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Sport, Neuroplasticity, and Freedom

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Biography

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Abstract
This paper plumbs the breadth and depth of neuroplasticity in connection with sport. Neuroplasticity functions across the developmental stages of life, and is implicated in learning, habit formation, recall, and execution. Thus, neuroplasticity has profound implications for sporting identities and for our lives in general. These implications have descriptive and normative dimensions. To help explicate these dimensions I utilize H.R. Niebuhr's notion of responsibility as entailing responsiveness and Charles Hartshorne's notion of "divine relativity." I also examine how neuroplasticity relates to freedom and its constriction. Neuroplasticity is implicated in the formation, maintenance, transformation, and dissolution of sporting identities.

Keywords
Neuroplasticity, Responsibility, Relativity, Sport, Freedom

I. Introduction[1]

It is a well-rehearsed fixture of basketball lore that Michael Jordan was once cut from his high school varsity basketball team (Lazenby 2014, 79-89). Of course, the story did not end there. He went on to a sterling career, first at the University of North Carolina, and then with the Chicago Bulls. While starring for the Bulls, his teams won six NBA championships, and Jordan established himself as one of the greatest basketball players of all time. After the first of two three-peats of NBA championships, and following the murder of his father, Jordan took a hiatus from the NBA. He attempted to make his mark in the world of professional baseball, a dream that his father had nurtured (Schonbrun 2018, 19). Jordan spent one season with the minor league Birmingham Barons. He finished the campaign batting only .202 (Schonbrun 2018, 18), after which he aborted the baseball experiment and returned to the NBA for another three-peat of championships.

Some have derided Jordan's ill-fated attempt to make it to the big leagues. Among the skeptics is neuroscientist Harald Klawans (1996), who claims that Jordan's age at the

1. Versions of this paper were presented at the Mind and Brain Annual Conference, Center for Cognition and Neuroethics and the Philosophy Department, University of Michigan-Flint, Flint, Michigan, September 2018, and at the Annual Conference of the Society for Philosophy in the Contemporary World, Portland, Oregon, July 2018.

time of his attempt to play professional baseball precluded the requisite neuroplasticity to make it to the top. The window of opportunity had closed. Klawans writes: "Hitting is a visual-motor skill, and like all other skills it has to be learned… And the sad fact was that at age thirty-one, Michael Jordan's brain was just too old to acquire that skill" (Klawans 1996, 5).

We will never know whether Klawans was correct in his assertion, but Zach Schonbrun points out that Jordan's naysayers may overlook one salient fact. Over the last month of the season, Jordan batted over .380 and hit two of his three home runs. His baseball career was on the "upswing" (Schonbrun 2018, 23). Whether or not Jordan could have advanced to and succeeded in Major League Baseball, the fact that he accomplished what he did in baseball was evidence of ongoing neuroplasticity.

The first appearance of the term "plasticity" is ascribed to William James in the *Principles of Psychology* (Costandi 2016, 8). James writes:

> *Plasticity*, then, in the wide sense of the word, means the possession of a structure weak enough to yield to an influence, but strong enough not to yield all at once. Each relatively stable phase of equilibrium in such a structure is marked by what we may call a new set of habits. Organic matter, especially nervous tissue, seems endowed with a very extraordinary degree of plasticity of this sort; so that we may without hesitation lay down as our first proposition the following, that *the phenomena of habit in living beings are due to the plasticity of the organic materials of which their bodies are composed*. (James [1890] 1950, 105; emphasis in original)

"Neuroplasticity" is a buzzword today both in neuroscience and in its popular expositions. It is now accepted that neuroplasticity is of fundamental importance throughout our lives, although this view was not always widely held (Costandi 2016, 1-2; 10; 72-73). In this paper I will attempt to unpack the nature and significance of neuroplasticity. In doing so I will look in particular at its pervasive, enabling presence in a slice of human existence, namely the world of sport. I will argue that neuroplasticity underlies a particular kind of freedom insofar as it enables change with respect to motor, cognitive, and emotional skills. There is no guarantee that this capacity for change will be exercised in a salutary manner. In fact, neuroplasticity is a risky business insofar as it enables growth and meliorism of human existence, on the one hand, but also regression and the formation of bad habits, on the other.

The structure of the paper is as follows. Part I provides some background into the various ways that neuroplasticity occurs. Part II looks at the significance of neuroplasticity, in terms of what it enables. There I point out that neuroplasticity has links to both descriptive and normative considerations. Part III examines how neuroplasticity makes possible a nuanced kind of freedom. Part IV puts sport under the microscope and explores some of the intersections of neuroplasticity and athletic endeavors.

II. Varieties of Neuroplasticity

The idea that neuroplasticity persists throughout the human lifespan was not always well received. As late as the mid-twentieth century, the denial of the existence of adult neuroplasticity was a dogma among many neuroscientists. It was widely held that the brain of an adult human being was fixed. Its wiring was complete and no neurogenesis occurred during adult life (Costandi 2016, 1-2; 10; 72-73). This dogma has since been overturned.

The neuroscience community now widely accepts that the human brain is plastic or changing from the period of prenatal development until the end of one's life.[2] Plasticity exists both in terms of the functioning and the structure of the brain. Costandi writes:

> Neuroplasticity can be seen in various forms at every level of nervous system organization, from the lowest levels of molecular activity and the structure and function of individual cells, through intermediate levels of discrete populations of neurons and widespread neuronal networks, to the highest level of brain-wide systems and behavior. Some occur continuously throughout life, others only at specific periods of life, and different types can be induced separately and together. (Costandi 2016, 11, 13)

As evidenced by fMRI scans, the brain is in constant flux as various neural assemblies fire. In addition, the structure of the brain changes as synapses wax and wane. While there are critical periods of heightened activity in which synaptic connections are formed or pruned in accelerated fashion, the process is nevertheless ongoing. In addition, neurons die while others arrive on the scene through a process of neurogenesis.[3] The flexibility of

2. For an illuminating primer on various forms of neuroplasticity see Costandi 2016. I draw on his account here.

3. The extent to which adult neurogenesis is functionally efficacious is a murky issue (see Costandi 2016, 79-83).

the brain is also evidenced by cross-modal neuroplasticity, which occurs when parts of the brain take over functions that were once the provenance of other areas of the brain (Costandi 2016, 22-32). Your plastic brain is always changing. In fact, it is changing right now. Michael Merzenich, known as "the father of neuroplasticity" (Merzenich 2013, 253), writes: "Human brains are *fundamentally* plastic" (Merzenich 2013, 28). If indeed it is the case that neuroplasticity is a pervasive phenomenon, what is the significance of this fact?

III. The Significance of Neuroplasticity

The importance of neuroplasticity does not hinge on one particular metaphysical construal of the mind-body relationship. While the assignment of fundamental significance for human identity to neuroplasticity is consistent with identity theory, in which the mind is identified with the brain or the brain and the nervous system, such an assessment of significance is also consonant with nonreductive materialist views that hold that mental states are supervenient upon brain states. Insofar as our brains are thought to have a causal role with respect to our conscious and unconscious mental states, to control our voluntary behavior, and to encode memories, including procedural memories, neuroplasticity will be of fundamental importance. This does not mean that our brains are solely responsible for who we are, or that we should endorse what ethicist Walter Glannon refers to as "brain-body dualism," in which we are reductively identified with our brains (Glannon 2013, 13-14). As Glannon argues, we are embrained, embodied, and embedded creatures (Glannon 2013).[4] Nevertheless, Adina Roskies suggests that the brain has a particular salience with respect to our identities. Roskies writes: "The brain is the proximate cause of our bodily movements, intentional actions, feelings, reactions, and the like" (Roskies 2009, 463).

Recent research has highlighted some spectacular outcomes of neuroplasticity. These include cases of individuals who have recovered from brain injuries such as stroke (Doidge 2007; 2015), and instances of phantom limb patients who report feeling sensations in their now absent limbs when they are, for example, stroked on the face (Ramachandran 2003; 2011). But while these eye-popping illustrations of neurological flexibility are indeed noteworthy, we should not overlook the profound significance of subtler ways that neuroplasticity is importantly linked to our identities. Neuroplasticity underlies the past and continuing development of our cognitive, emotional, and motor

4. According to Glannon, "The brain is the most important factor but not the only factor in shaping personhood, identity, and agency" (Glannon 2013, 12).

repertoires. Insofar as change in these domains occurs, this change is evidence of ongoing neuroplasticity.

The significance of neuroplasticity is not limited to the descriptive domain. Neuroplasticity also bridges the fact/value divide insofar as it is linked to normative issues as well. In his book *The Responsible Self*, the theologian H.R. Niebuhr explores the concept of responsibility and relates it to "fitting" responses (Niebuhr 1963).

Niebuhr writes:

> The idea or pattern of responsibility, then, may abstractly be defined as the idea of an agent's action as response to an action upon him in accordance with his interpretation of the latter action and with his expectation of response to his response; and all of this in a continuing community of agents. (Niebuhr 1963, 65)

Although he does not discuss it in his book, neuroplasticity underlies our ability to be responsive and to evolve in ways so that our responses become more or less "fitting." Our neurological systems become more or less attuned to respond in appropriate ways, including morally appropriate ways, in a flexible but not wanton way.

In his book *The Divine Relativity*, process philosopher Charles Hartshorne also explores how the ability to be affected by one's environment has normative dimensions. Hartshorne argues against the adequacy of a concept of divinity that portrays God as impassive and unchanging. Instead, Hartshorne claims that the most adequate concept of divinity should indicate that God is not only affected by the world, but indeed that God is "surrelative"—that is, supremely related to all creatures. In contrast to the concept of God in some systems of medieval theology, Hartshorne's panentheistic concept is one in which the divine being is plastic, affected by all that transpires in the universe. This feature of the divine nature enables an encompassing compassion (Hartshorne 1948).[5] Hartshorne writes:

> It is not self-evident that independence (or immutability) as such *is* excellence, and that excellence as such *is* independence. On the contrary… excellence or value has a dimension of dependence as well as independence, and there is no basis for the venerable doctrine that

5. Hartshorne writes: "A personal God is one who has social relations, really has them, and thus is constituted by relationships and hence is relative—in a sense not provided for by the traditional doctrine of a divine Substance wholly nonrelative toward the world, though allegedly containing loving relations between the 'persons' of the Trinity" (Hartshorne 1948, x).

> supreme independence will constitute supreme excellence of every kind. (Hartshorne 1948, 18)

In human beings, *neuro*plasticity heightens the possibility for a kind of relativity as well. While we do not exhibit the "surrelativism" that Hartshorne describes in his concept of divinity, the fact that we able to relate to and respond to our environment, such as in responding with compassion, means that we are relative, or affected by our surroundings. Neuroplasticity supports this relativity. In turn, this relativity implies a kind of freedom insofar as it undergirds novel responses over the course of our lives.

IV. Neuroplasticity and Freedom

To say that neuroplasticity enables change and growth is to suggest that neuroplasticity undergirds a kind of freedom—though perhaps not the freedom of the *will* as traditionally construed.[6] The form of freedom that I have in mind does not inherently resolve debates regarding determinism or indeterminism, or compatibilism versus incompatibilism.[7] Furthermore, it hinges in part on the kinds of external influences—political and otherwise—to which we are exposed. The key point for our consideration is that neuroplasticity provides a proximate explanation of our flexible natures and undergirds hope for a kind of meliorism of our individual and collective experiences.

Neuroplasticity does not entail a kind of neurally-centered wantonness or randomness. As the earlier quote from William James suggested, plastic structures do not "yield all at once" (p. 2 above). Changes resulting from neuroplasticity can be, in fact, stubbornly persistent. Changes that occur during times of emotional upheaval can have a particular salience and lasting quality. Neuroplasticity allows for a kind of continuity, in addition to flexibility, each of which is important for ascribing agency.

It is noteworthy that while neuroplasticity is connected to meliorism, neuroplastic changes are not always positive. Neuroplastic changes can lead to decrease in quality of life. Costandi notes that addiction and intractable pain are phenomena that point to maladaptive forms of neuroplasticity (Costandi 2016, 115-124). Further evidence of the potentially negative side of neuroplasticity can be found in post-traumatic stress

6. For an extended neurophilosophical treatment of free will, see Walter 2009.

7. Roskies writes: "I have argued that neuroplasticity cannot address the question of physicalism, nor can it adjudicate between the (seemingly both problematic) possibilities of determinism and indeterminism" (Roskies 2009, 465)

conditions in which, as psychiatrist Bessel van der Kolk suggests, people become "stuck in the past" (van der Kolk 10, 2014).

Given the potential for both positive and negative changes, neuroplasticity implies risk and vulnerability. Neuroplastic outcomes are thus subject to various forms of moral luck. Insofar as we are shaped in part by our embedded experiences, we are more or less fortunate in terms of the kinds of environmental influences to which we are exposed. Susan Greenfield writes: "In other words, *the biological basis of the mind is the personalization of the brain through unique dynamic configurations of neuronal connections, driven by unique experiences*" (Greenfield 2011, 57; emphasis in original). Included among the formative influences to which we may be exposed is one significant form of cultural influence—namely sport. In what conspicuous ways does sport intersect with neuroplasticity?

V. Neuroplasticity and Sport

To this point I have considered neuroplasticity at a fairly abstract level, in terms of its general significance. To help concretize the significance of neuroplasticity it may prove useful to see its relevance for a particular slice of life.

Neuroplasticity has pervasive significance in the world of sport. This is evidenced by both adaptive and maladaptive changes, as we "train up" our brains for athletic endeavors. Neuroplastic changes are inevitable. But we wish to direct those changes in positive directions. There is an old saw that goes "practice makes perfect." But as someone has responded, it would be more apt to hold that "perfect practice makes perfect." Because of neuroplasticity, we can undergo neurological changes that support bad athletic habits. Therefore, it is not just the amount of training that we undertake that determines whether there will be positive outcomes, but also how we train.[8] Paying attention to this fact can pay significant dividends. Amit Katwala explores how attention to *how* one trains can allow one to subvert the so-called "10,000 hour rule" that is often cited as a requisite amount of training for attaining expertise (Katwala 2016, 75-101).

Sport can also foster emotional debilitation. Sport participation is high during critical and vulnerable years of brain development.[9] Elsewhere I (Fry 2019) have argued that we should not only consider brain injuries that occur as a result of jarring the brain, as in concussions, but also brain injuries that result from emotional traumas that occur

8 I am indebted to Elizabeth N. Agnew for this emphasis.

9 See Jensen and Nutt 2015 on these critical periods of vulnerability.

through what Cozolino calls the "social synapse" (Cozolino 2014, xiv-xv). Therefore, given the plastic nature of the brain, it is also important to be attentive to the emotional atmosphere that athletes imbibe.

To apply H.R. Niebuhr's thinking about responsibility to the world of sport, sport requires "fitting" responses—to both our external and internal milieus. Indeed, sport requires fitting responses to an ever-changing environment. This requires a kind of dynamicism and flexibility in choosing the appropriate response. These fitting responses must be made not only to one's opponents, but, in the case of team sports, to the actions of one's teammates as well. Over the long haul, overcoming failure, and transitioning from novice to expert status, both require learning and development. This progression is supported by neuroplastic changes in our nervous systems.

Investigations into various forms of skillful endeavors provide evidence for the importance of neuroplasticity for expertise. Here are a few illustrative examples of what the research has shown. A study of musicians who were string players revealed that the area of the somatosensory cortex that represented the second to fifth digits of the left hand exceeded that which was found in controls. Furthermore, the degree of "cortical reorganization" among the musicians was correlated with the age at which they began training in music (Ebert et al. 1995; see also Costandi 2016, 91). A study of holders of karate black belts revealed that, in comparison to novices, the black belt holders had noticeable differences in the white matter of the primary motor cortex and the superior cerebellar peduncles (Roberts et al. 2013: see also Costandi 2016, 92). In another study of golfers the researchers concluded that their findings supported "the idea that neuroanatomical changes are induced by intensive golf practice" (Jähnke et al. 2009; see also Katwala 2016, 51-52). Yet another study revealed a greater amount of cortical representation devoted to muscles in the hand in five elite badminton players in comparison to individuals who either played for fun or who had not played racket sports (as reported by Katwala 2016, 57).

While some studies of expertise are cross-sectional, and thus complicate the inference of a causal relationship between training and brain enlargements, in other cases longitudinal studies support this inference more directly (Costandi 2016, 92). A longitudinal study by Draganski et al. (2004) using magnetic resonance imaging to compare individuals who learned to juggle over a period of three months with non-jugglers showed that after three months of training the jugglers had "transient bilateral expansion in grey matter in the mid-temporal area (hMT/N5) and in the left posterior intraparietal sulcus." The areas are associated with "the processing and storage of complex visual motion." No change was found in the non-jugglers (Draganski et al. 2004; see also

Katwala 2016, 53; and Costandi 2016, 92). In addition, a longitudinal study of individuals who passed a difficult test called "The Knowledge" in order to become licensed London taxi drivers showed an increase of gray matter in their posterior hippocampi from the time that they started training until shortly after they qualified (Woollett and Maguire 2011; see also Costandi 2016, 90-95; and Katwala 2016, 51). In light of the accumulated data with respect to sport and other activities, there is some reason to generalize that the acquisition of skills in sport is correlated with and supported by neuroplastic changes.

"Perfect practice" may "make perfect" (or something closer to it), and thus reduce the training time needed to achieve athletic excellence. But there are also other shortcuts to athletic progress. For example, neurotropic drugs could provide a number of boosts to athletic performance, including improvement of reaction times (Foddy 2008). The manifold possibilities of neuroenhancement through pharmaceuticals draw neuroplasticity into the burgeoning field of neuroethics. This is true both inside and outside the world of sport.

In light of the preceding discussion of neuroplasticity and sport, let us revisit the athletic career of Michael Jordan. Having been cut from his high school varsity basketball team, Jordan persevered and developed a host of skills by a prodigious amount of hard work. This development was due in part to neuroplasticity. In the midst of his NBA career, plasticity was in evidence in that he exhibited cognitive and emotional flexibility by adjusting to playing in the team-oriented "triangle offense" instituted by Phil Jackson, a new coach. At an age when he might have permanently retired from sport, he entered the world of professional baseball, partly in response to the memory of his father. His accomplishments in this arena may have been underrated. After this brief experiment he returned to heights of athletic glory that few have attained. Over time, Jordan's basketball skills would degrade, and this too would be evidence of a kind of neuroplasticity. Even Jordan, who once experienced it first-hand, may now have only a faded memory of what it was like to "be like Mike."

VI. Conclusion

Neuroscientists now widely accept the view that neuroplasticity is fundamentally related to our individual identities as human beings. Neuroplasticity occurs in terms of both functional and structural changes in the brain. The significance of these changes is consistent with a variety of views of the mind-body relationship.

While we are particularly aware of some spectacular outcomes of neuroplasticity, we should not lose sight of subtler, yet fundamental, ways in which neuroplasticity

underwrites humans' identities. It does this by supporting both stability and change. Therein lies a risk associated with neuroplasticity, insofar as neuroplastic changes can be either melioristic and adaptive or maladaptive.

The world of sport provides one slice of life for examining the significance of neuroplasticity. This is in part due to the fact that sport requires dynamic, fitting responses to one's environment in order for one to be successful. This implicates the need for functional and structural changes in the brain in order to develop and maintain athletic excellence. All of this takes place in interaction with an internal and external milieu, and under pressure to succeed. To the extent that neuroplasticity underwrites an ability to change and grow as athletes, it also confers a kind of freedom from consignment to well-traveled paths.

While sport is but a slice of human culture and life, the cognitive, motor, and emotional skills that are required by and showcased in sporting activity have ties to other spheres of life. Indeed, it is perhaps not overly bold to suggest that the development of sporting excellence through neuroplasticity reflects processes necessary for other kinds of skillful development, including the skillful navigation of the task of becoming a responsible and exemplary human being.

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