Neurosociology

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The Nexus Between Neuroscience and Social Psychology

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To Audrey J. Franks and Danny, our son, without whose help this book could not have been written, and to our daughters, Tisa and Julie

Preface

As a career sociologist I first became interested in neurosociology around 1987 when a graduate student lent me Michael Gazzaniga's *The Social Brain*. If the biological human brain was really social, I thought sociologists and their students should be the first, not the last, to know. As I read on I found little of the clumsy reductionism of the earlier biosociologists whom I had learned to see as the archenemy of our field. Clearly, reductionism does exist among many neuroscientists. But I also found some things that were very social and quite relevant for sociology. After reading *Descarte's Error* by Antonio Damasio, I learned how some types of emotion were necessary for rational thought – a very radical innovation for the long-honored "objective rationalist." I started inserting some things about split-brain research into my classes, mispronouncing terms like amygdala and being corrected by my students. That instruction helped me realize how much we professors needed to catch up with our students. I also wrote a review of Leslie Brothers' *Fridays Footprint: How Society Shapes the Human Mind*. I thought if she could write so well about social processes maybe I could attempt to do something similar in connection with my field. For several years I found her an e-mail partner with a wonderful sense of humor. She even retrieved copies of her book for the use of my graduate students when I had assigned it for a seminar. Soon, after attending an ASA session on the social aspects of the brain, I was lucky enough to gather together the few people working in the area of social applications of neuroscience for a spontaneous dinner meeting. It was agreed that the name for our embryonic field would be "neurosociology." It was also then that I learned that the first person who wrote under this label was Warren TenHouten who published *Science and its Mirror Image* with Charles Kaplan as early as 1973. Warren also published a news bulletin devoted to the brain and the social process. He is clearly the father of this new field. At that time I was editing an annual on the sociology of emotion and wanted to devote the next volume to social aspects of the brain and emotion.

In 1999, the year I retired from regular teaching, *Mind, Brain and Society* came out which I edited with Thomas Smith. One reviewer who was generally positive about the collection ended up saying that all sociologists should read this book, but that sadly, they would not. Needless to say he was accurate enough, but some positive signs were around the corner. One was the publication of Jonathan Turner's *On the Origins of Human Emotion* in 2000. Other encouraging signs had to do with a

symbolic interactionist, David Maines, who invited me to write about neuroscience in his special issue of the *Journal of Symbolic Interaction.* When Professor Maines followed up on that and gave me the opportunity to write a section about neurosociology in Ritzer's 2007*, Blackwell Encyclopedia of Sociology* I thought we had "arrived" as an accepted part of sociology. This was confirmed when Stets and Turner requested a chapter on the neuroscience of emotion in their 2006 *Handbook on the Sociology of Emotion*.

In the Spring of 2008 I taught what I believed was the only course in neurosociology in this country, but I was wrong. Anne Eisenberg at SUNY Geneseo had been teaching a neurosociology course devoted to mental disorder for several years. One of the things which attracted me to teaching this course was that neuroscience could be seen as a hub which could be related to so many disciplines of the liberal arts.

Growing up a minister's son I had never been able to involve myself in many of the ecclesiastical separations – or better said – walls like the one between high church and low church and whether the communion wine actually turned into the blood of Christ. Certainly there were more important things to put one's mind to!

But I have learned that in respect to walls, academia was not that much different. Within my own department the division was between social structuralists and social psychology as if there could not be a cybernetic relation between the two. To me, Winston Churchill allegedly described the situation well in one of his remarkable sound bites to the effect that in academia, never have so many fought for so few over so little. This book is an effort to work toward breaking down the walls between sociology and neuroscience to the benefit of both.

While studying for my undergraduate and graduate degree I was exposed to symbolic interaction and at the University of Minnesota I had the good fortune to study with Arnold Rose and Gregory Stone. There I met a group of colleagues who have provided me with intellectual stimulation and challenges for all these many years. But this does not mean that I could only think within the confines of that perspective, and later on I especially took issue with the postmodern solipsism and the extremes of social constructionism that ignored Mead's insistence on maintaining an epistemology which had retained the value of possible error. Without this possibility words could define anything in any way and one narrative was as good as another. My concern about this has been eloquently voiced by Carl Sagan as quoted by the neuroscientist, Gazzaniga (1985):

> It's a foreboding I have – maybe ill placed – of an America in my children's generation. . . when clutching our horoscopes, our critical functions in steep decline, unable to distinguish between what's true and what feels good, we slide, almost without noticing, into superstition and darkness."

If Carl Sagan were alive today he might not be so concerned about horoscopes. He might be more concerned about some things covered in this book like the frailty of the self that makes us defensive and prone to violence and the unconscious forces that power structures use to blind us into becoming uncritical believers with the same resulting idiocy.

This book represents a long path for me, much longer than I, and my editors expected. Hopefully, this work will make this path sizably shorter for my readers.

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Contents

Chapter 1
Introduction

This volume presents selected issues in neuroscience which can be helpful to social scientists interested in this new and exciting field. At the same time it summarizes ways that social processes enter into, and impact on, brain processes and therefore may be of interest to neuroscientists as well. The potential for cross-fertilization in the two fields clearly is enormous.

Many sociologists think that neuroscience is incompatible with sociology in general but I think most of this is based on superficial understandings of a field that is still a foreign land to many social scientists. Because I have been involved with symbolic interaction during most of my career, a great deal of my interests are related to this perspective although certainly not exclusively. During the 1980s many influential figures in symbolic interaction moved away from George Herbert Mead to develop new methodologies and styles like ethnographies and to embrace the notion of narratives. This pushed them further away from Mead's exclusive adherence to science and from the brief, but consistent references he made to what he called the "central nervous system," i.e., the brain. In the notes on his lectures in *Mind, Self and Society* (1934:1) Mead does not waste time addressing this connection. He says.

> While the minds and selves are essentially social products or phenomena of the social side of human experience, the physiological mechanism underlying experience is far from irrelevant- indeed is indispensable- to their genesis and existence; for individual experience and behavior is, of course, physiologically basic to social experience and behavior.

Later he adds:

> This experienced world does not appear except when the various excitements reach certain points in the central nervous system; it is also true that if you cut off any of these channels you wipe out much of the world. What the behaviorist does, or ought to do, is to take the complete act, the whole process of conduct as the unit in his analysis. In doing that he has to take into account not simply the nervous system but also the rest of the organism, for the nervous system is only a specialized part of the entire organism (1934:111).

There are further indications in his lectures on the biologic individual that would imply that current neuroscience would be critical in forwarding his social interests. While symbolic interaction's interest in going in new directions can justifiably be seen as a healthy impulse to go beyond its past, a familiarity with Mead's writings

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on the priority of manipulative action may have saved the field from the extremes of recent postmodernism. Mead and his brief comments on what we now call the brain do imply some bridges between neuroscience and traditional symbolic interaction which have not always been recognized.

Regardless of current symbolic interaction's departures from much in Mead's works, the broader field of sociological social psychology including early symbolic interaction was created and developed in opposition to essentialist views which were most often rooted in biological reductionism. These views saw human behavior as the inevitable and immutable result of the "the nature of things" which in scientific circles was attributed to instincts developed in our evolutionary past.

In the middle of the last century the largest battle sociology waged in that regard was against the reductionism of sociobiology, but recently we have encountered a new type of biology – that of neuroscience which has captured the attention of both the public and academia, particularly the field of cognitive psychology. It would be hard to overstate the influence of a new socially oriented neuroscience on cognitive psychology. Not so, however, in sociology where we have been reluctant to overcome our historic tendency to associate all biology with reductionism.[1] Ironically this has left many sociologists in the position of being the last to know about how our very biological brain is simultaneously social in nature.

This book is written because of my conviction that there is good enough reason for cognitive psychology's openness to a social neuroscience and that this field can help sociology as well; as a matter of fact, as Douglas Massey, former president of the American Sociological Association stated in his 2002 presidential address to the society; neuroscience may be essential for a contemporary sociology.

Another reason why sociology may be more reluctant than cognitive psychology to accept the relevance of neuroscience is the difference in our overall unit of analysis. Our field focuses on interaction or "joint effects" while brains traditionally are considered organisms lodged inside of peoples' heads. However, the neurologist Leslie Brothers (2001) is critical of this isolated image and refers to it as "neuroism." This is not to say that neuroscience and sociology are partners – far from it. As a matter of fact, it would be hard to imagine two fields so different in terms of method, theory, tradition, and practice. But herein could lie an advantage and that is to break us out of our comfortable sociological "assumptive order" and develop insights which may have otherwise been impossible, or at least very difficult to develop. In hypothesis testing, construct and convergent validity are the most highly regarded methods of privileging a thesis. If different methods and different theoretical positions converge on the same findings their validity is enhanced.

[1] Granted, however, that "neurosociology" as it is called, is attracting more and more interest as well as being strongly endorsed by many of our leading theorists and the past presidents of the ASA.

Split-Brain Research and Symbolic Interaction's Theory of Accounts: An Example of Convergence

Michael Gazzaniga's findings in his split-brain research confirm a core notion in the theory of "accounts" by Scott and Lyman (1968); their work posits that our explanations for our behavior are seldom accurate reflections of our motivations seen as an individual wellspring of action. Gazzaniga's results come from working with patients who have extreme epilepsy. As a treatment for such cases the corpus callosum, which allows communication between the right and left-brain hemispheres, is severed. The corpus callosum is a massive cable of 200 million fibers which enables the fully linguistic left-brain (in right-handed people) to know what the characteristically nonlinguistic right brain is doing. The mute right brain communicates only with electrochemical means. Sensory information from the patient's left side is processed by the right side of the brain and vice versa. The severed right side can no longer tell the conscious left side what it is doing. Thus, a patient can be given a written message flashed to the left side of his face instructing him to draw something. The patient is not aware of the message, as it cannot be communicated to the left hemisphere because of the severed corpus callosum. This leaves one person with two brains, one of which is ignorant of the other (Fig. 1.1).[2]

In one typical study, the researchers told the mute right brain to draw a picture of a dog. Patients had no clue about what they were drawing until its form becomes obvious during the sketching. Only then will they realize they are drawing a cat or dog, etc. When the right brain is asked why the patient drew what he or she did, the left, usually "linguistic brain" contrives an answer that makes some sense to the patient (who is the only one deceived). The "explanations" are frequently quick and convincing. In another situation when a patient was sitting in a room, a message was sent by similar means to a patient's right brain. When asked why she was leaving the patient said "I'm getting a Coke." No doubt she continued to do just that because she was convinced that was what she wanted. In another case, patients' right brains were asked to laugh and then they were asked what was so funny. The patients never said they did not know why they were laughing. A reason was always forthcoming that only the patients themselves could believe since the researchers knew they were actually only following their directives for the research.[3]

To the sociologist the explanations are rationalizations or accounts if they are based on socially acceptable statements of intent. To the neuroscientist they are "confabulations." Scott and Lyman being sociologists go on to connect these ad hoc "vocabularies of motive" to identity-concerns and to specify the situational aspects dictating when actors are challenged to make such accounts in everyday

[2]Gazzaniga (1988) notes that some communication between the split hemispheres remains. Though the different capacities of the two have been exaggerated in the past, they are needed to balance each other. For example, the left-brain excels in cognitive interpretations and the right brain, lacking such abilities, is accurate, precise, and literalistic.

[3]Other classic experiments on split-brain research can be found in Franks and Smith (eds.) (1999:163).

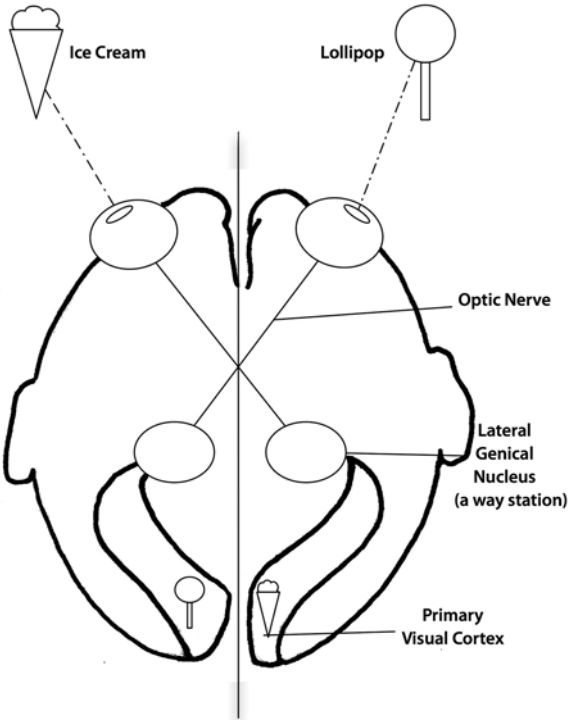

Fig. 1.1 Reversal of sight in two hemispheres of the brain

life. The human tendency to contrive such explanations independent of any actual intentions and then to believe them wholeheartedly is clearly established by the split-brain studies as well as in normal populations by Gazzaniga (1985:81–84). Getting beyond the account to the real reason – atleast in the narrow case of the split-brain research above – is something that sociologists could not do.

Neurosociology and the Self

Social psychology has taken on the daunting task of challenging one of our deepest and most compelling cultural images – that of the tightly bounded heroic individual whose ties to others are secondary to those of the self and whose powers come from within. This challenge is daunting because the very character of our culture and indeed that of the western world is premised on a kind of individualism that separates self from others and makes us uncomfortable with intimate connections between self and others. We cling tightly and lovingly to the belief that "we are the captains of our ships and the masters of our souls." It would be hard to overstate the power of this image on the western imagination. Our students shrink from the idea that we are strongly and unconsciously influenced by others. Intimate relations are

indeed sought, but are seen as threats to one's autonomy and "self-actualization." Witness the incomparable popularity of John Wayne along with other film heroes and the never tiring versions in movie after movie of the woman futilely pleading to go with him on his perilous journeys.

We have a long history of courting this asocial image of the person. Indeed the tautological ideology of "self-interest" has long been a cornerstone of our economy as well as an uncontested academic theory of motivation beginning with the enlightenment thinkers.

Compared to many other cultures and historical epochs, individualism is a part of our "assumptive order" and, no doubt, we have little perspective on its hold on us even as we cast doubt on its veracity. Nonetheless, a host of social psychologists has challenged this essentially asocial image of the person. See, for example, Geertz (1974), Sampson (1981,1988), Elias (1982), Tuan (1982), Westen (1985), Baumeister (1986), Franks and Heffernan (1998), and Scheff (1990). More recently Marková (2003: 9) has put it starkly:

> The concept of self is a construct. It is not a "natural kind" sited somewhere in the human brain. The western concept of self emphasizes individualism and autonomy but this view is cultural and no more scientific or truthful or advanced than the ... collective view of self developed in other cultures and which revolves around family or clan rather than the individual.

The image of the encapsulated self feels right to us, Elias says, because it correctly describes the emotional tone of life in a civilization whose valuation of the self and the metaphor of the "private realm within" forces attention on our separation.

One might think that taking on the Goliath of the westernized image of the asocial self was not of interest to those who study the singular brain, but there are signs that this is not the case. Certainly the majority of neuroscientists do not see this challenge as a priority, but a growing number do. Among these are, in varying degrees, Gazzaniga (1985), Brothers (1997, 2001), Cacioppo and Berntson (1992), Cacioppo (2002), Cozolino (2006), Edelman (1992), Damasio (2003), and lately Iacoboni's work on mirror neurons (2008).

Neuroscience and a Sociological Unit of Analysis

According to Cozolino, neither individual functioning of human brains nor isolated neurons actually exist in nature. This is a profound statement. Infants whose individual bodies are well nourished may wither and die from normally benign diseases when they lack social stimulation. We shall see in Chapter 3 how neuroscience has documented the brain processes involved in this physical collapse which is known generally as separation disorder. Similarly the neurons of our brains wither and die in a process known as apoptosis unless they are connected to other neurons. On both levels we must learn to see things in interaction. Our basic unit of causation in social psychology and in studies of the brain is not a single event, but a jointly created one

emerging from the connections made by at least two factors and including at least two people in relation with each other.

Sociologists can find various areas of creditable neuroscience that on closer analysis are compatible with their interests and expand the range of their field's own explanations. The field of neuroscience is not as monolithic as many presume. Also, for all the issues above, neuroscience has pushed the level of dialogue in matters such as agency and determinism into decidedly higher levels of sophistication which transcend simple either/or contrasts.

This variation applies even to our unit of analysis. For example, Leslie Brothers (1997: xii), armed with her experiences in the lab, her clinical practice and an in-depth knowledge of symbolic interaction, writes in a voice familiar to sociologists:

> To bridge the gap between minds and brains, we must grasp the significance of observations already available to us. We take the first step by acknowledging that the network of meanings we call culture arises from the joint activities of human brains. This network forms the living content of the mind, so that the mind is communal in its very nature: It cannot derive from any single brain in isolation.

Examples of Mutual Interests

Many areas of neuroscience inform sociological understanding and deepen our knowledge of our essential social natures. For illustrative purposes, two areas will be briefly described in this Introduction.

Self and others. There is a robust neuroscience of the reflexive self and how it is implicated so closely with others. Much of social psychology is based on the fact that our "primary adaptive mechanism"– human selfhood – derives from our interactional capacity for symbolic communication and self-conscious "mindedness." This implies a focus on consciousness and agency since our immediate awareness of what we are doing, or what we are about to do, is the basis for the flexible self-control of our own behavior. Because we think to ourselves with other people's linguistic symbols and are capable of seeing ourselves much as they do, self-control is inherently social control (Shibutani 1961). We shall see that neuroscience also has much to say about self-monitoring and related issues in self and other, volunteerism, and agency.

Determinism and Agency. At first glance, this interest in agency contrasts with the image so many of us have of neuroscience as being deterministic, reductionist, and generally more interested in the unconscious workings of the brain's "limbic" system than in conscious endeavors. But I have found much in the neuroscience literature which has been quite the contrary. Although there are strains of a reductionist view in some works, the larger part of the literature has been considerations of issues which go well beyond our usual sociological understandings and are often based on empirical findings rather than musings, however sophisticated these musings may be.

For example, Libet et al. (1983) found that our brains gear up for action before a conscious decision has been made to take action. This finding has produced a

vigorous literature on issues of "free-will" and determinism which are certainly relevant to the sociology of rational decision-making and notions of agency. Even if our impulses are automatic, the short time frame between the brain's preliminary actions can offer time to control them. A world totally free of determinant processes would render impossible any attempt at purposive action and the predictive capability it requires. This pushes the level of dialogue beyond simplistic contrasts and incorporates empirical evidence at a neurological level into the area of agency previously argued by speculation and assertion. These are just two of the many issues that can be explored to the benefit of members of both disciplines.

Early Recognitions of Emergents

Mead was among the early American scholars who discussed the concept of emergence. He rejected the idea found in an exclusive emphasis on conditioning where all causation was traced to the past which then pushed persons toward certain behaviors. For symbolic humans, the nature of the act was teleological and the anticipation of the consummation of an act pulled the person toward action. Reality for Mead was reserved for the "immediacy" of the moment. Adjustments to unexpected situations characterize the present. Novel events are the outcome of social interaction because different people draw out different sides of others. These outcomes become true emergents because the adjustments require participation by two people and cannot be predicted by observing any one person. This allowed Mead and his colleagues to avoid making choices between determinism and voluntarism, once more breaking down what had been seen as antithetical opposites. For Mead, mind was a true emergent from the structures of the brain, language, and social interaction.

The work of Schwartz and Begley (2002) on the mind's capacity to cause neuronal changes in the brain is a rare empirical example of emergence to be discussed in Chapter 10. It also provides evidence for recognizing mind as a causal force in the brain without falling into dualisms.

As early as the 1960s, Roger Sperry, Nobel Prize winner and the father of split-brain research, argued if mind were not more than the brain which gave it birth it could be reduced to epiphenomena and would not be necessary. This would be a terminal blow to Mead's whole perspective. Sperry's approach to emergence was different from Mead's since Sperry's work was based on a much more sophisticated knowledge of the brain compared to what was available to Mead. Nonetheless Mead's approach, though necessarily different, is still enlightening and will also be described in Chapter 10.

The reductionist view was prevalent in biology during Sperry's lifetime, and his thesis was only seriously considered secured in 1964. Before Sperry, the allegedly airtight and irrefutable assumption was that mind does not move matter; that no physical action awaits on anything but another physical action (Sperry 1993). However, he argued that mind was a true emergent arising from the neuronal functioning of brain cells and containing new characteristics that were fundamentally different from the parts giving it birth. What Sperry considered "mental forces"

could direct electrochemical traffic between neurons at the cellular level. He insisted that the causal potency of an idea becomes just as real as that of a neuron (Sperry 1993). In emergence, the whole is more than the parts taken separately. The important implication of what Sperry is saying is that the emergent whole can work back to exert influence on the parts that give it life. Like Mead, Sperry questioned the purely materialistic boundaries of science. However, this volume will demonstrate how recent findings and applications have supported his earlier findings and applications.

Given the imposing difference between the real and the mental, it was inevitable that Sperry would be charged with splitting mentality up into an irreconcilable dualism; however, this is not the case. His "emergent mentalism" as he called it, conceived of conscious experience as a non-reductive dynamic emergent of brain activity that cannot exist apart from the brain. It had no room for disembodied consciousness, mind, or spirit (Sperry 1993:16).

We are all familiar with the notion that the whole is more than the sum of its parts. The routine criticism of this notion is that it implies a mysterious "something" that exists between the parts and the whole. If you think of the parts as separate individuals who are mutually influencing each other the mystery disappears. This is what happens in "group think" where each person is privately against a position which is strongly desired by an authority. But they feel pressured to let their own positions rest and find themselves saying what they think the boss wants to hear. Being unaware that everyone else is feeling the same pressure and thinking just as they are, the individuals make a mutual decision which no one taken separately would have made. Nor would they have reached that decision had they voted by a secret ballot. In this way you can have unanimity in the group and yet have no one agreeing if the persons were taken separately. As common as it is to hear "that the whole is more than the sum of its parts" one needs to know if this means parts taken separately or taken in interaction. Sociological emergents imply the later.

Mind as Exerting a True Mental Force Over Its Parts

Sperry released science from its purely materialistic boundaries by showing that the emergent mind, now so different from the body from which it came, exerted a truly causal effect on its parts. If something causes changes in something else, it is real in any sense of the word. In this context we can seriously talk about mind over matter while staying within the bounds of naturalism. "The emergent character of mind does not mean that it is absolutely free of its parts, but that it overrides the physical and chemical elements giving it birth, and in turn can exert downward control over neural activity" (Sperry 1993). The causal chains in the brain are twofold and cybernetic. First we have the upward chain of causation going from the parts to the emergent mind. Second, we have the downward control by the mind to the parts from which it originally arose.

At first sight this seems to collide with the old directive that "nature takes no leaps." In a way it does and in a way it does not. Although the novelty of the emergent is indeed such a leap, it is a leap that carries with it the dynamics of the past and simply overrides it in power. According to Sperry, to override something does not mean that what is overridden has absolutely no influence on the emergent. "The old simple laws. . .never get lost or canceled in the process of compounding the compounds. They do, however, get superseded, overwhelmed, and outclassed by the higher level forces as these successively appear. . ." Sperry (1965). Thus, the continuity of the emergent with its past is preserved.

Sperry was far ahead of his time, however, as we shall discover, he has been vindicated by new findings and applications of his ideas in this century. In short we have seen a re-emergence of emergence.

Emotion's Involvement in Rational Choice

Moving away from Meadian theory, another example of neuroscience's contribution to sociology comes from Antonio Damasio (1994). He has shown one critical aspect of the relationship between emotion and thought, namely the actual necessity for emotion in rational decision-making. This was one of the most important discoveries of "The Decade of the Brain," and is succinctly summarized in Gazzaniga (2008). Thought gives us options but affective preferences – likes and dislikes – hold the key to the actual choice. Damasio used intellectually capable patients who had damages to the prefrontal lobes where emotions are integrated with thought. They showed some emotions like anger, but not the emotions of guilt, embarrassment, and shame which are important to maintaining social relationships. We will describe this in detail in Chapter 6. None of this means we should gloss over the distortions to reason which are made possible by emotion.

Damasio's (1994) finding that rational choice depended on certain kinds of emotional input has validated sociology's stress on the importance of emotion and refined our theories of rational decision-making. Damasio (1994: 178) goes further to discuss how social factors interact with biological ones to increase the condition he calls acquired sociopathology. He fears that sizable sectors of western society gradually are coming to be comparable to his patients. Damasio's concern reminds us of Max Weber's description of rational efficiency wherein the only criterion for decision-making is the quickest, least expense, and most guaranteed means to the ends, and the only emotional concern is profit.

Science's Rediscovery of Chicago Pragmatism and Curbs on the Excesses of the Linguistic Turn

Closely associated with this issue is the current stress on embodiment as we shall see in Damasio's patients. Embodiment has a critical place in his somatic-marker hypothesis on the importance of bodily feelings to making reasonable choices.

Some might wonder what this has to do with a social framework, but the social behaviorism of Mead was premised on the "transactional" framework developed by Dewey and Bentley (1949) which insisted that mind subserved practical, manipulative motor action on the world as well as social communication. Recently Lakoff and Johnson (1999) have shown that the metaphorical nature of mind has its roots in this same embodied action. Other currents in neuroscience, especially the work being done by those studying mirror neurons, has also illustrated how the principles and priorities developed by the Chicago pragmatists of Mead's day have been rediscovered in brain science.

Transcending Exclusive Reductionism

Another broad issue involves reductionism proper, which is assumed to explain away the social and to frame behavior in more "basic," non-social terms. Such a perspective denies sociology its reason for being. While there is disagreement in neuroscience circles, almost all of its current leading writers aiming for the educated public are distrustful of any position that reduces human experience to the mere motion of electrochemical synaptic impulses between neurons. Some writers are overt adherents to the general notion of emergence arising from the interaction of brain parts (Sperry 1965). To many of them, interaction is the irreducible force of lived experience and its emotions which drive and organize the brain. But we shall also see that another major force in organizing the brain is the motor cortex. It has its own heavy influence on minded behavior.

The concept of consciousness has long played a significant role in symbolic interaction. Neuroscientific considerations of consciousness are largely focused on the general issue of how tangible brain processes can enable intangible subjective experience and vice versa; whatever inhibitions neuroscience may have once had about studying consciousness in general and self-consciousness in particular have lessened considerably.

For example, Damasio (1994) clearly rejects the kind of reductionism that minimizes the importance of social processes:

> I am not attempting to reduce social phenomena to biological phenomena, but rather to discuss the powerful connection between them. It should be clear that although culture and civilization arise from the behavior of biological individuals, the behavior was generated in collectivities of individuals interacting in social environments. Culture and civilization could not have arisen from single individuals and thus cannot be reduced to biological mechanisms, and even less, can they be reduced to a subset of genetic specifications. Their comprehension demands not just general biology and neurobiology but the methodologies of the social sciences as well.

Edelman (1992:166), like Sperry, a Nobel Prize winner, uses more direct language about the matter:

> To reduce a theory of an individual's behavior to a theory of molecular reactions is simply silly, a point made clear when one considers how many different levels of physical,

biological and social interactions must be put in place before higher-order consciousness emerges.

The prominent neuroscientist V.S. Ramachandran has presented an interesting discussion on what the Nobel prize-winning Francis Crick referred to as the "astonishing hypothesis" (Crick 1994). This was the idea that our conscious experience and sense of self is merely the activity of a hundred billion bits of jelly (i.e., a functioning brain) with only the brain being real. This leaves our grandest thoughts and noblest intentions as but the epiphenomenal product of a pack of neurons.

Murphy (2003: 61–62) calls Crick's position "ontological reductionism." This means that ultimately entities, including us, are *nothing* but their parts. Crick takes the strongest possible view that only entities at the lowest levels are "*really* real." Murphy refers to this as "atomistic reduction" – an extreme type of ontological reductionism that Edelman calls "silly." Murphy notes that the phrase "really real" is more of an "attitude" or a preobjective intuition than an explicit philosophy and therefore Crick is hard to refute since his meaning is not clear.

A belief that this extreme meaning is prevalent among neuroscientists has been common among my colleagues and others who are apprehensive about the reductionism and determinism they associate with neuroscience. By referring to this "nothing but" reduction as a neuroscience revolution, Ramachandran suggests that there is a consensus about it in neuroscience which, given the quotations above (and his own position), is obviously not the case.

In conclusion, sociologist Franks and Smith (1999:5) suggest that reductionism and the doctrine of emergence are not necessarily opposed perspectives. Certainly, we should trace the "top-down" paths from emergence to the processes that give rise to them. There is no reason to reject the full picture of bottom-up and top-down causation, especially given the complexity and the cybernetic quality of the brain. Hopefully this can cleanse our field of what some have called our myopia against any type of reductionism.

Some Generalizations About the Emotional Brain

Use It or Lose It. The brain is highly reactive and needs to engage in actions on an environment to maintain itself and to develop. Brain cells die if they are not used. An interesting example occurs in temper tantrums. Children who are allowed to indulge freely in temper tantrums do not develop the neuronal pathways to control the robust circuits already existing in the structures involved in early emotion (Carter 1999:91). This leaves them without normal controls in their mature years. "Use it or lose it" is as true in childhood as it is in older age.

The Brain as Tinkerer. The brain's most recently developed structures did not come out of the blue as perfect solutions to new tasks. The brain is a "tinkerer." It can only build on what the past has made possible. This is why Wentworth and Yardley (1994) have to caution that we make a common mistake when we see the youthfulness of the neocortex and its large prefrontal lobes as reigning over other

brain parts in queenly fashion. We must realize that the older structures of the brain co-evolved with the cortext. The new constrains the old but the old also constrains the new and the brain has to make do with what its structures allow. The clearest example of the consequence of this "making do" is how the size of an infant's head is constrained by the mother's pelvis, making childbirth a hard and risky business. Nothing remains static. The developments of human emotional capacities developed at a faster rate than the neocortex which is why the neocortex is causally favored over the cortex. The old so-called limbic system of the brain was once considered the distinctive seat of the emotions, but the concept has been significantly modernized. The limbic system is a full partner in what is now seen as distinctive and currently human.

Plasticity. Contrary to older assumptions, we now believe the brain has immense flexibility. Alternative structures do what they can to perform the function of traumatized structures. Lateralization of the brain is especially important in this flexibility. Every structure in the brain is located on each hemisphere with the exception of the pituitary gland and the corpus callosum. If a baby lost half of its brain, the other hemisphere would rewire itself to perform the tasks usually seen as the exclusive prerogative of the left side. This capacity for flexibility declines with age and myelinisation – the hardening of the cover on nerve cells. The left and right brains have different, but often complimentary, styles, and capacities which will be explored later. As we shall see, with the proper tutelage and applying very hard work, mind, focus, and patience can regenerate synaptic structures of the brain destroyed, for example, by strokes. The material for such restoration comes from other places in the brain; spare parts can be in diverse parts of the brain and fashioned to meet other needs.

Synapses. Internal communication makes the brain work. This communication is both electrical and chemical. Microscopic fibers stretch out of cell neural bodies at both ends called axons. Those which send messages away from the cell body to other neurons are called output channels and those receiving input from other fibers are called dendrites. On their branches are many terminals allowing the cell body to communicate with the receiving dendrites of as many as 1,000 other neurons. The same neuron can receive up to 10,000 messages. Gaps thinner than the ink on these pages separate axons and dendrites. When the axon fires, chemicals called neurotransmitters from this synaptic space are released. At this point the communication between neurons become chemical. They release ion channels making the cell body likely to fire and become output cells. According to LeDoux (2003), the electrical output from the axons is like a pulse. Since the storage places for the neurotransmitters are only in the output terminal of the axon, transmission only works one way and becomes chemical. Numerous electrical pulses from axons are needed to make a dendrite receive them and these impulses must occur within milliseconds of each other.

The Brain as a Projector. Next, neuroscience has driven a final stake into the heart of Locke's "tabula rasa" theory wherein mind is conceived as an empty slate "writ" on by experience and passively mirroring "what is." As Lakoff and Johnson (1999) argue, "correspondence theory" is dead in the water. The brain consistently