* **26 (2),** 12-18

Feinberg, J. (1992). *Freedom and fulfillment. Philosophical essays*. (Princeton: Princeton University Press)

Fischer, K. W. (2009). Mind, brain, and education: Building a scientific groundwork for learning and teaching. *Mind, Brain, and Education,* **3**, 3-16.

Fischer, K. W. and Bidell, T. (2006). Dynamic development of psychological structures in action and thought, in W. Damon and R.M. Lerner (ed.) *Handbook of child psychology: Theoretical models of human development*, 6th ed., **1**, pp. 313-399. (New York: John Wiley & Sons)

Fischer, K. W., Daniel, D. B., Immordino-Yang, M. H., Stern, E., Battro, A. and Koizumi, H. (2007). Why Mind, Brain, and Education? Why now? *Mind, Brain, and Education,* **1**, 1-2

Fischer, K.W., Goswami, U. and Geake, J. (in press). The future of educational neuroscience. *Mind, Brain, and Education, 4*.

Fukuyama, F. (2002). *Our posthuman future*. (New York: Farrar, Straus, and Giroux)

Gallese, V. (2003). The roots of empathy: The shared manifold hypothesis and the neural basis of intersubjectivity. *Psychopathology*, **36 (4)**, 171-180

Ganoczy, A. (2008). *Christianisme et neurosciences*. (Paris: Odile Jacob, esp.)

Gazzaniga, M. (2006). *The ethical brain: The science of our moral dilemmas.* (New York: HarperCollins)

Glannon, W. (2007). *Bioethics and the brain*. (New York: Oxford University Press)

Glover, J. (2006). *Choosing children: The ethical dilemmas of genetic intervention*. (New York: Oxford UniversityPress)

Golombek D. and Cardinali, D. (2008). Mind, brain, education, and biological timing. *Mind, Brain, and Education*, **2**, 1-6

Goswami, U. (2009). Mind, brain, and literacy: Biomarkers as usable knowledge for education. *Mind, Brain, and Education,* **3**, 176-184

Gould, S. J. (1981). *The mismeasure of man*. (New York: Norton)

Greene, J. and Haidt, J. (2002). How (and where) does moral judgment work? *Trends in Cognitive Sciences,* **6**, 517-523

Habermas, J. (1987). *The theory of communicative action: Lifeworld and system, a critique of functionalist reason* (T. McCarthy, Trans. Vol. 2). (Boston: Beacon Press)

Habermas, J. (1990). *Moral consciousness and communicative action* (C. L. a. S. Nicholsen, Trans.). (Cambridge, MA: MIT Press)

Habermas, J. (1996). *Between facts and norms: Contributions to a discourse theory of law and democracy* (W. Rehg, Trans.). (Cambridge, MA: MIT Press)

Habermas, J. (2003). *The future of human nature*. (Cambridge, UK: Polity Press)

Habermas, J. (2007). The language game of responsible agency and the problem of free will: How can epistemic dualism be reconciled with ontological monism? *Philosophical Explorations,* **10 (1)**, 13-50

Henrich, J., Heine, S. J. and Norenzayan, A. (in press). The weirdest people in the world? *Behavioral and Brain Sciences*

Hinton, C. and Fischer, K. W. (2008). Research schools: Grounding research in educational practice. *Mind, Brain, and Education,* **2 (4)**, 157-160

Huxley, A. (1932/2010). *Brave new world*. (New York: Harper Perennial Modern Classics)

Illes, J. (ed.) (2005). *Neuroethics: Defining the issues in theory, practice, and policy*. (New York: Oxford University Press)

Immordino-Yang, M. H., McColl, A., Damasio, H. and Damasio, A. (2009). Neural correlates of admiration and compassion. *Proceedings of the National Academy of Sciences, USA,* **106**, 8021-8026

Kant, I. (1788/1996). *Kritik der praktischen Vernunft* (*Critique of practical reason)* (Gregor & Wood, Trans.). (Cambridge UK: Cambridge University Press)

Kant, I. (1785/2008). *Grundlegung zur Metaphysik der Sitten (Groundwork for the Metaphysics of Morals).* (Berlin: L. Heimann & Radford: Wilder)

Koizumi, H. (1999). A practical approach to transdisciplinary studies for the 21st century – The centennial of the discovery of radium by the Curies, *Journal of Seizon and Life Sciences,* **9***,* 19-20

Koizumi, H . (2007). The concept of 'brain-science and ethics'. *Journal of* Seizon *and Life Sciences,* **17B(3)**,13-32

Lagemann, E. C. (2000). *An elusive science: The troubling history of educational research*. (Chicago: University of Chicago Press)

Lagemann, E. C. (2008). Education research as a distributed activity across universities. *Educational Researcher, 3*7, 424-429.

Levy, N. (2007). *Neuroethics: Challenges for the 21st Ce*ntury. (Cambridge UK: Cambridge University Press)

Marcus, S. J. (ed.) (2002). *Neuroethics: Mapping the field*. (New York: Dana Press)

Mascolo, M. F. and Fischer, K. W. (in press). The dynamic development of thinking, feeling, and acting over the lifespan, in R. M. Lerner and W. F. Overton (ed.), *Handbook of life-span development. Vol. 1: Biology, cognition, and methods across the lifespan*. (Hoboken NJ: Wiley)

McCabe, D. P. and Castel, A. D. (2008). Seeing is believing: The effect of brain images on judgments of scientific reasoning. *Cognition,* **107**, 343-352

Neville, H.J. and Bruer, J.T. (2001). Language Processing: How Experience Affects Brain Organization, in D.B. Bailey, Jr., J.T. Bruer, F.J. Symons and J.W. Lichtman (ed.) *Critical thinking about critical periods,* pp. 151-172 (Baltimore : Paul H. Brookes Pub. Co.)

Obama, B. (2008). Speech to the 146th Annual Meeting and 87th Representative Assembly of the National Educational Association. Delivered July 5th, 2008.

OECD (2002): *Understanding the Brain: Towards a New Learning Science*. (Paris: OECD)

OECD (2007a). *Understanding the Brain: The Birth of a Learning Science.* (Paris: OECD)

OECD (2007b). *Understanding the social outcomes of learning*. (Paris: OECD)

OECD (2007c). *No more failures: Ten steps to equity in education*. (Paris: OECD)

OECD (2009). *Education at a glance 2009: OECD indicators*. (Paris: OECD)

Pavlov, I. P. (1927). *Conditional reflexes*. (New York: Dover Publications)

Rawls, J. (1968). Distributive justice: Some addenda. *Natural Law Forum,* **13**, 51-71

Rose and Dalton (2009). Reference missing!! No clue where this comes from. Zak?

Roth, G. (2003, 2009). *Aus Sicht des Gehirns*. (Frankfurt: Suhrkamp)

Savulescu, J. and Bostrom, N. (ed.) (2009). *Human enhancement*. (New York: Oxford University Press)

Scanlon, T. M. (1998). *What we owe to each other*. (Cambridge, MA: Harvard University Press)

Sellars, W. (2006). *In the space of reasons*. (Cambridge: Harvard University Press)

Sheridan, K., Zinchenko, E. and Gardner, H. (2005). Neuroethics in education, in J. Illes (ed.), *Neuroethics: Defining the issues in theory, practice, and policy*. (New York: Oxford University Press)

Singer, P. and Kuhse, H. (ed.) (2000). *Bioethics: An anthology*. (Malden, MA: Blackwell)

Singh, I. and Rose, N. (2009). Biomarkers in psychiatry. *Nature,* **460 (9)**, 202-207

Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis*. (New York: Appleton-Century-Crofts)

Spitzer, M. (2004). *Selbstbestimmen. Gehirnforschung und die Frage: Was sollen wir tun?* (München: Spektrum).

United Nations (1989). Convention on the Rights of the Child. New York. Available at: http://www2.ohchr.org/english/law/crc.htm (accessed 15 November 2009)

Weisberg, D. S., Keil, F. C., Goodstein, J., Rawson, E. and Gray, J. R. (2008). The seductive allure of neuroscience explanations. *Journal of Cognitive Neuroscience,* **20**, 470-477

Wolpe, P. R. (2002). Treatment, enhancement, and the ethics of neurotherapeutics. *Brain and cognition,* **50 (3)**, 387-395

Zelazo, P.D., Chandler, M. and Crone, E. (ed.) (2010). *Developmental Social Cognitive Neuroscience*. (New York: Psychology Press)