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A Critical Interrogation of the Mind, Brain, and Education Movement: Toward a Social Justice Paradigm

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A Critical Interrogation of the Mind, Brain, and Education Movement: Toward a Social Justice Paradigm

by

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DEDICATION

To Khaleh Maryam

Justice requires that we feel our pain, that we look our oppression square in the face, accept it as fact, and exhale. Twenty years ago, you slipped through our fingers like air, and I could not accept the vainness and injustice in your passing. So I held on to the pain, kept it close to my heart, fearful that if I cried out, the pain would cascade over the world and swallow me whole. I can never replace you. I can never complete your important and timely work, which could have only been done by someone with your unique lens and experiences, in your unique time. But I hope that by standing atop your giant but fragile shoulders, I have at least moved one step closer to exhaling my own grief and the grief of injustice that humanity still dares not cry out for we know the pain of the reckoning. I am forever grateful for the life you lived among us, for your memory, your scholarship, your intelligence, your grace, and the fierceness with which you set out to navigate a world of dichotomies, oppression and indoctrination that negates the spirit. You are my model of what I can aspire to be as an educator, a student, and an Iranian woman. How could your life have been in vain? You live in my bones.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

A Critical Interrogation of the Mind, Brain, and Education Movement:

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Much attention has been given to "bridging the gap" between research and practice since neuroscience research first made claim to its potential impact in classrooms. With the inception of Mind, Brain, and Education (MBE) as a new interdisciplinary field, an unprecedented opportunity to explore the educational implications of new research coming out of neuroscience has presented itself. And yet, the gap between research and practice persists while new problems arise as education looks to brain science for answers with ongoing social and academic difficulties faced by students. A critical bicultural methodology, grounded in a decolonizing interpretive approach, is utilized to interrogate the field of MBE in order to shed light on the epistemological power dynamics and social justice issues that inform the field. By examining the

historical, philosophical, economic, and ideological roots of neuroscience and education, a colonizing epistemology and hidden curriculum of inequality is revealed. The lack of awareness of how MBE, if left unexamined, will continue to fall short of the democratic and socially just goals of education is also addressed. The argument made is that there exists an abyssal divide within the field that epistemologically privileges neuroscience with its reductionist, Eurocentric, and positivist discourse. The case is made that the field must move toward an itinerant position that honors hierarchical dialogue and praxis and places the voices, scholarship, and values of educators and students at the forefront of this educational movement, in order to close the gap between research and practice in emancipatory ways.

CHAPTER 1

INTRODUCTION

Growing up, school always felt like a safe place where the chaos of everything around me, the pressures of war, an oppressive regime, and the chaos of my family life seemed to disappear as my mind was able to apply itself to something pure and clear: academics. Whereas it seemed overrun by anxiety in real life, in the classroom, my brain was my favorite friend. Like a high-performing car on an endless open highway, it could finally do what it was designed to do seamlessly: learn. That may have been when I decided, as early as first grade, that I would someday study learning.

But to study learning cannot be separate from studying education, and even in those early years when I took joy in my ability to learn and excel, I knew school didn't always make sense. As an "academic kid," as my schoolmates called me, I struggled with many aspects of our curriculum and could see that the very systems that often helped me to feel free (so long as I followed the rules), took away the freedom of many of my friends and classmates who could not follow the curriculum presented to them. It's no surprise then, that as a learning specialist, I not only work to understand learning better, but also try and understand curriculum and the school system better as well, in order to help the many different kinds of learners I encounter in my practice.

But the school system has yet to make this connection. Following the explosion of fMRI studies in the 1970s, where scientists were able to observe the brain as it learned, departments of neuroscience and education began to form at universities across the country in the face of both academic and public wonder. What can observation of what happens in the brain as it reads or

does math or as it experiences emotion teach us? How can educational practice shift to help the millions of kids who cannot access it, come to do so in a different way? How can learning about the brain help us make changes for kids who have specific learning difficulties? How will the brain's newly discovered plasticity change what educators once thought was impossible? And how can our age-old educational practices help inform this new science? The future seemed vast and bright, and the most important finding of brain science—plasticity—seemed almost like scientific proof of hope itself.

And yet, almost 50 years later, children with different learning styles or challenges are more marginalized in the special education system than ever. Classroom teachers report little to no helpful impact of neuroscientific research for their pedagogy and practices, and the literature in the field of neuroscience and education seems to be stuck on trying to figure out why the field has failed in effective communication and goal setting, all while the brain-based private educational market is booming, but with alarming consequences. These consequences may increase exponentially with the new U.S. administration and a push toward privatization, which will increase the risk of unfounded neuroscientific methodologies making their way to the forefront of new movements in education reform (Goldstein , Eder, & Fink, 2017).

As a learning specialist now with more than a decade of experience using neuroscience research to help kids with all kinds of minds thrive in school, I find such divides to be of concern. As someone who can see those with means access what the field of neuroscience has to offer, the issue of equity and why those without means continue to have little access, or are in fact exploited by the private sector because of their lack of knowledge, is also of concern to me.

And there are other curious questions. Why, for example, had I been working for 10 years, but the makeup of my clientele—affluent White families—has never changed? Work in private practice means that only people of a certain socioeconomic status usually walk through the office door. But why was the racial demographic of this group in West Los Angeles never changing? And how was it, that with all our advancement in neuroscientific tools, some of which were making it into public schools, children in public schools continue to struggle, while children who have access to learning specialists like me, in addition to the tools, are closing the gaps in their learning while others stay behind?

And, perhaps most alarmingly, how was it that although I had relationships with many of the school leaders in private schools, many of whom refer clients to me, they wanted my work with their students to remain "on the down-low," as if they were ashamed of these "infected" students? How is it that despite the fact that the National Association of Independent Schools (NAIS) stated, "We expect member schools to create and sustain diverse, inclusive, equitable, and just communities that are safe and welcoming for all" (National Association of Independent Schools, 2012) systems for more inclusionary pedagogical practices for diverse learners continue to be lacking? So, while we spoke about brain plasticity and multiple intelligences, when it came down to it, most students with diverse needs were being turned away from these schools; and those who remained were seen as having disorders that required labels and diagnosis, before any change or classroom modification could be implemented.

What these experiences showed me was that there were issues, both structural and philosophical, that prevented a change toward the very types of learning environments neuroscience research was aiming to shape. Neuroscience had taught me that we could change

the brain. But when it came to changing hearts and minds, and beliefs and structures, there was not much to be done. In fact, with all the advancements in neuroscience, all that was advancing in schools, even many progressive private schools, the discussion was ultimately just about more sophisticated testing and labeling techniques. My dream of someday using the Individuals with Disabilities Education Act as a blueprint for individualized education for all students, seemed to be always getting further, not closer, to becoming reality. What was happening?

The Canadian education and environmental activist Wendy Priesnitz (2000) argued, "public education reflects our society's paternalistic, hierarchical worldview, which exploits children in the same way it takes the earth's resources for granted" (p. 12). Could it be that this wasn't limited to just public education? And could it be that as scientific research moved into the practice of education, its positivist foundations have been doing more harm than any good that such research findings could do?

Beyond such questions is also the larger question of the field itself. My experience attending neuroscience and Mind, Brain, and Education (MBE) conferences has also raised concerns. The tendency in the field and in such venues seems to be to perpetuate science's universalism and patriarchal lens, often linked to a debilitating medical model that functions, wittingly or unwittingly, to perpetuate inequalities and derail conversations related to questions of social justice. As Paulo Freire (2000) argued, if we seek to eliminate injustice, we must get directly engaged. To understand how a process works in the brain, neuroscientists look at where it breaks down. In an attempt to better understand why there is such little engagement with social justice and such little (or sometimes negative) impact between neuroscience research and education, the first step is to take a closer look at the divide or the disjunction. This study aimed

precisely to dive into the context of the problem and, from there, move toward possibilities for establishing a critical paradigm for the study and practice of MBE, where social justice becomes a central concern.

Statement of the Problem

Much attention has been given to "bridging the gap" between research and practice since neuroscience research first made claims to its potential impact in classrooms. With the inception of Mind, Brain, and Education as a new interdisciplinary field, unprecedented opportunities to explore the educational implications of neuroscience research emerged, yet the gap between research and practice has persisted while new problems also arose as education looked to brain science for answers to learning difficulties (Bruer, 2006; Busso & Pollack, 2015; Clement & Lovat, 2012; Fischer, Goswami, & Geake, 2010; Goswami, 2004). This gap and the subsequent problems have been examined extensively in the literature, and there seems to be a consensus that, at the very core of this divide, is a question of differences in the histories, philosophies, and most importantly epistemologies between the fields of education and neuroscience (Bruer, 1997; Campbell, 2011; Clement & Lovat, 2012; Howard-Jones, 2008; Samuels, 2009).

However, a deeper look at the literature, its language, authors, and explanations for the enduring divide reveal that the problems facing research and practice may not be due to epistemological differences alone, but to the values given to these differences, creating a hierarchical relationship based on asymmetrical relations of power. Moreover, there is an absence of a critical social justice lens in the field that could potentially help shed new light and present new ways of interrogating how MBE can truly support education in classrooms and how

to shift away from bridging gaps or even working at boundaries to truly co-creating knowledge and establishing horizontal structures and conditions for dialogical praxis.

At the same time, as Special Education continues to fall short of its goals in serving students in public schools (Connor, Gabel, Gallagher, & Morton, 2008; Dudley-Marling & Burns, 2014; Smith, Gallagher, Owen, & Skrtic, 2009) and new brain research around learning is gaining traction in educational curriculum (Fischer et al., 2010), scientific research continues to advance some children, while leaving behind or labeling others (Four Arrows, Cajete, & Lee, 2009). This reality raises important questions and concerns about the value and influence of science and scientific thinking in education. The hierarchical manifestation of scientific research has a long history in the United States (Darder, 2012; Gould, 1996) and any emancipatory effort to bring brain research into educational settings must contend forthrightly with this history.

Therefore, while the mission of the new field of Mind, Brain, and Education (MBE) is to take shape as an interdisciplinary field that aims to move away from the old "paradigm war" (Campbell, 2011) between neuroscience and education, the fact remains that the field has not been well examined with respect to such an aim or, as a consequence, been informed by a critical or social justice analysis related to inequalities within the field. An underlying assumption of this study is that the lack of such a lens has had troubling consequences.

First, in its discussion of the issue, the MBE rhetoric within the fields of neuroscience and education, including inclusion rhetoric, claims neutrality, and objectivity, continues to ponder why the field remains disconnected. What is even more alarming is that some of the literature in the field suggests that many of its contributing scholars remain unaware of how disconnected and disconnecting their so-called scientific approach remains. Even within the

discussion of the historical and philosophical differences between science and education, there is no discussion related to the historicity or ideological dimensions of knowledge, which, as part of the critical tradition, reminds us that knowledge is created within a historical, cultural, political and economic contexts and, thus, everything has an intellectual history (Darder, 2014). Critical theory works to uncover the dominant ideologies (in this case, science) that present themselves as neutral and asks us to do away with preconditioned and hegemonic patterns in how we name the world, in order to move away from the fixed or prescribed ways of how things are, toward a relational understanding of knowledge (Darder, 2014). Reading the literature with a critical lens therefore helps reveal the more historical and political roots that contribute to the enduring gap between these two fields, with specific attention to the field of Mind, Brain, and Education.

Second, as new brain technologies continue to create a revolution (Four Arrows et al., 2009) with the MBE movement as a testament to the increasing interest in brain sciences in education, as educators we must be more vigilant than ever in our efforts to guard against the dominant Western ideologies both in academia and scientific research, particularly with respect to issues of implementation in public education, which have historically advanced a hegemonic perspective while labeling and hindering the advancement of other ways of knowing, thinking, and learning. In other words, according to Four Arrows et al., one of the major issues that the MBE movement must remain aware of as it grows and expands is that "Western neuroscientists and the philosophers who attempt to make sense of their 'objective' findings may lead us further away from, not closer to, the truth about what humans can do to live in harmony on this planet" (p. vii).

Although MBE claims to be an interdisciplinary field housed often in schools of education, the research and literature of the field is, ironically, lacking in its attention to educational theories and research methodologies. While the enduring gap and lack of impact between research and practice is what Paulo Freire might call a "limit situation," or a situation beyond which people cannot imagine themselves (Dimitraidis & Kamberelis, 2006; Freire, 2000), critical theories in education, which could potentially aid as pedagogical steps to move the conversation forward, are not part of the literature or pedagogy of the MBE field. As Darder (2014) argued, a true process of problematization that is integrated within a critical praxis of dialogue can only happen through what Freire called democratic forms of horizontal engagement. Only then can love and humanity, which Freire called our true vocation in the world, prevail. As such, it is not the idea of integrating neuroscience and education that is categorically problematic, but rather the persistence of dominant Western ideologies both in academia and in public education.

In short, the lack of critical literature in MBE puts the field at risk of first, not being able to have the impact it seeks; and second, perhaps even more problematic, reproducing bias and exclusionary outcomes that widen the divide. Moreover, the lack of a critical lens in the MBE literature has troubling consequences, the most important of which seems to be the lack of engagement with questions of social justice within the research in the field. This phenomenon, in turn, has resulted in questionable practices with respect to students from subaltern communities. To address this problem, this study first examines the history of the field of neuroscience, tracing its epistemological roots and its systematic progression into education, through the emergence of the field of neuroscience and education. From there, the history and subsequent literature in the

field of Mind, Brain, and Education is considered using a critical interpretive lens, in hopes of signaling a new emancipatory paradigm for the transformation of theory and practice in the MBE movement.

Research Questions

The overarching questions that inform this critical interpretive study of the field of Mind, Brain, and Education include:

- What are the historical and epistemological roots of neuroscience and MBE?
- How does the MBE field view the concept of social justice and its implications with respect to the impact of MBE research within oppressed communities?
- How does the MBE field view its relationship to educational institutions and how does this view impact teachers, students, and communities?
- What types of theoretical reformulations and new pedagogical practices are required within the field of MBE, in order to move in a more critical direction, where issues of social justice are central to research, teaching, and practice in the field?

Conceptual Lens

This study employed critical pedagogy as its conceptual lens. Critical pedagogy is grounded in principles of cultural politics, economics, dialectics, hegemonic power/knowledge relations, ideology, critique, dialogue, and social consciousness (Darder, Baltodano, & Torres, 2009). Simply stated, critical pedagogy is an educational philosophy that emerges when critical theory encounters education (Kincheloe, Steinberg, & Gresson, 1997). The genesis of the work in North America goes back to Paulo Freire, John Dewey, and other social reconstructionists (Darder et al., 2009); but because of its transdisciplinary origin, it serves as an umbrella under

which theorists have developed their own critical pedagogies. According to McLaren, critical pedagogy is first and foremost an approach to schooling (teaching, policymaking, and the production of curriculum) that emphasizes the political nature of education. Therefore, the aim of this framework is to understand, reveal, and disrupt the mechanisms of oppression imposed by the established order (in this case, science) pushing education toward its emancipatory goals. Inherent in this perspective are also concerns related to hidden curriculums, the banking model of learning, class formations, and obstacles to democratic schooling (Darder et al., 2009). More specifically, critical pedagogy is grounded in a set of critical philosophical principles that engage questions of cultural politics, economics, dialectics, hegemonic power/knowledge relations, ideology, critique, dialogue, and social consciousness (Darder et al., 2009).

Cultural Politics

Supporting a "politically emancipatory and humanizing culture of participation, voice, and social action" (Darder et al., 2009, p. 10) is at the heart of critical pedagogy. The principle of cultural politics, that is understanding that culture and power are inextricably linked (Darder, 2012), is central to examining asymmetrical power relations between neuroscience and education, specifically as it relates to the "cultural struggle over what is accepted as legitimate knowledge" (Darder et al., 2009, p. 10) by researchers and scholars in the field.

Political Economy

Institutions that gave rise to the MBE movement (namely academic institutions) function in the interests of conserving the existing political economy of capitalism and neoliberal ideals (Darder, 2012). The values of collaboration and interdisciplinary engagement of the MBE movement continue to be developed in ways that conserve the interests of the academic elite.

Moreover, the brain-based product industry is a $300 million a year industry (Busso & Pollack, 2015) that often capitalizes on the ignorance of teachers, parents, and students. As such, MBE, wittingly or unwittingly can function to preserve structures of power and privilege within educational institutions and the society at large.

Historicity of Knowledge

Knowledge is both historical and contextual (Darder et al., 2009). In scientific research, the lived histories of those being researched are often ignored or perceived as deficit. Similarly, what is generally ignored is the history of the privilege of researchers. Thus, the work done by scientific researchers can often result in the continuing colonization of the mind and body of the very "subjects" they seek to serve. Critical researchers understand themselves and their "subjects" as historical beings who, simultaneously, shape and are shaped by historical conditions that inform the contemporary moment. Thus, the personal histories of researchers and their "subjects" are always implicated in the research process and, because this is so, researchers begin their study of inequalities from the definitions provided by those with whom they seek to learn. Nowhere is this more important than in a field that seeks to understand teaching and learning.

Dialectical View of Knowledge

Critical research seeks to disrupt the traditional binaries, dichotomies, and hierarchical notions of the world. This speaks to an epistemology of knowledge construction where contradictory elements and tensions linked to the negation of positionalities must be recognized and engaged in efforts to arrive to emancipatory knowledge. Such a view is essential to a field like MBE, which also seeks to disrupt the traditional binaries but cannot do so until it recognizes

the embedded hierarchical notions that inform meaning making within the field. Critical researchers view knowledge as dynamic and reconstructive, much like how MBE researchers would like their research to be. A dialectical view of knowledge is therefore imperative to building a social justice paradigm of MBE.

Ideology and Critique

Ideology is the embedded societal lens through which order is created. Therefore, all theories and methods of research are linked to particular cultural/class interests and relations of power. Important to note here is that ideology generally exists at the level of unexamined assumptions often considered to be "common sense" or "naturally" existing. This is where critique becomes important. Through the process of critique, the MBE movement can be systematically deconstructed with respect to racialized, capitalistic, and neoliberal ideologies that conserve hegemonic practices. This allows, then, for commonsense, normative assumptions to be unveiled, challenged, and transformed.

Hegemony, Resistance, and Counter-Hegemony

The construction of commonsense notions within the process of research functions effectively to naturalize or normalize dominant relations of power and practices that perpetuate paternalism and deceptive notions of impartiality that shroud hegemonic interests (Gramsci, 1971). This is made possible in that traditional research practices, especially scientific research, serves to legitimate the existing social order, irrespective of contradictions and inequalities that exist. Research practices, then, as part of an ideological machine (i.e., culture industry) function to preserve the status quo. But the status quo is what the MBE movement wishes to disrupt. How then can this happen without a critical examination, of the moral and intellectual leadership of

researchers, deemed legitimate makers of knowledge? Further, principles of resistance and counter-hegemonic spaces are absolutely critical to any effort aimed at transforming the hegemonic culture of MBE. It is through forms of resistance and counter-hegemonic spaces that those engaged in MBE practice can potentially resist the dominant forms of knowledge in the field and work toward addressing social justice concerns.

Alliance of Theory and Practice

The alliance of theory and practice is a unique goal of the MBE movement. Critical researchers also contend that research must be informed by and exist in alliance with practice. However, for critical researchers, the emphasis is in on what Freire (1970) called *praxis*, where social relations are grounded in a reconstituting and self-generating process of reflection, dialogue, and action. Research then must be understood as having purpose within the context of institutions and everyday life of the most vulnerable populations. Hence, critical research outcomes must be linked to the real world; and, as such, must be flexible and fluid, able to shift and move according to the actual conditions that emerge within the context of human interactions. Similarly, critical research theory is always informed by practice, just as practice IS always informed by the epistemological loyalties we embrace. Since the aim of this study is toward a paradigm for this kind of praxis, understanding how theory and practice must align from a critical perspective will be hugely beneficial to the field.

Conscientization

Critical research seeks to support a purposeful and emancipatory interaction between the research and the people or the texts that are engaged in the course of study. Essential to this process is a deep concern for the development of democratic voice, participation, and solidarity

within the context of institutions and larger society. To this end, knowledge construction of the research process is always understood as a collective process (not just the personal curiosities of the researcher), which engages the on-going interactive process through a subjective/objective dialectical approach. Through this dialectical engagement, critical pedagogy seeks to support knowing the world and self through a connected, humanizing and democratizing process. At its core, a deliberate intent to support conscientization or what Freire (1970) termed *Conscientização*—the development of social consciousness and an expanding sense of collective human interaction—must be ever-present. Hence, underlying the outcome of critical approaches is always the question of collective emancipatory action for transforming existing conditions of inequality and injustice in schools and society. Such an aim is the purpose of this MBE research.

Methodology

The study employed a critical interpretive method. Rooted in critical social theory, interpretive research has evolved through the writings of Marx, Hegel, Gramsci, Lukács, the Frankfurt School, Foucault, Habermas as well as in the progressive and radical educational theorists of the 20th century such as Dewey, Freire, Giroux, McLaren, Apple, Shor, hooks, Kincheloe, and others (Darder, 2015). Interpretive research methods came into their own in the 1970s and 1980s, and have since become more present in education, nursing, and increasingly in psychology (Packer, 2000), allowing for standards of good research practice (e.g., Elliott, Fischer, & Rennie, 1999) though such standards are again more in line with the positivist approach.

The methodology is based on the recognition that there are important social and cultural variables impacting a subject matter, interconnections that must not be ignored (Maroun, 2012).

A major argument of this methodology is that research needs to be of relevance to the profession in which it is rooted as well as the larger society in order to be truly significant, and validity must be established not by a clinical or positivist approach but through detailed documentation that provides a thorough account (Maroun, 2012). In this way, interpretive methods work to disrupt the primary stance taken by the positivist outlook where research tends to become a means for the promotion and the self-fulfilling achievement of commanding respect in academic circles.

An interpretive approach is therefore a form of qualitative research practice, which seeks to formidably challenge and disrupt the one-dimensional Eurocentric epistemicides prevalent in traditional theories of schooling and society (Paraskeva, 2011). The methodology seeks to mine, articulate, and, where necessary, critique our everyday understandings (Packer, 2000). A hallmark of interpretive research is critical self-awareness of the researcher as well as a critical understanding of the complexity of social issues (Taylor & Medina, 2013).

Decolonizing interpretive research is rooted, then, in a critical approach that focuses on creating counterhegemonic intellectual spaces, in which new readings of the world can unfold in ways that lead us toward change both in theory and practice (Darder, 2015). According to Antonia Darder (2015), *decolonizing interpretive research* also "seeks to unveil and destabilize existing structures of power that perpetuate the material and social oppression of the most vulnerable populations" (p. 4). I have, therefore, used this qualitative methodology to examine, analyze, and interrogate the literature in the field of MBE regarding its mission and aims for education and practice, in order to expose what Henry Giroux (1983) considered the unstated norms, values, and beliefs embedded in the literature and social relationships of the field, in order to see how they are then transmitted to the practice of the field. Moreover, as Piantanida

and Garman (2009) posited, “It is the researcher’s right and obligation to decide what major message is important to put forward” (p. 190) through an inquiry of “sensitivity, rigor and integrity,” which can provide for “others who are struggling with the phenomenon” (p. 191).

The interpretive decolonizing research process is often an intimate one wherein the researcher is connected to and has intimate knowledge of the phenomenon (Piantanida & Garman, 2009) and it is through this connection that the researcher must “struggle toward the emancipatory reinvention of social and material relations” (Darder, 2015, p. 3). As a bicultural researcher with a background in neuroscience, education, and cognitive and developmental psychology, a member of the International Mind, Brain, and Education society, as well as a practicing learning specialist and educational therapist engaged in applying brain based research to student learning, my aim was to critically reinterpret the MBE movement, in hopes of creating a critical bicultural MBE pedagogy to counteract the classical positivist approach of the field and, instead, move toward a transformative theory and practice.

Tejeda (2008) emphasized the importance of acknowledging the *past* and *present* as coexisting in our understanding. Therefore, in order to understand where this young field is now and where it hopes to go, we must realize the present is unintelligible without a reading of the past cannot (Tejeda, 2008). The history of science with its colonial as well as its capitalistic structures must therefore be considered when examining the field of MBE, which both rests on those structures and aims to move past them through a decolonizing pedagogical praxis. As such, the aim of decolonizing interpretive research is to identify asymmetrical structures of power and recognize that all research practices are political processes that are not neutral, but instead political and historical. The aim of this type of research is therefore not to empower individuals

or impact specific research, but to be a systematic political effort to shift the field "in both theory and practice" in the ways "in which we comprehend ourselves and make sense of the world" (Darder, 2015, p. 3).

A critical perspective requires a deep commitment to an emancipatory ideal of schooling that is genuinely democratic (Darder et al., 2009). For MBE to be genuinely democratic, a radical re-engagement between the sciences and education is necessary. Such an engagement first requires re-reading the literature in the field through a critical lens that engages the historical and philosophical foundations that inform its evolution. Though it may not address this, the MBE movement is entrenched in dominant and hegemonic ways of thinking and oppressive practices that continue to engage education as a field and students from subordinate cultural communities as deficit. In the process, these become the targets of what Freire (1970) termed *false generosity* by those in the world of scientific research.

The aim of decolonizing interpretive educational researches is to engage the dominant literature on pedagogy, curriculum, methodology, and schooling in ways that treat these writings as data to be systematically and qualitatively analyzed, based upon their own historical and lived experiences as critical educators in the field (Darder, 2015). Darder has carefully articulated a set of critical principles for decolonizing interpretive research that are linked to a critical bicultural pedagogy. These principles—cultural politics, political economy, historicity of knowledge, dialectical theory, ideology and critique, hegemony, resistance and counter-hegemony, praxis, dialogue and conscientização—as discussed earlier, will be utilized theoretically and methodologically in this study to critically engage the literature with respect to its social justice connections and divergences within the research and practice in the MBE field.

Purpose of the Study

The purpose of this study was to re-think and re-envision the field of MBE, looking specifically at the lack of engagement with social justice concerns, in order to (a) critique the dominant epistemology of science that reproduces inequalities not just within the field itself but in its intended practice; and (b) move toward the formulation of a social justice paradigm of MBE that emancipates and humanizes teachers, students, and brain-based educational practices. The aim of this study, then, was to derive critical neuroscientific conclusions through a decolonizing examination of the primary literature that informs the field and to offer suggestions and recommendations for a social justice approach to MBE education and practice in the field. From a critical standpoint, therefore, instead of "taking issue with the rising dominance of brain sciences" we must "utilize these technologies in concert with a more organic grounding" (Four Arrows et al., 2009, p. vii). Only then, can the theories and practices of MBE begin to reflect an emancipatory intent.

Today, in my work as a learning specialist, I sometimes wonder if by working with children with learning difficulties, using some of the most cutting-edge brain-based tools we now have, I am still just trying to make school a safe place for kids. A place where they can go, no matter what kind of mind they have, and know that what they bring to that space, their questions and demands, are valid and important and worthy of recognition and encouragement. This is the reason that the Mind, Brain, and Education movement is so incredibly important to me.

I firmly believe that this field has the potential to close the gaps in academic success for all kinds of children, including children who are historically seen as having deficit intelligence. I am hopeful that in critically examining this movement I can help ensure that the field also works

to close the gap around making schools a place for the decolonization of our hearts, the expression and engagement of our souls, and the adventure of our spirits. As Paulo Freire reminds, humanization must be the work of education and love the vocation of educators, the vocation of us all. As the field of Mind, Brain, and Education begins to take hold in a time where new brain technologies are creating a revolution (Four Arrows et al., 2009), it is up to us as educators to insist on just philosophical interpretations of what is happening. This, more than anything, is the aim of this study.

Significance of the Study

Since George W. Bush termed the 1990s as "the decade of the brain" (See Presidential Proclamation 6158 http://www.loc.gov/loc/brain/proclaim.html), there has been unprecedented development in the field of neuroscience, with a particular emphasis on the field's potential for impacting the social and cultural life of human beings (Choudhury & Slaby, 2011). Aside from garnering attention at similar levels as the space race of the 1960s, "the neuroscientific revolution" (Lynch, 2009) is also accumulating resources at a tremendous pace, including President Barak Obama's multi-billion-dollar BRAIN initiative in 2013.

Alongside this overwhelming interest, a "widespread over-confidence in the transformative power of the new neurobiologism" (Choudhury & Slaby, 2011, p. xiv) has spread, including in the field of Mind, Brain, and Education. The field of MBE has made the enduring gap between neuroscience research and classroom practice (as well as some of the consequences of this gap) a central topic since its inception. However, the larger issues, including the economic and political context of brain-based initiatives, are seldom mentioned in the literature of the field. Issues of social justice as well as the differences in the placement of the sciences and education

in the field are equally absent from the literature. Moreover, while there now exists critical literature in both education and special education, no similar body of literature critically examines MBE in terms of social justice. This is one of the few studies concerned with social justice in MBE and the first with a critical interrogation of MBE as the primary focus of the work.

Currently, as the push for further privatization of public education puts the multi-billion-dollar brain-based industry in an advantageous position as an alternative or perhaps replacement for both special education and educational practices at large, critically examining the field using a social justice lens is ever more important. My hope is that leaders in MBE will take the social justice recommendations of this study seriously. Ultimately, this study seeks to help bridge the gap between neuroscience research and educational practice in ways that not only help students and teachers benefit from the rich knowledge base of MBE, but also encourage MBE practitioners to be a part of the conversation and begin to shift the way we do neuroscientific research so that our aims are emancipatory and move us toward a more socially just world.

Positionality

Growing up as a first-generation immigrant has given me a critical outlook. Coming from a country whose politics are in direct opposition to your new adopted country, further heightens such an outlook. I was born in Tehran, Iran, and lived there until I was 11. As a "child of the revolution" as we were called, I was taught in school and encouraged in society to critically examine the power structure of the world in which I lived. Unless, of course, such critique should turn to the Islamic regime. From the age of 11 to 15, I lived in Los Angeles, where I attended public schools, learned English in a time with no funding for English Language

Learners, where I was now faced with looking at my homeland through a very different lens. In Toronto, Canada, where I completed high school, I was once again charged with viewing my old homes, both Iran and the United States, with yet a different lens and from a different positionality.

These experiences not only exposed me to many different curriculums, philosophies, and systems of education, but also trained my brain to always step back and look at phenomena within a larger cultural, political, and economic context, and to do so with the understanding that there are relationships at play between otherwise seemingly separate entities that impact each other in ways not always apparent from within. Navigating three different cultures, from two very different and often antagonistic worlds, each with their own epistemologies, beliefs, history, philosophy, and goals, has forced me to constantly reflect not just on differences, similarities, and relationships, but on my own experiences while moving through these worlds. Therefore, my own lens and outlook lends itself to critical bicultural research.

My journey to work as an educator was not a typical one. I entered my undergraduate program at the University of Pittsburgh excited about my pre-med classes, convinced that a serious student like myself was meant for the sciences. As part of these requirements, I began taking courses in the then new field of neuroscience. But what began to stand out to me in these classes was the ways in which neuroscience was being linked to learning and education, which, much to my counselor's (and my parent's) dismay, prompted me to begin taking courses in education. Soon, I was "aimlessly" – to use my counselor's word - taking courses in different departments: psychology, linguistics, education, philosophy, and neuroscience. Since there was no existing major that connected these disciplines in the ways that I saw them connect, when the

final deadline for deciding on a major came, I decided to create my own major in neuroscience and education. I never thought then that a decade later there would be centers and degree programs that recognized the importance of connecting the mind and education in the ways I had envisioned. Hence, as the MBE movement continues to grow, I feel validated for making a very controversial choice at the time.

When I entered my graduate program at Teacher's College, Columbia University, I was excited to learn more about how the learning brain is influenced by developmental, social, and psychological factors. By this time, I knew that an interdisciplinary approach to studying learning and development was the right fit for me. I worked with Professor Herbert Ginsberg on learning how to administer clinical interviews with children. My practicum work with Professor Clea Fernandez on the differences between Japanese and American teachers' beliefs about their lessons in math allowed me to return to delve deep into comparative studies of education and to see how powerful teaching can be when professionalization and collaboration are emphasized. It was also at Columbia, in my work with Lucy Calkins at the Teacher's College Reading and Writing Project, that I learned research should never be just a theoretical construct. It can and must be applied in the real world with all its richness, nuances, and messiness. It was here that I realized the potential for creating effective partnerships between research and public education.

I began working in private practice after graduation for one reason alone: the one-on-one nature of private practice afforded me the privilege of being able to create an optimal environment where learning could happen, in the way that Piaget did, as well as the opportunity to work with students holistically within the context of their home, families, schools, and culture. This setting also allowed me the opportunity to work with children at their own pace. My hope

had been that I, in the tradition of great educational researchers, would be able to better understand "why children fail," to use John Holt's phrase in order to figure out how to assist them in succeeding. This work has provided me with the opportunity for real-life research. For years, I have been able to use brain-based approaches to actually make changes for struggling students while observing the larger forces at play in the education of children in Los Angeles.

Over the years, I have worked as what MBE scholars would refer to as a "neuro-educator" (Gardner, 2008) or an educational translator who helps "make useful connections between research and practice" (Fischer, 2009, p. 13). For example, I regularly use computer programs that have exercises that aim to rewire dyslexic brains, based on research from neuroscience that links dyslexia to a difficulty in processing the sounds of speech. Similarly, I may be asked by parents to evaluate brain-based programs recommended by others to ensure that they are in line with neuroscientific principles about how learning actually occurs at the synaptic level. Because of the private nature of my work and the privilege of in-depth, one-on-one work with students, their families, and their individual schools, I have been in a position also to see how fragile this work can be and how quickly and easily it can succumb to the threat of "neuromyths" (Fischer, 2009, p. 4), where, desperate to help their children, parents willingly spend thousands of dollars on programs that make false neuroscientific claims to "fix" children.

This phenomenon is also associated with over-testing, over-diagnosis, and misdiagnosis of children utilizing a clinical and medical model as well as the slippery slope that results when schools—sometimes well-meaning, sometimes not—either track students or place them in expensive outside-school programs. All these practices occur under the umbrella of brain-research and its positive impact in education, while sticking close to old beliefs about the brain

and children's lives and abilities despite the new and alluring label of neuroscience and cutting-edge brain research. Most alarmingly, I have watched as more advanced testing and diagnosis have rendered children "unfit" for regular classrooms, which has led to the popularity of different specialized schools that not only create a new educational economy but also cut at the very roots of our democratic ideals tied to education and inclusivity in our society.

Nonetheless, I continue to believe that MBE, neuroscientific research, and educational therapy have much to contribute to the field of education. Likewise, these fields have much to add to the ongoing conversation about the practices of special education in public schools, private and charter schools, and issues of social justice around education at large. It is important, however, that the field enter into this conversation as a member and partner. To do this, it is imperative that it first understands its critical position. One of the important ways in which neuroscience can transform the lives of children and citizen alike, for example, is through legislative action (Shen, 2016), as "legislators come in contact with the largest number and widest array of matters involving science" (Faigman as cited in Shen, 2016, p. 497). Therefore, MBE research today may very well fuel special education practices and policies in the near future. In fact, making such an impact is an explicit goal of the field. As a private practitioner with a background in neuroscience, I have the advantage of using the research of MBE in the informed ways the field wishes to have its research used. From this position, I could foresee many potential problems as brain science continues its push into both private and public education, including in special education.

I came to this study as an immigrant, a learning specialist, a student of neuroscience and MBE, an educational researcher, a woman in the sciences, and a social justice advocate for the

rights of all children to learn. I believe MBE can transcend the challenge of bringing together fields with different historical roots. However, I believe that, in order to do so, the field must first better understand its own positionality, as well as that of the fields it hopes to merge. Only then can true dialogue and praxis of the kind the field aims to have, take place. It is my hope to use my own positionality to help shed more light on the path toward this goal.

Definitions of Key Terms

Critical Pedagogy: A theoretical framework that proposes that education is a form of intervention and is capable of creating the necessary conditions for social transformation. The practice focuses on the lived experiences and genuine voices from which critique, resistance, and alternatives are to be realized.

Decolonizing Interpretive Research: A research methodology rooted in a critical approach that focuses on engaging the dominant literature on pedagogy, curriculum, methodology, and schooling in ways that treat these writings as data to be systematically and qualitatively analyzed, based upon the researcher's own (auto-ethnographic) historical experiences of difference, in order to create counterhegemonic intellectual spaces in which new readings of the world can unfold, leading to change in theory and practice.

Learning Specialist/Educational Therapist: A professional who combines educational and therapeutic approaches for evaluation, remediation, case management, and communication/advocacy on behalf of children, adolescents and adults with learning disabilities or learning problems.

Mind, Brain, Education (MBE): An emerging scientific field that brings together researchers in cognitive neuroscience, developmental cognitive neuroscience, educational

psychology, educational technology, education theory, and other related disciplines to explore the interactions among biological processes, learning, and education.

MBE Movement: A movement started by the Harvard Graduate School of Education to pull together different disciplines from neuroscience, psychology, and education in order to create a new scientific field within education to answer questions faced by classroom teachers.

Neuroscience: A branch of the life sciences that deals with the anatomy, physiology, biochemistry, or molecular biology of nerves and nervous tissue especially with their relation to behavior and learning.

Social Justice: The fair and just relation between the individual and society as measured by the explicit and tacit terms for the distribution of wealth, opportunities for personal activity, and social privileges.

Outline of Dissertation Chapters

A critical bicultural interpretive study of the field of MBE was conducted in order to interrogate normative assumptions about scientific research and educational practices that currently prevent the field from having the impact it seeks. This study took concepts that are usually assumed to be neutral—such as science, research, and learning—and engaged them with respect to the political assumptions that inform them. The aim of the study was to provide a new foundational paradigm for moving the field toward a more socially just direction.

Chapter 1 has provided an introduction to the problem, research questions, a discussion of the critical conceptual lens and research methodology that informs this work as well as the potential contribution of the study not just to the field of education.

Chapter 2 examines the history of neuroscience, how it came about as well as the historical, epistemological, and philosophical foundations that form neuroscience.

Chapter 3 tracks the movement of *neuroscience into education*, the politics related to this move, as well as the emergence of the field of Mind, Brain, and Education as its own field and the politics and circumstances that resulted in this phenomenon.

Chapter 4 takes a social justice lens to the meeting place of neuroscience and education and asks questions of the social justice implications and limitations of Mind, Brain, and Education as a field. This chapter also provides a rationale for moving toward a critical social justice paradigm of MBE and the emancipatory potential of such a shift.

Finally, Chapter 5 brings the study together by articulating a set of principles for a social justice vision of MBE and concludes with a set of recommendations, to support an emancipatory praxis of MBE and, by so doing, better support an effective relationship between MBE and education as intersecting fields of study.

CHAPTER 2

HISTORY OF NEUROSCIENCE AND ITS DISCONTENTS

In the sixteenth and seventeenth centuries, the scientific revolution took hold in Europe. Historians of science mark this as the beginning of modern science, modern philosophy, and modern life. It was in this revolution, or "crisis of European consciousness" (Koyre, 1957, p. v) that the geo and anthropocentric world of Greek and Medieval astronomy was replaced by a heliocentric, and later centerless, view of the universe, thus shifting social and even spiritual beliefs. Human beings were no longer mere spectators of nature, but owners and masters of it. Later, as the organismic pattern of thinking and explanation was replaced by the mechanical and causal, the "mechanization of this world-view" (Koyre, 1957, p. v), so prevalent in modern times, was born. It is at this point in history that the heavens no longer announced the glory of God and instead, the destruction of the infinite cosmos was followed by the measurement of space in an attempt to create a finite, well-ordered, hierarchy of perfection that forms the very basis of scientific thinking.

Interestingly, this divorce of the world of values and the world of facts and the secularization of consciousness as the human mind turned from transcendent goals to immanent ones is also reflected as a goal of the traditional historians of science. In other words, traditionally, the job of the historians of science was to find truths about science with emphasis on the peculiarities of science, which included disinterestedness, universality, epistemic communism, and organized skepticism (as opposed to the doubt of the isolated researcher), through the critical scrutiny of an entire community (Merton, 1938). If the job of the scientist was to seek truth, then the job of the historian of science was to chronicle the growing body of

knowledge, as scientists continuously repaired it and made it deeper. In short, scientism ruled strong and prestigious; following the positivist approach, most historians of science saw their field of history in the image of science, as a purely descriptive discipline.

Within this framework, and among scientists, a theory is accepted if and only if it is "true." To be true means that a theory is in agreement with observable facts that can be logically derived from it. The influence of moral, religious, or political factors must be kept separate or the theory becomes illegitimate and must be deemed as such by the community of scientists. This is how scientific theories come to be validated (Frank, 1954); and as such, the history of any science is to shed light on the nature of scientific enquiry and the processes that lead to scientific discovery of truth. In fact, the history of the sciences was meant to separate the facts of science from such influencing factors as history itself and the political, economic, and cultural forces it entails. As such, a history of science was meant to be a chronological series of encyclopedia articles in the manner of old-fashioned textbooks.

But as has been said, the historian is the avenger, standing as judge between the parties and rivalries of bygone generations (Butterfield, 1951). Generally speaking, historians do not assume that facts emerge in a simple and uncomplicated way from the record of the past because historical epistemology is necessarily inferential and inductive (Smail, 2012). However, in the traditional view of the history of science, the historian, like the scientist, was not to bring his or her own biases, preferences, and antipathies to the work.

"The beast lives unhistorically," wrote Nietzsche (1957), and nowhere is this truer than in the traditional history of science, where biology is seen as independent from a political order and the state and is, therefore, in Hegelian terms, a historyless (or ahistorical) condition. The idea

that history was founded on a break with nature cast a very long shadow over the practice of history in science and the traditional view of the history of science that ruled supreme for centuries. It was not until 1962, with the publication of *The Structure of Scientific Revolutions*, that coming from that tradition, Thomas Kuhn (1962) challenged the rigid and authoritarian view of science as a discipline and instead put forth a more creative, emergent view in the West of how the history of science ought to be considered.

Kuhn's book was considered the most revolutionary book about the history of science in the West and the "most widely read, and most influential work of philosophy written in English since the Second World War" (Rorty, 2000, cited in Kuhn 1962, p. 7). Influenced by the works of historians like Arthur Lovejoy and Alexandre Koyre, Kuhn's idea about how science evolves and the role science historians must play not only challenged traditional positivists views but also made popular the concepts of preconceptions, prejudices, points of view, principles, and conceptual frameworks as essential to comprehending science. Arguing that history is not a purely descriptive discipline, but an interpretive and normative one, Kuhn (1962) critiqued the traditional accounts of science and scientific texts, which imply that "the content of science is uniquely exemplified by the observations, laws, and theories described in their pages" (p. 1), resulting in "a view of science with profound implications about its nature and developments" (p. 1).

Kuhn (1962) argued that the position of scientific historians as chroniclers of an incremental process simply does not make sense when one looks at the development of the sciences. When we look at the data in science itself more carefully, according to Kuhn (1962), it becomes clear that much of what was once scientific belief is now myth such that if these out-of-

date-beliefs are to be called myths, "then myths can be produced by the same sort of methods and held for the same sorts of reasons that now lead to scientific knowledge" (p. 2).

Arguing that a concept of science drawn from books written by scientists is "no more likely to fit the enterprise that produced them than an image national culture drawn from a tourist brochure or a language text" (Kuhn, 1962, p. 1), Kuhn claimed that the logical positivist image that we possess of scientific history does not stand up to historical scrutiny. Hence, Kuhn's work in the history of sciences is important to this study for two reasons. First, while Kuhn is lauded as a revolutionary thinker who was the first to challenge the positivist approach to the history of science, countless other traditions of science and history were ignored within the history of science. This alone points us to the problematic nature of the history of science in the West. Yet, Kuhn is seen as suddenly shifting the job of the historian of science from a mere spectator and reporter of scientific developments to that of a critical thinker who must look at the underlying values, politics, and power relations that result in the success of one paradigm over another. However, this "discovery' is only new in the Western tradition itself. Second, and perhaps more alarmingly, none of his ideas is reflected in the history of neuroscience, which seems to rigidly follow the traditional view of history.

The literature on the history of neuroscience is sparse (Shepherd, 2010; Wickens, 2015). Stanley Finger's *Origins of Neuroscience* (1994) gives a historical account but only to explain brain functions, while his book *Minds Behind the Brain* (2000), written for a more general audience, focuses specifically on neuroscientists from ancient Egypt to the modern era who pushed the field forward. Andrew Wickens*'s A History of the Brain* (2015) is perhaps the most thorough account of the history of the field from the Stone Age to the modern era, while Gordon

Shepherd's *Creating Modern Neuroscience* (2010) covers the revolution of neuroscience in the 1950s exclusively. Outside of these books, little exists in the form of a history of the field.

History is of course itself a discipline, and as such, there is always concern for the implications for the historical method of construing it along one way, rather than another. It is important to note therefore that the authors of these books on the history of neuroscience are not historians of science but themselves trained scientists as in the early traditions of the history of science. Stanley Finger is Professor Emeritus of Psychology at Indiana University. Both Andrew Wickens and Gordon Shepherd are neuroscientists. In fact, the history of the neurosciences as it has been established in the International Society for the History of the Neurosciences (ISHN) was based on the accounts of the founding members of the ISHN who were practitioner-historians. In other words, they were practitioners of the neurosciences with an interest in the great moments and ideas in the history of their field.

The historiographical precedent set by these clinician-historians emphasizes the aspects of history most interesting to them as trained scientists (Smail, 2012), resulting in a rather biased account of the history of the field (Rosner, 1999). In raising such critiques of the historiographical tradition of the history of the neurosciences, the young age of neuroscience as a distinct science is often noted as a potential cause (Kragh, 2002; Rosner, 2010). Neural research is a new science, and hence it is not surprising that most of the contributors to its history are neurologists or, otherwise, practitioners of the neurosciences (Kragh, 2002). Understanding that "our knowledge of the past is seriously affected if we learn how that knowledge came into existence and see the part which historical study itself has played in the story of the human race" (Butterfield, 1955, p. 1) is central in the study of history as a field and is not a new idea. Given

this, and the work of Kuhn in the history of science, not to mention the radical science movement of the 1960s–1980s as well as the work of many critical thinkers around the biased ways in which history is presented, one would expect that neuroscience would be at an advantage not to follow the traditional positivist view in its own history, *because* of its young age. This, however, is not the case.

The thoroughly inter- or multidisciplinary nature of neuroscience is also noted as making it distinct from other sciences (Kragh, 2002). The interdisciplinary nature of this "hybrid of hybrids" field (Abi-Rached & Rose, 2010) is argued as presenting a challenge to historians even when the field does begin to be considered by them (Kragh, 2002). This is because historians would have to decide if they might approach the field from the history of medicine only, or from the perspective of history of psychology or physics only, for example, and would, in either case miss many important points characterizing the field. This critique, however, seems counterintuitive to how interdisciplinarity is seen as an asset in both neuroscience and the field of Mind, Brain, and Education. If Neuroscience is unique because of the way the field emerged from a number of distinct fields, why would that not be seen as an asset in studying the history of the field, unless of course the goal is to do that in the traditional way?

The dearth of literature on the history of the field then and the fact that only scientists and not historians of science have so far written on the history of the field is itself an interesting finding. Neuroscience remains a relatively new field and "the history of neuroscience is not regularly taught in schools or university" (Wickens, 2015, p. xi), although neuroscience has begun to make a strong showing within schools of psychology during the last decade. Yet, as Wickens contended, "History is less about hard facts, and more to do with reconstruction and

interpretation" (p. xiii). Therefore, the positionality of these authors is important to the account of history they provide.

History of Neuroscience

In the history of the neurosciences, there are also many parallels between neurological theories and classical philosophical questions, including questions on the nature of the soul, the free-will problem, and the origination of knowledge, such that tracing the history of neurosciences also traces the history of the soul. This other high degree of interdisciplinarity of neuroscience also necessitates a perspective that goes beyond traditional disciplinary boundaries (Kragh, 2002). But instead of using this as an opportunity to be truly interdisciplinary, it is viewed as a hindrance to the study of the history of the field (Kragh, 2002).

While the academic history of the sciences has shifted in recent decades toward a more contextual historiography, where science is no longer considered an autonomous body of knowledge but as a "social activity, born of society, and mediating its structures and values" (Young, 1973, p. 369), the history of neuroscience has not yet been considered in such a light and is instead presented in the texts of neuroscientists or practitioner-historians writing about the history of the field. What is interesting about these practitioner-historians accounts is that, despite being in and of this interdisciplinary field, they view their subject as "traditional theorists" (Horkheimer, 1937) who position themselves somehow outside of the practical, political, economic, and social contexts of their field of study. As such, the history of neuroscience is unrelated to the kind of interpretive, post-Kantian philosophical tradition and the post-Kuhnian tradition of scientific history, which would argue that scientific observation and methodology must not reduce the field to a single body of belief and that true and effective

scientific research by definition must not begin with the answers as decided upon by the scientific community.

Accordingly, the approach of most of the authors writing about the history of neuroscience echoes the same detached values of how they have been trained to approach nature or their own research as scientists. So while no historian in recent times would assume that facts emerge in a simple and uncomplicated way from the record of the past, historians of neuroscience still seem to do so. With this in mind, this literature review draws mainly from the texts of these practitioner-historians, although other texts from the neurosciences that occasionally refer to the history of the field are also engaged in the following historical discussion.

Antiquity to the 1800s

The ancient history of the neurosciences is a kind of chimera as there were obviously no neuroscientists in ancient times. Yet the study of the brain in the West dates back to ancient Egypt, whose writings about the brain have been found on the papyrus plant paper they used (Finger, 1994; Schulkin 2015; Walshe, 2016; Wickens, 2015). The Egyptian symbol for the brain (see Figure 1) is a four-part hieroglyph containing a vulture, reed, folded cloth, and the final suffix meaning "little." The sounds made by the symbol "ah-i-s" translates to "skull marrow," which the Egyptians, as evidenced from their writing and their mummies, did not view to be as important as the heart (Wickens, 2015). While the heart, which was believed to be the source of thoughts, desires, and actions, was meticulously persevered for the afterlife, the brain was extracted through the nose with an iron hook and discarded.

Figure 1. The ancient Egyptian hieroglyph for brain as shown in the Edwin Smith papyrus. Source: https://commons.wikimedia.org/wiki/File:Hieroglyphic-brain.jpg

Even so, the Egyptians placed the brain at the center of disease, as evidenced by skulls that were trepanned, perhaps to remove evil spirits (Finger, 1994; Wickens, 2015). Evidence of trepanation has also been discovered in Inca cemeteries, and the practice continued for thousands of years in Europe as a viable operation for Neolithic surgeons, perhaps as a way to control epilepsy (Finger, 1994; Wickens, 2015). Egyptian medicine seems to have set the context for inquiry into brain function in the West (Schulkin, 2015), and its discoveries are recognized in the field as important steps in neuroscientific history and development. Yet, for the Egyptians, it was the heart that had primacy as the center of the spiritual mind, which remained separate from the physical body, including the brain. The predominance of the heart continued into Biblical times, and the idea that body and spirit exist as separate entities persists as a central tenant of the world religions. Moreover, this line of reasoning continues in scientific and philosophical discussions within neuroscience today.

The Brain in Ancient Greece

The pre-Socratic thinker Alcameon (55–450 BC), who performed experimental dissections and focused on sensory and cognitive systems, is regarded as the first neuroscientist

in Western history (Finger, 1994; Schulkin, 2015; Wickens, 2015). He marks the point at which the Greeks turned their attention from gods and myths to analyzing human experience through reason. Until Alcameon, the Greeks also embraced the heart as the most important reasoning organ (Wickens, 2015); but, with the phrase "all senses are connected with the brain," (p. 23) Alcameon forever changed the course of Western thinking (or "mankind" as noted in the texts) and is therefore worthy of comparison to Copernicus and Darwin in the history of science (Wickens, 2015).

Hippocrates (460–370 BE), well recognized as the father of modern medicine, perhaps more than anyone "freed medical practice from mysticism and superstition by replacing it with the idea that health is a physical process amenable to understanding through observation and reasoning" (Wickens, 2015, p. 13). His book *On the Sacred Disease*, which deals with epilepsy, makes the claim that the brain is responsible for all human mental activity, including intelligence and madness, and provides detailed anatomical descriptions of the brain. In demythologizing the sacred disease, Hippocrates recognized the pathos of insanity as a pathology of the body, perhaps laying the foundation for all future Western thought that places disease in the body of the person.

Aristotle (384–322 BC), on the other hand, identified the heart as the seat of intelligence and believed that the "brain served to cool the heart" (Schulkin, 2015, p. 3). Like Plato, he believed the psyche to be made of three hierarchical parts (nutritive psyche, sensitive psyche, intellectual psyche), but unlike Plato he maintained that the psyches worked together and not as individual entities. Not content to observe, Aristotle (regarded as the greatest biologist of antiquity) cut into the brain; but, unimpressed with its cold and uniform structure, he maintained that the heart was the site where all the senses came together (Wickens, 2015). This is considered

Aristotle's greatest error, though one wonders if his error was due to his scientific observations alone.

As the Greeks went on to conquer other lands, they passed on their observational science on to the world, as did the Romans after them. The Roman physician Claudius Galen (AD 129–200), who worked in the great city of Alexandria, expanded on the works of the Greeks but believed the brain to be the final common pathway of experience and behavioral expression (Finger, 1994; Schulkin, 2015; Wickens, 2015). Galen, who discovered the nervous system, is believed to be the founder of experimental physiology, requiring "a constant supply of animals" (Wickens, 2015, p. 39), from pigs to the North African Barbury ape, his preferred choice, as he believed the ape most resembled man. As there was no anesthesia, the animals often had to be strapped down on his operating table, squealing and struggling as Galen began to discover how different nerves and the brain controlled different parts of the body (Wickens, 2015).

Galen's "rigorous and careful experimentations" (Wickens, 2015, p. 44) made him the authority in medical matters for 1,500 years, during which time there was no further study of the brain and the nervous system. He wrote voluminously, forming the basis of medicine through the Islamic world in the centuries after Rome's fall. Because he claimed that the beauty and the design of the body could not be due to chance, he had the endorsement of the Christian church helping him further rise as the greatest medical authority of the fourteenth and fifteenth centuries. It was not until the sixteenth century that the errors in his anatomical and physiological writings became apparent. In fact, using animals such as dogs, pigs, and macaques as models for the human body led to much misunderstanding, which was slow to be resolved, itself marking an important development in "mankind's quest to understand his nature better" (Wickens, 2015, p.

45), though his authority as "a genius whose determination to understand the workings of the body, brain and nervous system through experimental methodology" (Wickens, 2015, p. 45) lay the foundation for the scientific revolution later and earned him the title of the earliest true neuroscientist.

Building on Galen, thinkers in the Renaissance who emerged from the Dark Ages and saw no divide between the artist and the scientist, marked a particularly salient time for neuroscience as detailed drawings of the brain and the nervous system introduced "experimental philosophy" (Schulkin, 2015, p. 8) or a scientific approach based on the discernment of mechanisms. The science of this age was experimental, taxonomic, and naturalistic (Schulkin, 2015), resulting in positive knowledge, or logical positivism, culminating in the twentieth century in what came to be called the "unity of science" (Carnap, 1928). The culmination of the thinking of this time period came in the publication of *Fabrica* (1543) by Andreas Vesalius based on his own observations and dissections of the human body, which revealed much of Galen's errors and marking the reawakening of neuroscience.

The Long Century: 1660–1800s

The late sixteenth century until the opening decades of the eighteenth century, also known as the "long eighteenth century" (Whitaker, Smith, & Finger, 2007, p. 3), was an extraordinary period for all of science, including neuroscience, given "old teachings were replaced by fresh knowledge obtained through experimentation and empirical endeavor" (Wickens, 2015, p. 83). There was an "enormous increase in interest in the nervous system as the source of many ills of both body and mind, along with new therapies" (Whitaker et al., 2007, p. 3). The beginnings of the industrial society brought about new creations, like the microscope as

well as a new upper stratum of polite society with a new and often neurotic concern for the proper health and functioning of the nervous system. Alongside these changes was a shift in philosophical thought, as represented by Rene Descartes (1596–1650), in the use of objective scientific investigation for the discovery of truth. As Newtonian physics began to construct sound models of the universe, Descartes invented the "reflex" to show how, in the dualism of body and mind, the brain acted in mechanical ways independent of a guiding spirit. Descartes's book *Discourse on Method* (1637) offered a "new foundation for scientific thought based on certain and irrefutable knowledge" (Wickens, 2015, p. 84).

A short while after, Thomas Willis, the father of modern neurology, published his book *Cerebri anatome* (1664), which provided an updated and thorough anatomical and physiological account of the brain. No longer were the workings of the body to be explained by a spiritual or soul-like force. Cartesian dualism was doing away with the old thinking of the Egyptians, the Greeks, the Romans, and even the church at the time with the concept of automata or the machine-like nature of life. With Luigi Galvani's (1791) work on the intrinsic nature of electricity in the nervous system, the notion of spirit was firmly rejected. When the first action potential was recorded in the 1800s, a two-thousand-year belief that a spiritual force governed the body was replaced by "the nerve impulse." When the speed of the impulse was finally recorded in 1850 at about 60 miles per hour (much lower than expected), neuroscience as a field became convinced that it could someday measure and explain all biophysical and biochemical events, and perhaps even the soul itself.

Franz Joseph Gall and the Theory of Phrenology

The term *phrenology* was first put forth by Franz Joseph Gall (1798), a German-born physician who saw his theory that skull features indicated underlying brain development as the "new" science (Finger, 1994; Wickens, 2015) that could be used to "construct an entirely brand new science of human nature, with implications for the individual and society (Wickens, 2015, p. 135). That Gall was known as a womanizer with a colorful personality; that he used to entice street urchins into his home with cake and brandy in order to learn more about the skull features of the "lower classes"; that his theory was the idea of a self-determining spiritual entity held by the church at the time; that he was taking phrenology on a tour throughout Europe and the United states more like a circus show than a science; or the fact that many scientists at the time ridiculed his ideas did not avert phrenology's popularity in Europe (Wickens, 2015).

However, the movement really took off in the United States, where Gall and his colleagues were guests of honor at universities like Harvard and Yale and in the higher societies of Boston and New York, where American audiences, just 50 years after the American declaration of independence, were finding in phrenology a "scientific basis for the American belief in hard work and self-advancement" (Wickens, 2015, p. 147). The impact of phrenology did not end with Gall's death in 1828. By the 1830s, phrenology had become big business in America, where phrenologists toured and gave lectures and held exhibitions where customers paid high fees to have their skull features read. Phrenologists were consulted on choosing employees and marriage partners, published in *The American Phrenology Journal,* and even diagnosed illness.

Phrenology's popularity in the United States is attributed to the allure of the idea that mental phenomena have a biological origin that can be discovered (Wickens, 2015), an idea that persists today in modern neuroscience with more advanced techniques than reading skulls. But while there is little mention of the darker side of the history of phrenology in the United States, such as the way races were ranked from least to most evolved based on their skull patterns (see Figure 2), gender stereotyping, diagnosing criminal tendencies that had an impact on the prison system, as well as the negative impact of the field on education reform in these history texts, the fact remains that the desire to naturalize the inequality of people, in order to situate them in the most appropriate place in society is also a part of American history as well as the history of neuroscience.

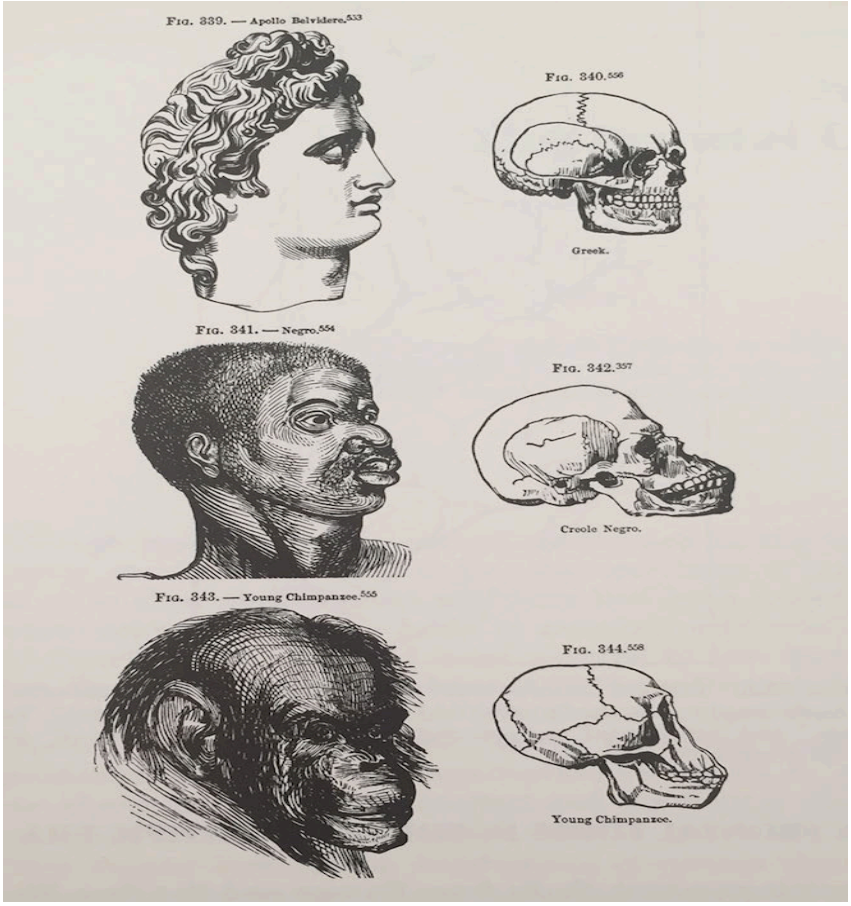

Figure 2. Skull patterns used in phrenology.
Source: Drawing of the Greek god Apollo with an extensively high forehead juxtaposed with drawings of black Africans with distorted features to make them look more like apes (Finger, 1994).

Instead, Gall's work is seen as one that was eventually disproved by scientists as evidence showed that "variability across subjects was high" (p. 307) and as it became inescapable that "brain size and complexity were unreliable correlates of intellectual powers or faculties" (Finger, 1994, p. 307).

It can be argued that the study of phrenology leads the historian "to face, inescapably, the political and social function of all scientific thought'" (Cooter, 1976, p. 228). However, in the current history of the field, ultimately, Gall's contribution is seen as "a positive one" (Wickens,

2015, p. 150) because he was the first major scientist to pursue the science of human behavior by replacing the soul with a materialistic view of the mind—known as monism, and the position adopted by most neuroscientists today—forever changing academic psychology with the pursuit of character typing, rating scales, and inventories to measure personality. Gall's work also had an impact on neurosurgery, as his cortical localization ideas led to lesioning methods, thus beginning a new chapter in brain research and psychology. Gall's science was perhaps also the first "neuromyth" (Pasquinelli, 2012) to capture the popular imagination, leading to the precursor discovery that brain science could be big business.

From the Neuron Doctrine to the American Psychiatric Association

The discovery and understanding of cell theory in the late 1830s was another major accomplishment of the long eighteenth century (Wickens, 2015). Also known as the "neuron doctrine," the cell or individual neuron was understood to be an independent, self-governing entity with various components like any other part of the body (Glickstein, 2006; Shepherd, 1991). This was an unexpected discovery, as the brain had still been assumed to be a more mystical organ at that time. Soon after the neuron doctrine, synapses were discovered, and the general flow of information from the dendrites into the cell and then down the axon was understood. Three of neuroscience's most prominent names, Camillo Golgi, Santiago Ramon y Cajal, and Charles Sherrington all played a role in this mapping, "when modern neuroscience is said to have been born" (Wickens, 2015, p. 160).

These findings also pointed to the return of the idea of Descartes's reflex, as Sherrington was able to show, through studies that identified how excitation and inhibition impact the nerve (Glickstein, 2006; Shepherd, 1991), an idea then used by Ivan Pavlov to explain how learning

occurs. Pavlov's work, along with the work of his student Donald Hebb, whose theory proposed that learning and memory involve circuits of reflexive neural activity in the brain had a strong impact on both education and psychology for years to come. Conditioned reflexes, which Pavlov believed to be the fundamental unit of learning in animals and human beings, began a period in the nineteenth century when psychology came to be dominated by experimental methods that brought "rigor and objectivity" (Wickens, 2015, p. 208) to the field, as stimulus-response psychology became highly influential (Hunt, 2007). Soon behaviorists followed, with promises that they could "train" any infant to become anything they wished acting as "social engineers, helping society to scientifically engineer individuals to fit their environment" (Wickens, 2015, p. 209).

At around the same time, the mapping of the cerebral cortex brought back Franz Gall's notion of cortical localization, as neuroscientists and doctors began to discover specific areas of the brain associated with specific functions. Paul Broca (2006), for example, localized speech in the posterior region of the left frontal lobe (Schiller, 1992), while Carl Wernicke discovered a second "language center" in the brain (Geschwind, 1974). With the return of the reflex and cortical localization as neuroscientifically proven theories, the long eighteenth century gave rise to both modern psychiatry and clinical neurology, which are based on the classification of psychiatric disorders and the practice of brain surgery. These classifications and methods served as the foundation of the American Psychiatric Association and The World Health Organization.

Two factors stand out in this reading of the history of neuroscience from antiquity to the modern age. First, this history once again attests that we are, in fact, a scientific culture and scientific rationality permeates our dominant mode of thinking (Aronowitz, 1988). At no point

do the authors who tell the story of neuroscience, nor the men who make up that science, seem to doubt that their way of seeing the world, their attempts at rationally understanding it should itself be called into question. Even in the ongoing philosophical debate over mind-body or even the bigger question of the existence of God or a mystical force that embodies or guides the soul, is there doubt about whether the answer to these questions should be interrogated rationally.

Of course, many of these men were, in their own time, radical thinkers who wished to emancipate human beings from darkness and doctrine. They sought truth, and one cannot deny that this is a noble endeavor. Nor can one deny the knowledge of the brain produced by this field and the ways in which it has transformed conditions of life, at least in the West. However, the pursuit seems too one-sided, reductionist, and unable to question itself. And, as has been argued, truth is neither outside power nor deprived of it (Foucault, 2008). Since science's claim to truth is bound to the methodology that dictates its implementation, unless something can be proven using the scientific method, it cannot be true; it then follows that only science can bring us to truth and, at a step further, that science is truth. It is therefore the "conflation of knowledge and truth" (Aronowitz, 1988, p. vii) that is problematic.

In explaining his critique of the traditional view of the history of science, Kuhn (1962) argued that science somehow always remembers its heroes, but seems to forget how they, and the scientific communities to which they belonged, came to their achievements. Instead of looking at science as a process, the field, even in its history, is seen as a series of products. Similarly, scientists, philosophers of science, and even historians of science seem to aim to present a rational reconstruction of the logic of science, making the discipline into a normative one. What results is a history of what science is at its best, as seen in this review of the literature,

rather than a true picture of how science really, or typically, is. But the fact is, the picture painted by these accounts of science is dependent on certain values, and different values would result in a very different and yet, historically accurate, picture of science.

To this point, Kuhn (1962) coined the term “paradigm,” or an integrated cluster of substantive concepts, variables, and problems attached with corresponding methodological approaches and tools to refer to the worldview held by any scientist at a given time. Paradigms provide a “scientific community” (Kuhn, 1962, p. 10) with a model for examining problems and finding solutions. A paradigm, then, is a set of accepted examples of scientific practice, including law, theory, application, and instrumentation, that provides a model from which spring particular coherent traditions of scientific research. Every scientific community shares its own paradigm of truth (examples are "Newtonian physics" and "Aristotelian dynamics”) and, in fact, it is its possession of a common paradigm that constitutes it as a scientific community.

The problem is that paradigms are limited in both scope and precision. The only reason some paradigms gain status is that they are more successful than their competitors in offering solutions to problems that a group of practitioners have recognized as important. In other words, there is no “truth” behind a paradigm—only that it can beat out other paradigms. In this way, science itself and its methodology can be seen as a paradigm that has been able to beat out other paradigms; and, has thus, become normalized by the scientific community (and in this case all academic communities).

It is only when the scientific community can no longer suppress an anomaly that the profession is led toward a new basis. This phenomenon Kuhn (1962) called “scientific revolutions” (p. 6) and the only way science has over history moved forward. Scientific progress

then occurs through a series of renegotiations by the established scientific community through a crisis of meaning. What is important here, however, is the argument that, in resisting new ways of thinking, science is ultimately the enemy of new discovery until the new way of thinking can no longer be suppressed. Copernicus, Newton, Lavoisier, and Einstein were all radical thinkers who were marginalized by the scientific community for rejecting their time-honored scientific theories of the time. Each transformed the scientific community by ultimately having to transform the world within which scientific work was done. It is easy to see, then, that if the paradigm is problematic, the field itself perpetuates falsehoods. Equally important, and perhaps even more so, is that if the paradigm is biased in its aims, one can easily see how phenomena like phrenology could gain such ground as science. All these, of course, still fall within the Western scientific tradition. Even with Kuhn's revolutions, there is no history of science allowing for a nonscientific, nonempiricist points of view.

There exists a rich body of critical literature on Western science that, pointing to the individualistic, androcentric, detached, and biologist tendencies of the sciences, brings the scientific epistemology, not just its history, under question (Alcoff & Potter; 2013; Harding, 1986, 2008; Potter, 2006). Unfortunately, the sources of the traditional history presented in this literature review do not employ any of these perspectives. Instead, the history, like the science itself, seeks to arrive at a "general or universal account of the nature and limits of knowledge, an account that ignores the social context and status of knowers" (Alcoff & Potter, 2013, p. 1), since "science must be held immune from the influences of social and historical situations" (Aronowitz, 1988, p. viii).

Feminist thinkers, for example, have called into question science's theories of knowledge, its professional philosophers and its epistemology "proper" both for its lack of attention to the significance and particularity of the context of its theory, but also to its inability to recognize that "dominant knowledges, that is, knowledge produced and authorized by people in the dominant political, social, and economic positions, can apply to subaltern knowledges as well" (Alcoff & Potter, 2013, p. 1). But before the question of where neuroscience as part of the dominant knowledge system can be applied to subaltern knowledge, one must call into question the innocence of science's limited epistemology. As the history shows, the pioneers in this field were all highly educated men with the necessary financial support to test and build their science, interlocking knowledge with power. With the exception of those women who served as patients (often plagued by neurosis) alongside men of the lower classes and races who were used as subjects, much like the North African Barbury ape, there are no women or racial minorities in the history of the field bringing to question issues around "patriarchy and reconstructing the sexual politics that obstruct the participation of women as full and equal contributing members of society" (Darder, Baltodano, & Torres, 2009, p. 14), as well as race and class relations in a hegemonic mindset.

One would expect historians of neuroscience, a field that boasts its interdisciplinary nature, to act more like critical theorists who consider themselves part of a movement accepting that "the scientific calling is only one, non-independent, element in the work or historical activity of man" (Horkheimer, 1972, p. 198). In this way, neuroscientists or historians of neuroscience, like a critical theorist, do not study objects objectively. This, moreover, highlights that the basic conceptual and methodological tools of science cannot be isolated from the social, political, and

economic forces in which they exist. But these historians easily ignore the contextual aspect of science and, instead, promote the naturalizing effect of the scientific method and theory, which postulates law-like generalizations into the natural and social world such that the world is experienced as alien and driven by forces outside human control.

The history of neuroscience presented then seems to begin with the logical positivist and empiricist tradition that assumes that science has to master nature and so it is conceived as "a sort of dialogue or interrogation in which one party (a scientist's inquiring mind) asks questions, while the other (nature) provides answers" (Machamer, Pera, & Baltas, 2000, p. 4). It follows that since the procedures are impersonal, the same means of interrogation are available to each and every person, and anyone can put questions to nature because nature is a book whose true meaning is manifest to anyone who can read the book in the proper way (Machamer et al., 2000) and as such, scientific findings are universal. What is missing in these assumptions, however, is not just the point of view of the scientist (who can never be objective no matter how impersonal the methodology) because she is human, but the point of view of nature itself. Nature is not a passive, silent "thing" to be studied.

Environmental history, a field that explores human history in relationship to the environment we inhabit, for example, challenges the assumptions of positivism and environmental determinism that assume human sovereignty over the environment and humans' "conquest of nature," which has a deep pedigree in nineteenth-century historiography (Kragh, 2002). The key feature of this field, which rejects a simple Aristotelian pattern of cause-and-effect, is that environmental history does not treat either humans or the environment as the sovereign partner in the relationship. Instead of a model in which influence flows from a prime

mover toward an object that is moved, the field puts forth a dialectical model for understanding change in human past. Challenging solipsistic history, wherein humanity is seen as the only agent in creating change, this field assumes that change emerges from a complex relationship between humans and the environment.

In his study of the German landscape from the age of Frederic the Great to the twentieth century, for example, the historian David Blackbourn (2006) explored how rivers, marshes, and coastal zones were diked, drained, dammed, and channeled, and how, in the process, a new landscape was created, with unpredictable consequences for the people who lived in it. The channeling of rivers, for instance, lowered the water table, and agrarian patterns were transformed by the resulting need to rely on irrigation. The channeling of rivers also influenced seasonal fish runs. In this changed environment, certain cultural patterns and institutions faded away and others emerged in their place. Studies like this promote an understanding of the past in which humans and their environment are engaged in an ongoing relationship defined by a mutual and reciprocal set of influences.

The study of nature then should not just generate knowledge about nature but also about how humans should behave with respect to nature, and the scientific paradigm does that by promoting a relation of power of humans over nature. In this way, positivism, as demonstrated in this history, has managed to disenchant nature in its attempts to objectively describe reality. This "scientism" (Habermas,1971), however, was not limited to science.

By legitimizing science and subjugating nature, positivism promotes a "technocratic consciousness" (Habermas, 1971) that suggests that all matters, including matters in the social and cultural dimensions such as education can be dealt with using a technological perspective.

Inside such a consciousness, human beings are no longer characterized as beings who "live together and discuss matters with each other" but rather beings "who manipulate" (Habermas, 1971, p. 255). In other words, the technocratic elite—which includes the neuroscientists of this history as well as the neuroscientists writing their history—do not regard human beings as capable of determining their own fate but as beings implementing the norms of technological reality, thus promoting a kind of scientific domination and coercion. In other words, positivism is not limited to scientific inquiry, but also to the natural sciences, including history and education, because it subjugates all knowledge to epistemic naturalism (Habermas, 1971). As such, epistemic naturalism considers the scientific method as the only avenue to truth and no other way of understanding human beings is deemed legitimate.

This is all to say that though there existed throughout the historical time noted above, other epistemologies, bodies of literature, and scientific knowledge that preceded Western science, there seems to be no hint even now as these books are written that Western science and its history present only one way of knowing. Instead, neuroscience is defined by the field and pursued as if the human brain is the property of European men and they themselves invented it. Therefore, the history of the field, thus far, demonstrates a "historical privileging of the purely conceptual or mental over the corporeal" (Grosz as cited in Alcoff & Potter, 2013, p. 187); such that even as the body is examined for understanding, it is seen as independent from its context—a view which, interestingly, neuroscience research itself now contradicts (Damasio, 2010; Holroyd, Larsen, & Cohen, 2004; Immordino-Yang & Damasio, 2007). So while the history of the field presents itself as neutral, much like its subject, from a critical perspective, it reads like an "all-consuming meta-narrative" steeped in notions of "totality, reason and the universality of

absolute knowledge" (Darder et al., 2009, p. 16), which seems to "legitimate its power by claiming self-referentiality" (Aronowitz, 1988, p. viii). As will be apparent, little seems to change as the field moves into the modern age.

The Move into the Modern Age

The ideas of cortical localization, the reflex, and cerebral dominance persist in psychology and education today. Speech language pathologists, for example, learn about Broca's and Wernicke's areas in the brain and how they are "impacted" in children and adults with dyslexia. Occupational therapists are taught that each half of the body is controlled by the opposite side of the brain; but these concepts have also been the cause of much debate and controversy in these fields since their discovery. The right hemisphere, for example, seen as the "female" (Finger, 1994, p. 388) hemisphere, was for years seen as the inferior hemisphere "that could be educated, perhaps even as much as the intelligent left hemisphere" (p. 397). These notions were put into practice in American schools, where left handed children were forced to use their right hand or where all children were forced to be ambidextrous for "balance in the brain," for example (Finger, 1994).

In short, there has been a long and robust history of "neuromyths" based on neuroscientific findings, sometimes with negative implications for society. Soon the concepts of cortical localization and cerebral dominance led to a wealth of other findings, giving a physical seat to learning problems such as alexia, dyslexia, apraxia, dysgraphia, in education and diseases such as Alzheimer's disease, Parkinson's, and Tourette's in psychology. Discovering the physical ground of disease in the "patient's" body in neuroscience solidified Western thinking's reliance on positivism, giving rise to a new view of human beings as neurological patients.

The Greatest Decade: The 1950s

"More has been learnt about the brain over the last 50 years than in the rest of human history put together" (Wickens, 2015, p. 345), suggesting that if the speed of progress keeps up at this exponential rate, we truly are on the cusp of a revolution. But while the last 50 years have been a time of incredible fecundity in the field, perhaps the decade of the 1950s can match this time in the advancement of neuroscience. In the aftermath of World War II, where science demonstrated its effectiveness in helping to win the war, broad and systematic federal support for the advancement of biomedical science began in the United States. With the establishment of The National Institutes of Health, direct research grants to students and researcher as well as well-established academics and academic departments allowed for money and the freedom to pursue the "solving of the next problem" (Shepherd, 2010, p. 235).

The energy of the post-war era in the United States, alongside monetary supports, advanced the biomedical field, including neuroscience, in unprecedented ways (Shepherd, 2010). This "freedom of inquiry" (Shepherd, 2010, p. 235) at the heart of the scientific enterprise" is in many ways the subject of Gordon Shepherd's *Creating Modern Neuroscience: The Revolutionary 1950s* (2010). Shepherd, one of the founding members of the Society for Neuroscience, wrote the book based on a course he taught with two of his graduate students beginning in 2005 at Yale University, where he serves as Professor of Neuroscience. He and his students developed the course, which is now mostly taught online, in response to growing interest in the history of the field.

A contemporary of Andrew Huxley and Francis Crick, Shepherd has given a passionate account of the investigators, the concepts, the history, and the politics and the people that

characterized the field as only an insider can. He has noted issues of gender, ethical concerns, and the role of history, politics, and culture in the development of the field. Educated at Harvard and Oxford Universities and author of over 280 articles and many of definitive texts in neuroscience, his approach has certainly not been a critical one, although it is one of a small number of books on the history of the field. Shepherd, who also wrote *Foundations of the Neuron Doctrine* (1991) declared the difficulty in writing a history of field that spans virtually every field of learning from physics, biology, and chemistry, to psychology, sociology, and philosophy, to politics and religion (Shepherd, 2010). Yet he maintained that the field must "take responsibility for its own history" (Shepherd, 2010, p. vii) and was the first person to form a committee on the History of Neuroscience in 1985.

To help illustrate the difficulty in establishing a history of neuroscience, Shepherd (2010) first offered a table to show all the fields involved in neuroscience (see Table 1). He then offered a list of all the species investigated in neuroscience (Table 2), a list that covers a large range of species from bacteria to human beings.

Table 1

Fields of Neuroscience

Nervous system fields
Neuroanatomy
Neurochemistry
Neurophysiology
Neuropharmacology
Neurology
Psychiatry
Biology fields
Molecular Biology
Biochemistry
Biophysics
Cell Biology
Genetics
Developmental biology
Evolution
Physical science fields
Physics
Chemistry
Engineering
Computer science
Behavior fields
Ethology
Psychology
Sociology
Neuroeconomics
Humanities fields
Linguistics
Neurophilosophy
Neuropolitics
Neuroreligion

Note. Reproduced from G. M. Shepherd (2010). *Creating modern neuroscience: The revolutionary 1950s*. New York, NY: Oxford University Press.

Table 2

Species Investigated in Neuroscience

Invertebrate
Bacteria
Worms
Insects
Arthropods
Molluscs
Limulus
Squid
Aplysia
Vertebrate
Fish
Amphibians
Reptiles
Birds
Mammals
Hedgehogs
Rabbits
Rats
Mice
Cats
Dogs
Subhuman primates
Humans

Note. Reproduced from G. M. Shepherd (2010). *Creating modern neuroscience: The revolutionary 1950s*. New York, NY: Oxford University Press.

Shepherd offered a similarly wide-ranging list of the systems studied in neuroscience (see Table 3), covering virtually every system from the five senses to the higher cognitive systems and made the claim that biological organization involves a hierarchy of levels that begins with the genes and ends in specifically neural pathways and systems that coordinate the multiple systems that underlie behavior (see Table 3).

Table 3

Systems Studied in Neuroscience

Sensory Systems
Smell
Taste
Touch
Hearing
Vision
Motor Systems
Autonomic
Posture
Reflexes
Central pattern generation
Spinal cord
Higher motor centers
Central Systems
Neuroendocrine
Circadian rhythms
Feeding
Mating and reproduction
Motivation
Perception
Learning and memory
Human higher cognitive functions

Note. Reproduced from G. M. Shepherd (2010). *Creating modern neuroscience: The revolutionary 1950s*. New York, NY: Oxford University Press.

Shepherd (2010) argued, "Our interest in history is much more than a recounting of what was discovered when" (p. 8). What interests him and the students and scientists for whom he is writing his book is the creative process. "What are the factors that produce the great leaps forward in science?" (Shepherd, 2010, p. 8), he asked. To answer this question, he offered a number of factors that he called the *gold standard* neuroscientists need in order to make their discoveries. They are methodology, biological preparation, investigator, theoretical framework, chance, and support (see Table 4).

Table 4

Hierarchy of Levels of Nervous Organization

Higher cognitive and social functions
Clinical disorders: neurology, neurosurgery, psychiatry
Systems for behavior
Circuits of specific systems
Dendritic integration
Cellular functional properties: synaptic potentials and action potentials
Synapses
Molecules in development and neurotransmission
Genes

Note. Reproduced from G. M. Shepherd (2010). *Creating modern neuroscience: The revolutionary 1950s*. New York, NY: Oxford University Press.

Table 5

Factors in Discovery in Neuroscience

Methodology
Biological Preparation
Investigator
Theoretical framework
Chance
Support

Note. Reproduced from G. M. Shepherd (2010). *Creating modern neuroscience: The revolutionary 1950s*. New York, NY: Oxford University Press.

Methodology, expressed in the Latin dictum "*Teknik ist alles*" from the nineteenth-century, meaning, "Methods are not everything, they are the only thing" (Shepherd, 2010, p. 8) are crucial to the success of the neuroscientist, according to Shepherd. "Historically, knowledge of neural mechanisms has been built on those systems accessible to study by the methods available at the time" (Shepherd, 2010, p. 6). In the nineteenth century, therefore, neuroscientific study was limited to reflexes, the sensory systems, and learning around central behavioral systems. In the 1950s, however, with the advances in technology, knowledge expanded to all the

systems. Perhaps this was one of the reasons for the neuro-revolution in that decade. Of this time, Shepherd (2010) wrote, “Biological preparations come in an almost infinite variety; the trick is to find a ‘model system’ that will enable something new to be discovered” (p. 9). The neuroscientific value of a number of new species, for example, the squid with its giant axon, was discovered during this time, which allowed neuroscientist to more careful study nerves.

As such, the investigator, with a blend of skills, insights, and personality, used the available methodology to apply to the model system of investigation. But the investigator had to be educated and trained properly and had to know how to interact effectively with others in order to persevere (Shepherd, 2010). And although, “Experimentalists often prioritize experiments over theory…the importance of a strong theoretical foundation for the development of a field cannot be overemphasized” (Shepherd, 2010, p. 9). Theoretical framework was the next important factor in the aiding of discovery. Shepherd contended that one could not explain a fact without a theory and emphasized the importance of one’s theoretical framework for generating hypothesis and making predictions.

Next, the hand of chance or luck must also be present. Scientists rely on “the fortuitous coming together of these components in unpredictable ways” (Shepherd, 2010, p. 9) to make their discoveries. Finally, Shepherd (2010) cited the importance of support for scientists like any “artist or creative worker” (p. 9). It is important to note that the rise of technically sophisticated science in the late nineteenth century gave rise to scientists receiving support from philanthropic institutions such as the Rockefeller Foundation. While the vast demands of WWII were following the use of the atomic bomb, science became important not as a “creative process” but as a means to power and critical to scientists receiving the support they needed.

All these factors combined to lead to the density of discoveries Shepherd shows in Table 6 when we were first thrust into the brave new world of modern neuroscience. Reminding the reader that "it is not enough to leave one's mark by one's discoveries" (Shepherd, 2010, p. 10) Shepherd also offered a table that summarizes the ethical issues in neuroscience (see Table 6) to show relationships between mentors and students, male and female, competition between laboratories, single-discipline and multidisciplinary studies, bias on the basis of race and ethnic group, political intrusion and coercion, nationalities and language.

Table 6

Ethical Issues in Neuroscience

Recognition between mentor and student
Recognition between male and female
Recognition in competition between laboratories
Recognition between single-discipline and multidisciplinary studies
Bias on the basis of race and ethnic group
Political intrusion and coercion
Nationalities and language

Note. Reproduced from G. M. Shepherd (2010). *Creating modern neuroscience: The revolutionary 1950s*. New York, NY: Oxford University Press.

Throughout the book, he referred to the exclusion and difficulty faced by Jewish scientists through the use of their individual stories, and also highlighted the "historical gender wall" (Shepherd, 2010, p. 234) as he chronicled the mostly male (he mentions eight women in the history of the field), mostly White (of European decent) pioneers of the field. Nonetheless, Shepherd maintained, "The origins of modern neuroscience are truly international" (p. 234).

The issue of methodology in science has been the subject of critique. First, in scientific methodology, "the qualitative is excluded, or, more precisely, quality is occluded from the objective world" (Aronowitz, 1988, p. x). Second, scientific methodology is rooted in the idea that statements must be tested and validated by others, using the identical methodology, in order to guarantee validity and reliability. But the fact is that when all scientists must use the same methodology, what is first guaranteed is the reliability of what counts as science (Aronowitz, 1988). In other words, the field defines rationality in a specific way, makes that way the privileged discourse, and uses empirical validation to hold its privilege. Stanley Aronowitz (1988) argued that "Since the truth claims of science are tied to the methodological imperative, it insists that science must be held immune from the influences of social and historical situations" (p. viii); which explains how Shepherd goes on to tell a history of neuroscience embedded within larger historical developments but assured that none of that larger history could impact the science, because the methodology makes it immune to such penetration.

Perhaps, this is because, as Sandra Harding (1986) posited, "Only to the extent that one person or group can dominate the whole, can 'reality' appear to be governed by one set of rules or be constituted by one privileged set of social relations" (p. 26). In fact, it can be argued, "it is commitments to antiauthoritarian, anti-elitist, participatory, and emancipatory values and projects that increase the objectivity of science" (Harding, 1986, p. 27). But Shepherd obviously does not prefer such an approach. Instead, it then follows that in "searching for the machine that can yield the raw material for penetrating the secrets of nature" (Aronowitz, 1988, p. viii), what is set up is a competition to forever develop more sophisticated equipment in order to conquer nature and yield its secrets.

Atop the shoulders of the many slaughtered animals in the history of neuroscience then lies the squid with its giant axon as the prime example of the biology "to which a technique is applied" (Shepherd, 2010, p. 9), a phrase that in no way reflects a dialogical relationship between man and nature but instead "fractures knowledge and supports the further alienation of human beings from nature" (Darder et al., 2009, p. 17). Other epistemologies, for example, indigenous knowledge, would find such an approach problematic at the very least in coming to understand the secrets of nature, arguing that the principal relationship here between man and nature is one of exploitation or the imposed extraction of natural resources for personal gain (Four Arrows, Cajete, & Lee, 2009; Grande, 2015) though the researcher or scientists is not an active participant in, but rather a detached observer, of life (Banuri, 1990). One would expect that a methodology dedicated to the study of nature would be more enchanted with its object of study, taking a more loving approach toward the interrelationship and delicate balance that exists between all living beings. But instead of a formidable relationship with the earth, one that is infused with physical, emotional, intellectual, and spiritual wisdom, the process feels rigid and missing a "supple and fluid view of humans and nature that is relational; an objectivity and subjectivity that is interconnected" (Darder et al., 2009, p. 11).

In its place, values such as individualism, competition, and privatization reflect the free market more than nature, only to "sustain patriarchy and its subjugation of all subordinate living things" (Darder, as cited in Kahn, 2010, p. xii), ultimately disrupting the ecological order of knowledge essential to the sustainability of nature itself. In its discussions around objectivity versus subjectivity, rationality versus intuition, mind versus body, and so forth, the scientific method seems to claim that "human progress requires the former to achieve domination of the

latter" (Harding, 1986, p. 23), where the former, in this case scientists as knowing subjects, are associated with masculinity, while the latter, objects of his inquiry are associated with the feminine. Nowhere is this more apparent than in the videos of the scientists working on the giant squid laying itself bare on the table for the curious pleasure of the highly respected neuroscientist.

In outlining the characteristic of the investigator, Shepherd emphasized that being educated and trained is a requirement for scientists. In other words, you must first agree to this particular way of knowing, train your brain in it, and exclude all other ways, in order to be allowed to participate in scientific inquiry. What follows, and the history shows this, is not just a preference for particularly educated investigators but for investigators of a particular race and gender as science insists that "only those inducted, by means of training and credentials, into its community are qualified to undertake whatever renovations the scientific project requires" (Aronowitz, 1988, p. viii). As a result, the very notion that the scientific method rids us of bias comes under question because of the androcentric bias that results in the selection of certain problems as interesting over others. There is also the critique that males tend to interpret nature based on masculine metaphors of power (Harding, 1986), again making scientific research politicized exactly at the places it claims to create neutrality.

While Shepherd acknowledges that we cannot know a fact independent of theory, at no point does he question science's preferred theories of empiricism and positivism. In other words, no matter what the specifics of a theoretical framework in science, they must all follow empiricism as a general theory. As a theory, not only does empiricism not consider "the practical intent of transforming asymmetrical relations of power" (Darder et al., 2009, p. 13), but one

could also argue that science's insistence on empiricism enacts the existing power relations between science and its subjects of study in order for science to retain its privileged position. Harding (1986) asked, "If theories are constructed to explain problems, if methodologies are always theory-laden, and if observations are methodology-laden, can there be value-neutral design and interpretation of research?" (p. 22). Shepherd has insisted there can be.

Similarly, in his discussion of chance or luck, given the academic climate of competition in the 1950s, when scientists were looking to leave their mark, it is unclear if Shepherd is referring to the eureka effect or the kind of luck that kept the ethical issues he notes in neuroscience in place long enough for the pioneers of the field to push forth in their endeavors. Instead, what is presented as luck seems to be about calculated support, advancement from both the U.S. government as well as traditional philanthropic foundations hoping to make the 1950s the "greatest decade in the history of modern biology and neuroscience" (Shepherd, 2010, p. viii).

Perhaps Shepherd's positionality as a neuroscientist explains his exceptionalism and his "belief that Western science alone among all human knowledge systems are capable of grasping reality in its own terms" (Harding, 2008, p. 3). Nowhere in the book is there any doubt about the excellence of "objectivity, rationality, good method, real science, social progress, and civilization" (Harding, 2008, p. 3) that advances the field. His work exemplifies "triumphalism" or the assumption that "the history of science consists of narratives of achievements" with no significant downsides (Harding, 2008, p. 4).

Although a look at the specific scientific models and explanations presented by neuroscience is beyond the scope of this study, it is worth noting that the scientific method itself

with its unidirectional attempts to control is itself problematic; although not according to Shepherd. Like all scientists he gives the scientific method primacy and power over all, without questioning the validity of the commonsensical assumptions that drive the method. As a result, within the pages of Shepherd's treatise, there are two stories—one of the history of neuroscience from the perspective of a White male neuroscientist and the other hidden, subaltern story of oppression, which bleeds through between the pristine lines of his proclaimed neutrality.

The Discovery of DNA

While the discovery of DNA in 1953 did not have an immediate impact on neuroscience, Shepherd (2010) maintained that this discovery alone is "sufficient to claim the 1950s as the greatest decade in the history of modern biology" (p. 15). This is because the discovery of the structure of DNA showed once and for all that "biology could be based purely on classical physics" and on "principles of chemistry and biophysics" (Shepherd, 2010, p. 27). In other words, "the hereditary material was firmly in the domain of biological structures operating by biological mechanisms" (Shepherd, 2010, p. 27). The information contained in these structures and mechanisms provided the blueprint for the human being and the most complex information would be found in the most complex organ: the brain.

The distance between the gene and the brain did not take long to travel, though it may have seemed "infinite at the time" (Shepherd, 2010, p. 27). After the discovery in 1953, the genetic code was obtained by 1963. DNA engineering was ushered in the 1970s. The polymerase chain reaction was discovered in the 1980s allowing the identification of any gene and protein in any cell and, in the year 2000, the full human genome was obtained. Half of the genes were expressed in the brain bringing us to the "threshold of a new golden age" (Shepherd, 2010, p.

28), where, because of its continuing impact on stem cell research, this discovery set up brain research to overshadow all other biosciences forever (Wickens, 2015). This is the reason that the discovery of DNA, by James Watson and Francis Crick, is considered by neuroscientists to be the single most important neuroscientific advance of the 1950s. However, for non-neuroscientists, interested in the history of the field—what may stand out most about the discovery of DNA is not the scientific advances it allowed but the story itself. It is perhaps one of the most famous stories in modern science. Most high school graduates have at least heard the names Watson and Crick and can picture the double helix. What they may not know is that while the story is often told as a great moment of discovery by two curious, enthusiastic, and smart young scientists, it was anything but.

In a section called "The Race to DNA" (Shepherd, 2010, p. 19), Shepherd described the environment in the United States around biomedical research after the second World War, where, inspired more by the opportunity for fame, young graduate science students could get direct monetary support to solve the secret of the universe. James Watson, an American, and Francis Crick, a Brit, were both doctoral fellows wandering through different laboratories in academia "looking for something stimulating" (Shepherd, 2010, p. 20); which, when the story is examined closely, simply means something that would allow them to leave their mark and make a name for themselves. By the early 1950s, it was already recognized that the chemical structure of DNA would reveal the holy grail of the mechanisms of hereditary material and Watson and Crick got together specifically to try "to win the race to discover the structure of DNA" (Shepherd, 2010, p. 22).

The story is legendary and well-documented from the moment the two scientists raised a pint at Cambridge to declare they had "discovered the secret to life" (Shepherd, 2010, p. 20) to the story of Rosalind Franklin, their young contemporary whose pioneering crystallographic data Watson and Crick used without her knowledge or permission to construct their physical model. While Shepherd has noted the ethical issue with using other people's data, recognizing the ethical issue around the fact that, at the time, female scientists were not even allowed in the same university lunchrooms as males, Watson and Crick are characterized as heroes and pioneers in the field, two great minds with an appetite for prodigious work. Yet they seem, according to Shepherd's account (and their own account—see *The Double Helix* [1968] and *What Mad Pursuit* [1988]) two ambitious men galvanized not by scientific curiosity, but by the large-scale investment by politicians in the aftermath of the WWII and the development of the radar and the atomic bomb to carve out a name for themselves by discovering "the secret to life," confident that this was a noble goal, indeed, and to do it at the expense of others who later "generously acknowledged the correctness and beauty of the final structure" (Shepherd, 2010, p. 21).

Perhaps a different account of this history might note the discovery of DNA as the most important of the neuroscientific discoveries in the 1950s not because of how much the discovery pushed the field forward but because the story symbolizes the insatiable ego, calculated ambition, colonizing mindset toward nature, and androcentrism that defines the history of the field both before, during, and after the 1950s. Despite the rich critical literature around science, feminist critiques of science, and the simple facts of the story, little more than regret is offered for Rosalind Franklin, who was not named for her contribution to the discovery of the DNA double helix with her colleagues who received the Nobel Prize in 1962, followed by a wish to

bring more women into the field. Otherwise, by itself, the discovery of the structure of DNA is enough to warrant the 1950s as the golden age of neuroscience, impacting how neuroscience has been conducted since that time. The discovery gave a new perspective on doing science, where it was made out to be an exhilarating race among gifted scientists who were out to take the exciting steps toward the discovery of truth.

From Signaling Molecules to Neural Circuits

Another factor contributing to the explosion of neuroscience in the 1950s was the improvement of methodology and techniques. While scientists before had to rely on limited experimental methods for observing and "manipulating" nature such as frog embryos and the large eggs of sea urchins (two of neuroscience's favorite subjects), advanced methods now allowed neuroscientists to push the field forward.

The "nerve growth factor" was reported in 1951, followed by confirmation of the axonal growth cone (possible because of advances in the microscope, including the invention of the electron microscope that allowed the study of cellular structure). By the early 1960s, the introduction of radioactive tracers allowed for the tracing of axonal transport, finally helping to confirm and build on the work of Cajal (Shepherd, 2010). Before the 1950s, the biochemistry and pharmacology of the brain was also nonexistent. It was in this decade that second messengers, neuropeptides, pheromones, and other signaling molecules were discovered, leading to the understanding of neurotransmitters in the 1980s.

In 1954, The First International Neurochemical Symposium was held in Oxford which published *Biochemistry of the Nervous System* (1954). Three more books, *Biochemistry and the Central Nervous System* (1955), *The Pharmacological Basis of Therapeutics* (1955), and *Central*

and Synaptic Transmission in the Nervous System; Pharmacological Aspects (1961) followed this text. These four publications are significant because with the discovery of these chemical molecules that seemed to "control" the brain and behavior came "drug discoveries in the 1950s" (Shepherd, 2010, p. 206)—precursor discoveries that would propel the future multi-billion-dollar profits of the pharmaceutical industrial complex.

Before 1950, psychiatric disorders were treated with psychoanalysis, on one hand, and more extreme treatments such as surgery or electrical stimulation on the other. "The Mind was still conceived to be separate from body" (Shepherd, 2010, p. 206). This all changed in the 1950s as a central theme in neuroscience became the molecular basis of the synapse and neurological disorders began to be viewed as "pathological changes affecting synaptic function" (Shepherd, 2010, p. 65). As a result, pharmaceutical research on drug discovery began to target the synapse. New drugs such as chlorpromazine, reserpine, and butyrophenones showed dramatic changes in quieting schizophrenic patients, especially around their violent outburst in hospital wards. Antidepressive drugs (such as iproniazid, monoamine oxidase inhibitors, and tricyclics) were discovered to treat both mental and emotional disorders. Lithium began to be used as a treatment for depression and bipolar disorder. Drugs such as meprobamate and benzodiazepines were prescribed for anxiety, which then was referred to as "neuroses." Discoveries about the chemical composition of the brain and the drugs that could be used to manipulate were considered "revolutionary not only for psychiatry but for all humanity" (Shepherd, 2010, p. 206). Whether one interprets this revolution as positive or negative, there is no denying that modern psychiatry was established as a result of advances in neuroscience in the 1950s.

As it often happens in science, a concept that seems universal is suddenly found to have exceptions. Soon after advances tied to chemical synapse were made, electrical interaction between nerve cells was shown. The nerve impulse therefore seemed to contain both the physical spread of electricity as through a wire as well as active biological processes. The term "action potential" was therefore coined and the study of action potentials began. But it was also shown during this time that the speed of the action potential was not as fast as once thought. The fact that the impulse travels at far more moderate rates than originally believed had tremendous implications for psychology as the action potential seemed to "separate the mind from the actions that the mind wills" (Shepherd, 2010, p. 71), supporting Descartes's dualism. This discovery also contributed to the materialistic view that the mind can be equated with the signals in the nerves, laying the foundation for modern psychology and behavioral studies.

The Neural Basis of Behavior

The advances in methodology in the 1950s also validated the "neuron doctrine" and showed the importance of dendritic function. It soon became evident that the nerve cell was not a simple functional unit as originally envisioned by the classic neuron doctrine. Neurons contained "complexity within unity" (Shepherd, 2010, p. 100) and did not function as a single element but had different properties in the dendrites and axons with several forms of graded activity. Theodore Bullock (as cited in Shepherd) in his review of electrophysiological studies during the 1950s called this a "quiet but sweeping revolution" (Shepherd, 2010, p. 112) in neuroscience as it shifted the view from seeing the neuron as the only functional unit to new concepts of multilevel, multi-neuronal functional units, moving the field away from simple explanations and

toward more complexity and begging the question: can what appears to be complex and creative processes in the brain be studied and explained by the linear approach of science?

In addition to methodology, biological preparation advanced greatly in the 1950s. Science has long used nature, animals specifically, to inquire about the workings of human beings, and the 1950s were no exception in this regard. Many animals, including frogs whose electrocuted muscles helped neuroscientist better understand electrical signaling in the body, to the giant squid (video of the ongoing contribution of the giant squid is available for view at http://www.science.smith.edu/departments/neurosci/courses/bio330/squid.html) whose axon was used with the voltage-clamp technique that lead to discovery of the action potential and a Nobel Prize for the experimenters (Alan Hodgkin and Andrew Huxley), to the large unborn embryos of the sea urchin that illuminated how cell development occurs and how cells organize, nature continued to offer herself as the biology "to which a technique is applied" (Shepherd, 2015, p. 9). In fact, the story of neuroscientific advances in this era is overwhelmed by examples of what philosophers of science typically refer to "cutting nature at its joints" (p. 4) and then "projecting onto nature cultural assumptions, fears, and desires" (Harding, 2008, p. 4).

The Rockefeller Foundation "whose benignant hand was behind the establishment of many research institutes around the world and many travelling fellowships in the early part of the century" (Shepherd, 2010, p. 235) also played a chief role in the funding of research in neuroscience following WWII in the United States. As part of the support factor in the discovery of neuroscience, these grants funded further research of the giant squid axon, resulting in the Hodgkin-Huxley Action Potential model that then opened the door for a physical basis to experimentally test neuroscientific theories for decades. Thus began "the hunt" (Shepherd, 2010,

p. 83) in the 1950s for the identification of other molecular structures and physiology of the nervous system, bringing many scientists to fame at the expense, one would imagine, of many more giant squids and other animals. Shepherd professes that the history of neuroscience extends across all species and provides a table (see Table 2) of the specific species of vertebrates and invertebrates "utilized in research through the 1950s" (Harding, 2008, p. 6). The mere title of the table "Species Investigated in Neuroscience" reveals the unchallenged power given to man and to science over all other species. Nowhere is there evidence to be found of the profound love for the world of which Freire speaks when he insists, "the naming of the world, which is an act of creation and re-creation, is not possible if it is not infused with love" (Freire, 2000, p. 87). In Shepherd's history, careerism at the expense of separating humankind from nature, for purposes of domination, seems more paramount than a life-affirming ecological praxis that places the scientist where he belongs, within nature.

Learning and Memory

The 1950s also marked the physiological study of the human cortex. Surgical removal of cortical tissue for the relief of epilepsy lead to the mapping of the human cortex and pushing recording microelectrodes into the unknown territories of the major cortical systems, resulting in the homunculus or map of the cortex. But this research more than anything, allowed for advances in methodology that specifically allowed more exact manipulation and control, in order to push the field forward. The control this research provided allowed scientists to begin to understand that the brain is not just a computer but also a gland. Neuroscience was therefore for the first time challenging the long-held position of behavioral studies conducted through laboratory manipulation.

Until that point, learning theory was the domain of psychology and was primarily studied by behavioral psychologists, who observed animals in laboratories carrying out tasks they devised (Boring, 1950; Mandler, 2011). The most famous examples are Pavlovs dogs, Skinners boxes, and Watsons conditioning experiments. In these experiments, the brain was treated as a black box, and psychologists argued that studies of the brain are not relevant to studies of the mind. In the earlier part of the century, operant conditioning as exemplified by Skinner's box (1953) was the dominant form of behavior analysis (Shepherd, 2010), and motivation was not understood as intrinsic. Some have called this period in psychology the "bad period" (Milner, 1999).

Neuroscience studies in the 1950s, however—specifically those concerned with feeding behavior—were now showing that "the sensory characteristics of food transform themselves into a complex conditioned stimulus that guides behavior" (p. 151), suggesting a "learning of palatability" (Shepherd, 2010, p. 151) that, along with comparative studies, further proved that the brain is not just a computer but also a gland. **S**tudy after study in neuroscience was showing that the brain can self-stimulate. This shift had profound effects on psychology. With the advents in neuroscience, a "good period" began in psychology. It was around this time that studies of brain-damaged patients also began to change how scientists perceived mechanisms of motivation and learning. In fact, it was the study of one particular and now-famous brain-damaged patient that lay the foundation for the new study of cognitive science.

The Case of H. M. and the Emergence of Cognitive Psychology

Neuroscience considers learning and memory to be fundamental to human cognitive abilities. Much of what is still understood about these mechanisms today is based on the work of

Donald Hebb, who, in the 1950s, developed Hebb's Postulate, reflected in one of the most well-known phrases in neuroscience today: "Cells that fire together, wire together." Hebb was influenced during his graduate studies in psychology by reading William James, James Watson, and Sigmund Freud. He was convinced that learning was the most important factor in intelligence. Armed with the new research and information on neurons and synapses, membrane physiology, fine cell structure, and the role of neurotransmitter and bioactive substances on the 1950s, Hebb published his book *The Organization of Behavior* (1949), arguing for associative learning.

Hebb's Postulate asserts that when an axon of cell *A* is near enough to excite a cell *B* and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that *A*'s efficiency, as one of the cells firing *B*, is increased (Hebb, 1949). This biological basis for learning challenged pure behaviorism and the idea that psychological concepts were divorced from neural substrates. More importantly, Hebb showed that synapses have the ability to strengthen or weaken over time, in response to increases or decreases in their activity. This idea not only gave rise to physiological psychology and psychobiology in the 1960s and 1970s, but also lay the foundation of what later came to be known as the "plasticity" of the brain—neuroscience's most revolutionary contribution to education.

Hebb therefore established what later became cognitive psychology in the 1980s, which directly informs how we think about teaching and learning in education today. For this reason, his book is considered by some to be as influential in the history of biology as Darwin's *On the Origin of Species* (Shepherd, 2010). Hebb's influence on what we, today, considered

foundational in our understanding of cognition, learning, and memory, continued with his graduate student, Brenda Milner. Milner's work with H. M. (perhaps the most famous patient in the history of brain science) is well documented and well known. William Scoville, the man who performed the doomed psychosurgery on H. M., called in Milner on the case because of her background and expertise analyzing the effects of brain lesions and the insights this might provide into brain mechanisms.

While most who have taken a course in cognitive psychology have heard of H. M., it is important to also reveal what is known about William Scoville as he demonstrates the "clinical gaze" (Jacyna & Casper, 2012, p. 1) of doctors and scientists toward disease and also toward patients. Scoville was a practicing neurosurgeon who based his work on neurosurgeries conducted on a chimpanzee named Becky whose vicious behavior became docile after the removal of her frontal lobes. Scoville, who completed his undergraduate work at Yale, finished his medical degree at Penn, and trained in neurosurgery at Harvard, had a sober academic record but also an insatiable ego and sometimes "unchecked emotions" (Shepherd, 2010, p. 170). In a story that reads like a desire to play god, Scoville, who seemed to take particular pleasure in administering frontal leucotomies, performed the surgery on H. M. on September 1, 1953, despite having shown only some success with previous patients who had undergone the procedure. It should be noted here that the procedure, known as "frontal leucotomy," gained prominence as a treatment for schizophrenic patients and was particularly taken up in the United States, where "by early 1950s some 10,000 operations had been performed" (Shepherd, 2010, p.169).

H. M. had come to Scoville with his family because of seizures he was experiencing after a childhood biking accident. When Scoville recommended the operation, H. M. had already completed his education and held a job but had to fight drowsiness, a complication from the medication he was taking. What happens next is one of the most famous stories in modern science. Following an operation that went well and was initially deemed successful, H. M. suffered severe memory loss, including anterograde amnesia. He could not remember anything up to 3 years before the accident and would never again be able to form a new memory. Stunned and distressed, Scoville called in Milner to evaluate H. M.'s "undesirable side effects" (Shepherd, 2010, p. 171).

What followed was a historical turning point in neuroscience's understanding of memory and the role of the hippocampus. Milner and Scoville went on to publish many articles, noting "The experimental procedure was justifiable because the patient was totally incapacitated by his seizures" (Shepherd, 2010, p. 172). H. M. was invaluable to the field because his mental state could be assessed without complications of a disturbed emotional state as in the case of schizophrenic patients studied before him. Milner spent her lifetime "studying" H. M. and earning herself recognition as a co-founder, along with Hebb, of cognitive neuroscience. On December 2, 2008, *The New York Times* revealed H. M.'s identity in his obituary and recognized Henry Gustav Molaison as "the most important patient in the history of brain science. As a participant in hundreds of studies, he helped scientists understand the biology of learning memory and physical dexterity, as well as the fragile nature of human identity" (p. 175).

The case of H. M. marked another turning point in the history of the field. In the 1960s and 1970s, a new histography of medicine began because of the tragedy of cases such as H. M.,

who were essentially part of the construction of a category in Western medicine called the neurological patient (Jacyna & Casper, 2012). Concerned with how doctors constructed categories of nervous disease for centuries, these historians of medicine began to question how neurological disease is not an essence waiting to be discovered, but rather a construct with a discernible historicity. This view is not currently reflected in the literature on the history of neuroscience.

The 1950s ends with what some call the second big advance (after the discovery of DNA) in the history of neuroscience: the rise of the digital computer (Wickens, 2015). The developments of the 1950s also created the new field of cybernetics contributing to artificial intelligence and computer-brain interfaces. Game theory also has its roots in the 1950s, as does information theory (Shepherd, 2010; Wickens, 2015). The promises of these fields moved us into a new era of big investments targeting the brain. Congress and the European Union have begun investing large sums of money into long-term and large-scale multidisciplinary brain projects paralleled perhaps by the investments into biomedical sciences in the 1950s. While these projects have many aims, one overarching aim is to "finally establish the true nature of the human mind" (Wickens, 2015, p. 372).

Advances in Brain Imaging and Neuroscience Today

Advances in techniques continued after the 1950s with the introduction of the operating microscope as well as noninvasive brain imaging. Both these techniques pushed neurosurgery into the modern era but they also helped shift neuroscience, no longer bound to studying dead or defective brains, into other fields, namely education. The word *neuroscience,* though generally meant to define the study of the nervous system, began to be used more specifically as the study

of the human brain, after the formation of The Neuroscience Program (by Francis Schmitt) in the 1960s, and gained currency after the establishment of The Society for Neuroscience in 1971 (Shepherd, 2010). Soon after, departments of Neuroscience and Education began to form in schools across the United States, first as part of cognitive psychology programs but soon as their own interdisciplinary programs focused on the educational implications of brain research and how this research could be used to enhance student success.

A Final Note

It is not difficult to see in the history of neuroscience its epistemological parallels with the deep structures of colonialist consciousness: belief in progress as change and change as progress; belief in the effective separateness of faith and reason; belief in the essential quality of the universe as of reality as impersonal, secular, material, mechanistic, and relativistic; subscription to ontological individualism; and belief in human beings as separate from and superior to the rest of nature (Grande, 2015). It is also not difficult to see the implications of such a consciousness on schooling today, where independence, achievement, competition, consumerism, humanism, and a detachment from local sources of knowledge and nature form the dominant definitions of reality all under the guise of scientific thinking.

As may be apparent, important to this discussion has been the critical pedagogical principle of historicity, which asserts, "that all knowledge is created within a historical context and it is this historical context which gives life and meaning to human experience" (Darder et al., 2009, p. 10). With this in mind, following the history of neuroscience within the larger historical context of the 1950s reveals two surprising features about this history. First, while it seems that philosophical developments in history have always influenced and even shaped the scientific

mindset, the fact is throughout history critiques of dominant philosophies have also existed not just in the form of non-Western philosophies but as part of the Western tradition. Thomas Kuhn's critique of the historical accounts of science is one example. Hegel's critique of science in *Phenomenology of the Spirit* is another. While Hegel did not dispute the validity of the scientific method or scientific knowledge as a partial truth, he saw the subject-object relationship as key to seeking truth within a totality of relations, but the scientific community seems to have conveniently ignored this philosophy (Aronowitz, 1988). It is in Hegel's thinking that the feminist standpoint originates and later gets elaborated through the writings of Marx, Engels, and Lukas (Harding, 1986). Similarly, postmodern thinkers beginning with Nietzsche, Derrida, and later Foucault, Cavell, Wittgenstein, and others shared a "profound skepticism regarding universal (or universalizing) claims about the existence, nature and powers of reason, progress, science, language and the 'subject/self'" (Flax as cited in Harding, 1986, p. 27).

These philosophies and critiques all predate Shepherd's book, challenging philosophies of science and arguing that European patriarchal dominance in social life "results in partial and perverse understandings" (Harding, 1986, p. 26). But Shepherd, perhaps due to his scientific training, seems ignorant to all such critiques. Even when discussing the ethical issue of the gender gap in neuroscience, the discussion remains at the surface level (i.e., we need to have more women in the field) but maintains the problematic mainstream notion that if women are to become scientists, they must first train their brain to think empirically and embrace a Western scientific epistemology of knowledge construction.

In short, what is put forth by this history is a kind of intellectual fascism that promotes the epistemological power of the sciences over all other domains. In the process, it determines

what is legitimate thought, while ignoring challenges to scientific discourse. As such, knowledge produced as science becomes "the privileged discourse, and all others are relegated to the margins" (Aronowitz, 1988, p. 9). In this way, any critique or difference is rendered invisible or as acceptable in the margins, but nonscientifically acceptable. Hence, the scientific framework is considered singularly paramount to explaining facts (Shepherd, 2010). As a result, even philosophy "has become the servant of the sciences" (Aronowitz, 1988, p. x), despite the fact that, during the enlightenment and before, the scientist and the philosopher were one.

Second, after demoting philosophy to the "arts," science seems to have also risen above religion in a genius way. In its ability to "identify the absolute with knowledge of nature, taken as a quantitatively apprehended series of appearances whose essential object is a particle that defies observation" (Aronowitz, 1988, p. viii), science has gained absolute power much like religion, but without the doubt. While in religious beliefs, those who doubt can turn to scientific methods or experience or reality as a way to escape the power of religious dogma; in science, because there is always the promise that we will eventually find a way to prove what is true, the power becomes more absolute than God. Herein lie the authoritarian epistemological roots of science that will be discussed in Chapter 4.

As a result, one would expect that as neuroscience makes its way into education—the focus of Chapter 3—education itself, like art, philosophy, and religion can be pushed to the margins of human experience and "become extracurricular" (Aronowitz, 1988, p. 9). The irony here is that the scientific methodology, much like dogmatic religion, actually trains our brains to "exclude speculation" (Aronowitz, 1988, p. x), except at the outset of the empirical tradition. This, in essence, limits our learning capacity, thereby training our brains to become worse at

learning. The implications of scientific empiricism, particularly with respect to neuroscience, in schooling and education, therefore, necessitate careful exploration and interrogation. Equally important is the consequence of science's social structures on the issues of social justice in education.

CHAPTER 3

THE HISTORY OF SCIENCE IN EDUCATION

While most would trace the beginning of neuroscience's move into education to the advent of fMRIs in the 1970s (Fischer 2009; Fischer, Daniel, Immordino-Yang, Stern, Battro, & Koizumi, 2007; Jensen, 1998; Tokuhama-Espinoza, 2011a), the fact is the field has had a strong presence in American public education since its inception. Just as in other aspects of society, the industrial revolution forever changed the face of education. As a result, education went from an apprenticeship model, to what has often been referred to as the "factory model" (Jenson, 1998, p. 2). In the process, standardization was introduced, allowing for the formation of larger classrooms and schools, where the idea flourished that everyone could be brought together in a single place and taught through a "conveyer belt" curriculum (Jenson, 1998, p. 1). This paradigm of schooling, already influenced by scientific ideas, both reinforced the universality of knowledge as well as science's universalizing claims about the human brain.

Therefore, despite the democratic ideals of many forefathers of American education, like John Dewey (Darder et al., 2009), the popularity of the factory model of schooling in America has mimicked the Aristotelian view of science that regards children's brains as blank slates that should be molded and shaped by those with power, authority, and knowledge (Darder, 2012). Although a review of the history of American public education is beyond the scope of this study, one must wonder about the political and economic goals of schooling, in the same light that one must question such goals in the pursuit of science. There is much literature critiquing the ways in which schooling, especially in a capitalist system like the United States, reifies existing

economic inequality and class structures (Bowles & Gintis, 2011). What is noteworthy in this discussion is that

> the evolution of the modern school system is accounted for not by the gradual perfection of a demographic or pedagogical ideal, but by a series of class and other conflicts arising through the transformation of the social organization of work and its rewards. (Bowles & Gintis, 2011, p. x)

The reason this evolution of modern schooling is of concern here is that the entire system has been grounded on a foundation of behaviorism wherein students, like mice, have been viewed as subjects in an operant conditioning experiment, in line with B. F. Skinner's famous remark: "Give me a child and I'll shape him into anything." In concert, the institution of schooling has managed to shape children into what the workplace required them to be, all the while constructing scientific proof to legitimize their subjugation and deem inequalities as nothing but the natural order of things, given the inferiority of subaltern populations. In fact, it could be argued that the origins of neuroscience in education started when psychology first began to promote itself as a science, grounded in empiricism and experimentation. Prior to when the "physicalists" like Joseph Gall first began to shift psychology toward measurement and science (Wickens, 2015), "prescientific psychology" was led by philosophers who were regarded as the leaders in Western education practices. However, as a result of this shift, and long before science began to move directly into education, psychology sought to align itself with the field in an effort to establish greater legitimacy. Thus, as psychology moved into the arena of education, it naturally planted the seeds that later easily permitted the move of the scientific paradigm into the educational system.

Psychology as Science: The Measurers

Many claim that psychology was born on a December day in 1879 (Hunt, 2007). On this day, at the University of Leipzig, a professor and two younger graduate students positioned a chronoscope on a table with a sounder, a telegrapher's key, a battery, and a rheostat, in order to collect data for a dissertation project on the duration of apperception, or the time lag, between when a "subject" hears a ball hit the platform and when he presses the telegraph key (Hunt, 2007). The professor, Wilhelm Wundt, and his students, Max Freidrich (a German) and G. Stanley Hall (an American) recorded the elapsed time on the chronoscope, thus marking the moment "the modern era of psychology begun" (Hunt, 2007, p. 140).

Of course it could be argued that many psychologists already did empirical experiments attempting to measure nature since the early 1800s—Helmholtz's measurement of the speed of nerve transmission in 1850 is one particular example relating to neuroscience specifically, as is, some would argue, Gall's skull readings—but that experiment in that room in 1879 went on to result in a formally organized laboratory that became the mecca for aspiring psychologists and later enlarged to become the university's official Psychologisches Institute (Hunt, 2007). Mostly because of this institute, Wundt is today considered the principal founder of modern psychology, which at its core aligns itself with the scientific method and studies driven by empirical data and measurement. Wundt is also credited with restoring the study of conscious mental processes to psychology, which had been at the core of the field from the time of the Greeks, though they were mostly explored through introspection. But the German mechanist, seeking to make psychology scientific, rejected introspection on the grounds that it was subjective and dealt with unobservable phenomena. Instead, Wundt became the leading proponent that mental processes

must be experimentally studied, claiming that "as soon as the psyche is viewed as a natural phenomenon, and psychology as a natural science, the experimental methods must also be capable of full application to this science" (Wundt as cited in Hunt, 2007, p. 142).

Some years later, in 1867, even the famous American psychologist William James, who later, when writing about psychology, claimed "this is no science, it is only the hope of a science" (James as cited in Hunt, 2007, p. 160), is known to have expressed an interest in meeting Wundt (although the meeting never happened), writing in a letter to a friend as a young man in 1867, "perhaps the time has come for psychology to begin to be a science" (James as cited in Hunt, 2007, p. 142). Of course, in the midst of this view was a larger social and intellectual milieu that was also contributing to the emergence of the new science of psychology. The sociological studies of Auguste Comte, the growth in the field of anthropology, even the publication of Darwin's *On the Origin of Species*, all created an atmosphere to think that human nature could and must be scientifically studied. But, while William James, with his eventual skepticism and dislike of experimentation in psychology, is considered the founding father of psychology in America, Wundt's efforts to make psychology a scientific endeavor have endured.

It is important to note that even Sigmund Freud, who invented psychoanalysis, was trained first as a medical doctor and created the practice with no clear historical or sociological explanation of how psychoanalysis suddenly came to be. In this sense, James and Freud, and even later Carl Jung, perhaps the most famous of all the modern psychologists, were actually outliers in their own field. It was, in fact, the measurers like Francis Galton and the behaviorists like Thorndike, Pavlov, Watson, Hull, and Skinner whose work had the most enduring impact in the larger society, and especially within education.

While Wundt looked for universal psychological principles that could be measured and applied, another prominent psychologist of his time, Francis Galton, a cousin of Charles Darwin, was looking to scientifically substantiate differences in individual characteristics. A firm believer in the hereditary basis of intelligence, Galton was the first to use mental tests (Hunt, 2007). He believed in the importance of measurement and published *Hereditary Genius* (1869), in which he gave an account of unusually gifted people and presented how their traits were more common in their families than in the general population (Hunt, 2007). The most influential of his four books, *Hereditary Genius* launched a new form of psychological research and the new field of study of individual differences.

While Galton's anthropometric approach to mental testing died out rapidly, his studies on the biology of learning have endured in education. Moreover, Galton, who is considered by some to be the father of eugenics, not only initiated the nature versus nurture scientific debate, asking if intelligence was based on genetics, but questioned whether schools should be obliged to serve all students (Gould, 1996). Using the argument that no matter how bright or dull, our genes are not our fault, Galton argued that it is morally acceptable for schools to serve only those pupils with proven intelligence (Tokuhama-Espinoza, 2011a). Mark Baldwin's theory, around the same time (the Baldwin Effect), proposed that learning ability follows the dictates of evolutionary selection, suggesting that learning occurs only when it is beneficial to survival. And so, by the start of the 1900s, there was a great rush not just in psychology but also in education to link behavior scientifically to biology and to measurable criteria (Tokuhama-Espinoza, 2011a).

The Measurers in Schools: Intelligence Testing

It is ironic that it was, in fact, the beliefs in the democratic nature of schooling that introduced intelligence testing into education. In 1904, commissioned by the minister of public education to develop techniques for identifying children who might qualify for extra services and special education, Alfred Binet began his work on the development of what came to be known as the IQ test (Gould, 1996). It is not surprising that Binet began his work by looking to craniometry and measuring skulls, but switched his techniques from the medical to the psychological in hopes of better assessing reasoning and intelligence. After developing a series of tasks and assigning an age level to each task, a child's "mental age" was determined based on how far an individual could get on the tasks. The mental age was then subtracted from the child's chronological age, producing a number that determined whether the child qualified for special education services, thus fulfilling Binet's charge from the French Ministry (Gould, 1996). Though Binet did not know it at the time, and never meant for his tests to be used on the regular population as they later were, the tests he developed had (and continue to have) considerable consequences in American life, especially in public education. In fact, soon, what craniometry was for the nineteenth century, intelligence testing became for the twentieth century (Gould, 1996).

In 1912, the German psychologist W. Stern made the case to divide the mental age by the chronological age (instead of subtracting it) creating the intelligence quotient (IQ) with the assumption that intelligence is a fixed, quantifiable, innate "thing" housed in the brain. While Binet continued to fear that his test might be misused, especially by school masters to get rid of troublesome students, and declined intelligence as inborn, the hereditarian argument for the IQ

scale took full form in America, where the tests were no longer used for identification and remediation as Binet intended but to create a kind of "theory of limits" (Gould, 1996, p. 183), which shifted social policy and educational practice aimed at reification and hereditarianism to maintain social ranks (Darder, 2012).

Given America's egalitarian values, it is paradoxical that IQ testing for such purposes became an American product. However, the "indigenous racism" (Gould, 1996, p. 188) that resulted was in response to patriotic nationalism, which instilled fear about the nation's identity as people from Eastern and Southern Europe were immigrating to the United States during World War II. Pioneers of hereditarianism in America like H. H. Goddard (who first brought Binet's scale to America and then reified the scores as innate), L. M. Terman (who developed the Stanford-Binet scale at Stanford University in hopes of developing a rational society based on IQ scores), and R. M. Rakes (who convinced the U.S. army to test nearly two million soldiers during WWI, leading to the Immigration Restriction act of 1924), which paved the way for what was to become yet another wave of eugenics practices in American history (Gould, 1996). The results of these efforts, in particular army tests that ranked 89% of Black men as "morons," were used to argue for "the development of primary schools, on the training in activities, habits, occupations which do not demand the more evolved faculties" (Cornelia James Cannon as cited in Gould, 1996, p. 261), not only limiting access for Black people to higher education but also justifying segregation in schools, since "A public school system, preparing for life young people of a race, 50 percent of whom never reach a mental age of 10, is a system yet to be perfected" (Cornelia James Cannon as cited in Gould, 1996, p. 261).

Considering the prestige that science enjoys as objective knowledge and mathematics as a way to "guarantee irrefutable precision" (Gould, 1996, p. 106), those in power can easily claim that their positions are free from social and political taint, given that science and the status quo is considered to be "an extension of nature" (p. 53). Therefore, to criticize the natural manifestations of science is to criticize nature itself, unless of course you can make the argument that science is not an objective enterprise but rather a social phenomenon influenced by culture and human error, and itself "a socially embedded activity" (Gould, 1996, p. 53) where "quantifiable data are as subject to cultural constraint as any other aspect of science" (Gould, 1996, p. 59). But such critiques are usually met by being labeled as nonscientific, not serious, forever suspending us in "the twin myths of objectivity and inexorable march toward truth" (p. 55) as we record and prove with certainty little more than social prejudice. In other words, it may be science's enduring allure about its own objectivity that allowed Alfred Binet's tests to win out over Galton's, but Galton's quantophrenic views won out over Binet's (Hunt, 2007).

And so, psychologists of the second half of the nineteenth century came to be known as "the measurers" (Hunt, 2007, p. 233), intrigued by the allure of numbers and faithful that measurement guaranteed irrefutable precision (Gould, 2011); and their work, coupled with advances in anthropology, formed an "unholy alliance" (Gould, 2011, p. 106), forging a new powerful theory of "scientific racism" (p. 106). The fact is that science is rooted in creative interpretation, as is any human endeavor, and numbers do not by themselves tell a story. As Shepherd (2010) correctly stated, it is the theoretical framework of the scientist that gives meaning to the experiment, and once again, as in the case of Broca, the influence of the cultural context and preheld beliefs of practicing scientists were mistaken for objective truth.

Of course, this durable ideology of science and measurement as objective has had immense and tragic consequences for oppressed populations in all aspects of society but especially in education, where children enter school with the promise of democracy and justice. The history of how the American education system has systematically reproduced, reinforced, sustained and promoted practices of social control and regulation is well documented (Au, 2008; Darder, 2002, 2012; Bowles & Gintis, 2011; De Lissovoy & McLaren, 2003; Lipman, 2004; Molnar, 1996). What is sad is that the overwhelming support for the over-testing of racialized children in schools is normalized because of the public trust in the power and objectivity of tests, numbers, and science, with little understanding of the racializing or colonizing *epistemicides* employed by scientists, who use numbers to substantiate and reproduce their existing ideologies of inequality (de Sousa Santos, 2005; Paraskeva, 2011). It is important to note that this history is very current, though today the term "measurer" has been replaced by "psychometrics." As late as 1989, for example, John Rust, who still directs The Psychometrics Centre at the University of Cambridge, gained the contract from the Psychological Corporation to carry out the standardization of the Wechsler Intelligence Scale for Children (WISC). The WISC is the most widely used test for determining children's intelligence and educational placement worldwide. The test's popularity endures despite mounting critiques of its reliability and construct and ecological validity (Stein, 2014). Similarly, centers such as The Psychometrics Centre at the University of Cambridge continue to be heavily funded in order to research and be involved in the invention and refinement of more tests. In fact, excellence in psychometry and the development of ever more sophisticated schemes for basing school improvement on technological advancement continues to surpass research on the actual nature of learning (Stein,

2014). Coupled with the power of expertise, this enthusiasm has helped psychometrics become the biggest proponent of educational determinism in history (Stein, 2014). Everything from the advent of SAT testing, ETS, and the legislating of NCLB continues to build on this history, at the expense of subaltern children, in the name of objectivity.

Psychology as Science: The Behaviorists

As Galton's eugenics won the nineteenth century, the views of behaviorists ruled the twentieth century, especially in America (Hunt, 2007). Again, the popularity of behaviorists' perspectives was in sync with the era of modernity, in which the promotion of their branch of psychology as "the first truly scientific psychology" (p. 296) was fully embraced. Moreover, claiming that they could construct a psychology from totally visible and measurable events in animals (Thorndike's cats and Pavlov's dogs are the primary examples), behaviorist psychologists were finally able to do what Wundt had dreamt: "given the stimulus, to predict the response" (Wundt as cited in Hunt, 2007, p. 297). The power to predict behavior further solidified the view of behaviorists as grounded in the scientific laws of the universe and, consequently, "the laws of natural learning" (Wundt as cited in Hunt, 2007, p. 277). This phenomenon was highly evident, from Thorndike's experiments and "the laws of conditioning" (Wundt as cited in Hunt, 2007, p. 277) to Pavlov's experiments—generating ideas that were translated into laws of human learning and quickly permeated into the field of education.

But perhaps no behaviorist—or psychologist—left as deep a mark on American schooling as did Burrhus Frederic Skinner and his theory of reinforcement (Hunt, 2007). Like Broca and Wundt before him, what distinguished Skinner is not so much the credibility of his views, as the confidence and authority with which he believed and promoted them.

"[Behaviorism] may need to be clarified, but it does not need to be argued" (Skinner as cited in Hunt, 2007, p. 304), Skinner claimed, all while insisting that thinking *is* behaving and that "we do not need to try to discover what personalities, states of mind, feelings, traits of character, plans, purposes intentions, or other prerequisites of autonomous man really are in order to get on with a scientific analysis of behavior" (Skinner as cited in Hunt, 2007, p. 305).

It was during a visit to his granddaughter's fourth-grade class in 1953 that it first occurred to B. F. Skinner that his *operant conditioning*, which allowed him to teach pigeons how to play the piano, could be far more efficient in teaching children than the traditional methods (Hunt, 2007). Operant conditioning can best be understood as a type of learning where the learning behavior of the subject is controlled by consequences. Key to this approach is the use of positive reinforcement, negative reinforcement, positive punishment, and negative punishment to procure the desired behavior from subjects. Perhaps it is the allure of efficiency within the capitalist modernist culture of America that aided the popularization of Skinner's views in education, even more than the power to predict and measure. The resulting "programmed instruction" (Hunt, 2007, p. 309) based upon principles of operant conditioning, where complex subjects are simply broken down into logical simple steps and presented to students who then hear whether their thoughts are correct or wrong, coupled with provision or withholding of immediate reward or reinforcer, forever changed schooling in America.

Since one teacher cannot simultaneously provide reinforcement to an entire classroom of children, new textbooks with step-by-step instruction and answers that the children could look up on their own came about. A "programmed learning movement" (Hunt, 2007, p. 309), in which teachers were systematically taught how to instruct through operant conditioning, was also

developed; the remnants of which continues to be seen in contemporary reform efforts in education. What is ironic is that as psychology began to critique and move away from behaviorism, opting for theories that allowed for more complexity—such as Gestalt psychology, developmental psychology, and social psychology—and despite advancing arguments for holistic, whole child approaches to education, behaviorism continues to dominate how we view teaching, learning, and testing in our education system. In fact, it could be argued that while psychology as a field divided into two groups of social and experimental psychologists, and social psychologists were never eclipsed by behaviorism as were the experimental psychologists, and that experimental psychology has, paradoxically, dominated the social expectations and business of education and schooling.

Behaviorists in Schools: Standardized Teaching

By the early 1900s, standardized tests were already being used in making curricular and eligibility decisions in American public schools (Darder, 2012). The impact of behaviorism in education, however, with its assumption and promise that all students are blank slates that could be shaped, if subjected to the right mix of training and accountability, led to the school system's use of standardized testing as a way to standardize teaching. Ironically, much of this was done in the name of equity. Following WWII and later during the Sputnik era, education became even more competitive, with the desire to teach all American children in ways that could ensure American superiority. This competitive drive within education eventually resulted in the Elementary and Secondary Education Act (ESEA) of 1965 (Darder, 2012). The ESEA was passed as a part of United States President Lyndon B. Johnson's "War on Poverty" and has been

the most far-reaching federal legislation affecting education ever passed by the United States Congress.

More specifically, ESEA constitutes an expansive statute that funds primary and secondary education by emphasizing equal access to education through high standards and accountability. And so, by using both the rhetoric of equity and closing the achievement gaps, public education under ESEA was expected to provide each child with fair and equal opportunities to achieve an exceptional education. Undergirding this legislation, however, was a deep commonsensical belief in science, measurement, and behaviorism, which proponents believed would change the face of schooling in America. President George W. Bush reauthorized ESEA under the No Child Left Behind Act of 2001; and, on December 10, 2015, President Barack Obama reauthorized the ESEA as the Every Student Succeeds Act (ESSA). Accordingly, testing practices that had originally been meant to identify deficiency in children, now through the promise of behaviorist theories, became mandated practice for all children.

The Culture of Special Education

While this literature review is concerned with the impact of science on public education in general, it must be noted that science, namely the psychological movements discussed above, fueled a culture of labeling, categorizing, and separating of students, which shaped special education practices in American schools. The history of Special Education in America, which includes the counter-narratives of people with disabilities who gave rise to a movement against handicapism and the rise of what came to be known as disability studies and the social model of disability (Connor, Gabel, Gallagher, & Morton, 2008; Smith, Gallagher, Owen, & Skrtic, 2009) contains a rich literature far more deserving than what this study can cover. However, it is

important to understand that the traditional model of special education, which continues to be enacted in schools today, has managed to ignore educational critiques of positivism and meritocratic cultural ideals of the United States. This is so much so, that special education in the current moment continues to be deeply entrenched in the empirical and medical assumptions (Connor et al., 2008; Dudley-Marling & Burns, 2014; Smith et al., 2009) made popular by the "measurers," while special education pedagogy and curriculum emphasizes the models put forth by the "behaviorists."

Many believe that special education, as we know it today, grew out of the landmark civil rights case of Brown v. Topeka Board of Education (Osgood, 2005; Smith et al., 2009). But the fact is, the field of Special Education has a 200-year history in the United States (Osgood, 2005). Moreover, the adversarial relationship waged with children with disabilities in American schools has been there from the start (Osgood, 2010); which actually sheds more light on the impact of science on American schooling.

Despite the work of such pioneering educators as Elizabeth Farrell—the first person in the United States to bring attention, on a large scale, to kids with different learning needs and to try to systematically deal with their educational needs in the public school system (Kode & Howard, 2002)—the dominant belief of the education system in the United States in those early years was that the presence of children with disabilities gets in the way of the American school system working efficiently (Osgood, 2010). Labeled as laggards and later, as "morons, imbeciles, idiots" (Osgood, 2005, p. 6) officially, many believed that having these children in classrooms made the life of the teacher more difficult because they took time and attention away from "the normal children" (Osgood, 2005, p. 5). Deeply rooted in the belief that schools must

be efficient systems, the question of what to do with "these" children plagues the history of the field of special education; and some argue, the "age old battle of student-centered practices vs. efficiency and convenience in school operations" (Osgood, 2005, p. 8) have always been at the heart of the special education movement.

Over the years, many have contended that behind the forces driving the field of special education are far deeper questions of meaning related to the very definitions of democracy and identity (Young, 2002), as well as questions of purpose related to politics and economics (Brantlinger, 2006). Recognizing the positivist and meritocratic cultural ideals of the United States is therefore critical to understanding the empirical and medical assumptions (Connor et al., 2008; Dudley-Marling & Burns, 2014; Smith et al., 2009) that form special education as a field. In fact, the traditional model of special education that persists in schools today, despite such radical movements as the disability and inclusion movements in more recent years (Connor et al., 2008; Smith et al., 2009), follows the scientific method and has its roots in the neuroscientific evidence of the late 1800s.

Later, as in the case of general education, special education began to rely more and more heavily on testing and diagnosis of children in order to appropriately place them with the intention of predicting, diagnosing, controlling, and fixing students at best and marginalizing and segregating them at worst (Slee, 1998), when they are not able to fit in the dominant system of education. This trend, which eventually led to not only the overrepresentation but also misrepresentation of students of color and English language learners in special education (Artiles, Rueda, Salazar, & Higareda, 2002; Artiles & Trent, 1994; Connor et al., 2008; Skrtic, 1991) has its roots in neuroscience and phrenology. Hence, one could argue that neuroscience

has done more to damage the democratic ideals of American schooling than to support or cultivate them.

Psychology as Science: The Cognitivists

The dominance of experimental psychology within cognitive psychology effectively laid the ground for the official entrance of neuroscience into education and later the Mind, Brain, and Education movement. Trained in behaviorism and experimental psychology, George A. Miller started the first department of Cognitive Psychology at Harvard University in 1960, thus beginning a movement that fundamentally changed and zealously led the field ever since (Hunt, 2007). Behaviorists, until then, like neuroscientists, had primarily focused on rats and mazes and electric impulses. This new scientific flurry, which came to be known in psychology as "the cognitive revolution" (Hunt, 2007, p. 592), shifted the focus of the field to experimentation with higher human mental processes.

Many factors combined to lead to this shift in the field. Within psychology itself, Gestaltists, personality researchers, developmentalists, and social as well as Freudian psychoanalysts had brought much attention to higher mental processes, since behaviorist ideas first surfaced. It is important to note, however, that none of these groups had the tools to measure the processes they studied. Once again, as Shepherd (2010) has argued, in science it is new methodology, tools, and techniques, allowing more precise measurement, that pushes the field forward. Two methods—advances in computer science and imaging techniques—along with advances in drugs and biomarkers, became the driving force behind the development of cognitive psychology. These methods pushed the field to the point where "some expected it to replace the field of psychology" (Hunt, 2007, p. 593) altogether.

Following WWII, where allied forces urgently needed computers to calculate large sets of numbers, the field of computer science was born. In 1948, the idea that a computer functions like the human mind resulted in an explosion of research and funding in the field (Hunt, 2007). The first artificial intelligence program (Logic Theorist) was formed during the 1950s as advances in neuroscience were also taking place; and, by the late 1970s, cognitive psychology, along with the related fields of mathematics, psycholinguistics, computer science, neuroscience, and anthropology came to be known collectively as "cognitive science" (Hunt, 2007). The interdisciplinary nature of cognitive science mimics that of MBE as later some argued that efforts to combine neuroscience and education should remain part of cognitive psychology (Bruer, 1997). However, it was the advances in imaging techniques that brought about the "cognitive neuroscience revolution" on the heels of the "cognitive revolution" (Hunt, 2007, p. 598). Most of the literature on the history of MBE begins in the 1970s; with the invention of imaging techniques, there was once again a resurgence of empirical efforts to quantitatively measure natural phenomena, in this case, mental processes. This resurgence, moreover, was responsible for pushing the field forward.

While behavioral neuroscientists had attempted to surgically manipulate brains in order to link it to behavior, now scientists were able to measure the workings of the brain in a living human being. Before the 1980s, the electroencephalogram (EEG) was used to measure the electrical output of the brain, but in the 1980s several new advances were made as the PET (positive emission tomography) scan, and CAT (computerized axial tomography) scans allowed the measure of blood flow. By far, the most important tool, the MRI (magnetic resonance imaging) and its sub-tool the fMRI (functional magnetic resonance imaging) allowed scientists to

observe the brain while it worked. These techniques, especially the fMRI, had profound implications for education, as scientist could now study the brain as it set out to learn. Thus the fMRI became "the workhorse of cognitive neuroscience" (Hunt, 2007, p. 604) and promised to replace old school pen and paper IQ tests in the everlasting quest to label and categorize human brains, but now at the molecular level. Data from imaging also promised to end, once and for all, the ancient debate about body and mind, by explaining mental processes in terms of material substances and events.

These advances, which came largely out of neuroscience, also gave cognitive psychologists dominance in their own field because their measurements now legitimized their field as a real science. In the 1970s, a number of neuroscientists began to explicitly link brain functioning to education and learning. One of the most notable scientists, Michael Posner (Peterson, Fox, Posner, Mintun & Raichle, 1998; Posner, 1980; Posner & Boies, 1971; Posner & Raichle, 1994;), conducted research on attention, memory, and sound processing, and made notable contributions to the field of educational neuropsychology, a precursory field to MBE, which sought to merge education, neuroscience and psychology (Tokuhama-Espinoza, 2011a). Soon, cognitive psychology, armed with quantitative data, marched into the larger public sphere, including education. For example, learning specialists often use a commercial program based on Michael Posner's work to aid in the remediation of specific language and sound processing difficulties. Unfortunately, in my own practice, I have found that the use of this program, which is advertised for almost all learning problems, is actually not appropriate for many children.

The 1980s became "the last hurrah of brain-free psychology" (Hunt, 2007, p. 602), setting the stage for what President George W. Bush later termed, "the decade of the brain" (See

Presidential Proclamation 6158 http://www.loc.gov/loc/brain/proclaim.html) in the 1990s. In 1983, a new paradigm the combined brain function and educational practice was established. While many trace the roots of the coming together of neuroscience and education to Howard Gardner's book *Frames of Mind: The Theory of Multiple Intelligences* (1983), it was the argument put forth by Leslie Hart (1983) in her book *Human Brain and Human Lear*ning—where she argued that education threatened cognitive processes—that lit the flame for both fear and excitement, fueling a completely new field of neuroscience and education. Nonetheless, both of these books, because they were written first with the educator in mind, influenced those in educational circles to truly take note of the brain–learning connection in the teaching profession.

Soon, the word brain became popular as a new genre of books emerged, but this time the funding for academic fields was not that of the earlier post-war era government grants but from pharmaceutical companies pouring a massive influx of dollars into brain research to see who would find the next Coumadin, Zoloft, Celebrex, or Viagra (Jensen, 2008). This interest resulted in the establishment of the first departments of Neuroscience and Education. It is important to note that most of these departments were housed within departments of cognitive psychology, although in 1990 the first undergraduate educational degree in educational neuroscience was instituted at Dartmouth College, which incidentally also held the oldest doctorate program in the nation in psychological and brain science (Tokuhama-Espinoza, 2011a).

However, the merger between neuroscience and education proved difficult from the start, and there were many objections from the field of cognitive psychology, especially stating that the aim to connect the two fields was too lofty a goal and that all efforts should be kept under the umbrella of cognitive psychology (Bruer, 1997), which had established a strong reputation as a

credible offshoot of experimental science. Nevertheless, as interest in the brain grew, the new field of Mind, Brain, and Education began to take shape, creating a separate research niche within the field of education.

The Cognitivists in Schools: Mind, Brain, and Education

Before the first dissertation on MBE science, entitled *Neuroeducation: Brain Compatible Learning Strategies* was written by O'Dell in 1981 (Tokuhama-Espinosa, 2011a), many different terms were used to define the field: brain-based teaching, brain-based education, educational neuroscience, learning sciences, educational psychology, cognitive neuropsychology, cognitive neuroscience, and educational neuropsychology. Many of these terms continue to exist today, even as fields of study; but it was in the establishment of the Mind, Brain, and Education program at Harvard University by Kurt Fischer that the push to bring neuroscience into education took its most official hold. But even after the establishment of the program, there were about three decades of confusion about how and if neuroscience and education could actually coexist.

From its inception, MBE set out to distinguish itself from neuroscience and education by rejecting the idea of being housed in a department of psychology and by shaping itself as a field not just interested in the science of learning, but also "the scientifically substantiated art of teaching" (Tokuhama-Espinosa, 2010, p. 9), thus establishing itself as the Rosetta Stone for educators and researchers about all things related to the mind, brain, and learning. While "teaching was a simpler craft in generations past" (Tokuhama-Espinosa, 2011b, p. xxi) when only the wealthy aspired to education, today teachers face the challenge of teaching children with a wealth of differences. This shift in the demographics of schools led to the creation of a new

kind of scientist called the MBE scientist (Tokuhama-Espinosa, 2010). Hence, a neuroscientist working in a lab, a teacher working in a classroom using MBE-approved methods, and a psychologist using therapy to stimulate behavioral changes in a student would all be considered MBE scientists (Tokuhama-Espinosa, 2010). However, regardless of the neuroscientist, the field perseveres a scientific bias of learning as a brain function, and is built on the commonsensical assumption that "if learning can be well understood then good teaching will follow" (Geake, 2009, p. ix).

From its inception, MBE science also set out to distinguish itself as a practical field, concerned with the science of learning *and* teaching, claiming that while neuroscience and psychology have been helpful in establishing theories of learning, education has been left on its own (with no guidance from science, one assumes) to develop teaching. In this light, Usha Goswami (2008), one of the most prominent researchers in MBE working to secure funding for the field and impact policy, noted, "The identification and analysis of successful pedagogy is central to research in education, but it is currently a foreign field to cognitive neuroscience" (p. 35). In other words, despite the rhetoric of communication and interdisciplinary relationships, the fact is a major aim of MBE has been to make education more "scientific." The MBE goal to make education more scientific will be further discussed in Chapter 4. The point here is to establish that, despite its desire to separate itself from cognitive psychology, MBE was deeply influenced by and embraced a similar mission as the psychological movements that preceded it, in terms of its relationship to education.

Similarly, despite the desire to emerge as an interdisciplinary field with the intention of communication between scientific research and educational practice, from the beginning, MBE

has been plagued with failure to establish the types of communication it aspired to, wittingly or unwittingly, preserving the gap between the fields (Beauchamp & Beauchamp, 2013; Bruer, 1997; Bruer, 2006; Busso & Pollack, 2015; Campbell, 2011; Clement & Lovat, 2012; Fischer, 2009; Fischer, Goswami, & Geake, 2010; Howard-Jones, 2008; Samuels, 2009). In fact, much of the literature of its own journal, *Mind, Brain, and Education* (established in 2007), seems to be focused on addressing the same questions that have plagued neuroscience and education over the years (Fischer, 2009; Fischer et al., 2010). It would seem, then, that while MBE aimed to evolve as its own interdisciplinary or even transdisciplinary field (Beauchamp & Beauchamp, 2013), it continued to grapple with the old science/education divide while also struggling to set itself free from the insipid language and conceptual problematics of bridges and islands (Fischer, 2009; Szűcs & Goswami, 2007). As will be discussed in Chapter 4, this points to the epistemological impossibility of transcending what Boaventura de Sousa Santos (2007c) calls the *abyssal divide*, as long as the same colonizing or hegemonic constructs continue to frame the research in the field.

It should be noted that epistemological differences between science and the social sciences and how such differences impact MBE have been acknowledged by both critics and proponents of the field. Some have warned against "mixing" the two fields as far back as when it was first gaining popularity in the public sphere (Bruer, 1997). Dividing the disciplines into hard versus soft and pure versus applied (Samuels, 2009) has been one way to look at the reason behind why these fields can't mix. The impact of these more general epistemological differences on how learning is defined is also discussed (Bruer, 1997; Campbell, 2011; Clement & Lovat, 2012; Howard-Jones, 2008; Fischer, 2009; Samuels, 2009). From the point of view of

neuroscience, learning is often perceived as being synonymous with memory (Howard-Jones, 2008); for example, whereas educational ideas about learning are diverse and eclectic in their sources.

The general consensus in education is that learning is the product of a variety of processes and forces that include not just the educational system (much less the laboratory), but also the students' own knowledge, cultural influences, emotions, and values (Howard-Jones, 2008). Using the language of "holistic and subjective" with respect to education and "analytic and objective" for neuroscience, Samuels (2009) further posed a question that echoes throughout the literature: How can findings about learning in neuroscience inform the field, when one group is interpreting the results based on knowledge as a constructed phenomenon, while the other sees it as memory tied to internal neurological factors.

The issue has also been approached from a mind and brain perspective where it has been argued that neuroscientists hold a monistic view; the brain equals the mind; and educators hold a dualistic view, where the mind and the brain are considered two separate entities (Howard-Jones, 2008). Another argument has been that the idea of brain science being relevant to learning results in a "category mistake" from the beginning (Bruer, 1997; Howard-Jones, 2008). In yet another critique, it has been pointed out that neuroscience and education each have their own academic "tribes" or "territories" (Biglan, 1973), making communication and collaboration across these cultural terrains difficult. As described by Mel (2002) for example, "pull the average neuroscientist off the street and ask them about learning, and you're likely to get a response that includes such pat phrases as actively-dependent changes in synaptic strength LRP/LTD" (as cited in Howard-Jones, 2008, p. 363).

Aside from the epistemological implications of this language, there is the issue of language differences itself. When one goes into a new tribe, it is expected that one adopt the culture and language of the new terrain. It has been argued that neither field has been either willing or terribly successful at accomplishing this level of inclusion. Yet, regardless of how epistemological differences have been described in this "paradigm war" (Campbell, 2011), or agreements that an enduring epistemological barrier has made the two fields fundamentally impermeable to one another (Beauchamp & Beauchamp, 2013; Busso & Pollack, 2015; Bruer, 1997; Campbell, 2011; Clement & Lovat, 2012; Samuels, 2009), what has not been discussed are the underlying values associated with these epistemologies.

In a study that used 26 semistructured interviews with 14 neuroscientists and 12 education professionals between 2010 and 2013 (all people who could have already demonstrated interest in both neuroscience and education), researchers aimed to find out how education and neuroscience professionals view the field of neuroscience and education. What the study revealed was that the dominant opinion of the neuroscientists was that the gap is mostly due to language differences between the fields, claiming that educators didn't understand the language of science while educators mostly cited differences in the cultures of each field as the problem (Edelenbosch, Kupper, Krabbendam, & Broerse, 2015). Accordingly, the researchers concluded that cooperation is not apparent and that professionals in both groups demonstrated the type of incalcitrant barriers often noted in the literature (Edelenbosch et al., 2015).

What is missing from the analysis of the results of this study, in particular, and from the discourse in MBE literature, in general, however, is what these differences reveal. First, there is no question of whether MBE should even seek to have an impact in education, given the

detrimental history of science in education. That is a given. In fact, it could be argued from the responses of the neuroscientists and the analysis of the authors, that the field itself views the contentious history of science in education as a problem of education not being scientific enough. Building on the assumption that educational research does not and cannot provide the best approach to many educational issues from its own resources and thinking (Blakemore & Firth, 2005), the implication of such studies is that educators need to become more well versed and educated as scientists.

In one of the foundational articles in the *Journal of Mind, Brain, and Education*, where the authors answer the "why" question of MBE, they asserted, "It is time to for education, biology, and cognitive science, to join together to create a new science and practice of learning and development" (Fischer et al., 2007, p. 1). To make this connection and create this "new science," the authors offered the comparison between medical research and medical practice, in order to make the argument that research must move beyond the ivory tower and into the arena of real life, such that "educational practices must be available for scientific scrutiny" (Fischer et al., 2007, p. 1). Nowhere is there talk of whether such a comparison could or should be made, all while the language of interweaving and reciprocity is seen throughout. Ultimately, the argument is that educational practice and policy must be based on empirical evidence, and MBE can now finally help the field achieve this goal.

Education as Science: A Bridge Too Far?

Perhaps no one has brought more focus to the issue of the gap between neuroscience and education than the field's most cited critic, John T. Bruer. In his now-seminal critique of neuroscience and education, Bruer called the attempt to connect the two fields "a bridge too far"

(Bruer, 1997). While Bruer's argument echoes others who have questioned the inability of neuroscience to produce "usable knowledge" in terms of curriculum for educators (Clement & Lovat, 2012), it is the phrase he coined—"a bridge too far"—that turns up in much of the literature in the field (Clement & Lovat, 2012; Fischer, 2009; Samuels, 2009) as a problematic metaphor that seems to have shaped MBE even as MBE scholars have struggled to separate from it. In suggesting that it should be cognitive psychologists who build and cross the bridge between the two islands of neuroscience and education, what Bruer (1997, 2006) inadvertently did was to reveal the banking model of education upon which the field is built.

Further, even as MBE scholars debate this divide throughout the literature of the field (Fischer, 2009; Fischer et al., 2010; Szucs & Goswami, 2007), they find themselves in what Paulo Freire (2000) called a "limit situation," or a situation beyond which people cannot imagine themselves (Dimitradis & Kamberelis, 2006; Freire, 2000). What they reveal is that, like Bruer, they possess little knowledge related to theories of education, which could potentially aid collaborative conversation between the two fields. Central to the process of learning in Freire's work, for example, is the power of dialogue, which he defined as encompassing collective reflection, naming the world, and action (Freire, 2000). However, this concept of collective dialogue and what Freire called a "problem-posing" approach is not only missing, but also negated by the literature that attempts to address this untenable divide. In short, even as the field now encourages its scholars to "mind their metaphors" (Stein, 2015, p. 1) and move away from concrete notions of islands and see the field more as an ecosystem, the earlier literature in the field around this problem exposed the underlying positivist and colonial roots of the field.

In other words, the field of neuroscience functions from a Western epistemology that privileges mastery *of* or power *over*, protecting and privileging the place of science historically, as pure and analytical—a process Freire (2000) would deem a replication of hegemonic values, reinforcing separation, and preserving a hierarchy that undermines education. Precisely this epistemological limitation has created a "relationship of struggle" (Darder, 2014), making horizontal dialogue (the basis for just human interactions) impossible (Darder, 2014; Freire, 2000). Bruer's metaphor absolutizes the separation, creating polarity and hinting that neuroscientific knowledge is an object that must be carried across a bridge and inserted into educators. This, again, echoes the "banking model" (Freire, 2000), rather than an emancipatory view of knowledge and education as a constructed phenomenon that emerges from dialogue. For example, Bruer and those who critique him concentrate on the gap as an irredeemable problem, instead of a problem with the possibility of solution. From a Freirean perspective, not only are the two fields of knowledge not separate, but also the ideological separation could be engaged through horizontal dialogue, in ways that might point to a transformative praxis, which could potentially result in new and more expansive understanding (Darder, 2014; Freire, 2000). But this is only possible if mutual respect, dignity, and a liberatory vision serve as the foundation for such discussions.

While Bruer's (1997) major criticism is that neuroscience has discovered a great deal about neurons and synapses but not nearly enough to guide educational practice, his own language seems devoid of the epistemological understanding required for transforming the divide. The span between brain and learning, he contended, cannot support much of the "load," arguing that too many people marching in step across "the bridge" could be dangerous. This language is laden

with the non-constructivist view of knowledge that informs the early days of the field and, wittingly or unwittingly, pushes the two fields even further apart, suggesting that communication is so impossible that a mediator is necessary. So even scholars in the field who engage and even reject Bruer's metaphor (Ansari & Coch, 2006) seemed to miss the point that the possibility for constructive dialogue across neuroscience and education is debilitated in the field from its very core.

The point here is that whether the metaphor is bridge, boundary (Beauchamp & Beauchamp, 2013), or ecosystem (Stein, 2015), and whether cognitive psychologists "inform" or "neuroeducators" (Fischer, 2009) "facilitate" discourse, what is missing in the field, even in the arguments put forth by MBE scholars who seem to be more aware of critical theories (Samuels, 2009) and social justice (Stein, 2010, 2013, 2014) is a deeper understanding of the epistemological impossibility of transcending MBE's colonial and positivist history. So when Usha Goswami (in Szucs & Goswami, 2007), one of the people consulted in the formation of the Common Core standards, used the phrase "the shaping of individual brains via targeted practice in the classroom" (p. 120) to describe education, the issue is not just with how words like "shaping" and "targeted" are historically rooted in both individualistic and colonial sensibilities, but that so long as the field is not decolonized—and not just metaphorically (Tuck & Wayne Yang, 2012)—it is in danger of continuing and even renewing science's colonial history in education.

The Decade of the Brain and the New Phrenology

While the push for neuroscience into education was coming about in academia, the full impact of advances made by imaging techniques began to capture the public imagination in the

1990s. Much like the popularization of phrenology in America, brain-based learning (fueled by the same fervor to "measure" the brain) entered the business sector, where educators and others interested in the brain were able to take part in the many workshops (not strictly educational, but business-based workshops). In this context, phrases like "super learning" and "accelerated learning" emerged as the information age came into full bloom (Jensen, 2008, p. 2).

As brain research emerged as the "holy grail" for learning, the "neuro-hype" resulted in an explosion of books on brain-based education aimed at teachers and parents. The idea was that teachers are teaching brains, so it would make sense that they understand as much as possible about the brain. But that idea itself is based on a scientific view that students are just brains and their capacity to learn is only tied to classroom information. Another reason for the interest had roots in the scientific view of pathology. Brain science promised to make clear for educators why some children have difficulty with learning, which from the perspective of disability studies, again, clearly put the problem in the "body" or, in this case, in the brain of the student (Connor et al., 2008; Smith et al., 2009).

However, since science is already so deeply engrained in our thinking, it seemed educators—even more than the scientists—became (and continue to be) fascinated by the implications of neuroscience to classroom teaching; reflecting how they, too, though not technically trained in the sciences, have been socialized by commonsensical notions of science within schools and society. Many educators, such as Eric Jensen, Pat Wolfe, David Sousa, Bob Sylvester, to name just a few, became world renowned experts in neuroscience and education, pushing the field forward, writing books, holding workshops and professional development programs, and ultimately creating a new field where teachers "considered tops in their field"

(Wolfe as cited in Glick, 2011, p. xiii) were recruited to become coaches to help other teachers and school leaders understand how they might use neuroscience research in schools.

Even Jensen (2008) admitted that he discovered brain-based learning in a business development workshop. Excited to transfer these kinds of learning in seminars to teachers and students, educators easily forget that this view is too simplistic, in that it ignores the context and history of the students. I have to admit when I first came across the promises of brain-based learning, I myself had a similar response. After years of training in scientific thinking, my own brain was used to generalizing from one case to an entire population—in this case, to all brains. It took years of work in the context of individual families and students for me to realize that it is not enough to even say that no two brains are alike (as in the case of dyslexic brains for example), the issue is that no two human beings are alike. Each child requires her or his own unique approach. Of course we can make some cultural generalizations, but they are always only a starting point, linked to communal life and the histories of survival of cultural communities.

A student is dyslexic, beyond knowing that they struggle with reading, even with extensive testing that pinpoints exactly which wiring is impacted, there is no way to predict how best that student will learn. That understanding only comes with time and with getting to know the students and how their particular brain functions, the cultural and familial background, context, and history and the conditions of everyday world, which shape their lives. In pursuit of this understanding, however, I have to admit that, as an educator, I, too, soon became a victim of the brain-based economy. Targeted by myriad books, conferences, and programs, I spent countless hours and a great deal of money learning about "brain research," much of it amounting

to little that could help students. Today, I spend much time in my practice separating the wheat from the chaff.

During this explosion of brain research in academia, research from unrelated fields such as genetics, physics, and pharmacology also began to appear in scientific journals (i.e., *Biological Psychiatry* and *Journal of Social Neuroscience*) where Mind, Brain, and Education research was being established. Suddenly, lay people were equally captivated by brain-based research in every area of life, aiming to make connections between the laboratory and the world (Choudhury & Slaby, 2011). In the process, the term "brain-based" gained widespread use and, in education, came to be defined as: "the engagement of strategies based on principles derived from an understanding of the brain" (Jensen, 2008, p. 4) and a multidisciplinary approach based on learning in accordance with the way the brain is "naturally" designed to learn. The problem here, of course—as with the case of phrenology and IQ testing—is that the dominant epistemology still impacts how one views the world. Just as science has long explained natural phenomena using androcentric principles (Alcoff & Potter, 1993; Aronowitz, 1988; Harding, 2008; Harding, 2004), so too can we begin to build a model of how the brain "naturally learns" based on epistemicides (Paraskeva, 2011), and then disseminate this knowledge as scientific fact.

A perfect example can be found in Eric Jensen's (2008) book *Brain-Based Learning: The New Paradigm of Teaching*. In a subsection titled "Survival of the Fittest," Jensen (2008) referred to the old adage "You can lead a horse to water, but you can't make it drink" (p. 5) to first criticize traditional educators' views that if children don't learn how to read using a standard curriculum, for example, it is because they are deficient. This view, he explained, is based on determined behaviorist ideas that assert: with enough punishment and reward, we can get any

desired behavior. As a brain-based naturalist, on the other hand, he asked: how can we make the horse thirsty, so that it will want to drink from the trough? In other words, according to Jensen, a brain-based educator would think, "How could I discover the learner's natural impediments and built-in motivators, so that desired behavior emerges as a natural consequence?" (Jensen, 2008, p. 6).

At first glance, this approach seems more evolved; however, it still follows a scientific approach that views the brain as independent of society and history, views impediments as natural and as part of the learner and not socially constructed, and is still ultimately aiming to engineer a desired outcome. Moreover, a few paragraphs later, Jensen proclaimed that the "brain is designed for survival," and since it "operates naturally on a selection principle, can it still learn through instruction?" (Jensen, 2008, p. 6). Jensen, thus, raised fewer questions about classroom teaching and more questions about the conclusions being made about how the brain "naturally" learns. This book, like many others in the field, offers a series of lessons on brain physiology and function, then continues with individualistic and meritocratically based conclusions about how the brain learns, along with suggestions on how educators can help students "grow a better brain" (Jensen, 2008, p. 189). In short, there is little innovation offered by neuroscience and, instead, all of its reform suggestions retain the traditional underlying scientific views about knowledge and education.

Somehow, even though we still don't have a cohesive picture of how the brain works, there seemed to be little hesitation about the assumption that we know enough to change the way we teach, based on brain research (Jensen, 2008). A more popular example, related specifically to MBE, is the research on "enriched environments" that led to the development of the "baby

Einstein" boom in the 1990s (Tokuhama-Espinoza, 2010). Even though the scientific research later took back the claims that the rats in the enriched environments had in fact made more synaptic connections and admitted that the difference observed was between normal and deficient environments, the baby Einstein phenomenon which promised super babies, if parents simply enriched their children's learning environment, continues to be a part of the educational landscape today and to generate millions of dollars in sales. This is just one of countless examples of how faulty brain-based education research began to capture the public imagination, influencing not just the private market, but also public policy and funding (Howard-Jones, 2014).

The 1990s also ushered in the idea of the "chemical learner" (Jensen, 2008, p. 4). Whereas the idea of the brain as a computer was the prominent model between the 1950s and 1980s, in the 1990s, the idea that the best brains are those with the "just right" brain chemicals took hold. This suggested that those with the right combination of brain chemicals—like dopamine and serotonin—would succeed, while "those whose chemistry is not quite right will be inattentive, unmotivated, or violent" (Jensen, 2008, p. 4). Such ideas fueled a whole new billion-dollar industry of brain-alerting medications, mind foods, and smart drugs worldwide (Jensen, 2008). The growth was international. The field exploded. In 1969, there were only 500 neuroscientists registered in the International Society of Neuroscience; by the 1990s, there were more than 30,000 (Jensen, 2008). Diseases like Parkinson's and Alzheimer's were being better understood and treated, but now scientists could begin to also look for "the biological roots of impulsive and violent classroom behavior" (Jensen, 2008, p. 2), shattering conventional educational beliefs. All in all, the 1990s solidified that neuroscience was the next great frontier in

both research and product innovation; while the quest to use science to explain the mysteries of life also became the means for amassing wealth.

Perhaps the most important discovery of brain science in the latter half of the 20th century, which contributed greatly to interest in the brain and education, was the understanding of *neuroplasticity*. Where science once showed that intelligence was innate and unchanging, and that the brain develops during a critical period in early childhood and then becomes static, new brain science was showing that many aspects of the brain could be altered (are plastic) well into adulthood. The hopeful implications of plasticity for education (which had of course always been there until science decided it wasn't, with its limited research on intelligence) should have had positive repercussions. However, soon the research on neuroplasticity turned into a Frankesteinian attempt to create a kind of super human. About this, Glick (2011) wrote,

> Science has given us a solid foundation from which to be optimistic about the ability of the human brain to sculpt, change, and rewire itself through different experiences. These experiences can make us smarter, healthier, more engaged human beings. Plasticity makes it possible for the mediocre teacher to become the great teacher, for the principal who has trouble with public speaking to develop into a masterful communicator, and maybe, most importantly, for the child who sees school as a series of disappointments to see, instead, his own success. (p. 173)

Armed with this research, there began a new economy of brain-based education, which continues to haunt the field of Mind, Brain and Education (Dekker, Lee, Howard-Jones, & Jolles, 2012; Howard-Jones, 2014; Pasquinelli, 2012;).

Neuro-Phrenology and Today's Educational Landscape

The neuro-education boom also fit in well with the accountability policies of No Child Left Behind, eventually morphing into what we see today as the call for Mind, Brain, and Education becoming one more "innovation," promising new "tools to resolve" the "onslaught of issues" challenging schools (Glick, 2011, p. 175). In short, neuroscience has become one more reform-driven movement, now being sold as the new great White hope to fix the supposed failing American education system. In concert with this view, Leslie Hart (1983) proclaimed,

> Education is discovering the brain and that's about the best news there could be . . . anyone who does not have a thorough, holistic grasp of the brain's architecture, purposes, and main ways of operating is as far behind the times as an automobile designer without a full understanding of engines. (p. xi)

The problematic comparison between children as automobiles and teachers as automobile designers aside, the very definition of education as a discovery of the brain is steeped in scientific thinking, exposing the framework that Mind, Brain, and Education is built upon. This is most likely not how most educators view their role, not to mention that for centuries we have not had a thorough grasp of "the architecture of the brain," but that has not stopped the work in education. The point is that the push for the Mind, Brain, and Education movement from the side of educators as mediators has in effect constituted a "selling out" of the democratic principles of education once held dear; and, instead, issues a call for teachers and students alike to become more like scientists. This view is also echoed in the belief that if educators want to make more money or have the same prestige as doctors in society, they need to become more like scientists and neuroscience and that education can provide the path (Jensen, 2008). In other words, it is not

society that needs to begin to respect and reward those in the social sciences—which feminists claim is usually associated with the feminine (Harding, 2008)—but rather they must become more scientific or masculine in order to earn the right to respect and prestige. Therefore, while it might seem on the surface that those educators encouraging teachers to learn the language of science are encouraging communication, in truth they are advocating for a deeper acculturation and assimilation into hegemonic norms (Darder, 2012).

As a result, where critical educators see love as part of the pedagogical vocation of teachers (Darder, 2004, 2015; Freire, 2000), these "neuroeducators" (Fischer, 2009) see their primary charge as agents who must "increase learning" and "analyze the learning organ and begin to understand how we learn" (Glick, 2011, p. 1). In this way, they can act as a "game changer" (Glick, 2011, p. 173) for students' academic achievement, social emotional environments, morale, communication, and engagement. Hence, the belief is that "the skills and habits of mind we will need for the 21st Century are embedded in these practices and programs" (Glick, 2011, p. 176) promised by neuroscience. But it might be of use for MBE scholars to remember that the founder of American public education, Horace Mann, also believed that pedagogy should be based on sound scientific principles and his science of choice was phrenology (Cozolino, 2013; Davies, 1955)—the detailed study of the shape and size of the cranium as a supposed indication of character and mental abilities—which he regarded as "the greatest discovery of the ages and built all his theories of mental and moral improvement upon" (Davies, 1955, p. 85).

In fact, there exists a sad but similar history in American public education, ironically among more progressive movements in the field, that shows the excitement over phrenology as a

way to educating all students, including those with learning struggles and difficulties that very much mimic the excitement around brain-based education today (Davies, 1955; Tomlinson, 2005). What is most alarming about this history is that, in its time, phrenology was not seen as a fad but a scientifically based approach with the aim to emancipate (Bakan, 1966; Davies, 1955). With its "important cultural influence in America, especially in vitalizing many varieties of reform movements" (Davies, 1955, p. xi), one cannot help but see the parallels to MBE.

Equally worrisome, are the cultural and economic conditions today that, much like the post WWII era, are producing a perfect storm, in which the desire to reduce humanity to its most basic and understandable units (alongside funding to do so), creating an atmosphere that can lead to an exacerbation of the problems we have lived with for decades. Neuroscience now promises to finally reveal the simple biological truths about learning, behavior, and education perhaps "with neuro-replacing the old psycho-" (Billington, 2017, p. 869) and even further back, the old phreno-. The aim, Billington (2017) asserted, is the same: "to police the boundaries of difference and to sustain exclusive practices, social and educational" (p. 869).

So the question that remains is whether "the field of neuroscience has given educators a great gift" (Glick, 2011, p. 176), which allows, "stitching together powerful foundational understanding regarding learning and teaching" (p. 176), or is the gift a Trojan horse? The fact remains, whether all this is rooted in rhetoric of failure and the need to save students or the rhetoric of success and the dream to be superior (or more recently, as it has become trendy, the dream to serve *all* children), it is not an epistemological lens in line with a humanistic view of education. Today, as research into the genetics of learning has begun with the hopes that someday soon, it will be possible to select genes for teaching and learning (Blakemore & Firth,

2005), one must wonder if the need to make learning "less and less mysterious" and to make the art of teaching supposedly "more and more accessible" (Glick, 2011, p. 176) through a focus on the brain—at the exclusion of heart, body, and spirit—is nothing more than a veiled attack on democracy itself, despite the fact that the call is made in the name of democracy and equity.

With this in mind, it is up to us as Mind, Body, and Education educators committed to justice to decide "not only [to] recognize this gift, [and] unwrap it" (Glick, 2011, p. 176) but to critically question the strengths, limitations, and consequences to the making of a more just world. With this intent in mind, the following chapter aims to utilize a social justice lens to consider more closely the epistemological roots of Mind, Brain, and Education and more recent advances in the field, in order to interrogate the social justice implications and limitations of the field. By so doing, the discussion will provide a rationale for the establishment of a critical social justice paradigm of MBE and consider the emancipatory potential of such a shift.

CHAPTER 4

THE EPISTEMOLOGICAL ROOTS OF MIND, BRAIN, AND EDUCATION

Epistemology can be defined as the study of knowledge, its sources, structures, and borders, and how knowledge gets created, justified, disseminated and legitimized. As the study of the historical roots of neuroscience and its move into education reveal, the field of MBE is deeply rooted in the empirical, positivist tradition. Epistemology is also concerned with how our knowledge of reality is essentially limited by the means and methods used to discern what is viewed as legitimate and, as the previous discussion demonstrates, MBE knowledge is implicated not just by the scientific method but also by the systems of schooling and academia in which hegemonic ways of knowing are embedded and reinforced across disciplines and within the larger context of society.

Important to understand here, however, is that science's epistemology is not just about the promotion of positivist epistemologies, or the ways in which this epistemology, which is predominantly that of the Western male and Western scientific methods, has achieved what Haraway (1988) called the "god trick of seeing everything from nowhere" (p. 581), but also that this hegemonic epistemology has been able to violently impose forms of knowledge production directly linked to the persistence of the coloniality of power (Quijano, 2000). Therefore, further exploration of epistemology, the coloniality of power, and the struggle over knowledge control is vital to the heart of this study.

The Coloniality of Power and the Construction of Epistemicidal Knowledge

Boaventura de Sousa Santos has eloquently argued that an "abyssal line" divides the hegemonic epistemological terrain—a line that depicts the global South as nonexistent.

Consequently, this produces deadening epistemologies or epistemicidal knowledge that bolster the unequal power dynamics necessary for the hegemonic production and containment of this nonexistence (Janson & Paraskeva, 2015). This one-dimensional consciousness, so to speak, is representative, then, of what de Sousa Santos (2010) termed an "epistemicide," that is, the extermination of knowledge and ways of knowing that coincide with the emergence of modern/colonial structures of knowledge as the foundational epistemology of Westernized systems of governance and education.

In other words, it is not just that the scientific epistemology is limiting, but that what science (steeped in epistemicidal values) has managed to do is to kill off all other ways of knowing. What this further represents is a coloniality of power, a concept interrelating to the practices and persistent legacies of European colonialism within both governing social orders and the production of knowledge (Quijano, 2000). Here, non-Western ways of knowing are absorbed, invisibilized, or destroyed (de Sousa Santos, 2009) by the abiding sensibilities and epistemologies of the hegemonic order (Darder, 2018) such that "the model of power that is globally hegemonic today presupposes an element of coloniality" (Quijano, 2000, p. 533).

As such, epistemicidal knowledge has devastating effects globally—in sync with a global coloniality of power (Grosfoguel, 2011; Mignolo, 2007b; Quijano, 2000)—in that it is "deeply anchored within dominant cultural and class expectations—expectations defined by the interests of the economically and politically powerful" (Darder, 2002, p. 9). This has resulted in internationalized forms of cognitive injustice, which have supported attacks upon the very existence of racialized populations who exist outside of the global North (de Sousa Santos, 2010). As Paraskeva (2011) argued, "The epistemicide needs to be seen as a world *tout court*

Western secular rationality spreading from the hard sciences to the social sciences and on to the humanities;" such that the humanities are "gradually being dominated by the prestigious Anglophone discourses (and practices), due no doubt to its associations with the power structures of modernity (slavery, eugenics, technology, industry, and capitalism) that impose a positivist worldview" (p. 3).

What is of particular concern to this discussion of the field of MBE is the manner in which science's epistemicides have not been limited to scientific endeavors. In other words, as the previous history of science in education shows, what the positivist and empirical tradition has done is colonize schooling and society as a whole in such a way that it has forced education as a field to also be absorbed into its epistemology, thus rendering invisible all other traditions and identities within the field of education in the West in the name of science and modernity. This is the reason that the more recent calls in MBE for new metaphors for the brain, such as an "ecosystem" instead of a "computer" (Stein, 2015), for example, or the call to replace standardized testing with cognitive testing in schools, in the name of social justice (Stein, 2014), continues to fall short of a true decolonization of the field. New research, no matter how novel or inclusive its models, will not be able to cross the abyssal divide and will, in fact, continue to widen it, unless attention is given to the ideologies of our society at large as well as Western science, research, and education's powerful positions as colonizing agents of a divided world, with MBE belonging to this world.

Similarly, it is crucial to take note of the way a colonizing—or what Edward Said (1978) called "orientalist" gaze—is implicated in MBE research about the *other*. The literature in the field is rich with references to educators as naïve and uneducated in the ways of science,

contributing to the production of neuromyths that sustain the superior and unquestionable authority of neuroscience (Goswami, 2006; Howard-Jones, 2014). Educators are therefore depicted as being in desperate need of a re-education by science and the insertion of neuroscientific research into their educational practice in order to lend real legitimacy to their teaching. The assumption is that educational systems without neuroscience guidance are "inadequate to provide an answer to the challenges of the 21st century" and must therefore be "guided by scientific principles rather than by intuition and professional wisdom only (or, worst, by tradition)" (Pasquinelli, 2011, p. 186). It is interesting to note that this rhetoric mimics the historical discourse of imperialism with respect to the colonization of indigenous knowledges (Cajete, 2008; Grande, 2015; Smith, 1999).

Within a decolonizing approach to the exploration of a social phenomenon (such as MBE) then, bodies of research produced within the context of hegemonic epistemologies and traditional research priorities must be analyzed, deconstructed, and reinvented in order to dialectically posit decolonizing meanings to support emancipatory praxis and social change (Darder, 2015). Such an interrogation must consider epistemology as well as ideology and remain attentive to questions of cultural politics, the political economy as well as the historicity of knowledge in order to understand and prevent a repetition of oppressive histories. To do so, we must carefully consider the "abyssal divide" (de Sousa Santos, 2010) within MBE, understanding that this divide bolsters the imperial gaze and the empirical ideology of conquest that drives its persistent control over what constitutes legitimate knowledge. Hence, within the tradition of critical progressive theorists such as Apple, Giroux, Darder, Paraskeva, de Sousa Santos, and Smith, the dominant traditions and curriculums of MBE, fueled by positivist

dogmas, must be challenged in order to more effectively shift toward an itinerant and organic grounding, where new ways of knowing and emancipatory knowledge can emerge and unfold.

Epistemology and the Struggle over Knowledge Control

In her book *Decolonizing Methodologies; Research and Indigenous Peoples* (1999), Linda Tuhiwai Smith explained why the very word "research" is one of the dirtiest words in indigenous vocabulary. Inextricably linked to imperialism and colonialism, the word conjures images, she explains, ironically, of scientists filling skulls of indigenous peoples with millet seeds in an attempt to measure their intelligence (Smith, 1999, p. 1). From an indigenous perspective, or the vantage point of the colonized, Smith speaks of the collective memory of imperialism through the use of scientific research—a means by which the coloniality of power continues to be exercised (Darder, 2018)—where information about indigenous people was collected, classified, and represented through the eyes of the West based on encounters with a few; yet, resulting in the rejection of the knowledges and ways of knowing of entire civilizations, all while extracting and claiming ownership and propriety over them.

In mainstream American educational circles, the word research does not necessarily conjure such feelings or memories, because despite the rhetoric in MBE literature about the different epistemologies of science and education, education in the West is itself built upon a positivist tradition. In fact, institutions of schooling are the places we all go to have our minds "trained" in the scientific, empirical, and positivist values of knowledge construction. Nonetheless, the language used in MBE—when talking about educators and education in general—is that of "imperialism as the subjugation of 'others'" and "imperialism as a discursive field of knowledge," and as evident in the brain-based industry and policy and reform

movements, now based on neuroscience as a current form of "imperialism as economic expansion" (Smith, 1999, p. 21).

In this way, just as there has been a mystification of indigenous cultures and knowledge —or what Paraskeva (2011) called "indigenoustude" (p. 3)—so, too, there is a deeper mythologizing of the ways in which teachers practice as unscientific because, even though teachers are raised and educated under the positivistic educational system of the West, their messy human (and gendered) practices cannot be clearly measured and fall outside the Western requirements of legitimate rationality. These practices must, therefore, either be fixed or silenced. Scholars in MBE, often formally trained neuroscientists themselves, do not readily recognize their call for an interdisciplinary or transdisciplinary field, with its own curriculum based on the hegemony of science, as a form of "curriculum epistemicide."

What is clear from the literature and the goals of MBE is that "science" has acquired and perpetuated a "positional superiority" (Smith, 1999, p. 59) over education, based on the established hegemony scientific thinking enjoys. So much so that all educational initiatives, in order to be considered legitimate or even lawful (Bransford, Brown, & Cocking, 1999), must, today, pursue more rigorously the positivist tradition in now neuroscientific ways. Therefore, today's scientific hegemony is not satisfied with solely maintaining its current dominance, but instead insists on engulfing educational practices even further, by way of its quickly evolving neuroscientific epistemologies. In this way, as the literature reveals, we observe what can be referred to as a "social fascist view of epistemology" (Paraskeva, 2011, p. 4), whose primary aim is to imperialize education, rather than "to develop alternatives" (Kliebard, 1975, p. 49) to the ways we think about the field of neuroscience and education as a whole.

An accompanying question, therefore, in exploring the epistemological roots of MBE is: To what extent do political and economic interests distort perceptions of the "other" within education, given the history of educational reforms based on so-called scientific research and evidenced based proclamations? As will be discussed later in the chapter, what soon becomes apparent from the literature of MBE is an underlying, hidden curriculum whose assimilation of the other (in this case, education) into the epistemologies of science is the underlying goal. How much of this goal is simply the result of the allure and legitimizing impact of science and how much is based on the embeddedness of the coloniality of power, where classed, racialized, gendered, and sexual hierarchies or supremacies of Western scientific domination fuel the capitalist aims and special interests of the field?

As Paraskeva (2011) noted, what is necessary when dealing with conflicts in curriculum and epistemology is the recognition that to theorize a new field and a new curriculum—in this case for MBE—requires we

> (1) put into historical context the emergence and development of the history of the field; (2) unveil the emergence of a group of critical theorists within the curriculum field; (3) offer a new metaphor of the field as 'a critical curriculum river' that meanders extensively to help understand these theorists' complex journey, including the battles fought for control of the field; and (4) examine and lay out a critique of the reconceptualist movement. (p. 1)

Only then can MBE truly emerge as a new field, not anchored in any one discipline or in the positivist epistemology that has ruled education over its history, but as an itinerant field that follows a rhizomic model of "ands" instead of "ors" (De Freitas, 2012; Strom, 2015).

In short, what is needed in MBE is not a new and more sophisticated scientific educational curriculum but a decolonizing curriculum theory that goes beyond the struggle for curriculum relevance and beyond the tensions between science and education as described in the MBE literature, to assume an "itinerant position" (Paraskeva, 2011). Here, cognitive fluidity and non-fixity drive the struggle for curriculum relevance away from knowledge epistemicides and toward a different and more just path. But the question remains, does the field, as represented by its literature today, have the level of intellectual honesty required for such a shift?

Education, Science and Knowledge Control

No institutional apparatus has been employed more completely as a global tool for the control of knowledge than the Western educational system. What is of note in that system is that at the end of the nineteenth century it, too, went through an epistemological shift where the metaphor of "the mind as a muscle" (Paraskeva, 2011, p. 22), began to impose a new social order in the United States via a mainstream curriculum in which only institutionally authorized knowledge was to be diffused in schools. This move, which further solidified the culture of positivism (Giroux, 1981) was fundamentally concerned "with controlling and dominating the natural and human environment" (Wexler, 1976, p. 8), thus fostering cognitive passivity (Kincheloe, 1993) through a colonizing curriculum built on a persistent legacy of genocide with respect to all other knowledge forms.

A dark chapter in the history of American education (and not limited to the United States but extending globally to all colonizing empires of the West) includes the outlawing of indigenous languages and cultures and the forced removal of indigenous children from their families and cultures in order for them to be "educated" in "modern" schools by Western

(superior) thinking (Smith, 1999) educators. No place is the politics of location (Braidotti, 2013; Haraway, 1988) then more relevant than in the classroom, where the battle over knowledge is played out by educators and where the dominion of science is presented as an authorizing corpus of knowledge, without being analyzed with respect to its perpetuation of cognitive and social exclusions. As Freire (1987) argued, *naming the world* is directly linked to claiming it and to claiming those ways of viewing the world that count as legitimate within the context of lived experiences —this speaks to the knowledge that has been systematically excluded and erased from the educational process of subaltern populations (Darder, 2012).

In presenting itself as the overarching knowledge authority, achieved by a specific set of cognitive techniques that reflect a hegemonic society ruled by excluding norms and values, science has undermined other ways of knowing in order to shroud and eliminate conflicts that would normally catalyze new knowledge paradigms—paradigms that might question those formerly unquestionable epistemological conceptions of the world and the interests that inform them. In other words, science, has been amputated from its own historical etiology, no longer taught as a complex field of argumentation and counter argumentation based on contested theoretical and procedural frameworks, but instead as neutral and objective while concealing moral, intellectual, and political conflicts (Gouldner, 1970). Students are therefore introduced to a scientific methodology that lacks contestation of its objectives, its methods, and the foundation of its paradigms (Dreeben, 1968, Paraskeva, 2011). In this way, science is no longer an ideology, in Gramscian terms, but an objective applied notion that has done away with discords and is understood as the true sources of scientific progress.

This is especially worrisome in a field like MBE, where there is a push to bring together two systems of knowledge without allowing for engagement with the conflict that should and must arise from such a meeting. From an indigenous perspective, for example, "science is an abstract, symbolic, and metaphoric way of perceiving and understanding the world" (Cajete, 2008, p. 494). This is in direct contradiction to the Western cultural perspective that views science as a rational way to solve problems. But these two approaches might share some complementary dimensions if they were allowed to exist side-by-side and engaged in the Freirean sense horizontally (Darder, 2015). Cajete (2008) likened this to "the sacred twins in Native American mythology, they are by nature intimately interrelated. Each derives its meaning from the other" (p. 494).

Such a vision, however, is beyond the reach of MBE, where the gap between research and practice persists because neuroscience aims to install the rational as supreme rule within education. Yet, Cajete (2008) again has reminded us that, from an indigenous perspective, science as a whole is based on *both* the intuitive and rational minds. This perspective moves more inclusively beyond the "boundaries of objective measurement" and honors the importance of "direct experience, interconnectedness, relationship, holism, quality, and value" (Cajete, 2008, p. 491). These standards of Native American science are far more in line with the standards and values of an emancipatory education approach; and, more importantly, could work to transform the exclusions of Western science if it were to "allow for more holistic and integrated perception of itself to take hold and grow" (Cajete, 2008, p. 496); and, as such, perhaps the bridge between neuroscience and education would no longer be "a bridge too far" (Bruer, 1997).

Giroux (1981) has noted, "American educational theory and research became firmly entrenched within an instrumentalist tradition that defined progress as technological growth and learning as the mastery of skills and the solving of practical problems" (p. 5). This is precisely the kind of educational theory that the field of MBE wishes to advance. This "instrumentalist tradition" is now even more engrained within the new evaluative instruments made available by neuroscience, in concert with the definition of learning "the mastery of skills and the solving of practical problems . . . [as opposed to a] natural activity for all human beings [that is] lifelong and holistic" (Cajete, 2008, p. 496).

It cannot be overlooked that even considering the question of the enduring gap between neuroscience research and classroom practice in MBE feels intellectually dishonest, as it assumes the question to be left open for discussion from different paradigms, including that of education. But, in reality, when answering the question, "What knowledge is of most worth?" (Spencer, 1860, p. 84), MBE still promotes the ideas of Spencer (1860), who pioneered a functional curriculum design based on identifying and classifying human activities that became the predominant way of thinking within the U.S. educational system. Accordingly, the field answers the question indirectly, by stating that "not science, but neglect of science, is irreligious" (Spencer, 1902, p. 45). The Spencerian conception of a worthwhile curriculum has had major repercussions on the U.S. curriculum for over a century (Paraskeva, 2011), and MBE falls right in line with Spencer's (1860) vision:

> Science. This is the verdict on all the counts. For direct self-preservation, or the maintenance of life and health, the all-important knowledge is—Science. For that indirect self-preservation which we call gaining a livelihood, the knowledge of greatest value is—

> Science. For the due discharge of parental functions, the proper guidance is to be found only in—Science. For that interpretation of national life, past and present, without which the citizen cannot rightly regulate his conduct, the indispensable key is—Science. Alike for the most perfect production and present enjoyment of art in all its forms, the needful preparation is still—Science, and for the purposes of discipline—intellectual, moral, religious, the most efficient study is, one more—Science. (p. 84)

This, therefore, is the push in MBE today, because if science rules supreme, then our very methods of teaching and pedagogy must themselves be scientifically valid. Neuroscience then is not meant to learn along or with education; it is not even meant to simply impact it. There is, moreover, a quest to obliterate conflict between the two fields, by assuming authorship and authority over education. Hence the gap is simply because the take-over of education by science is not yet complete. This echoes the sentiment of Smith (1999) when she argued:

> Imperialism and colonialism are the specific formations through which the West came to "see," to "name," and to "know" indigenous communities. The cultural archive with its systems of representation, codes for unlocking systems of classification, and fragmented artifacts of knowledge enabled travelers and observers to make sense of what they saw and to represent their new-found knowledge back to the West through the authorship and authority of their representations. (p. 60)

This colonizing approach is found throughout the literature and language of MBE, on both the educational and neuroscience side. Science's imperialism of course, as shown in the previous chapters, was, ironically, born of the Enlightenment period and its modernity project and then facilitated by the industrial revolution (which transformed schools into assembly lines) as well as

the philosophy of liberalism (with its focus on individualism), which determined Western scientific knowledge to be superior (Smith, 1999).

How, then, can science stand to save education, when science set up the modern educational system specifically to discover, extract, appropriate, and distribute what it deems legitimate knowledge, in an organized, excluding, and systematic way? If MBE aims to move forward in ways that actually tackle the problems faced by our educational system, it must first examine the history that this system carries and dissect the relationship that exists between knowledge, research, and imperialism, instead of, for example, simply appropriating indigenous knowledge forms where convenient and to its own benefit, only to turn around and continue its epistemicidal project of colonizing the minds of teachers, students, and the educational system as a whole. In other words, it is science, with its hidden curriculum—that, on one hand, promotes itself as ideologically neutral and, on the other, harkens *positional superiority*, as Said would put it—that is itself the source of the problem.

The Hidden Curriculum of MBE

So, if in both science and education ideology is declared dead, what has emerged is an Orwellian reality that has been both naturalized and normalized as common sense and embedded into the hidden curriculum of hegemonic schooling (Darder, 2012). Michael Apple (1990) has noted that the hidden curriculum consists of "the norms and values that are implicitly, but effectively, taught in schools and that are not usually talked about" (p. 84). Simple examples are the great psychological premises of American education: (a) that the aim of life is happiness, that is maximum pleasure; and (b) that egotism, selfishness, and greed, as the system needs to generate them in order to function, actually lead to harmony and peace (Fromm, 1976).

Similarly, widespread proclamations of self-esteem within American education, rooted in quasi-scientific explanations, belie the underlying conditioned passivity of hegemonic schooling, particularly with respect to racialized and impoverished communities (Bergeron, 2017).

Ironically, these deceptive notions are also the basis for the failure of the "Great Promise" of education in the United States (Paraskeva, 2011). The hidden curriculum, however, goes even further. As Ivan Illich (1971) noted, the hidden curriculum "adds prejudice and guilt to the discrimination which a society practices against some of its members and compounds the privilege of others with a new title to condescend to the majority" (p. 33). It is part of the bureaucratic and managerial functions of the school and serves as a place and ritual of initiation into a consumer society obsessed with the aims of science to explain, to conquer, to perfect, to demystify, and to own (Illich, 1971). Perhaps, this is why scholars who identify themselves as critical neuroscientists—who are concerned with the tremendous pace of developments in neuroscience and an increasing emphasis on using these findings to impact the cultural and the social lives of human beings—push back against the hegemonic curriculum of the field (Choudhury & Slaby, 2012).

But how does this hidden curriculum emerge in MBE? The literature in the field reveals that a major concern continues to be the gap between neuroscience and education as well as attempts to move beyond this gap. But what is missing is an understanding that this gap itself is a reflection of the hidden curriculum or the pedagogical *unsaid*, which aims to deform knowledge into discrete and decontextualized technical skills that are then packaged to serve the politics of ideological conformity that support the interests of big business at the expense of humanity (Paraskeva, 2011; Steiner et al., 2004). Giroux (1988) maintained that our systems of reason

"always represent patterns of judgments about the nature of knowledge, classroom social relationships, and the distribution of power" (p. 15). To focus on systems of reason is to consider the rules and standards that order the practices of curriculum and teaching.

The field of MBE since its inception has struggled with how to bring together seemingly opposite fields, given the limiting positivist lens that informs its production of knowledge. Under this explanation, schooling embodies a style of comparative thought that differentiates, distinguishes, and divides (Popkewitz, 2009), preventing MBE from having the type of truly transformative impact that education needs today. This is partly so because the field continues to function unaware of its ideological historicity, when the fact is that "These rules and standards are historically produced, and function as cultural theses" (Popkewitz, 2009, p. 303) within the overarching curricular endeavors of American education. Along similar lines, Giroux (1981) argued:

> The hidden curriculum represents one of the most important conceptual tools by which radicals can explore the dialectical relationships and tensions that accompany the process of reproduction at the level of day-to-day classroom interactions...to make sense of the hidden curriculum means that schools have to be analyzed as agents of legitimating organized to produce and reproduce the dominant categories, values, and social relationships necessary for the maintenance of the larger society. (p. 72)

Hence, to try to make sense of the hidden curriculum means that schools have to be analyzed as legitimating agents that labor to produce and reproduce the dominant values, and social relationships necessary for the maintenance of the status quo (Paraskeva, 2011). Therefore, MBE cannot break loose of its unexamined hegemonic intentions without undertaking a critical

examination and exploration into the dialectical tensions that accompany the process of reproduction at the level of day-to-day classroom interactions and the asymmetrical power relations that belie its democratic pronouncements.

As Paraskeva (2011) argued, an accurate examination of the nature of conflict enables one to explicitly experience the profoundly political nature of curriculum content, unveiling the overt and intricate nexus between the hidden curriculum and the knowledge relayed via school dynamics. Moreover, for MBE to consider the gap in the field, it must first recognize that social change and progress emerge and are fueled by the dynamics of conflict. These dynamics cannot be dissociated from the curriculum as a mechanism of knowledge construction. With such dissociation, "there [will be] no union between the school and society" (Gramsci, 1971, p. 35). In short, any analysis that does not take into account the asymmetrical power dynamics that inform the pedagogical culture and political vision of the educational process within and outside schools is likely to fall into reductive and instrumentalizing conclusions related to student achievement—a conclusion that squelches the dynamics of transformation or strategies of resistance necessary for structural change.

Critical educational theorists (Apple, 2004; Darder, 1991/2012, 2015; Freire, 2000; Giroux, 1981; hooks, 1994; McLaren, 1998) have long argued that it is the job of teachers to work critically within their classrooms and out in the world in order to unveil the hidden curriculum of oppressive pedagogical notions and to reinvent and re-imagine a pedagogy for the evolution of social consciousness. In the case of MBE, this task falls not only on teachers, but also on anyone who identifies as an MBE scholar, practitioner, or "neuroeducator," given that

MBE has always aimed to situate itself squarely as part of the larger field of education (Tokuhama-Espinosa, 2011a).

Therefore, it is the job of those who claim to have an interest in social justice to work to unveil the hidden curriculum of the field, and "the tacit ways in which knowledge and behavior get constructed" (McLaren, 1994, p. 191), instead of trying to get teachers and students alike to comply with dominant ideologies and pedagogical practices tied to Western scientific thinking and its ramifications. It is, moreover, the job of social justice advocates who claim interest in the field to require that MBE be submitted to a wider form of analytical accountability, recognizing that

> the crisis of the curriculum and organization of the schools, i.e. of the overall framework of a policy for forming modern intellectual cadres, is to a great extent an aspect and a ramification of the more comprehensive and general organic crisis [of capitalist inequalities]. (Gramsci, 1971, p. 40)

The conflict between neuroscience and education must thus be viewed from different perspectives. From a Marxist perspective, for example, conflict is actually considered be to a necessary source of social change and innovation. The conflict between neuroscience and education could be understood as a key dialectical moment for engaging the dynamics of legitimization and potential emancipatory possibilities. But this can only occur through a process of critical interrogation, one that begins by asking who is part of the conversation; and why? Who is not part of the conversation; and why? What kinds of issues are at the core of the conversation? Where are the voices of teachers and students? What is the impact of the

conversation on classroom practice? Who benefits from the "complicated" conversation? And, in which language(s) will this conversation be carried out?

Challenging Epistemicidal Formations

It is by engaging conflicts within the field where the potential exists to challenge what de Sousa Santos (1998) denounced as epistemicides. It is therefore important to understand that education is itself a positivist enterprise, drowning under a crisis of curriculum and a call for reform that stems not from a lack of empirical evidence in the field, as MBE suggests, but from the presence of the positivist tradition itself. In order for MBE to move toward a social justice paradigm, it must challenge epistemicidal formations within the field in a new and critically informed way. If we are to understand that the ongoing almost-epidemic call for reform in U.S. education has far less to do with not having the ideal curriculum (which MBE, through the use of neuroscience evidence, now promises) and much more to do with practices and curriculum that dehumanizes students and teachers alike.

Hence, conflict in the field of MBE reflects the larger societal and ideological conflicts at work in a society where both scientific and educational formations reinforce and reproduce considerable social exclusions and inequalities. MBE will forever be plagued by this conflict, so long as we refuse to look at the underlying formations of inequality and instead opt to pretend that all that is needed is a more scientifically sound curriculum. With this mind, the following section examines the medicalization of education, the myth of development, economic priorities, and the language of conquest and colonization as epistemicidal formations that challenge the move toward social justice in the MBE field.

The Medicalization of Education

As noted in the last chapter, throughout the MBE journal, comparisons with the field of medicine are common. In these comparisons, MBE scholars often point to the ways in which research and practice are thoroughly intertwined in medicine, resulting in huge improvements in treatments and interventions (Fischer, 2009). Other examples such as meteorology, cosmetics, food processing as well as automobile manufacturing, agriculture, the chemicals industry and construction are used to pose the rhetorical question: "What happened to education?" The lamentable answer, of course, is that education has been left behind; and thus requires a hefty dose of the medical model to bring reform to contemporary notions of schooling.

Claiming that "every major modern business grounds itself solidly in research that is shaped by practical questions about how products function and how they can be used effectively in context" (Fischer, 2009, p. 3), the field views itself as the scientific and business solution to the problems of education. Despite staking its claim as part of departments of education, the field seems oblivious to the history of science in education, as well as previous attempts to "fix" education using both scientific and business models, with catastrophic results. Ironically ignoring scientific research that shows Black children, for example, are twice as likely as White children to be put into programs because of brain deficits (Children's Defense Fund, 2007), the field forges on with a need for a *new science* (Fischer et al., 2007) to save education from its humanistic peril. Even more ironic, the comparison between medical research and medical practice is used to argue that research must move beyond the ivory tower and into the arena of "real" life, in order to ensure that educational practices are made "available for scientific scrutiny" (Fischer et al., 2007, p. 1). While there is no talk of whether such a comparison could

or should be made, the language of interweaving and reciprocity of the medical and educational fields peppers the literature throughout.

These comparisons are then used to make the case that "Knowledge- and evidence-based approaches to education put forward the fact that educational systems are inadequate to provide an answer to the challenges of the 21st century" (Pasquinelli, 2011, p. 186), making the claim that scientific principles should guide education, rather than intuition or professional wisdom. Schools are regretfully deemed "to be a science-free space" (Hille, 2011, p. 63) with "no culture of applying science to the classroom" (p. 64), while others in the field call for integrating ''translational research'', as done in medical research by "a special type of scientist" (p. 63), as a means to ensure "transferring" neuroscientific findings into education (Hille, 2011).

Ultimately, it seems the argument is that educational practice and policy must be medicalized; that is must be based on empirical evidence, as the time has come for "education, biology, and cognitive science, to join together to create a new science and practice of learning and development" (Fischer et al., 2007, p. 1). In this way, MBE views itself as a vehicle for making education more empirically sound, by specifically seeking to introduce medical clinical approaches within classrooms. Interestingly, at the same time, in its 2002 Educational Strategic Plan, the U.S. Department of Education set a specific goal to transform education into an evidence-based field and to increase the relevance of research to meet practitioners' needs, asserting that

> unlike medicine, agriculture and industrial production, the field of education operates largely on the basis of ideology and professional consensus. As such, it is subject to fads and is incapable of the cumulative progress that follows from the application of the

> scientific method and from the systematic collection and use of objective information in policy making. (U.S. Department of Education, 2002)

This demonstrates that the push by MBE is similarly met by a push by national imperatives to make education more empirically (that is, scientifically) based—thus more like medicine.

But what the argument for this scientification formation of education in MBE essentially does is to bolster and enact, as mentioned earlier, what de Sousa Santos (2009) called abyssal thinking:

> Modern Western thinking is an abyssal thinking. It is a system of visible and invisible distinctions, and the invisible sustain the visible. The invisible distinctions are established through radical lines that divide social reality into two distinctive realms: the universe from this side of the line and the universe of the other side of the line. The division is such that the other side of the line vanishes as reality, becomes nonexistent and is simultaneously produced as nonexistent. Everything that is produced as nonexistent is radically excluded for it lies beyond the realm of what the accepted conception of inclusion. (p. 23)

It is not difficult to imagine a future in which classroom teachers are expected to use neuroscience methods to diagnose normalcy on one side of the divide, making everyone on the other side simply irrelevant or nonexistent. Thus, scientific knowledge and modern law, de Sousa Santos (2009) argued, represents the most accomplished pillars of modern Western abyssal thinking:

> In the field of knowledge, abyssal thinking concedes to modern science the monopoly of the universal distinction between true and false. Tensions between science, philosophy

> and theology are explicit although they occur just on this side of the line. Its visibility is based on the invisibility of forms of knowledge that do not fit into any of these ways of knowing. I refer to the popular, lay, plebeian, peasant and indigenous knowledges across the line. Across the line there is no knowledge, there are beliefs, opinions, magic, idolatry, intuitive understandings, or subjective, which, at best, can become objects or raw material for scientific inquiry. (p. 8)

Once neuroscience rules supreme, fighting for the inclusion of children who are "othered," or advocating for inclusionary practices where diversity and difference are viewed not through the dichotomous black-and-white lens of science will become increasingly difficult. This is especially true because this "epistemological disenfranchisement" (Connell, 2007, p. 109) is not limited to MBE. In education itself, despite small disruptions in the 1960s and 1970s (Bowles & Gintis, 1976; Henry, 1963; Jackson, 1968; Jencks, 1972; Kozol, 1967) that for a moment inflamed the U.S. curriculum field (Paraskeva, 2011), what persists is the culture of testing (Darder, 2012), which is being further developed into the push for "the shaping of individual brains via targeted practice in the classroom" (Szucs & Goswami, 2007, p. 120), as the new definition and formation of learning. All this is happening alongside the simultaneous demand for policy-making anchored in science (Alberts, 2010), which has become more vociferous in the three decades.

Researchers who promote the push for neuroscience, with its medical formation, into education argue that "the objective of evidence-based education at this level is to ensure that future research on education meets the criteria of scientific validity, high-quality, and practical relevance that is sometimes lacking in existing evidence on educational activities, processes, and

outcomes" (Davies, 1999, p. 109). Such a reductive analysis ignores the relational and more encompassing vision of democratic education by failing to recognize its capacity for resistance and transformation of injustices within school and society. But this reductive vision is deeply ensconced not only in science, but also in the arena of education and educational policy.

Accordingly, despite concerns in MBE about the field's lack of impact in education, the fact is, the time is now ripe for science to enter education in even more exclusionary ways. This, unfortunately, sits rather comfortably in the field as well as within the larger society, given normalization of the belief that limited and faulty cognitive capacities lie within the individual, rather than as socially emergent conditions of a deeply unjust capitalist society (Augoustinos, 1999). This echoes the traditional medical model's orientation, wherein a problem exists solely within the individual and the physician's task is to fix the problem.

What is more, as Paraskeva (2011) argued, epistemology helps us understand that the knowledge of reality is inevitably limited by the (technical/scientific) means and methods used to investigate and discern what constitute truths. Researchers in MBE call for empirical investigations, which take place in real learning contexts; claiming that these are required, in order to establish evidence-based education. Even the language of "empirical investigations" and "educational treatments" and "empirical evidence gathered through reliable, methodologically sound evaluations'' (Pasquinelli, 2011, p. 187) are is based on colonizing sensibilities that point to an absolute truth that is held in the hands of the scientific (or medical) expert.

What is most worrisome is that if we create a new rule in education where only that which is supported by empirical evidence is valid, we are, wittingly or unwittingly, bound to disempower teachers and students who are now the "objects and raw material for scientific

inquiry," pushing the entire field "across the line." Unfortunately, according to Pasquinelli (2011), this seems to be the very aim of MBE, namely to lead the field toward:

> (a) the generalized feeling of the necessity of reforming education; (b) the idea that education is too much of a crucial condition for the development of individuals and society to be influenced by prejudice and bias in favor of tradition. We must know *what* works, and eventually *why* it works—thus establishing a fully scientific approach; and (c) the analogy with healthcare institutions and methods. (p. 187)

But these aims as well as the language used to articulate them are the tools of conquest and control used often, as history shows, at the price of the misuse and destruction of nature.

Some have also argued "neuroscience and any conjecture of 'normal', therefore, needs to be performed not just by neuroscientists but by social scientists," and "those who will be at the receiving end of such theories and diagnoses and who are at risk of exclusion" (Billington, 2017, p. 875). But from a decolonizing perspective, the desire to reduce humanity to binary categories of normal and abnormal is itself problematic. Dumit (2011) noted,

> There are concerns in any studies which attempt to find 'normal' whenever in the sampling they fail to take into account, for example, 'such characteristics as age, ethnicity, handedness, culture (refugee status), sexuality, familial histories, past head trauma, and medical history [which] are all still unknown confounders. (p. 201)

These failures, Dumit (2011) further argued, "fatally compromise" many neuroscientific studies because "there are so many different definitions of normal, of who could be included as a normal control, and how explicitly their attributes should be noted" (p. 201) that attempts to standardize

a database ends up being a contrived affair and, thus, makes little sense beyond an ideology of social control.

Yet these efforts persist, leading to the danger that "neuroscience will merely lead to the 'same old' antics, generating new technologies in pursuit of a new 'normal'"; and, as the field encroaches into education, "it is possible that neuroscience and education might ignore the opportunity to focus on the benefits of diversity and aspire instead to the eugenicist dream of unearthing perhaps just a few fortunate 'supernormal who have no probable pathology'" (Dumit, 2012, p. 200), upon whom we can build some kind of "utopian/dystopian future" (Billington, 2017, p. 875). As this pursuit of 'normal' continues, it is possible, as has been in the case of psychology in the past, that new neuroscientific pathologies would rise with potentially more serious consequences (Hyman, 2010), especially for those already marginalized, while fabricating epidemics in an ongoing attempt to formalize diagnoses (Kutchins & Kirk, 1997).

In this way, the science offered by brain images may not only be misleading but could be in danger of crudely repeating old mistakes. Of this, Bao and Pöppel (2012) argued, "An uncritical use of new imaging technology may open the door to a new kind of old fashioned phrenology" (p. 2144). Even if the images and "evidence" offered by neuroscience might not be misleading in and of themselves, their inclusion in education without critical preparation and engagement of what these mean and their varied impacts can "merely enhance the processes and procedures of psychopathologisation" (Billington, 2017, p. 875). MBE, then, if it seeks to present itself as a transdisciplinary field, must spend far more time and energy addressing these concerns both in the literature and within its practice. Moreover, about the folly of perpetuating such an exclusionary formation within education, Billington (2017) noted:

> The impact of a century of exclusion in education cannot be calculated because persons cannot be calculated while the value of human qualities such as dignity, respect and courage in the face of oppression is opaque to a positivist science. As educators, therefore, we might be well-advised to sustain our focus on the value of our own work with young people, the subjectivities and mind (i.e. as process) which lie beyond any scan. It would be a serious educational, psychological and indeed serious scientific error were we to ignore the void that exists between compelling images of electrical activity in the brain and the actual experience of persons which remain much less accessible to any form of neurological or psychological reductionism; "there is an abyss between knowledge and experience which cannot be bridged scientifically." (p. 876)

The Myth of Development

As mentioned earlier, a major area of concern for scholars in MBE is the issue of neuromyths. The creation of these "biased distortions of scientific fact" (Howard-Jones, 2014, p. 1), however, is mainly blamed on educators and/or lay people who are not trained in the sciences and perpetuate myths because of their ignorance. Article after article in *The Journal of Mind, Brain, and Education* make references to the dangers of neuromyths and the importance of guiding against them (Christoff, 2008; Grotzer, 2011; Lindell & Kidd, 2013; Pasquinelli, 2012; Tardif, Doudin & Meylan, 2015), as well as on the importance of "Educating to Use Evidence in Thinking About Education" (Newcombe, 2013, p. 147). Ironically, the tendency toward reductionism is highlighted in the discourse around neuromyths in the field, but without any discussion of the reductionist tendencies of science.

According to Shiva (1993), modern Western patriarchy's special epistemological tradition is reductionism because it not only "reduces the capacity of humans to know nature both by excluding other knowers and other ways of knowing, but also because it manipulates science as inert and fragmented matter" (p. 22). In a way, such a reductionist mechanism is "protected not merely by its own mythology, but it is also protected by the interests it serves. Far from being an epistemological accident, reductionism is a response to the needs of a particular form of economic and political organization" (Shiva, 1993, p. 23). The mechanical reductionist Western scientific paradigm, Shiva (1993) argued, together with "the industrial revolution and the capitalist economy are the philosophical, technological and economic components of the same process" (p. 24).

Yet, there is no such discussion in the literature on neuromyths in MBE. At best, one might say that scientific training has been so successful as to render these researchers blind to their own biases. At worst, one wonders if all the talk about the dangers of neuromyths is nothing more than lip service, as the field pushes its colonizing agenda of development. The irony here is reminiscent of the Plan of the Millennium where 10 or so industrialized countries through the United Nations appointed committees that involved research by distinguished scholars and prestigious universities. These then produced reports that raise funds to fight poverty; money that was—ironically—solicited from the same people whose wealth is founded on the corporate systems that produce poverty and whose policies keep it in place (Mignolo, 2011). "The same vicious cycle informs the fight against pollution and global warming" (Mignolo, 2011, p. 295) and, it seems, MBE, as well. In other words, the truest neuromyth seems to be the myth of modernity that would have us believe that our world can only be genuinely known through

dispassionate inquiries and transcendent postures of scientific neutrality, as defined by Western philosophical assumptions of knowledge (Darder, 2011a).

Many such examples of the myth of development exist in the literature where neuroscience aims to make its case in education. A common (and far simpler) example of how neuroscience research has been able to successfully inform education, for instance, concerns high school opening times. Research on circadian rhythms in adolescence has shown that adolescent body rhythms are naturally shifted (Crowley, Acebo, & Carskadon, 2007), so that high school students find it difficult to get to sleep and wake up as they must, if they are to start school at 7:30 a.m. What this research ignores, however, is the colonizing history from which the school system emerged (Bowles & Gintis, 2011; Darder, 2012), so that rules focused on productivity rather than human needs have forced adolescents to wake up against their circadian rhythms for generations. Similar arguments can easily be made regarding neuroscience's other great claims of contributions to education, such as the case of remediation of learning disabilities (a construct created by science), or neuroplasticity—whose negation by science caused centuries of oppression. So while it is true that scientific evidence can also help us question our common-sense traditions, we must first question from whence common-sense traditions originated, if we are not to reproduce them.

In short, the trouble with neuromyths is not just that "the cognitive and brain sciences have been misunderstood, and misused" (Pasquinelli, 2012, p. 89). The problem isn't simply that "there are many hypotheses in science which are wrong" (Sagan as cited in Pasquinelli, 2012, p. 89), but why? Why does scientific information, even wrong scientific information, feed into "neurophillia" (Pasquinelli, 2012, p. 91)? Are the reasons limited to the untrained mind of

educators and the general public, or the communication shortcomings of the media, as the literature in MBE suggests, or is there something deeper going on? Are the dangers of the persistence of neuromyths and the appetite for brain news simply due to "deeper cognitive intuitions" (p. 89) that favor confirmation of bias or the tendency to seek or interpret fresh information in a way that confirms previous beliefs (Nickerson, 1998) limited by unfounded notions of hemispheric specialization? Or does neuroscience promise to confirm our hidden desires for power? Can MBE truly protect itself from the rise and dangers of "neuromarketing" (Lindell & Kidd, 2013, p. 35) and "the seductive allure of neuroscience explanations" (Weisberg, Taylor, & Hopkins, 2015, p. 429) without asking why it is that "by implying a strong scientific basis, 'brain-based' product names are remarkably effective in implicitly manipulating consumer opinion" (Lindell & Kidd, 2013, p. 35). In other words, how can the field critique and fight the engrained beliefs in the larger culture about the powers and prestige of science, at the same time that it forms itself on that very belief in the power and prestige of science as necessary for legitimizing educational practice?

Moreover, we cannot ignore (as noted above) that such research is (re)produced by the same institutions that have created the problems of inequality and exclusion in the first place. So in inquiring about the problems of education, like those of hunger, justice, and inequality, one cannot help to wonder, for example, about the

> undying myth of development, that it will remove all poverty forever from all corners of the world . . . [when the fact is] "that even societies that have witnessed unprecedented prosperity during the last five decades, such as the United States, have not been able to

> exile either poverty or destitution from within their borders. (Sen as cited in Mignolo, 2011, p. 303)

Correspondingly, this similar "undying myth of development" that neuroscience will ameliorate all our educational woes once and for all, which is the biggest myth within MBE and the dark undercurrent of the MBE movement. In fact, as Mignolo (2011) argued, the real answer lies in "decolonizing development" (p. 302) and, in this case, decolonizing MBE.

In my own work as an educational therapist, for example, I can attest that the biggest gains my students make are due to the trusting relationship we build together, and to the old pencil and paper methods and consistent hard work and sweat they put in, more than any brain-based tool I use. So while I do use neuroscientifically based methods and tools, it is exactly because I remember that they are my tools as a teacher and not the other way around, that I am able to use them effectively. This is not the case, however, with many of my colleagues and parents who have these tools marketed to them directly and who, inadvertently, turn over all power of their own knowledge, history, and experience to them.

When we leave out issues related to power and exclusions within the history of science and education in this country, we also close off the possibility for "openly discussing disciplinary differences and assumptions" (Fisher & Daniel, 2009, p. 2). How can we, therefore, critique neuromyths and the dangers of the brain-hype without a deeper interrogation of the epistemological roots that inform them and how the field promotes these neuromyths for its own economic and political interests? Does simply acknowledging that neuromyths exist and placing the blame on the media or the shoulders of the layperson who, also uninformed about science, "buys into" what the media peddles, relieve the field of ethical responsibility? And if the

solution is "building a *trans*disciplinary framework that focuses on issues of interest across the disciplines and methods" (Fisher & Daniel, 2009, p. 2), can we really ignore decades of work tied to pedagogies of liberation and critiques of science, whilst we hang tight to old colonial frameworks? If MBE aims to inform education in an increasingly global world, can we do this work without "remapping the order of knowing" (Mignolo, 2011, p. 77) and addressing its own contradictions inherent in its formations?

About this, Emmerich (2015) argued:

> What is required is a more acutely socio-political understanding of not only the neurosciences and what they have to offer but also of neuroethics more generally. Human beings are not simply neurological, or even biological phenomena. We are made up of socio-cultural and historical elements and, like psychological discourses before it, the neurosciences are now part of this realm…There needs to be a greater level of dialogue and engagement between neuroscience and social science if we are to use the knowledge and technologies that emerge from this domain in a politically, and not just ethically, responsible manner. ("A Broader View" section, para. 3).

As such, under the guise of promoting development or the claim that "the diversity of abilities and disabilities will help educators and parents to facilitate individual students' learning and development" (Fischer et al., 2010, p. 68), we have to be careful that we are not simply reproducing the very same lines of economic, racialized, and gendered divisions that we politically claim to want to eliminate.

Moreover, to create "a strong research foundation for education requires a collaborative approach," as MBE scholars assert, "with a two-way dialogue in which practitioners and

researchers work together to formulate research questions and methods so that they can be connected to practice and policy" (Fischer et al., 2010, p. 68), in ways that do not reproduce old myths of inequality and exclusion. Unfortunately, instead of representing and integrating the voices of teachers and students, MBE researchers often try to scientifically dissect and understand why differences exist, producing lists of categories such as "differences in orientation" and "lack of understanding of the entrenched and unspoken differences across research disciplines" and "special challenges for interdisciplinary fields" (Kalra & O'Keeffe, 2011, p. 163). Moreover, this is carried out without considering that perhaps this is not a question that can be answered using scientific methods, but rather requires conversations that begin with acknowledging the question of humanity and the wealth to be found within the silenced knowledge of those we seek to "save."

From this vantage point, MBE must ask new questions that move away from trying to identify what is wrong with "the other" so as to fix it, and instead support emancipatory conditions where teachers and students can participate in posing and answering questions essential to their own well-being. In short, instead of pathologizing the divisions in the field, the way forward is to examine how cultural formations within the field inform these divides, in order to better "let the questions be your guide" (Rose, Daley, & Rose, 2011, p.153).

Economic Priorities

In an alarming study about the allure of neuroscientific explanations and neuromyths, Weisberg et al. (2015) showed that people find explanations more satisfying when they contain irrelevant neuroscience information and are then offered a number of reasons as to why this may be. The first reason offered is that explanations that reference "harder" sciences are seen as

generally more legitimate across disciplines (and even a more pronounced effect in psychology, which holds a general bias toward making psychological explanations sound "more scientific"). A second explanation is that people are intuitively dualist. Yet another is that people tend to embrace causal explanations and are particularly biased toward teleological information that provides evidence of an ultimate cause for an event. And finally, the authors asserted that it is possible that neuroscience seduces because of a general preference for reductive explanations.

However, what is missing from these arguments is an acknowledgement of the commonsensical manner in which Western scientific ideology conditions us; which may, perhaps, explain what is behind these tendencies to see with authority anything considered to be scientific. As such, human beings (as in their biology) tend to prefer reductionist, causal, dualist scientific proof, without concern over what knowledge is not allowed to exist. Science has so successfully managed to erase and limit human thinking that we simply now assert our socialization under its reign, explaining it as "how people tend to be." The fact is, it is neither our brains nor biology that make us susceptible to science's exploitations. This ideological phenomenon occurs by epistemological design.

As critics have asserted, "Both psychology and education in their institutional forms became absorbed by the 'modern', a project in which psychological science offered simultaneously both to individualize and to homogenize all human functioning as part of an underlying commitment to progress" (Billington, 2007, p. 869). Neuroscience, then, and brain-based education, specifically, like phrenology before it, are popular perhaps because of the underlying promise of modernization they offer through methodologies that produce tangible economic results. As the studies on the allure of neuroscience demonstrate, modernity has a

"darker side" (Mignolo, 2011, p. 3), such that, in the popularization of neuroscience and its methodologies in everyday life and as part of "global modernities," we are, once again, forgetting the implications of "global colonialities" (p. 3) tied to the advancement of interests held by the wealthy and powerful.

It is no wonder then that with the emergence of the "neuro-world" (Billington, 2017, p. 866) and the dubbing of the 21st century as "the century of the brain," critical neuroscientists are concerned not just with the widespread distribution of neuroscientific research and discourse and the threatening ways in which it is permeating social life (Billington, 2017; Choudhury & Slaby, 2012; Davis, 2004; De Kessel, 2015; De Vos, 2015; Kirmayer & Gold, 2012; Kraus, 2015; Rose, 2012), but also with the ways in which neuroscience methodology promotes the hegemonic power of and profit from neuro-knowledge, all while limiting our actual understanding of the potential of the human brain.

Nonetheless, as the study by Weisberg et al. (2015) and others who have demonstrated how most people simply trust anything with a scientific explanation, name, or a picture of the brain attached (McCabe & Castel, 2008; Lindell & Kidd, 2013) show, the hegemony of empirical science contributes much to the accumulation of capital. The economic consequences of the global prevalence of neuromyths (Howard-Jones, 2014) have been well documented. The billion-dollar brain-based educational industry aside, neuromyths from *Baby-Einstein* and *The Mozart Effect* to *The Myth of Three* (Howard-Jones, 2014) and programs packaged to cure learning disabilities (Goswami, 2006) lay the foundation of a political economy where bad science is shaping policy and misusing public funds in the name of so-called evidence-based education (Howard-Jones, 2014).

So, it is not just that notions of personhood are being radically transformed in this new and growing medicalized context (Vidal, 2009), where neuroscience pushes us toward a reality where "we are our brains" and no more than our "neurochemical selves" (Rose, 2003, 2007), but that such notions are being used to build economic models of educational investment (Heckman, 2008). In this way, "the prefix neuro- has won its final battle" not just because "it has conquered critique itself" (De Vos & Pluth, 2016, p. 22), but because it has done so while turning a hefty profit. Moreover, as Giroux (1988) has argued, the development of psychological science and new technologies not only suppresses historical consciousness but also replaces that consciousness with a new rationality wherein all areas of social existence are informed by the advancement of industrial capitalism. What generally emerges in place of real or meaningful reform is simply the reproduction of an epistemicidal formation that reifies knowledge and acts to pacify minds—all in the interest of advancing capitalist gains.

Language of Conquest and Colonization

Finally, the question of language formation is also of concern in MBE's analysis of why the field struggles with its identity and unity (Knox, 2016; Scott & Curran, 2010). As Samuels (2009) matter-of-factly stated, "Historically, science and education have demonstrated separate, but interwoven, influences on society that have led to a characterization of science as prestigious and education as failure ridden" (p. 46). This language, though is meant to "help," is not only insulting, but also reproduces traditional beliefs about education and educators that are simply not true, reflecting a version of history in which one group is superior over the other and where science reigns supreme (Smith, 1999). Hence, MBE employs a language that, as Smith argued, mimics the "colonizing of disciplines" (p. 65). Accordingly, "academic knowledge are organized

around the idea of disciplines and fields of knowledge" but with the underpinning belief that only science is the "all-embracing method for gaining an understanding of the world" (Smith, 1999, p.65).

In the same way, the linguistic use of the prefix "neuro" and the discourse that follows it is, itself. problematic. The use of this prefix, like the use of brain images, immediately affords legitimacy while undermining other forms of knowledge. The word exemplifies the language of power (Rizvi, Lingard, & Lavia, 2006), "being circulated, not in any neutral way but on the basis of a politically sanctioned authority" (Billington, 2017, p. 868), gaining an ever-expanding sphere of influence (Kirmayer, 2012; Rose, 2006). The fact is,

> renaming teaching as "brain-based education", while keeping the present model in place, is like rearranging the deck chairs on the Titanic. This is because teaching is a social, interpersonal, attachment-based endeavor, ill matched to Western scientific methodologies applied within a model of industrial mass production. (Cozolino, 2013, p. xxi).

Ideology lies deep within a culture and within its language (Darder, 2012). It is therefore imperative to critically examine how the language of MBE and the neuro discourse reflect our unconscious power imbalances.

If MBE is to be a true transdisciplinary field it must be "resistant to a universalizing language—a language of empirical inquiry that has often been anchored in dominant epistemologies" (Darder, 2015, p. 63). MBE research concurs, "learning and teaching require active construction of knowledge" (Fischer, 2009, p. 6) and cites that both cognitive science research (Baldwin, 1894; Bartlett, 1932; Piaget, 1952) and neuroscience research (Singer, 1995)

have demonstrated this consistently for over a century. Hence, to move toward social justice, the field must begin with a shift from the language of *conduit* models of knowledge transmission (Lakoff & Johnson, 1980; Reddy, 1979)—that reflect Freire's (2000) banking model—toward a language of inclusion and reinventing (Freire, 1989), anchored to a political intent where "new readings of the world can unfold in ways that lead us toward change, both in theory and practice" (Darder, 2015, p. 63).

Decolonizing the Field of MBE

At the end of the nineteenth century, a complex social framework (economic, political, cultural, religious, and ideological) emerged in the United States (Paraskeva, 2011). As the Industrial Revolution brought about significant transformations in society, the last two decades of the nineteenth century revealed that schooling was an outdated institution facing the pressures of a newly emergent social order. This marked the beginning not just of new tensions in the curriculum field, but also of a profound and entangled struggle for the control of school knowledge, as well as its social and cultural functions (Paraskeva, 2011). What we see in MBE today is a continuum of this struggle. Moreover, the role of decolonizing challenges aimed at the very core of such political, ideological, cultural, and educational debates over school knowledge cannot be minimized.

A just curriculum that can foster equality, democracy, and social justice can only be born of complexifying the struggle for curriculum relevance and challenging obsolete and positivistic functionalist school systems. In a way, ironically, this is what MBE aims to do. However, as the literature in the field shows, MBE continues to fall short of its goals because it continues to employ the exclusionary epistemology and methods that created the problems. As Freire (2000)

argued, educators who "(even with the best intentions) carry out the revolution for the people" (p. 127) —a process whereby indigenous knowledge is excluded by the curricular imposition of "official" knowledge—"by the same methods and procedures used to oppress them" (p. 128) must be denounced. This calls for the radical ethics embraced by both de Sousa Santos and Paraskeva, who have argued that the struggle for social justice must challenge the coloniality of power and knowledge at the very foundations of West-centric knowledge. This further entails an understanding of what it means to have "a rich and paradoxical engagement with the pertinence of what lay in an *oblique* or alien relation to the forces of centering" (Bhabha, 1994, p. xi).

Thus, as an ethical radical pedagogical project, MBE would also signify an ethical radical political project that engages in the struggle against epistemicides, de-territorializes its approaches, and assumes a critical itinerant position (Paraskeva, 2011). At the heart of this is, of course, the assumption that another knowledge is, in fact, possible—but only when we are able to go beyond the Western epistemological platform, respecting and being attentive to other forms of knowledge, beyond the abyssal divide of the West. Such an approach would require MBE to move away from its current territorialized curriculum wars (predicated on a positivist epistemology of supremacy) and fixed knowledge borders toward epistemological diversity, an itinerant fluidity, and socio and cognitive justice. To move in this direction, MBE must begin with the task of decolonizing itself. As Shiva (1993) noted,

> decolonization in the North becomes essential if what is called the environment and development crisis in the South is to be overcome. The North's prescription for the South's salvation has always created new burdens and new bondages, and the salvation of the environment cannot be achieved through the old colonial order based on the White

Man's Burden, the two are ethically, economically and epistemologically incongruent. (p. 265)

If the past 500 years of history have taught us anything, it is that a relationship of colonization persists in the world today and continues to be reflected within the context of education. Of this colonizing relationship, Shiva (1993) argued,

> The colonizing men and society have assumed a position of superiority, and thus of responsibility for the future of the earth and for other peoples and cultures. Out of the assumption of superiority flows the notion of the White Man's Burden. Out of the *idea* of the White Man's Burden flows the *reality* of the burdens imposed by the White Man on nature, women, and others. Therefore, colonizing the South is intimately linked to the issue of colonizing the North. Decolonization is therefore as relevant in the context of the colonizer as in that of the colonized. Decolonization in the North is also essential because process of wealth creation simultaneously create poverty process of knowledge creation simultaneously generates ignorance and process for the creation of freedom simultaneously generate unfreedom. (p. 264)

For MBE, then, to move toward a social justice paradigm and become a genuinely transformative and transdisciplinary field—as argued throughout this chapter—it must move to overcome its adherence to the coloniality of power and its epistemicidal formations, which perpetuate false conflicts between neuroscience and education (two positivist traditions) and ignore deeper issues of cognitive injustice. More importantly, MBE must integrate silenced epistemologies that aim to liberate and emancipate the educational agenda—for which neuroscientific claims in education are not absolved from participation. The struggle against the

West's eugenic coloniality of knowledge is essential then to pedagogical and political efforts to transform the field of MBE, as well as schools and society. No doubt, such a struggle is a Herculean task, but one that cannot be ignored if we are truly committed to what Freire considered a just and loving society.

CHAPTER 5

TOWARD A SOCIAL JUSTICE PARADIGM FOR MIND BRAIN EDUCATION

In September of 2016, I attended the fourth biannual conference of the International Mind, Brain, and Education Society (iMBES). I knew the work of the group. A few years prior, I had been accepted to the Mind, Brain, and Education (MBE) Master's program at Harvard University, a program I had not technically applied for, but had been encouraged to attend in place of the doctoral program for which I had been waitlisted. Since I already held a master's degree, it did not make sense to me to go into almost a hundred thousand dollars of more student debt for a one-year degree. Yet this seemed to be the advice of the faculty there who presented the one-year master's program as a good way to get acclimated with the work and the culture at Harvard and a good way to open opportunities to move toward doctoral work at the university. This was my first interaction with MBE as a field. It left a bad taste.

Still, I decided to leave the experience behind and for now, as a first-year doctoral student at Loyola Marymount University in a program that felt far more closely aligned with my personal values, re-engage with the field. I had just spent a year delving deeply into social justice issues in education, and I felt strongly that my new understandings of social justice implications with regard to the meeting of science and education might add to the conversation in MBE. I decided to submit a poster that focused on my preliminary conceptual and research design for this study at the conference. I was very excited to have it accepted. To attend the conference in Toronto meant missing two days of work, and over a thousand dollars in travel cost and conference fees, but I did not mind. This was my opportunity to learn alongside the very people doing the kind of work I hoped to be doing once I finished my degree: bringing neuroscience and

brain-based tools into classrooms in ways that could truly support teachers and students. But my three days at the conference turned out to be a very different experience than what I had expected.

From the first keynote, which was given by a prominent psychology professor from the University of California at Berkeley, I felt disconnected. This was not my first scientific conference. I had spent quite a bit of time as an undergraduate student circling medical conferences, trying to figure out if I wanted to stay in the sciences before deciding against it, partially because of the same feeling of disconnectedness. But this was an education conference, and yet, the psychology professor went on for over an hour presenting on her lab's quantitative findings on social cognition and learning, which was hard to follow, despite my science background. It was not long before I started to feel that I was in the wrong place, that my work is not scientific enough for iMBES, and that as an educator and a budding social justice scholar, I certainly did not belong.

That night, as I struggled to fall asleep on the uncomfortable bed at the only Airbnb room I could afford (the conference had been scheduled during the Toronto Film Festival and all accommodations were astronomical in price, which may not have been a hindrance for many, but must have been for some), I found myself crying. Perplexed by my own strong reaction, I decided that the overwhelming feeling that I had wasted my life and gone in the wrong direction by becoming an educator was due to my inherent inability to accept that I had not been smart enough to stick with the sciences. As is the tendency at such moments, I blamed myself, rather than stopping to consider that there might be something about the culture expressed in the

conference that caused feelings of alienation and isolation to anyone whose thinking sat outside its narrow epistemology.

The next day, the feeling got heavier with yet another keynote speaker, presenting on the effects of early life stress on the executive function skills of "at risk" children. But this time, I didn't just feel disengaged and overwhelmed by scientific data and jargon, the language being used (inner-city children, high-poverty kids, subjects, etc.) felt demeaning. For a moment I thought, what if, instead of spending all this money on MBE research, we used that money to actually change the conditions of the schools and communities in which the children being researched must survive? And that's when I first took notice that every keynote speaker, with the exception of one Oxford-educated presenter of East Indian decent, was Caucasian or Euromerican.

The realization made me feel even more uncomfortable. Suddenly, I was aware of my presence and my skin color in a way I never expected to be at an educational/academic conference. Once again, I felt I didn't belong. I looked around for the two MBE graduate students I had reached out to prior to the conference, hoping that connecting with other students would make me feel more at ease. They both worked in labs at a different university in Los Angeles, and I had been excited to share my research with them. However, when we met, and I had explained my approach to them, they seemed confused and not particularly curious. Now, at the conference, one gave me a quick smile from a different table, and the other simply avoided eye contact, despite two attempts on my part to actually wave at her.

Whatever the culture or politics of MBE, I seemed to lack competency and I now found myself using my foot to quietly push my poster tube deep under the table. I was no longer

excited about my poster presentations that afternoon and even contemplated leaving the conference early. At lunch that day, I sat quietly chewing on my salad as students who identified as neuroscientists introduced themselves to one another. At one point, I eavesdropped on a conversation between two researchers complaining about the frustrations of doing research in classrooms, because of the uncontrollable variables that do not allow for funding. No one listening seemed concerned with the irony of that fact. No one seemed concerned with education at all it seemed. "Implications for educators" seemed like an after-thought at the conference much as it was in the papers being presented.

Finally, it was time for the poster sessions. I stood, again quietly, by my poster, as person after person talked to the presenters on either side of me, their posters filled with fMRI images and data graphs before politely passing mine with a smile. The thought to take down the poster and leave crossed my mind more than once, but I kept reminding myself that they had seen my poster ahead of time and had approved it. They had invited me to come, so I could not be that out of place. That is when it first occurred to me that perhaps I was there not because of the merit of my work, but because the words "social justice"—ironically written in big bold letters across my poster—were a necessary accent to the conference. My approach to the work was not a legitimate methodology to them, and as I let my self-criticism get the best of me, my work no longer felt legitimate even to me. The hegemonic force of the hidden curriculum of authority had eroded my confidence and rendered my research irrelevant and inconsequential.

It wasn't until I found myself in the hotel restaurant patio, fighting cigarette smoke and the cold chill of the Canadian fall for a reprieve, that I noticed a small group of three women, brown like me, congregated nearby. "Are you with the iMBES conference?" one of them finally

asked, perhaps noticing my desperate stare. “Yes!” I said and for the first time since I had arrived, I felt safe. They were all educators and they were all bicultural women, and two of them were also from Los Angeles. They didn’t work in the lab with the MBE students I had met, although they attended the same school. They were also doctoral students in an education leadership program and had been encouraged to attend the conference so that they could learn more about the work of the star MBE professor at their school.

When I asked about how the women were experiencing the conference, one of them replied, “I feel like it’s a bit boring.” Yet, there was the sound of intimidation in her voice—a sound that I recognized. I wondered if she meant boring in the same way my students say they are bored when they feel intimidated by school. Then one of them finally dared to critique the absence of educational discourse. “They keep saying education but what does any of this have to do with education? Why aren't there any keynotes by educators? The best talk I've heard so far was done before the conference by a history teacher in the pre-conference workshops. The rest of this conference makes no sense to me.” Her honesty broke the ice, and for the rest of the conference, us four brown women were inseparable, secretly whispering our observations and critiques, not behaving like the dutiful student groupies we were supposed to be, but instead having serious, critical conversations among ourselves about why the research we were hearing about was problematic.

By the third day, our solidarity had given me a new resolve. So, after yet another talk that emphasized the collaborative and interdisciplinary nature of MBE but did not include teachers or students, I raised my hand. “Why is no one on the presenter panel right now, in fact no one presenting at this whole conference, a full-time educator?” I asked the star MBE scholar who had

called on me. The question had struggled to leave my throat, perhaps adding to the force with which it finally came out. We all watched as her face changed, her voice becoming defensive: "No one can be a full-time educator and a full-time neuroscientist," she said. "I used to be a public school teacher," she continued and her emphasis on the point made me wonder if she thought that would get her "street cred" with us. She continued, "but when I decided to do research after a couple years, I was advised by Kurt Fischer to leave the classroom. If you want to be a serious scientist, it's a full-time job." The silence in the room was palpable.

In an attempt to ease the tension perhaps, another star in the field chimed in, "Please keep in mind, this is a very young field and we are still working toward more collaborative research," she said. But it was too late. There was nothing anyone could now say to un-ring the bell we had all heard. The dominant subordinate tensions I had been struggling with throughout the conference were a part of the structures, terms of engagement, and guided recommendations of the field; so, just like that, the MBE scholar, hesitant to be seen as a lowly educator, had shown me that I was in fact, exactly in the right place and that that there was much work to be done—decolonizing work that sought to challenge the field of MBE both for its marginalization of education (considered a gendered or soft science at most) and the isolation of bicultural MBE practitioners who seldom found their cultural knowledge reflected in the articulation of the field.

Hence, from this difficult experience emerged my dissertation focus, in which I have sought to understand the elements necessary for a bicultural or subaltern MBE scholar to enact a decolonizing praxis in the field, in order to unveil and challenge the power dynamics cloaked in the traditional paradigm, underneath a language of "interdisciplinary" collaboration, while simultaneously reproducing inequalities. Of course, returning to that fateful moment at the

conference, I didn't have any of this language as I sat down slowly, wiping the sweat off my palms on the white table cloth, locking my shaking knees so I didn't fall into the heavy silence of the room, worried that I had just burned every important bridge within the field. But later that night, when I sat with my new MBE educator friends at a burger joint in Toronto, candidly sharing how upset we were by the conference, how much money we had all just spent to feel "less than," and what a waste of time and money the research we had heard about was to our actual struggles, a new language started to form. We exchanged numbers. "Don't give up," I pleaded with them. "Let's work on a presentation for the next conference. Let's show them why our contribution matters."

We parted ways and on the flight home, I made the decision to hold on to the difficult feelings I had experienced all weekend, to not try so hard to shake them off, because maybe they were there to teach me something important. These feeling, in fact, became the fuel for launching this study, in that I began to recognize them as my human response to practices of exclusion, which signaled the dire need for a social justice paradigm of MBE to guide our future work in the field. Hence this chapter is an effort to identify a variety of components that must come together in the process of reinventing an emancipatory vision for the future of MBE.

Decolonizing Mind Brain Education

A deep dive into the history of neuroscience, the branch of science that informs MBE, and the epistemological shaping of the American education system by the sciences not only reveals the colonial roots of MBE but also serves as a warning, a sounding an alarm for the potentially destructive consequences MBE can have in education, if it is not re-imagined through an epistemological disruption that shifts the field away from its Eurocentric, scientific,

capitalistic paradigm toward a paradigm of love that honors the genuinely democratic aims of emancipatory education.

In defining critical theory and pedagogy as it relates to education, Giroux (1981) referred to the nature of self-conscious critique and the need for a discourse of social transformation and emancipation that not only critiques positivism but also envisions schools as a place for social and cultural transformation. Such a view embraces a dialectical view of knowledge and a fluid, supple view of humans that is relational, where theory and practice co-exist with the aim to liberate, through an organic resistance to reification, rather than domination (Darder et al., 2009). In his philosophy for a humanizing education and liberating praxis, Freire (2000) further built on this discourse by offering a vision of teachers and students engaged in the process of overcoming authoritarianism and alienating intellectualism by becoming subjects of educational process wherein the pursuit of humanity and a commitment to the process of becoming is at the heart of education. A new paradigm for MBE must rest on these traditions.

However, to accomplish this, a process of decolonization must first be in place. Of this Freire (2000) argued that decolonization begins in our own minds. For communities that have been purposefully neglected and willfully damaged by the colonizing processes of society and schooling, Freire called for an educational project linked with other anticolonial movements for political self- determination to become full subjects of history, in the struggle to control their own destinies. A decolonizing approach to MBE would support such shifts not just in schools but within the field itself. Here, its intentions, research, and practice must aim toward working to develop an emancipatory critical consciousness, from which to take action to produce research that views *all* students and teachers as integral beings (Darder, 2012).

Further, MBE must combat the effects of a disempowering capitalist system, build on a cultural hegemony that relies on "banking" epistemicides within education by first recognizing that these systems exist and challenging them as a significant part of the very mission of the field. In fact, transforming existing conditions of inequality and injustice in schools and society must be at the heart of the MBE movement. A critical awareness of the colonizing hidden curriculum of MBE research and practice is therefore fundamental because only then can the field uncover the actual problems and needs at work in schools in order to create change.

Michael Yellow Bird described this decolonizing process as a different way of knowing (Waziyatawin & Yellow Bird, 2012). In his *conceptual model of decolonization,* Yellow Bird defined decolonization as both an event and a process and of reaching a level of critical consciousness where we have an active understanding that we are (or have been) colonized as an event. But as the historical and epistemological review of the literature in this study has demonstrated, a number of decolonizing principles must also be enacted in order to activate the necessary state of critical consciousness that can serve as the jumping ground for establishing a decolonizing praxis of MBE—an emancipatory praxis that must begin with our own minds.

As I have been working my way through this study, the acronym MBE has regularly conjured an image of the field in my own mind. The image has been a cold one, of an isolated brain with wires that could be EGG wires or computer wires connecting it to nowhere. The acronym has also summoned the color blue, like the brain on the cover of the MBE journal, as well as the feeling of isolation and disconnection that I felt at the iMBES conference. Perhaps this is a feature of acronyms in general, but throughout this study, I have found myself forcing

my mind to pull apart these letters and visualize the words, Mind, Brain, and Education, focusing on the word education as it elicits the warmest feeling, given my lived history and experience.

This may be a more literal way to begin in our own mind than Freire intended, but as I now come to my vision of a socially just paradigm of MBE, I cannot help but think of the visceral experience of this language and its symbolism in my mind and body. It has made me wonder, as I often wonder, about the ways in which we separate and isolate the mind and the brain and the structural, systematic, almost industrial way we approach education. Language, in all traditions, including in the scientific study of it in the field of linguistics, holds the highest place in humanity's attempts to make meaning.

In decolonizing traditions and social justice work, language again carries great power. As Yellow Bird argued, the first activity to engage in is to work within Indigenous cultural traditions to develop words in the Indigenous language for both colonization and decolonization (Waziyatawin & Yellow Bird, 2012). The purpose of this exercise is to provide an opportunity for both individuals and communities to think consciously and critically about the meaning of the terms from within their own cultural framework. Similarly, Smith (1999) talked about the importance of how identifying the literal and figurative meanings of words allow us to own them and thus consciously understand our cultural worldview through our interpretations. In indigenous epistemologies and axiology, for example, where science is about interdependence and resonating with nature, the word "science" itself translates as "seeking life" or "for life's sake" (Cajete, 2000). In short, through the idea that we are participants in science, not just observers or manipulators, the hope of creating a more sustainable and meaningful world and future is embedded in the language.

In this same tradition, I would like to put forth the challenge of consciously and critically redefining the words Mind, Brain, and Education, so that, as educators, leaders, and MBE scholars with a social justice mission, we can own and understand our view of these terms and this field within both *our* cultural understanding of the world and our lived histories of teaching and learning. Therefore, as part of arriving to greater critical consciousness (which is an ongoing and ever-evolving process), there must be a process of creating, restoring, and birthing (Waziyatawin & Yellow Bird, 2012). This process involves restoring cultural practices, thinking, beliefs, and values that were taken away or abandoned but are still relevant and necessary to survival. It also means the birthing of new language, frameworks, ideas, thinking, technologies, and lifestyles that contribute to the advancement and empowerment of communities. As mentioned, the first step of this decolonizing process is the process of daring to unveil the silence and rename our world in ways to center the subaltern voice (Darder, 2018). In this light, for a decolonizing, socially just paradigm of MBE to emerge, we must examine courageously the meaning of the terms that comprise its parts—Mind, Brain, and Education—so that we can reconfigure or reinvent these meanings for a new vision of the field.

The Mind

While Western science has historically and epistemologically separated the mind from the body, other medical traditions such as Chinese, Ayurvedic, and Indigenous medicine do not separate the mind and body. Western medicine has yet to confirm this mind-body connection, thus limiting the way we look at problems all together. But new research, specifically research from neuroscience, confirms that the mind is not separate from the body as in the medical model nor is the mind an isolated mental state or isolated experience (Damasio, 2003; Mate, 2011).

Rather, it is a connected collective that influences and is influenced by other humans, our environment, histories, cultures, and our values and priorities. So, while the word "mind" in MBE seems to invite the study of mind in the Western science and psychological tradition, I would argue that in a decolonized paradigm of MBE, other excluded scientific traditions and philosophies must be now included in our definition of mind (Squire & Kandel, 1999). Such a philosophical perspective would not just call for a rational or critical analysis, but would encourage healthy skepticism, a skepticism that is constantly wary of reductionism and the possibility that the problem may not be the child's mind or brain, in of itself, but rather the context in which the child exists that impacts the mind.

Such a philosophical perspective would also be both critical and synthetic, raising important questions regarding the nature of personhood, the world we live in and how humans fit into the overall scheme of things. In Chinese philosophy an *orientative view* always has the intention to "effect some change in the self or in the world" (Lao, 1989, p. 277). Remembering that our thoughts and feelings are real, not just mechanical as in the Newtonian tradition nor a duality as in Descartes's tradition, and they are not only causally related to our brains but also to our social interactions with the environment and others in the world. As such, the word "mind" no longer conjures images of firing neurons in the brain, but of an expansive phenomenon of integral social interaction, of personal thoughts and feelings, of metaphysics and spirituality as well as an ethics of knowing, which questions the limits of neuroscientific research rooted in the old paradigm of science (Lipton, 2005). In short, the word mind must encourage teachers to adopt a broad philosophical perspective on issues related to the mind and its function, instead of a mechanical one that is both reductive and deterministic, a view that complicates knowledge

construction and the dynamic relations between human existence and the environment of which we comprise one knowing, living, and breathing dimension of the living ecosystem.

The Brain

Perhaps no word is as important and potentially problematic in the field of MBE as the word "brain"—which research in the field suggests may have been included in the name of the field specifically for its allure (Lindell & Kidd, 2013; Weisberg et al., 2015). Whether as part of "brain-based learning" or actual images of the brain or in the prefix "neuro," which also conjures up images of synapses and the cold gray matter of the organ, the word brain has been weaponized in the field simply because of the power and mystique it holds. Demystifying the word and grounding it in the body where it exists, and in connection to others, where even neuroscience research suggests it works best (Damasio, 1995), is therefore imperative to reframing how we understand and practice MBE.

In the Western scientific tradition, the brain is the seat of rational thinking or the mind. But neuroscience research has shown that the ability to think rationally requires a balanced input of emotion and feeling (Damasio, 2000). In fact, it seems that cognition actually rests on an edifice of emotion and that the millions of children diagnosed as having learning-related deficits according to the DSM (*Diagnostic Statistical Manual of Mental Disorders*) are actually underserved because of the way diagnostic criteria ignore the emotional seat of the brain, which is connected to our visceral state (Mate, 2011). In this light, the brain is simply an organizational entity that receives more messages from the inside than the outside at any given time, including our bodies. In a society where we are less and less connected to our feelings and to each other, it would make sense, then, that our brains are less and less efficient in dealing with our external

world, thus creating the epidemic of learning disabilities, especially among already isolated and marginalized populations (Shifrer, Muller & Callahan, 2011) who suffer disconnection, given their social location and political state of subalternity.

Today, there are many more kids with behavior problems, emotional outbursts, and difficulty learning in our society than ever before (Mate, 2000, 2011). This burgeoning in the culture is occurring just as the brain sciences are entering the conversation in education with claims to having the answers and solutions. The question we are not asking as we focus on the brain is what is happening in children's lives that is hindering their ability to socially interact well, to pay attention well, to learn well, and to be self-regulated? Critical theories encourage us to pay more attention to do what is occurring within the cultural and societal context than solely what is happening at the genetic or neuropsychological level. This, unfortunately, is not the approach being taken in education or MBE.

The consequence here is that the conditions for healthy brain development, especially for the prefrontal cortex, are less and less available to children today (Lipton, 2005; Mate, 2000); yet we continue to use brain science to address the behavior and symptoms while the emotional edifice causing the child to either act out or display learning difficulties is ignored. In discussions in the literature about the use of MBE to impact classrooms or write policy, the scientific epistemology continues to place the brain as an organ to be diagnosed, fixed, or perfected. But in a decolonizing paradigm of MBE, the brain must be viewed as the seat of relationality, where subaltern or indigenous philosophies, beliefs, and values that counter colonizing views of the brain and focus on well-being of students are privileged (Waziyatawin & Yellow Bird, 2012).

So for MBE to re-direct, instead of contribute to the growing intense cultural interest in the brain alongside which there is also a growing rate of childhood diagnosis of brain and learning disorders and the use of pharmacological drugs that aim to alter the developing center nervous system of children, it must take this organ associated solely with rationality and connect it to the relationality of the heart and gut as critical neuroscience research suggests (Mayer, 2011). What we seem to be facing today is a massive social experiment fueled by a vision of the brain and its function that is extremely limited. History shows that such an experiment will most likely take as its greatest collateral damage the most marginalized and disempowered children—children whose conditions for learning can severely impact their neurological health, as we see, for example, with Spanish-speaking children who are forced to learn in a language that is not their first language (Darder, 2012). But what if we were to shift this at an epistemological (not just symbolic) level so that our understanding of the brain can embody the complexity of its mystical dimension? What if mutually responsiveness adult-child relationships and loving teaching was seen as the best thing we can do for our brain circuitry and our genetic evolution, as neuroscience research suggests it is? What if we attempted not to diagnose children's isolated brains but the social, emotional, and cultural environments of scarcity, stress, instability, and disconnectedness that threaten our humanity and thus, our capacity for healthy and happy lives?

We know that genes are regulated by the environment such that even those born genetically predisposed to certain diseases can prevent the turning on of those genes with a nurturing environment (Lipton, 2005). What if brain-based education was actually about understanding how brain development occurs and not about projecting our narrow Western scientific projections about its function? What if the brain as a word or picture didn't make

teachers feel shameful about their lack of understanding, but rather powerful, given their intuitive intelligence born from their lived histories and practice and the very important role they can play in its students' development? What if kids didn't experience the stress and test anxiety that comes from the conditioned false belief that tests scores are tied to their intelligence and worth, thus shutting down learning altogether; and instead, relate it to the importance of their bodily sensibility which is the most necessary state for learning and brain development (Schulkin, 2006)? What if the brain became a symbol for safety, acceptance, connection and feeling, rather than an instrumentalized representation of our fixed potential?

New findings in neuroscience, moreover, now point to the brain-to-gut connection, arguing that the seat of our intelligence may actually be in the gut (Kinsley, 2018). So, while the argument here is not that MBE should omit the word brain from its title, but to use the name to re-imagine a more grounded and decolonizing vision, where the relationship of the brain to the body and soul is genuinely understood and engaged as an integral and harmonious dialectic of our human existence.

Education

This study challenges MBE's medicalization and scientification of education, the paternalistic tendency to undermine the knowledge of education as a field, and the marginalization of cultural sensibilities outside its narrow purview. It is precisely by replacing science's definition of learning and education with decolonizing educational views that the field can move closer to a more socially just paradigm (Abdi, 2012). In this way, education becomes synonymous with love, ethics, social engagement, politics, and the building of a culturally democratic society by empowered citizens. Education becomes a call of conscience where all

students (along with their brains) are respected subjects of the world, not objects to be manipulated or fixed.

Such a reframing of the MBE field brings teachers and teaching into a new light. Critical pedagogy calls upon teachers to examine the ways in which the school system sustains inequality and exclusion (Darder, Baltodano, & Torres, 2017). A social justice–fueled MBE must call upon teachers to examine the ways in which the school system isolates brains and sustains inequality and exclusion by denying the relational needs of human beings (and their brains) for learning. As has been argued throughout this study, it is the struggle against the West's eugenic coloniality of knowledge that is essential to the pedagogical and political efforts of MBE to transform education in more socially just ways. It is this work that must be the work of neuro-educators who, through critical dialogue, must challenge the dominant discourses overwhelming the field of MBE and move instead toward embracing a humanizing definition of education, which embodies a pedagogy of love that can also inform neuroscience research in decolonizing ways as well.

As part of this effort, neuro-educators must also evaluate the current state of neuroscientific methods, findings, representations, and interpretations of empirical brain research and develop concepts for more reflective, inclusive, and itinerant debates in education and in all social spheres. Such efforts already exist, for example, in the area of neurofeminism where the intent is to initiate dialogue across disciplinary borders, and develop detailed and enriched approaches for neuroscientific analyses themselves (Bluhm, Jacobson, & Maibom, 2012; Nelson & Nelson, 1997; Schmitz & Höppner, 2014).

Neuroethics is another area where some have pointed out that brain and culture must be understood as being indivisibly intertwined in an assemblage of reciprocal exchange (Levy 2007; 2008). In other words, the phenomenon is of the "brain-body-in-culture" constituting and continuously re-shaping each other. Adopting such a view makes sense because then education becomes a meaningful and active resistance to the forces that perpetuate the subjugation and/or exploitation of our minds, bodies, and hearts. Education becomes a means for decolonizing our minds and our society, signaling our liberation from colonialism. Key here is the need to reclaim and reinvent our understanding mind, body, and education, so that we can, as Freire taught, reinvent the field in a more humanizing and socially just direction.

However, Tuck and Yang (2012) have insisted that decolonization is not a metaphor. It is not a term that we simply add to the social justice jargon to reconcile settler guilt and complicity. Hence, critical MBE scholars must contend with the fact that decolonization is a historical process, which "cannot be understood, it cannot become intelligible nor clear to itself except in the exact measure that we can discern the movements which give it historical form and content" (Fanon, 1963, p. 36). In its decolonizing efforts, MBE must therefore be aware that "because settler colonialism is built upon an entangled triad structure of settler-native-slave, the decolonial desires of white, non- white, immigrant, postcolonial, and oppressed people, can similarly be entangled in resettlement, reoccupation, and reinhabitation that actually further settler colonialism" (Tuck & Yang, 2012, p. 1). The aim then is not to simply equip the field with the superficial language of social justice and decolonization. The aim is to actually create decolonizing spaces for meaningful alliances from which new language, new research, and silenced epistemologies can be heard and take shape, all while remembering that "the process of

decolonization requires our continual efforts toward questioning and revealing hidden colonial influences in past and current beliefs and practices" (Kaomea, 2004, p. 32).

In countering the settler premise of colonization and working toward decolonization, we must actively work toward our own empowerment and the freedom to transform our lives and the world around us. Education as a field, and education as part of MBE, must recognize the manner in which historically the scientific paradigm has colonized the field and all who called into question the legitimacy of its conclusions. It is from this place that we then begin the decolonization of MBE, whereas educators and MBE scholars we begin to actively work toward a critical praxis, where we reflect, dialogue, and act (Darder, 2015) upon the field with the aim of transforming it. In short, decolonizing MBE and the revolutionary potential it holds must begin with the problem-posing of educators (especially, educators from subaltern communities) and within the field of education. Only then, will the project have revolutionary potential.

This is directly in line with my own process of engagement with this field since my experience at the iMBES conference. Without a willingness to question the legitimizing of status qua beliefs and practices, there can be no possibility of decolonizing the field. This is the means by which we turn from subjugated human beings into empowered subjects of history; and the way in which we begin to move MBE's exclusionary paradigm toward an emancipatory direction. Unveiling and renaming the field is therefore the first step. In this process, once the unveiling and renaming of Mind, Brain, and Education begins to take place, we can turn to critical principals to inform our decolonizing praxis as MBE educators.

Critical Principles for Decolonizing MBE Praxis

While critical educational theory is not defined in a definitive manner by scholars in the field (Bauman, 1995; Carlson & Apple, 1998; Darder, 1991; Freire 1971; Giroux 1981,1983; Grande, 2015; hooks, 1994; Kahn 2010; Kellner, 1995; Kincheloe, 2008; Kincheloe & McLaren, 2005; McLaren 1986; Shor & Freire, 1987), there are principles that move across their work that can help us to think differently about MBE, in ways that guide us toward emancipatory and democratic outcomes. The following is a discussion of some of the ways in which critical principles can inform a paradigmatic shift in the field.

Cultural Politics

According to Giroux (1983), learning "takes place in a variety of public spheres outside of the schools" (p. xxviii). As a result, curriculum cannot be analyzed in isolation from the social dynamics that construct themselves daily around constitutive and preferential rules (McLure & Fisher, 1969). As Darder (2014) posited, all research is conducted and functions within a cultural context and is shaped by the norms of the dominant culture that, mediated through power, define what we consider legitimate knowledge. Critical MBE research must, therefore, aim to uncover the ways in which cultural politics shapes research and the practice of MBE. This idea is grounded in Freire's claim that all education is a political act, where struggles are waged over the definition and control of knowledge and curriculum. Therefore, recognizing the asymmetrical power relations at work within the field constitutes an important step in decolonizing MBE research and undergirds the aim of this study. As discussed earlier, MBE is anchored in and continues to function under the dominant epistemology and methodology of Western science, thus putting the field at risk of reproducing the dynamics of conquest and control, which result in

the intellectual, social, and material colonization of school populations, most notably those from subalterns communities.

What is taught, by whom, and under what conditions is also determined by the group who controls the political agenda and, thus, generally enacts hegemonic values, beliefs, and ideological construction in commonsensical ways that tend to shroud inequalities and exclusions. Therefore, an important task of critical MBE scholars concerned with the future of the field is to consider how MBE is implicated by its cultural politics, so much so that it can enact a form of pedagogical terrorism. Therefore, in all the research MBE funds and undertakes, a first question must be: how is this study implicated in and how will its findings contribute to the cultural perpetuation of hegemonic domination and exclusion?

As long as the boundaries of legitimate knowledge are set by Western science and Western science only, the field will fail to accomplish its expressed interdisciplinary aims. Separating disciplines is itself a Western scientific methodology of reductive categorization. As de Sousa Santos (2005) has argued, given the power of Western science to instigate and foster a paradigm anchored in

> strict and narrow divisions among disciplines, its positivist methodologies, that do not distinguished objectivity from neutrality, its bureaucratic and discriminatory organization of knowledge into departments, laboratories, and faculties that reduce the advance of knowledge to a matter of corporatist privilege. (p. xix)

The decolonizing aim of MBE should not be, therefore, to bring together disciplines but to question the lens that dictates the enforced separation. Having the field open itself to different traditions of science, such as Native American perspectives, according to Cajete (2008) would

allow for the co-existence—in a non-hierarchical way—of both the intuitive and rational minds, opening the field to completely new and innovative ways to do research alongside teachers and students. It is important to note this is not advocating for the measurement of intuition, as certain trends in neuroscience attempt to do, but to allow room for the messy, intuitive, and mysterious approaches employed by teachers in their practice and do away with mania of measurement, particularly within the context of MBE practice.

Honoring the importance of direct experience, interconnectedness, and relationship, does not mean dissecting and measuring it. As Stein (2014) noted, one of the most dangerous trends of modern life has been the measurement and subsequent monetization of that which is unmeasurable and should not have a price. Teaching and learning, within MBE, need to be seen as the sacred human development processes they are, in order to redefine and reinvent the mainstream cultural politics that fuel research today. By understanding that science, like teaching, is a political process and not a neutral one, MBE science must engage with the cultural and political nature of the classroom, the school, and the larger society. And from this point, recognize the transformation of the MBE curriculum is a fundamentally political, ideological, cultural, and economic project.

Political Economy

Historically, research has conserved the political and economic interests of the powerful (Darder, 2014). In today's neoliberal society, the impact of the political economy on the construction of knowledge has placed us in a position where education, more often than not, serves as an economic engine to propel capitalist interests. The large sums of money being directed into neuroscience research, the explosion of the private brain-based industry, and the

money and political will behind the "neurorevolution," along with the potential consequences of these advances for human populations, has ignited a branch of the field focused on the study of neuroethics (Illes & Sahakian, 2013).

Testing, for example, has been a large and profitable industry in the United States since its early history (Brown, 1992), representing the first real successful commercialization of psychology (other than phrenology before it). Federal legislation has ensured that nearly every child in the United States is tested multiple times during his or her years in school (Stein, 2014). Moreover, given the largely for-profit nature of the testing industry, the political economy of testing today involves public money going into private hands on a massive scale. It is imperative that MBE research and practices not only steer clear of contributing to this trend, but also deliberately work to oppose it.

For MBE to serve as an emancipatory intent against the regulation and dehumanization of students, teachers, and the educational system as a whole, it must guard against the proliferation of neuromyths in more meaningful ways than simply calling them out as a problem, without taking action to address their damaging impact to schooling and, in particular, subaltern populations. Instead, the field must work intentionally (including the use of research money) to carry out efforts to prevent neuromyths from influencing public policy. Hence, the field must acknowledge that built into all curricular efforts are the political economic interests that perpetuate the cultural hegemony of an assimilative education and society, such that the hegemonic interests of the racialized, patriarchal, heterosexist, neoliberal dominant culture are carried out systematically through the conformity and complicity of MBE agents (students, teachers, neurosciences, neuro-educators, etc.).

Some vital questions at the outset of every MBE research endeavor, then, must be, how will this work contribute to the values and economic interests of those in power? How does this come at the expense of already marginalized groups? How can the project work to shift the power to the people? These questions are even more crucial in our current political environment, where funding is being withdrawn from public education and used for private programs in the name of parental choice. MBE as a field stands on a razor's edge when it comes to this moment in our nation's educational history. This is because the field and its research can, in the name of reform or scientific progress, easily reproduce the educational inequalities and injustices that interfere with full participation in democratic life.

Historicity of Knowledge

Perhaps the biggest blind spot in the field of MBE is the field's inability to engage with its historicity and how the legacy of conquest is implicated in the research process. While the literature on the history of MBE occasionally makes mention of the study of the brain sciences dating back to the Egyptians and the Greeks, the field, for the most part, sees itself as truly beginning with recent advances in brain technologies. This inability to see that MBE is in fact a continuation of research and practice that has long dominated education is problematic. For critical researchers, all knowledge is understood as both historical and contextual (Darder, 2014), such that the supposed immutable nature to structural conditions of inequality are understood as colonizing myths. One myth that MBE must contend with is that it was established to battle inequality in schools because of the universality of science. The fact is that the field was formed as a continuation of the very historical forces that have created deficit views that sustain mainstream systems of inequality.

Only when MBE can see itself and the educational system it wishes to impact as historical institutions, rooted in the coloniality of power and shaped by historical conditions that inform the contemporary moment can the field truly move toward socially just goals. The field must then move away from the colonizing language and belief system that studies "subjects," particularly of color, as deficit beings (or brains) in need of fixing. Instead, the research in the field must begin with the lived histories of the students, teachers, schools, and communities it wishes to serve, while also recognizing and acknowledging the positionality and history of the researcher—especially when those "being studied" are from subaltern communities. The aim, therefore, must not be to impact education, but rather to understand how settler colonialism has shaped schooling and educational research in the United States, and how the history of science has contributed to its perpetuation.

Dialectical View of Knowledge

In its view of knowledge and knowledge formation, MBE continues to struggle to break the barrier between research and practice. Similarly, the field struggles with effective communication between researchers and practitioners. This is partly due to the fixed and dualistic view of knowledge that categorizes fields into absolutes, like neuroscience and education. In the critical tradition, knowledge is understood as dynamic, reconstructive, regenerative, and always contextual and partial in nature. With this in mind, critical research seeks to disrupt the traditional binaries and dichotomies (i.e., humans/nature; mind/body, science/non-science) and hierarchical notions (i.e., elitism, privilege, empirical) of the world (Darder, 2014). In this way, oppositional elements that exist across a fluid continuum of tension or negations are seen as the source of transformative change. Therefore, through challenging

MBE's scientific epistemology, we can confront and unveil, name, and challenge its limit-situations (Freire,1970) and construct new possibilities of interaction between neuroscientist and educators, in the interest of emancipatory knowledge.

What is necessary then is not just dialogue between researchers and practitioners as the field now claims, but dialogue about the actual differences and tensions that exist between them. Freire and Macedo (1995) spoke of a critical relationship between theory and practice, where there is neither "a theoretic elitism or a practice ungrounded in theory, but the unity between theory and practice. In order to achieve this unity, one must have an epistemological curiosity—a curiosity that is often missing in dialogue as conversation" (p. 382). Instead of working to transcend self-set boundaries, MBE must work to understand that a truly dialectical view of knowledge recognizes and engages contradictory elements and tensions linked to the negation of oppositions (Darder, 2015). It is through this dialectical process of knowledge construction that more just possibilities can emerge. Further, Smith (1999) noted, decolonizing research is not simply a complete rejection of Western theories and research approaches. It actually implies the deconstruction of dominant Western views of science and challenges the totalitarianism of Western science in terms of what counts as science, arguing instead for collaborative work among native and non-native researchers.

> One aim of decolonizing research then is to create the conditions to question. Who defines and legitimizes what counts as scholarship, who has the power to name? How does naming reify existing power relations? Are the tools for decolonization only available to indigenous researchers or can this be a shared process? How has the discourse on decolonizing research been colonized or appropriated? (Mutua & Swadener,

2004, p. 2). These are difficult questions, since the very structures of academia are often "an impediment to the decolonization of research" (Blauner & Wellman, 1973, p. 324), but asking these tough questions is essential to decolonizing the field. Yet, while democratic forms of horizontal engagement are necessary to the process of problematization (Darder 2014), it is naïve and counter-productive to think that MBE can shift the dominant western ideologies both in academia and in public education on its own. One of the suggestions of this study is that fields like special education, educational therapy, and K–12 education are also in need of decolonizing interrogations and fundamental transformative shifts toward socially just structures and practices.

Ideology and Critique

A decolonizing pedagogy and methodology requires that we understand that research is never neutral but instead encompasses the values, beliefs, ethics and contradictions; or, in brief, the ideology of the dominant society. Once the ideology behind research is acknowledged, it must be carefully critiqued with respect to questions of social justice. Critique entails the decolonizing interrogation of values and beliefs that sustains asymmetrical or colonizing relations of power. An aim of this study has been to unveil the hidden epistemologies and logics of coloniality at work within the structure of MBE methodologies and, thus, its research conclusions. After this process of deconstruction, there must be a reconstruction or reinvention of the field for transformative practice and social empowerment. This however can only happen if those in the field are able to name their own reality and positionality, problematize it, and posit new possibilities for change (Darder, 2014). This cannot happen without the recognition and

critique of the ideology behind the field, both as a scientific enterprise and as a part of the educational system within capitalist society.

In a time where our education system is being pushed toward specific ideological goals that value the defunding of public education in the name of choice, addressing ideology in critical ways is essential, especially in a field that produces educational research. It is also important to understand that critique must be infused by and grounded in an emancipatory political vision, for it is within this vision that one is able to coherently and precisely engage the deeply embedded issues at work within the hegemonic terrain of MBE. What this requires is a counterhegemonic space for resistance and critique (especially by teachers and students).

In addition to creating such a space within the context of MBE, such efforts need to be supported with research funds set aside specifically for studies that work to self-critique in the field. Both the *Journal of Mind, Brain, and Education* as well as the iMBES conference can serve as places for such research and practice, though recognition of the importance of critique as part of a research and practical process that advances a social justice vision and mission within schools and society. Honoring and recognizing the practices of teachers at iMBES conferences, acknowledging the cultural differences that exist, and creating a place for unveiling oppressive ideological views, attitudes, and practices represents an important first step. Engaging systematically the critiques that emerge from the first step is a vital second step.

Hegemony, Resistance, and Counter-Hegemony

If the greatest trick of science has been the "god trick of seeing everything from nowhere" (Haraway, 1988, p. 581), the greatest sleight of hand of the U.S. educational system is its often-touted self-description as a tool for the creation and promotion of equity and democracy

in our nation. Unfortunately, despite such lofty aims, commonsense notions have functioned to naturalize and normalize assimilative relations of power, which perpetuate paternalism and deceptive notions of impartiality, shrouding underlying hegemonic interests. Unveiling the ways in which practices of research serve to perpetuate the coloniality of power and legitimate the existing social order, must be at the center of a socially just approach to MBE. MBE has to work to ensure that its own research practices do not replicate the ideological machinery that preserves the status quo, but in fact specifically works to create counter-hegemonic spaces for research and knowledge formation, as noted above.

Decolonizing MBE's research efforts must therefore aim to dismantle oppressive theories and practices in order to emancipate and transform existing conditions in education. As such, research that is supported by MBE must support the creation of intellectual and social counterhegemonic spaces where alternative readings of the world can exist in the interest of liberatory practice. Any decolonizing political project, by necessity, must seek to push back against the dominant hegemonic theories and practices that allow for asymmetrical relations of power to persist. As Darder (2014) had pointed out:

> There is an enduring legacy of cultural hegemony and racialized language policies associated with centuries of colonialism that has resulted in a long history of protracted language struggles around the world . . . In order to ensure that the "Other" is kept in line with the system of production, racialized institutional policies and practices historically have led to national efforts which have resulted in the push for assimilation, deportation, incarceration, and even the genocide of minority populations. (p. 1)

In examining these interpretations more deeply, we can begin to better understand the way in which asymmetrical relations of power are exerted through the use of an institutional structure (academia) that perpetuate contemporary forms of colonization and social injustice (Darder, 2014).

Rather than business as usual, a decolonizing MBE must work to resist these structures. Freire believed that the political empowerment of teachers functions to nourish and cultivate the seeds of political resistance, "a resistance historically linked to a multitude of personal and collective struggles waged around the world in efforts to democratize education" (Darder, 2002, p. 61). MBE research must then work to engage the voices of teachers and subaltern communities in a variety of ways, recognizing that it is through their understanding and lived practices that resistance to hegemonic practices in education will ensue—not the mainstream views of scientists or the MBE field as it exists today. Moreover, incorporating decolonizing approaches to teaching social justice as part of the preparation of MBE practitioners is paramount, in that programs that aim to graduate MBE scholars and practitioners must include such coursework in their curriculum.

Alliance of Theory and Practice

Research must be of relevance not only to the profession in which it is rooted, but to the larger society as well. What this work argues is that this relevance cannot be established solely through a clinical or positivist approach, but requires a detailed re-documentation of MBE phenomenon that integrates an emancipatory understanding of theory and practice (Maroun, 2012). A decolonizing methodology and curriculum must therefore be fundamentally linked to the practical intent of transforming current inequities in the MBE field. The emphasis here is on

what Freire (1970) called *praxis*, where social relations (as noted earlier) are grounded in a reconstituting and self-generating process of reflection, dialogue, and action (Darder, 2014). Decolonizing MBE research must aim to have a purpose in the everyday life of vulnerable populations and be linked to the real world. As de Sousa Santos (2009) has argued, a Southern epistemology respects three fundamental pillars: (a) learning that the South exists, (b) learning to go to the South, and (c) learning from and with the South. MBE must consider these decolonizing pillars as it also works to become more flexible and fluid, shifting and moving according to the actual conditions that emerge within the context of classrooms, rather than laboratories where conditions are fabricated. About this, Freire (2000) has noted:

> No pedagogy which is truly liberating can remain distant from the oppressed by treating them as unfortunates and by presenting for their emulation models from among the oppressors. The oppressed must be their own example in the struggle for their redemption...Pedagogy which begins with the egoistic interests of the oppressors (an egoism cloaked in the false generosity of paternalism) and makes of the oppressed the objects of its humanitarianism, itself maintains and embodies oppression. It is an instrument of dehumanization. (p. 23)

There is a loud call for classroom-based research in MBE (Fischer et al., 2010) but how can such research be funded when science calls for exact measurements and empirical evidence and decontextualized neutrality, while the living classroom enacts a muddy and messy human reality? Unless MBE aligns its theories with the realities of real life practices, it will continue to fall short of any social justice goals. Therefore, the question should never be how can we better use student data to inform our scientific aims, but rather how can we create methodologies and

epistemologies that reflect the realities in which students exist and the condition in which they are forced to survive?

Dialogue

All this requires that we begin with the voices of students and teacher. As a result, an aim of the field must be to create dialogical spaces where perspectives and insights of students and teachers are encouraged and engaged as legitimate forms of knowledge. To do this, the field must ensure that it is echoing the voices of the classroom instead of inserting science's historically paternalistic and assimilative voice into the classroom. Trinh Min-Ha (2009) explained:

> You who understand the dehumanization of forced removal-relocation-re- education-redefinition, the humiliation of having to falsify your own reality, your voice—you know. And often cannot say it. You try and keep on trying to unsay it, for if you don't, they will not fail to fill in the blanks on your behalf, and you will be said. (p. 80)

Hence, dialogue is essential to the alliance of research and practice, but dialogue is no easy task, as it requires an ongoing commitment to be *with* the people. Darder and colleagues (2009) have noted that dialogue constitutes one of the most important aspects of critical pedagogy, in that it engages an emancipatory process that is committed to the social empowerment of communities, by respecting them as rightful historical subjects of their world. Freire's approach to pedagogy (Freire & Macedo, 1995) necessitated that we move from "speaking to" to "speaking with" others, which implicitly communicates respect for the knowledge and dignity that others bring to our dialogue. Freire and Macedo (1995) argued:

> Dialogue characterizes an epistemological relationship. Thus, in this sense dialogue is a way of knowing and should never be viewed as a mere tactic to involve students in a particular task. We have to make this point very clear. I engage in dialogue not necessarily because I like the other person. I engage in dialogue because I recognize the social and not merely the individualistic character of the process of knowing. In this sense, dialogue presents itself as an indispensable component of the process of both learning and knowing. (p. 379)

With this in mind, dialogue between scientists and teachers and students would require meaningful opportunities to engage with one another, across our differences. It would mean earnestly involving communities, families, young children, students, faculty, and all that are directly impacted by the research and the practice. This, of course, requires the humility to let go of the arrogant shield of expertise often found among MBE professionals and to instead enter these relationships as vulnerable and open human beings. This also requires a commitment to dialogue, even when it seems like the difficult choice or too "time consuming." In this way, dialogue within MBE can become an earnest attempt to engage students and teachers with respect, for who they are, rather than adhering to a common tendency to see teachers and nonscientists as those who need to be educated and students as subjects to fulfill the research needs of the field.

Conscientization

As has been repeatedly stressed, collective emancipatory action for transforming existing conditions of inequality and injustice in schools and society must be at the heart of decolonizing the MBE movement. To combat the effects of a capitalist system that relies on a "banking"

epistemicide within education, Freire (2000) posited "Conscientização—a term that denotes the skill of perceiving social, political, and economic contradictions—to take action against the oppressive elements of reality" (p. 35). This social critical consciousness affirms a commitment to the humanity of subaltern communities, anchored by a "deeply reflexive interpretation of the dialectical relationship between our cultural existence as individuals and our political and economic existence as social beings" (Darder, 2002, p. 568). While MBE presents itself as a field where knowledge construction of the research process is understood as a collective process, such a dialectical engagement is still lacking in the field (Fischer et al., 2010). A critical awareness of its own research and actions is fundamental because only then can the field uncover commonsensical notions that reproduce inequalities, in order to seek ways to create genuine change.

Freire's (2000) work was as much about unveiling the structures of domination as it was about decolonizing our minds from "hegemonic ideologies that made us complicit with our oppression" (Darder, 2015, p. 34). Instead of educating students for the dehumanizing roles prescribed by racializing epistemologies, Freire's pedagogy challenged notions of identity and Western concepts of human development (Darder, 2015). For communities that have been, at the same time, purposefully neglected and willfully damaged by the colonizing processes of schooling, Freire's work supports the call for an MBE educational project linked to anticolonial struggles for self-determination and a politically just world. To this end, MBE must support decolonizing shifts not just in schools but within the field itself, its intentions, and its research and practice by working to develop a critical consciousness from which to forge a decolonizing MBE curriculum that views students and teachers as integral and capable human beings.

Forging A Decolonizing MBE Curriculum

Following our reasoning regarding the need to decolonize the field of MBE in order to move toward a social justice paradigm, there must also be a decolonizing vision of curriculum that embraces a global push for cognitive justice. From this perspective a decolonizing curriculum would push back against the current positivist curriculum in MBE and struggle for a more itinerant, deterritorialized, and rhizomic epistemology (Paraskeva, 2011) for the field.

An Itinerant, Deterritorialized, Rhizomic Curriculum

What is clear from this study is the need for a more culturally relevant curriculum in MBE and for recognition that this struggle is one against the coloniality of knowledges as well as a fight against epistemicides. In essence, as has been argued, the struggle for social justice is a struggle to achieve cognitive justice (de Sousa Santos, 2007b) and to democratize knowledge (Paraskeva, 2011). In such a struggle, there is a need for a shift from our current position toward a more itinerant theoretical posture with what Paraskeva (2011) called "the critical curriculum river" (p. 1) running beneath it. Such a posture would go beyond the obstacles created by the Eurocentric and patriarchal tensions between science and education and instead "turn from science as the single standard of knowledge [that currently dominates education] in favor of a plurality of equally ways of knowing" (Wexler, 1976, p. 8).

Such an itinerant curriculum theory (ICT) would dare to violate the scientific canon and (Paraskeva, 2011) and propose decolonizing alternatives for research and practice in the field. In MBE, ICT would actually bring scientific knowledge face-to-face with nonscientific knowledge, explicitly local knowledges from classrooms and communities that are grounded in the experience of teachers as well as leaders and activists of social movements in education

(Paraskeva, 2011). These knowledges and realities of education are not just limited to the classroom but would extend to the larger context of schooling and politics. This decolonizing, deterritorialized, rhizomatous approach sees reality beyond dichotomies, beyond beginnings and ends, and looks to research that is not stable but arises from a multiplicity of platforms. The "clean" and "absolutizing" knowledge territories that center around science are at the heart of the problem in MBE; in response, a centerless, periphery-less position is required to build something truly new (Deleuze & Guattari, 1987; Eco, 1984). To do this, the field must commit to fight for a decolonizing research platform where we can push toward "instability, not stability" (O'Brien & Penna, 1999, p. 106) and embrace the actual conditions of the messy, non-Western-scientific world of education.

Central to such a vision is also the move from dualism to monism, away from a binary perspective that is characterized by separations and oppositional "either-ors" to a world that is interconnected, where knowledge is porous, and the only separations that exist are seen to be imposed by our own thinking. Similarly, this requires a simultaneous focus on developing a *politics of location* (Braidotti, 2013; Haraway, 1988)—or mapping out the power relations characterizing the assemblages or multiplicities in which we are embedded. MBE must therefore work to decenter notions of the human (and the human brain) as the central actor in the world and instead offer a more collective referent in theorizing the place of the mind and brain within education.

One of the most important ways to do this is to account for the ways we, as teachers and researchers, decide on what and how we teach and research from our own politics of location and to move away from the dangerous myth of the distanced, objective researcher, and instead

reframe research in more situated, fluid, relational, and complex terms. Such understandings are also essential to developing systems-level perspectives that see the self as one part of a larger, relational network that is constantly in motion, instead of the current individualistic and atomistic view of the field that places all power (and deficit) in the individual brain and aims to alter that brain through drugs, brain-training, and the like. As mentioned earlier, some in the field have begun to push for such shifts by calling for a metaphor of "ecosystems" for the mind as "living, growing, and self-regulating in a metabolic relationship to its environment" (Stein, 2015, p. 28). But what this Neo-Piagetian approach continues to ignore are the historical, political, and structural oppressions at work in this paradigm and why simply changing our scientific metaphors will do little to transform the colonizing structures that continue to bind marginalized groups in this country and around the world.

The notion of the world as produced by heterogeneous mixtures is also a way to develop a different understanding of the differences we see among students. From this vantage point, we can try to reconsider not just how we look at norms and those who are different from the norm, but the power of collectives, so that we can begin to "think about the addressable, the unthinkable, the non-thinkable of the curriculum" (Corazza as cited by Paraskeva, 2011, p. xxiii) and imagine new ways to think in order to simultaneously oppose the oppressive neuromyths that persist. Only with such a call to engage in a radical creativity of thought can we expect neuroscience and education to forge, together, decolonizing and just alternatives (Braidotti, 2013).

It is important to note again that this is not a struggle against science. As Freire (1998) claimed, "To deify or demonize technology or science is an extremely negative way of thinking

incorrectly" (p. 39). Instead, the point is making a political commitment to advancing a new understanding of science, which implies an effort to decolonize fields across universities, in particular teacher-education programs as well as neuro-educator programs. ICT challenges one of the fundamental characteristic of abyssal thinking: the impossibility of co-presence of the two sides of the line. But to do this, we must ask the towering question: *Dare MBE build a decolonizing social order?* Because only then, in such a post-abyssal theory and curriculum can a just form of science truly be possible.

If we can assume such a rhizomatous approach (Gough, 2000) that sees reality beyond dichotomies, beyond beginnings and ends, a theory of non-spaces (Augé, 2003) that breeds from the multiplicity of immanent platforms and defies clean knowledge territories (Deleuze & Guattari, 1987; Eco, 1984), we can also come to imagine schools that are no longer tyrannized by the rhythms of classification and compartmentalization, headed by spurious dynamics, or consigned to produce segregated outcomes. The great challenge facing curriculum theory in MBE then is to figure out how "to operate a [decolonizing] order, a new system anchored in new and powerful non-state ways of articulation, which imposes new geographies of centrality" (Sassen, 2004, p. 126).

MBE must also engage in the struggle for what de Sousa Santos, Nunes, and Meneses (2007) have called *epistemological diversity* and a commitment to an emancipatory, nonrelativistic, cosmopolitan ecology of knowledges, bringing together dialogues and alliances between diverse forms of knowledge, cultures, and "cosmopologies" in response to different forms of oppression that enact the coloniality of knowledge and power (Paraskeva, 2011). MBE must remember that we need to learn from the South because reinventing social emancipation

goes beyond the critical theory produced in the North and the social and political praxis to which it has subscribed (de Sousa Santos et al., 2007a). This is the reason the field must reimagine through a decolonizing lens the role of students, teachers, and schools and understand that it is engaged in a fight for a just and equal society alongside them.

But MBE must do this while recognizing its own position in the battle against the monoculture of scientific knowledge. Though not in the MBE literature specifically, for example, other educational offshoots of neuroscience research such as Universal Design for Learning (UDL) aim to bring "a scientifically valid framework for guiding educational practice" in order to "address the primary barrier to fostering expert learners within instructional environments" (http://www.udlcenter.org/aboutudl/whatisudl/conceptofudl). Ironically, programs and frameworks such as UDL have formed as a way to critique "inflexible" and "one-size-fits-all" curricula and instead try to promote curricula "designed from the outset to meet the needs of all learners" by addressing learner variability by suggesting flexible goals, methods, materials, and assessments that empower educators to meet the varied needs of all learners (http://www.udlcenter.org/aboutudl/whatisudl/conceptofudl).

But the fact remains that a scientific framework that aims to meet the needs of all learners is by definition a form of "monoculture of knowledge" (de Sousa Santos, 2007a, p. xxxix). About this de Sousa Santos (2007a) asserted, "It is increasingly acknowledging that current scientific knowledge imposes as the only true or adequate interpretation of reality a worldview conceived as a global explanation of the world, thereby eliminating the possibility of a complementarity or articulation of knowledges" (p. xxxix). It is exactly these global explanations that such programs aim to achieve in education, all the while emphasizing variability and

flexibility. Similarly, some MBE scholars, including Zach Stein (2014), who leads the conversation about social justice in the field, have criticized critical educators' stance that the learning sciences have been a predominately negative force in schools, claiming that this is shortsighted because:

> There has, in fact, never been a true science of education brought into the schools. Like Christianity and Communism, as the saying goes, a true science of education has not failed—it has never been tried. Given the significance of advances in the learning sciences in recent decades, the possibilities for adopting them for use in test design are profound, (p. 264)

But reducing the argument of critical theorists to that of just blaming all injustices on science is evidence that these theories have not been seriously engaged. The point is not to blame science nor is it to give it dominance. Rather, the point is to push away from universal notions of learning and testing and adopt a more itinerant position that recognizes the multiplicity of our humanity—including within the cognitive sphere.

This is not just limited to MBE or the sciences. The overwhelming majority of teacher-education programs are deeply insensitive to fostering different ways of thinking, which is partly why universalizing neuromyths perpetuated by MBE can easily take authority. Teachers, however, are exhausted by the attempt to produce "similarities" in the midst of an increasingly diverse and intricate multiplicity (Roy, 2003). We therefore need to free teacher education from a representational framework, allowing young teachers to think differently and in new ways, in order to better understand the productive and relational power of difference (Paraskeva, 2007; Roy, 2003). For it is, indeed, difference rather than similarity that drives the process of change

and transformation. The challenge then is to work within critical curriculum theory and practice, in order to find decolonizing methodologies that incorporate teachers' and students' understanding of difference in new and positive ways (El-Haj, 2006; Paraskeva, 2011; Roy, 2003).

Drawing from Deleuze's (1994) analyses, as MBE scholars and advocates of cognitive justice then, we need to fight for a curriculum theory and practice that departs from dominant systems of meaning that take a Platonic position and reproduce the coloniality of power, which perceives the world as a reproduction of a particular original model (Paraskeva, 2006, 2007, 2008; Roy, 2003). Instead, we must fight for theories and practices that view education as a set of relationships in which the personal plays a leading role and change is embraced as a critical aspect in the evolution of human consciousness (Darder, 2015).

In short, before talk of neuro-educators or new testing models, MBE must engage the educational and curriculum theorists who function as epistemological pariahs, challenging a decolonizing theoretical path that appear to them as inexact; yet, these are, in fact, the result of rigorous inquiry (Deleuze, 1990) in search of cognitive justice and ready to unveil hidden curriculums and denounce epistemicides. This is a call then. For the formation of itinerant MBE theorists who are profoundly sentient of the multiplicities of lines, spaces, and dynamic becomings (Deleuze, 1990), willing to get engaged with alternative readings within the curriculum field that have been erased or marginalized (Malewski, 2010). In other words, the first decolonizing task of MBE researchers is to cultivate the capacity to be critical (Freire, 2000).

Ethics and Emancipatory Possibilities for MBE

To conceive of a decolonizing vision requires that it be tied to one's lived history and to a clear political emancipatory project (Darder, 2011b). About this, Freire (1994) argued:

> A politicized person is one who has transcended the perception of life as a pure biological process to arrive at a perception of life as a biographical, historical, and collective process. A politicized person is one who can sort out the different and often fragmented pieces contained in the flux. Political clarity is possible to the extent that we reflect critically on day-to-day facts and to the extent that we can transcend our sensibilities so as to progressively gain a more rigorous understanding of the facts. (p. 130)

Similarly, MBE as a field needs to become politicized, first, to ensure that the field is not upholding the structures of domination and exploitation that prevail, and second, to transform the oppressive structures that exist. Such an emancipatory political vision of the field requires commitment to moral and ethical relationships with the world. The field must embody these in its language, literature, methodology, research goals, and practice.

In both the MBE literature and the larger literature around neuroscience is a great deal of discussion around ethics. Generally, two ethical themes run through the literature (Illes & Sahakian, 2013; Levy, 2009). One is concerned with the integrity and autonomy of individuals, questioning the limits of scientifically based interventions and asking the important question: Should all knowledge be used just because it can be? This area of study has come to be known as neuro-ethics. The other theme is concerned with questions of equity, access, and the fair distribution of scientific benefits, as science continues to make progress.

There is no question that, as MBE scholars, as critical educators, and as critical neuroscientists we must ask: What dangers do the vision and mission of MBE pose? With the advances of brain-training and the war against public education, could the future of education be nothing more than brain training, where the definition of learning is reduced to making synapses—synapses that can be made through computerized trainings more than thoughtful discussion, critical engagement, and connection. As Stein (2013) noted, we must also recognize "where educational processes become unacceptable because of what is being *done to* students, not just because of what is *withheld*, lacking, or inequitably distributed" (p. 2).

There is also no question that our public education system, which has been historically conceived by policy makers as a "sorting machine" for human capital (Spring, 1989), is now being dismantled and replaced by a mixture of for-profit private schools, charter schools, on-line education providers, and what remains of traditional public schools as they become increasingly underfunded and undervalued. What emerge are perhaps the most complex and overtly economically driven educational configurations in the history of our country and the world. In this new education system, we are already overwhelmed like never before by the swift replacement of Deweyian ideals of a democratic system by economic interests all while we watch brain sciences take us from the task of raising children to designing them (Stein, 2010). As this happens, students, especially those who have historically been the collateral damage of our educational practices and unjust economic structures, are at risk of once again as our approach to education aims to accelerate a process of epistemological McDonaldization (Andrew, 2009). It is a dark moment, indeed, and somehow the discussion around neuro-ethics sheds an even darker, more paralyzing, shadow on the future.

It is exactly in these moments, however, that we must remember that "as men and women inserted in and formed by a socio-historical context of relations, we become capable of comparing, evaluating, intervening, deciding, taking new directions, and thereby constituting ourselves as ethical beings" (Freire, 1998, p. 38). In other words, our first order of business must be to recall that ethics, like love, reflect a continuing "interpretation of the dialectical relationship between our cultural existence as individuals and our political and economic existence as social beings" (Darder 2009, p. 568). Our ethical responsibility must therefore move beyond the discussion of ethics we see in MBE today. Our ethical responsibility as decolonizing MBE educators comes back to our capacities as critical moral leaders. We must question how our own ideological beliefs and pedagogical intentions and our own adherence to the status quo impacts us and, from this place, work to unveil the hidden curriculum of oppressive pedagogical structures, transforming the fear that binds us, into courage and into an armed love (Freire, 2000).

The questions raised in the field around ethics, then, while important, fall more under the reach of morality than they do ethics, in the Freirean tradition. For Freire, the best way to struggle for ethics is to live it in our educational practice, in our relationships with our students, and in the way we deal with the contents of what we teach (Darder, 2014; Freire, 1998). To be grounded ethically then, is to understand our own being in the world as a presence that is in relationship and interdependent with the world and others.

This presence can reflect upon itself, it can intervene, it can speak of what it does, it can take stock, evaluate, decide, and it can transform (Freire, 1998). It is important then that we, as educators and researchers, do not subsume our ethics under large questions of morality, or

simply look at them as an area of study such as in neuro-ethics; but that we, instead, ground our decolonizing ethics in our everyday lives and actions. This is what Freire meant by transgression. We must therefore take responsibility for our own individual actions and, in so doing, exercise our power and release our fear of doom. Only then can we see that the future, while problematic, is not determined fatalistically, despite the fatalism that seems to surround us. In fact, if we focus on Freire's ethical framework of presence, our present moment slowly escapes its overwhelming pessimism and shifts from what we might perceive as the darkness of the tomb, to what might actually be, the darkness of the womb. This moment might constitute the moment of transgression we have all been waiting for and a decolonizing approach to MBE can serve as a means in that mission. But only if we remember that it is our ethical responsibility to embrace a politics of hope in our daily work.

MBE as Social Justice Paradigm

The purpose of this study has been to re-think and re-envision the field of MBE, looking specifically at the lack of engagement with social justice concerns in order to: (a) critique the dominant epistemology of science that reproduces inequalities, not just within the field itself but in its intended practice; and (b) move toward the formulation of a social justice paradigm of MBE that supports the conditions for an emancipatory and humanizing view of teachers, students, and brain-based educational practices, through a decolonizing interpretive methodology (Darder, 2014). Toward this aim, this study first worked to challenge and dismantle the deep hegemonic epistemologies and structures of the field. This disruption is the necessary first step toward opening up the field to re-inventing itself, using a decolonizing lens in order to create a

new emancipatory vision for the field. This chapter has outlined the principles that inform such an organic reinvention and that support a decolonizing praxis.

The aim of decolonizing interpretive educational research is to engage the dominant literature on pedagogy, curriculum, methodology, and schooling with the aim of disrupting dominant epistemologies and building them anew (Darder, 2015). In the case of MBE, the first goal is to disrupt the primary stance shaped by a positivist epistemology, where research tends to become a means for the promotion of Western scientific thought and its political economic project of conquest. In fact, an argument of decolonizing interpretive methodology is that research needs to "unveil and destabilize existing structures of power that perpetuate the material and social oppression of the most vulnerable populations" (Darder, 2015, p. 4), not contribute to the reproduction and perpetuation of these structures.

As Tejeda (2008) has emphasized, it is important to acknowledge the *past* and *present* as coexisting in our understanding. Therefore, in order to understand where this young field is now and where it hopes to go, it is imperative that we realize the present is unintelligible without a reading of the past (Tejeda, 2008). As has been done in this study, the history of science with its colonial and capitalistic structures must be considered when examining the field of MBE, which both rests on those structures and promotes them. For MBE to be genuinely democratic, the field also requires a radical re-engagement between the sciences and education. Such an engagement first necessitates a re-reading of the literature in the field through a critical lens, as has been done here, in order to unveil the historical and philosophical foundations that inform its evolution. Though it may work to cloak the power dynamics within itself, this study has shown that the MBE movement is entrenched in hegemonic ways of thinking and oppressive practices that

project deficit views upon education as a field as well as teachers as a group and students from subaltern communities. In the process, education has become the target of what Freire (2000) termed *false generosity* by those in the world of scientific research.

As has been demonstrated through this decolonizing interpretive research, this study has sought to undertake a critical analysis of bodies of knowledge related to MBE, in order to engage with issues related to the lives and survival of those deemed as *other*. As such, the question of the "orientalist" gaze (Said, 1978), as implicated in the Western production of research and conclusions about the other, was also considered, especially as the *other* is now reduced to the brains of children (Stein et al, 2010). Similarly, the extent to which Western political and economic interests distort the perceptions of the *other*, where an underlying hidden curriculum is aimed at the assimilation of the *other* in order to preserve the classed, racialized, gendered, and sexual hierarchies or supremacies of Western cultural domination (Darder, 2015) has been and must continue to be critically interrogated.

Once these steps have taken place, and once the very definitions of the words in the name of the field have been decolonized and re-imagined, a new paradigm emerges that is informed by decolonizing principles, an itinerant curriculum, and ethical responsibility. This paradigm rests on four pillars (see Figure 3) that includes a value-laden ideology, a rhizomic curriculum, contextual research, and locally valid practice. Rejecting the scientific gold standard of research for the objective and unbiased search for knowledge, this social justice paradigm recognizes that all knowledge is ideological, political, cultural, historical, spiritual, and encourages a deep understanding and recognition of the interconnectedness and holism of nature, moving beyond boundaries of objective measurement.

Assuming such a value-laden ideology would also mean accepting responsibility for maintaining harmonious relationships among people, nature, and all life, and placing ethics, not objectivity, at the center of all research. This paradigm also follows an itinerant, rhizomic epistemology, and fluid curriculum that honors multiple ways of knowing and places them on a horizontal field, allowing dialogue and interdependence. Such a curriculum is naturally interconnected (not discipline based) and honors epistemological diversity. In this paradigm, instead of valuing abstract knowledge derived from experiments and controlled variables, knowledge is derived through direct interaction with the natural world and research encompasses all processes of perceiving, thinking, acting, and coming to know that evolve through human experience.

Finally, from this paradigm, the practice of MBE would aim to have specific impact that is meaningful to the place where the work is ongoing. In other words, instead of seeking to be universally valid, research is rooted in local places and is practiced to meet the specific needs of the community, aimed at its long-term survival through practical and applied goals.

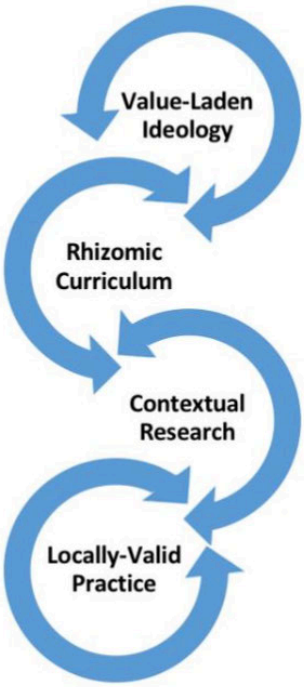

Figure 3 A social justice paradigm of MBE.

Conclusion

During the first decade of the 21st century, the world economy fell into crisis as the national discourse around politics and policy began to fall once again behind the idea of U.S. technological and scientific superiority. This resulted in yet another push for comprehensive educational reform in the name of preparing American children for the techno-scientific economy of the new century (Stein, 2013). The climate saw federal testing policies move toward even more overwhelming accountability metrics for schools, as prescription drugs for academic under-performance skyrocketed and "brainhood" (Vidal, 2009, p. 1) became a new way to describe personhood. As the neuro-discourse (and the money that fueled it) entered educational

policy, neuroscientific research furthered the ideology of brainhood, marking a new shift in our very concepts of being human (Lowe, Lee, & Macvarish, 2015; Vidal, 2009; Wilson, 2002).

As it has been historically the case, these changes have led to an increase in the already large financial inequalities between school districts, as technological progress in the broader culture began outstripping school infrastructures (Stein, 2013) conducting the further deterioration of teaching and learning in schools, during recent decades (Hursh, 2008; RAND, 2010). Now, almost two decades in, evidence continues to mount concerning the detrimental effects of these naïve educational practices, especially around their stigmatizing and disempowering impact on students as well as on teachers who have seen their pedagogical and curricular options truncated (RAND, 2010). One cannot help but wonder how the continued push for the use of neuroscience research in classrooms will impact teaching and learning in the coming decades; if history teaches us anything, the trend should be of concern to those of us committed to democratic education.

Just as the last push of science into education in the form of testing and measurement left teachers fearful, feeling "they are no longer with their students because the force of punishment and threatening dominant ideology comes between them" (Darder, 2002, p. 60), this new push will likely further solidify the instrumentalization of education through the intensification of ideological values and beliefs that support standardized, prepackaged, teacher-proof curricula, and rigorous testing and assessment procedures. Except this new shift now comes with even more perfect, more "scientifically sound" measurements. We live in a great shift of consciousness, which Freire (1998) warned, if left unaddressed, will bring us to a brutal and unforgiving time. Perhaps this time has already come to pass, but surely it is not too late.

Freire (2000) was convinced that schools exist as significant sites of struggle, and that teachers must "embrace an ethical responsibility as citizens of history" because they are "in an ideal position to collectively fight for the re-invention of the world" (Darder, 2002, p. 31). Part of the argument of this study has been that such a struggle and re-envisioning is not limited to teachers in classrooms but to all those who view themselves as committed to education, including MBE scholars, neuroscientists, and policy workers. As such, it is the job of people in these positions to engage teachers in promoting social justice and neurodiversity as part of their work. This would need to be done at every level including in policy that impacts teacher training, and professional development that brings together research and practice in ways that emancipate, not bind, students. On the other hand, educators themselves must push back against the scientification of their field in ways that limit the work of students and their own work. It is therefore the work of MBE scholars to call for this kind of resistance and to work with teachers in advocating for the human rights of their students. What Freire's (2000) vision of a humanizing education gave us is an example of a reflective praxis wherein individuals become socially conscious of themselves and the world around them. If we were to reject the perils of the exploitative system of education fueled by capitalism, he argued, and allowed citizens to realize the power of their ontological vocation, we would find on the other side a more meaningful existence.

To achieve this, Freire (2000) provided us with a language and theoretical framework for being, in hopes of "transcending a colonial existence that is almost culturally schizophrenic" (p. 11), a phrase that well describes the ideology of brainhood in education. But such an emancipated existence requires first a fundamental shift in the way leaders, educators, and in this

case neuroscientists and MBE scholars, view themselves and their role. Such an existence requires the rejection of colonizing ideologies that have been responsible for the cultural domination of our education system and for the recognition of the self as a subject of history, in order to "critique, decolonize, and reinvent the world anew, in the interest of a truly just and democratic future" (Darder, 2015, p. 40) in solidarity with others.

In such an existence, teachers and scientists would not be on opposite sides of a "bridge too far" (Bruer, 1997) that could never link the "abyssal divide" (de Sousa Santos, 2009), but engaged with one another in a critical understanding of the world that encourages inventive, emancipatory arrangements (Darder, 2002). In this new paradigm, all MBE educators would work together to decolonize the field by renaming it, to utilize the decolonizing principles to inform their work in the field, to push for and engage in a more itinerant curriculum, and to uphold the ethical and emancipatory possibilities of MBE in their everyday practice. The pursuit of our full humanity, in education or elsewhere, can never be achieved in isolation but "only in the fellowship and solidarity of community and social movement" (Darder, 2015, p. 39). This is the reason that in order for MBE to reposition itself as a socially just field, it must first commit to developing political and social consciousness as a field of study (Darder, 2015). Only then can the field overcome the risks it now faces of educating students for the dehumanizing roles prescribed by Eurocentric epistemologies and move toward a pedagogy of transgression (Freire, 2000), committed to transforming the "oppressive ideologies, attitudes, structures, conditions, and practices within education and society that debilitate our humanity" (Darder, 2015, p. 5).

EPILOGUE

A persistent question among my family and friends, and even some colleagues, has always been, why do you work with "special needs" kids? I didn't grow up with a learning disability. No one I knew or loved struggled with one. I was always good at school, exceeding expectations, getting good grades, the perfect student. But the perfection, and the praise and value I received for it, came at a devastatingly high price. It came at the price of my creativity, the full potential of my learning, and it limited me, ironically eating away at my confidence, creating an environment of fear in which I always thrived but wished I could crash. I would go so far as to say it came at the price of the full expression of my soul.

I grew up of course in a particularly patriarchal and authoritarian regime and school system. But like the kids I work with now, I felt unseen, invisible, punished, shamed, and ultimately undervalued, underutilized, and disconnected. There is not much difference between a student who has disconnected because of an inability to learn and one who has burned out on "learning" in the banking model. And it has been in doing this study that I have come to recognize why I identify and empathize with a population of which I was never a member.

My education before this doctorate program was also all in the service of understanding why I felt so disconnected and unseen in my schooling. We have such a romanticized and beautiful definition of education in the culture but that was rarely my experience. So, I wanted to understand how learning is actually meant to happen—and where things go wrong. This is what drew me to the learning sciences and education. But while I found much of what I learned interesting, the answers to my questions were not in the synapses of the brain or in the developmental milestone of the growing child. My studies in the sciences and developmental

psychology taught me that children, if given resources and opportunity and guidance, can do great things. But one thing was still missing from education, and that was radical love.

Talk of child-centered education, of constructing meaning, of developmentally informed pedagogy fills the progressive education movements and the schools where many of my clients come from. But even there, among their privilege, resources, cutting-edge educational practices, something was missing, and I would find them turning to me, a brown woman of far lesser pedigree, background opportunity, money, and in many instances, education, for help and answers.

My work as an educational therapist taught me that connection, love, trust, hope, feelings, safety—these are things that nurture brains and cure "disorders" because that is what disordered brains are, they are disconnected. Not surprisingly, this is also what supports the empowerment of families, parenting, and even schools. An hour of uninterrupted loving human attention does more for a child than three months of a brain-training app. This, I came to know in experience after experience. So, while I came into this doctoral program hoping to understand how to scale my work as an educational therapist, the quiet secret I carried was, how do you scale love?

As I leave this program now, I feel far more at ease, far less anxious and troubled by the always-blatant, sometimes-savage inequalities and inequities I see in the educational opportunities of students in our country. I know first-hand that a privileged but disconnected, drugged up child in an affluent Los Angeles neighborhood faces similar social injustice as a child fighting poverty on the other side of the concrete freeway. Lack of love, the forces that disconnect those children from each other, from themselves, and their world, these are the social injustices we must fight and resist.

In my own life and learning, I finally see that self-love, self-acceptance, self-connection as well as empathic connection to others is all of our calling. Decolonizing our minds and bodies from the sources that promote disconnection from self, in exchange for achievement, so-called success, perfection, and conquest, must be our goal, as educators and as humans. This is not an easy task. The socialization, the culture that wires our brains, is strong, pervasive, and overwhelming. At times, I wonder if my work, my time with a student or a parent or an educator seeking answers ultimately makes any difference. I know they are up against the same forces as I am, as all of us are, with the lure of detachment now so close and readily available at all our fingertips, literally. How do we come back to being human? How do we keep trying to reconnect? And not just how, but why? Why fight for a world like ours? Why fight for humanity even as it shows its worst sides? Or simply its apathetic, disconnected side? The answer is simple. Therein lies our salvation. If this process has taught me one thing it is that love is scalable when you become it, and salvation is possible when you are privileged enough to have it be the byproduct of your efforts.

More specifically, since completing this study, the shift I have experienced in myself has begun to shift my practice. In a field where I am expected to rely heavily on testing and diagnoses, I now find myself pushing back against the essentialized belief that all children need to be tested not just in the privacy of my work with families, but in schools, with colleagues, and the in the field at large. Whereas I have always looked at testing and diagnoses with a grain of salt, I now find myself referring less for neuropsychological testing and instead trusting the learning process of my students. Similarly, I have started to try and engage the field more intentionally with respect to the issue of social justice by writing proposals for national

presentations and publications in both MBE and the field of Educational Therapy that put social justice at the center of the conversation, and by working to bring this discussion to local study groups and schools. I have also begun to work at the leadership level with the Association of Educational Therapists as Chair of Research with the sole goal of promoting both student and subaltern voices in the field as well as of bringing issues of social justice to the forefront, including questioning the field's tendency to train practitioners specifically for private practice. My work with schools has also shifted. Whereas my position before was to offer critique from the margins of schools, I now directly engage with schools from within, working with principals, learning specialists, and others at the leadership level to invite them to engage more deeply with questions of epistemology and how our lens defines the questions we ask.

None of this is easy. I regularly find myself facing rejection and resistance in the field and, in some instances, even the belittling of my work as antiscience or unimportant. I have watched the changing expression of colleagues who used to rely on my expertise when they now hear me speak in these more revolutionary ways. All this of course brings about initial anxiety and self-doubt. But if we are to push back on the structures that bind us and ask others to do the same, I remind myself, we must make friends with these doubts. It is in these small moments of conflict that the seeds of change are planted, and although this work will no doubt be difficult, especially in our current climate, what I also feel in the community is the beginnings of a curiosity alongside this fear, perhaps *because* of our current climate. I am therefore determined to invite and welcome into conversation both the fear and the curiosity, in the same way I do with students who first come to meet their own learning potential.

Since this study, I have also come to appreciate just how much this type of work requires time and community. This is not work anyone can do alone, and it is not work that can be done quickly. This is community work that needs contributions from those working in theory, research, policy, and practice and, like all soul work, it moves at a glacial pace. My hope as a researcher, practitioner, and leader is to\ create opportunities for contribution, dialogue, and revolutionary praxis across all levels as we work together toward a liberating pedagogy and world. But I know not to expect quick fixes or clear answers. The point is to ask better questions.

For these shifting paradigms, I am eternally grateful to this study and to Dr. Antonia Darder, for her trust and belief in me. I came to her with little more than an intuitive feeling that something must change, and at an epistemological level (though I did not understand it as such then) in my work. The perspective, education, reclaiming of history, authenticity, and my own humanity, this work has afforded me has in fact transformed what seemed like the darkness of an eternal tomb of disconnectedness, to the darkness of a womb preparing for a birth. For this, I am grateful to her and to this methodology, as well as the critical traditions that have informed it, for allowing me to decolonize my own mind from the oppressive chains that bound it, so that my heart can sing again. My life and the lives of the students I hope to continue to have the privilege to serve are undoubtedly forever changed by the tectonic epistemological shift in my understanding of self, a shift I now feel empowered to enact, using the tools of this research methodology, in every area of my own life and the lives of those I serve.

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