The Era of Plasticity: Tradition & Change

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Certainly one of the most fascinating developments in the brain sciences during the last quarter century has been the shift in understandings about brain plasticity. It is also notable that the emerging ideas on plasticity were anticipated by Freud and others more than a century ago. Quite recently plasticity has become something of the mark of the era. Catherine Malabou pushes for a new era of philosophy centered on the idea of plasticity and being directly influenced and inspired by neuroscientific developments.

The traditional view, still widely held, is that the brain is highly plastic only during the first few years of human life. In these first years a child is capable of uttering perfectly any phoneme, becoming fluent in any one or several languages, learning to read, to speak, to walk, to play piano, to perform complicated bodily and mental tasks. Yet, once this critical period passes the brain becomes fixed and mental capacities are then set. During the rest of one's life change certainly occurs through learning, yet the basic equipment and capabilities to learn are considered set. Thus, human development throughout the early critical years is understood as of a different order and type than change throughout the balance of life. At the end of the critical developmental period where brains are plastic the door is closed, the equipment and tools are fixed, and from then on one is rather stuck, for better or worse, with the mental equipment one has at that point. While the influence of genetics and environment, nature and nurture, is hotly debated, attitudes toward child development hold that most believe that environment plays a significant role, consequently there is much attention given to what parents and schools may do, while acknowledging that genetics has a powerfully deterministic effect.

Interestingly my examination of the literature on youth brain development reflects a marked difference in tone and attitude between the critical period of child development and the post-critical period of child development. The literature on critical-period child development has an urgent positivity about it. It hums with the concern that these critical years be taken advantage of. The adult brain is in formation and schools and parents are prodded and pushed into providing every opportunity and encouragement to these adult-brains-in-the-making, that they develop as fully as possible. Notably the Bush administration's "no child left behind" legislation is considered by many to be significant. Importantly during these early formative years, self-movement is seen as healthy and contributing to child development, yet usually in rather inadequately specified ways. A shift in attitude takes place as youth reach their teens. Suddenly the lion's share of the literature addresses human development in terms of "problems." There are endless articles and programs devoted to curtailing the brain-damaging effects of drugs, alcohol, television, risky behavior, careless sexual behavior, and so on. Surely it is not incidental that this shift from potentiality to problem, from positive to negative, correlates almost perfectly with the belief that brain development ceases at the end of the pre-teen critical developmental period. It also correlates with a shift in the place self-movement plays in development. Increasingly self-

movement is seen as a deterrent to education and development. Likewise the emotional experiential aspects of teen behavior are increasingly seen as irrational, as distracting, as inexplicable.

Recent scientific studies, conducted in both clinic and laboratory, have markedly shifted these beliefs about brain development and, though it remains controversial, the impact has yet to be widely felt in the general population. And there are but rare hints of the importance of self-movement, experience, interoception and emotion, to healthy human development.

In her book *The Primal Teen*,[1] Barbara Strauch outlines the research findings of Jay Giedd of the National Institute of Health. Giedd's research findings, based on the studies of 150 living teen brains beginning in 1997, convinced him that teenage brains undergo periods when the cerebellum keeps getting bigger and better throughout the teen years. Teen brains experience periods of exuberance followed by a rapid reduction to their final set adult brain level. Periods of exuberance likely continue into the early twenties. What this discovery means is not all that clear. Interestingly Strauch, a mother of teens, finds it important as a way of understanding the erratic behavior of her teens, that is, it explains why they are problems. But it certainly raises the question, which seems to follow on the attitude about critical period brain and human development, of what environmental elements influence what happens to the teen brain during these periods of exuberance and refinement. It is commonly held that some parts of the brain are more plastic, less genetically fixed, during these periods than others. The issue of what to do to assure full and healthy teen brain and human development seems to be only informally discussed. There are a few ideas here worth noting. There is a general pervasive attitude that is effectively expressed as "use it or lose it." There is a general belief that since the teen brain is more malleable than formerly believed the potential for damage from environmental causes—drugs, video games, etc—is greater. But it isn't yet that clear what sorts of experiences teenagers might have that would be most beneficial to this seeming gift of extensions to the "critical period." Giedd simply says, "If that teenage brain is still changing so much, we have to think about what kinds of experiences we want that growing brain to have." [2] Chuck Nelson at the Institute of Child Development at the University of Minnesota wrote, "The thing is, we know experience matters, but we just don't know what nature of experience matters, what's best for the brain." [3] Curious to me in light of my having for a long time studied the importance of play, Giedd wrote, "What if we find out that, in the end, **what the brain wants is play**, that's certainly possible. What if the brain grows best when it is allowed to play?"[4] I'm not really sure what he means here by play; I'm thinking he has something like lacrosse in mind. Provocative in any case.

Paralleling in time this idea that the critical period of brain plasticity may be extended through the teenage years are the numerous studies of neuroplasty of adult brains, most notably those conducted by Paul Bach-y-Rita and Michael Merzenich. Their research findings and those of a number of others are

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[1] Barbara Strauch, *The Primal Teen:What the New Discoveries about the Teenage Brain Tell us About our Kids* (New York: Anchor Books, 2003).
[2] Strauch, p. 21.
[3] Quoted in Strauch, p. 42.
[4] Quoted in Strauch, p. 44.

presented in a bestselling book *The Brain That Changes Itself* by Norman Doidge.[5] Notably the science of brain plasticity seems invariably to arise from dramatic individual cases of severe trauma or malfunctions that have, seemingly miraculously, been overcome in clinical settings. Doidge engages us in this book by focusing initially on important cases which opened doors to the expanding evidence that brains remain plastic throughout life.

While there isn't enough space here for an adequate reflection, it is essential to remind of Paul Bach-y-Rita's invention and development of amazing devices that map sensory data of one sense through the experience of another in the brain to allow, for example, the congenitally blind to "see" through stimulation on the skin and generally to offer an alternative to the localizationist perspectives on the brain.

We must carefully study Merzenich's extensive works which have provided much evidence that brains remain plastic, in some senses, throughout life. Merzenich recognized the profound implications of his findings on many developmental and disabling situations. He developed *Fast ForWord*, a computer software program directed to children with learning disorders, even disorders as acute as autism. The results from extensive trials and use have shown phenomenal results. He has also developed a business called "Posit Science" directed toward creating computer based tools to keep malleable the brains of aging people. These plasticity studies forge a new biography for the brain.

Michael Gazzaniga has long been a prominent brain researcher. In his book *Nature's Mind*,[6] Gazzaniga posits a position that explains apparent brain plasticity in terms of genetic programming and the processes of selectivity that are consistent with long term evolution. He argues that all cells, as genetically determined, have a wide range of potential roles when confronted by differing environmental demands. He argues for biological determinism. And he explicitly argues that brain malleability claims made for aging adults, such as Merzenich has made, are wrong. I have read his discussion fairly carefully, yet, clearly based in my limited knowledge and obviously shaped by the deep patterned schemas that bias me toward brain plasticity. As I see it, Gazzaniga can certainly be correct,[7] while we may still continue to accept the results that demonstrate brain plasticity. For example, should a brain cell have the genetic possibility of being mapped to many different body parts, a remapping may certainly be based in this selection of genetic coding rather than some fundamental change in the cell or the creation of some completely new cell. While I don't pretend to fully understand Gazzaniga, and his work is well worth much fuller study, I continue to be totally convinced by the work of Bach-y-Rita and Merzenich, and frankly, even if I was intellectually convinced that their work was without grounding in brain physiology and neurology, their demonstrated practical results are so extensive that I would still follow the implications of their work. While I understand that for brain scientists it is of great importance to know whether plasticity is the result of the growth of new cells or the selection that

[5] Norman Doidge, *The Brain that Changes Itself* (New York: Penguin Books, 2007).
[6] Michael S. Gazzaniga, *Nature's Mind: The Biological Roots of Thinking, Emotions, Sexuality, Language, and Intelligence* (New York: Basic Books, 1992).
[7] Gazzaniga's argument is that each cell is multiply capable of many tasks, thus under different demands a different capability is selected rather than the brain actually changing. To some this can still be evidence of endless plasticity.

results from environmental demands turning on certain capacities among large possibilities that existing cells are already genetically coded with, to me either resolution seems to support amazing plasticity throughout life. In some senses the sheer complexity of the brain makes this issue one primarily the concern of specialists.

Given that these brain studies can be read by those of us without technical knowledge in the various scientific fields is relieving. However, I think that as we begin to direct some of our attention to studies based on the implications of these works we need to invest ourselves at least to a degree in the descriptive aspects of these technical studies. It would be irresponsible and perhaps reckless to shirk this task.

What is the significance of all of this new information on brain plasticity to us as human beings and to us as students of religion and culture? Perhaps there is an analogy that may be of value drawn from our experience with computers. To extend this analogy is only for provocation; I do not believe the brain is a computer or that computers will ever function like the human brain and largely for the reasons that I think the brain works as it does only because it is part of a system that provides afferent information from the interoceptive systems that are joined in the muscles and bones of a self-mover. We are familiar with the difference between hardware, software, and application. In the realm of science fiction we can imagine a merging and intelligent interaction of hardware and software and the field of artificial intelligence is directed to progressively bridging the gap between them. Our science fiction and fantasy are built on the overlap of hardware and software. Certainly the dancing humorous emotional wisdom of WALL-E is a recent and one of the most successful examples. We may think of the brain, if understood as necessarily including the interoceptors in the muscles and ligaments, as the hardware we use to move our bodies in the process of discovering ourselves and our environment, essential clearly for us to live and interact with the world. Yet, we also acknowledge that not only is the brain physically growing and developing, but it is being trained and shaped. This second function is similar to the installation of more or less permanently resident software. An obvious example would be the sensorimotor programs that support gestural movement. We believe in the magic of the influence of the development of brain hardware and resident software during the critical period, but after that we resolve ourselves to the fact that the brain is now hardwired with relatively fixed resident software and closed to physical extension. From this point forward the brain works like our quotidian computer. Most intriguing to me is how this belief correlates with a wide range of attitudes and practices related to post critical period in human life. We accept without question, and therefore act decisively in accordance, that teen brains are hardwired and thus anything having to do with teen brains is restricted to how to protect them against damage. Stroke victims are commonly relegated to the permanently disabled, because it is assumed that since a brain is not plastic, brain damage is permanent. And we abandon self-movement as making any contribution to development of intelligence. However, Paul Bach-y-Rita's father's remarkable recovery from a disabling stroke was the very motivation that led Paul to embark on his remarkable studies of brain plasticity. Two important things for us to remember in this case is how difficult, how highly repetitive, how physically based was his father's recovery. And we must be amazed that he recovered to near normalcy despite nearly 97% loss, through stroke damage, of the nerves that run from the cerebral cortex to the spine. Aging brains are commonly considered to be like

computer mother-boards, certain to become outdated, increasingly slow, and progressively useless. Declining memory, forgetfulness, dementia, Alzheimer's disease, slowing, malfunction, are expected of aging adults. It is remarkable to me how our understanding of the life history of brains corresponds with our understanding of the human life cycle, including the biography of motility. Perhaps our unquestioned trajectory of the normal human cycle of life is actually the cause of a wide range of social practices that pervade our culture, from no-child-left-behind to the very ideas of retirement and assisted living.

The radical message that is presented to us by neuroplasty studies is that change, malleability, remains possible even beyond the critical period of early childhood when the formation of brain hardware and semi-hardwired resident patterns are installed. There is abundant and increasing evidence that aspects of the malleability, adaptability, growth, change in brain hardware and resident software can and do take place throughout the entire life cycle, or it has the potential to do so. It is becoming increasingly clear that demanding improvisational self-movement is key to these changes. I believe another quite radical idea presented in this research is the emerging sense that while brain functions are localized to specific parts of the brain, the brain nonetheless is so aware of itself and its vast complexity that changes in any parts of the brain tend to be experienced in some respects throughout the brain. Again "use it or lose it" applies as does "neurons that fire together wire together," and "neurons that fire apart wire apart or neurons out of sync fail to link."[i8]

New ideas on brain plasticity are nice, but what do they have to do with what we are about? First of all, it seems to me that there are clear links between Mark Johnson's discussion[9] of various types of body-mind meanings and research results focused on brain plasticity. Clearly a major portion of the brain hardware developed and designed through experience in the critical periods contributes to what Johnson referred to as that foundational body-based type of meaning that is pre-cognitive, non-linguistic, comprised of images (though not visual or even mentally visual), schemas and so forth. These, he argues, underlie and inform the so-called "higher" forms of meaning that we recognize as meaning more properly, that is, propositional, descriptive, and conceptual, all based in language. Indeed, what seems to be fixed through critical periods of brain development are just these foundational patterns and schemas and images which provide the ground patterns and processing routines that we use to learn, to perceive, to adapt to the world, to comprehend ourselves as selves and bodies. They seem to be established in the hard wired circuitry of our brains and the semi-hardwired resident programs.

But secondly we need to recall that all of these so-called image schemas and bodily concepts are the product of groping explorative self-movement that characterizes human vitality. We must also anticipate that these so called image schemas and bodily concepts are not "purely mental" entities, but rather reside as interdependent systems that pervade the body organized as gestural and postural sensorimotor-proprioceptive systems.

[8] Doidge, p. 64.
[9] Mark Johnson, pp. 11-14.

To consider these kinds of ideas allows us to begin to see that brain plasticity may also be powerfully connected with the kinds of experiences we may describe as cultural and religious. Indeed, they are interdependent. Should this be correct then the critical periods are imprinting periods for culture. We know that the brain becomes deeply patterned through enormous repetition of self-movement that forges sensorimotor patterns. The brain is inseparable from our kinesthetic selves. The distinctive gestures and postures that distinguish a culture and a religion insinuate themselves onto human beings through the high repetition of patterned movements and practices and value/meaning/feeling associations. Once enculturated, change, while possible, is as difficult as breaking a bad habit because culture does not occur at the propositional level, but at the usually subconscious body-based gestural postural level of meaning. Change of these patterns requires high repetition. And change can scarcely be separated from kinesthetic activities. If we want to change the way we think, we cannot simply think our way from where we are to this new place. Such change requires a lengthy, repetitious, kinesthetic process. It is at once humorous and frightening to think of academics engaging this process, yet how can they be exceptions?

Were we to follow up these ideas, we would likely understand that religions and cultures might be better understood in terms of the repetitious sensorimotor activities that occur during critical periods of brain development, when cultures and religions become inseparable from brain hardware; it remains malleable, yet with reticence. We have referred to this aspect of culture and religion as "tradition." We appreciate tradition in these terms as the continual enactment through gesture and posture of the distinctive values that are literally embedded in the brains and tissues of its people.

But we can also begin to understand both the mechanisms of change and the difficulty of change occurring. Since tradition, shifting to this term, is borne in the tissues of the people of the tradition, the enactment of tradition is not done in any way that transcends the individual, the individual moving being. Because individuals who enact gestural and postural patterns also experience them in the context of their existential environmental setting, they may individually find motivation for change even unconsciously. A tracing of these plastic adjustments and maleabilities we call history. Thus change comes through plasticity that is inherent and only possible because of a deeply patterned set of actions and positions. Yet, such patterning, inscribed so deeply within the organism functions much like habit and we all know how difficult it is to change habitual behaviors and the values that are sutured to them.

Quite at odds with our common views that hold great stock in the influence of propositional, objectivist, and conceptual knowledge, plasticity studies and the primacy of self-movement studies, and gestural studies reveal that these so-called "higher forms" of meaning offer far less influence than we have thought, far less than the influence of culture and religion extended through the performance of distinctive actions that insinuate the values and meanings of the tradition on the very muscles and in the neuronal connections in the brain. Evidence of this view is everywhere in the world today. We are often confounded by, but shouldn't be, the seeming impossibility of even talk occurring between the Israelis and the Palestinians. The same seems to apply to the so-called liberals and conservatives in the US government who cannot seem to compromise or see any gray areas on anything. The pattern is that we despise our rivals and actually cannot see in our foes anything of value. From the analysis I'm

developing here we can now begin to understand that this inability to see the value of one's foe can be taken quite literally.

I think we can actually understand ourselves, our religions and cultures, more interestingly by placing ourselves in the context of neuroplasty and we may be more insightful about how to change ourselves, relate to others, and to understand human processes.

In her 2010 book *Plasticity at the Dusk of Writing: Dialectic, Destruction, Deconstruction*, Catherine Malabou, traces the history of the development of plasticity from Hegel through Heidegger finding that plasticity refers to "the inner mobility in the system" (Hegel) and "the very movement of being" (Heidegger). She posits a world without any exterior, no outside, no transcendence. This shifts the emphasis to transformation and metamorphosis (here I think of Massumi's analysis of movement) and away from trace and writing as championed by Derrida and others. While I am not adequately prepared to fully comprehend the impact on philosophy offered by Malabou, her use of neuroplasticity to distinguish her position from the writing-centered views of Derrida and others is, in the context of our present consideration, fairly clear. She writes, "The brain's plasticity presents a model of organization that can still be described in terms of an imprint economy, but neuronal traces don't proceed as do writing traces: *they do not leave a trace*; they occur as *changes in form*" (79). She even concludes her book with an autobiographical identity with the title of Doidge's popular book *The Brain that Changes Itself*. Malabou's work deserves much fuller consideration and I believe might offer inspiration and precedent for vast changes in the academic study of religion.

A quick agenda for the development of the study of religion and culture that proceeds from these ideas can be quickly drawn. The role and treatment of children in the establishment of tradition is critical. Children are the subjects of education and psychology, but rarely of interest to the study of religion and culture. Adult converts to religions are of special interest here in understanding how a tradition is embodied, that is, how body-minded meanings based in sensorimotor activities are insinuated onto an adult. Likely the experience for the adult is markedly different than for children. Also we may now understand why adult converts to a religion often act quite differently than those born into it.

Agency, which is currently so often our concern, must now be understood as based in these gestural and postural sensorimotor patterns. Action and inaction rest in these moving meanings perhaps much more than being produced as the result of conscious considerations and choices.

We have experienced a significant challenge in developing methods for the appropriate articulation of these insights calling for the from the philosophical side terms like "bodily concepts" and "image schemas." As students of religion we have focused largely on the interpretation of the conceptual, propositional, conceptual meanings in "texts." We might now be inspired to interpret "stories" and "myths" and "rites" and "ritual dance dramas" with particular attention to repetitions and habitus and gestures and postures that are sutured into the fibers of the practitioners, with attention to the interoceptive sensory experience of these actions. This shift is more than a minor adjustment.

From these perspectives we may even reflect on our own academic processes to see that they participate in the same patterns. Thomas Kuhn, in *The Structure of Scientific Revolutions*,[10] described the developmental process of science as progressing within paradigms (correlating to the application of a given set of theories) and as the result of a paradigm shift, where the basic operative and established theories are replaced by new ones. The difficulty of changing the hardwired patterns is so great that he noted that paradigm shifts usually do not take place except between generations. We may appreciate why this is the case recognizing that the presumptions on which a whole view of the world do not operate at the propositional, objective, cognitive, conscious level, but below that in the emotional, feeling, deeply body-based meanings. In this view we should complement our academic obsession with theory and method with careful considerations of academic gestures and postures, the self-movement activities which connect scholars to our subjects.

[10] Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1996).