

# 6 Policy Implications of Advances in Cognitive Neuroscience

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Many years ago Francis Crick said, “No scientific study is more vital to man—humans—than the study of one’s own brain.”<sup>1</sup> The Decade of the Brain in the 1990s led to incredible advances in neuroscience and especially in cognitive neuroscience. But, some have raised questions as to whether our political institutions and social scientists and ethicists are keeping up with these advances.

We have seen tremendous advances due to many initiatives in science. The questions have to do with how we interpret the implications of these advances. This chapter covers three areas. First, it gives a very brief, oversimplified view of the developments in neuroscience in general. Second, it takes a more detailed look at research in cognitive neuroscience and its implications for our study of human behavior and our understanding of human beings. Third, it examines whether institutions, in fact, are keeping up with these changes (I do not believe they are).

## Developments in Neuroscience

We have had advances in a variety of areas in the new neuroscience. While we know a lot more about the brain than we did 10 years ago, it is still rudimentary information. We have a lot of theories and suppositions, as well as a building amount of information and findings. We are working to identify the anatomical connections and to understand the biochemical, molecular, and genetic mechanisms of the brain. We see a synergism and convergence of many

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types of research coming together in the neuroscience research area. One example is our ability to measure and visualize human brain function during mental activity. We can correlate what is happening in the brain, biochemically, magnetically, and so forth, with behaviors at the very time that these behaviors are going on. The potential for more precise and effective means to predict, modify, and potentially control behavior raises many political issues. We must decide how to use appropriately these new treatments for neurodiseases, disorders, and tumors, which are major burdens on society. And, as our population ages, the number of neurodegenerative diseases increases substantially.

### *Political Issues*

Every time we intervene in the brain, we must deal with a series of political issues. Electroconvulsive therapy (ECT) has been around for many decades and is still a political issue. The same is true of electronic stimulation of the brain (ESB), which has been around for over 50 years.

Why are these therapies political issues? First, we have questions concerning informed consent. Informed consent with any medical procedure is an issue. But in this case the informed consent has to come from the organ that, in fact, is designated as having a problem. This raises difficult issues of consent.

Second, any time you deal with ECT, ESB, psychosurgery, or any type of mental illness or mental disorder you have potential stigmatization. Mental disorders are not treated like physical diseases. You can see this in the wide range of budgets for different issues in health care. Some of this disparity has to do with stigmatization.

Third, we draw a fine line between experimentation and therapy. We find this, as well, with other areas of research, such as stem cell research. But here the question is: When are we intervening in a person's brain as therapy and when are we intervening to experiment?

We also have questions of autonomy and personal identity. The brain is our source of both. The brain is also the source of our free will, supposedly, and this brings questions of potential control.

There are also questions as to whether terms like “free will” and “individual responsibility” mean much anymore (these will be discussed below).

These are just some of the issues accompanying any intervention in the brain. And particular applications raise additional issues. For example, in the area of mind-altering and psychotropic drugs, we have questions of overuse and questions of using these drugs on children (especially Ritalin and Prozac). We also have questions of the long-term effects of psychotropic drugs. These are issues that have not been fully addressed. It might be many decades before we understand the long-term effects of large amounts of these and other drugs on children and even on adults.

We also have questions of the impact of nootropics, or smart drugs (enhancement drugs). A recent study said that 30 percent of symphony orchestra members are on enhancers, beta-blockers, and other drugs, to lower anxiety.<sup>2</sup> We also see questions in the media recently about problems related with the routine use of hormonal treatments.

### *Virtual Reality*

Virtual reality is being used more and more in therapeutic sessions for phobias, compulsions, and obsessive behaviors. Basically, virtual reality is a deliberate manipulation of the senses to provide an almost hallucinogenic state or a new (virtual) reality. As virtual reality techniques and technologies develop and give us more complete perceptual fields with less intrusive delivery mechanisms, they are going to be used more and more to provide alternative realities.

In spite of many books on virtual reality and on the use of virtual reality as a therapy, there is very little discussion and analysis of what this therapy means for the people who are using it. This is certainly true for people outside the area of cognitive neuroscience (that is, social scientists, ethicists, and policymakers). It may become very hard, particularly as these virtual realities become more real, for certain individuals to distinguish the artificial world from the real world. This therapy also might interfere with normal psychological processes. We do not know what happens when a person is put on long-term therapy with virtual reality. It also may become a means of so-

cial withdrawal. Virtual reality might be a lot better place to be for that individual than the real world. (Addiction is another area in which an alternative reality offers a more pleasurable experience.)

### *Genetics*

Most of the attention in this area is on stem cell transplants. And most of the politically controversial targets in the future of stem cell research are centered on the brain.

In the area of genetic intervention, one of the areas that certainly has great promise is using viral vectors to remove tumors. Viruses with herpes simplex have been inserted in brain tumors and then drugs given to kill any cells with herpes.

There are other areas where genetic engineering, genetic technology, and neuroscience overlap. One area tries to supplement deficient neurotransmitters or block certain transmitters that are involved with particular genes. Another area identifies genes that prevent normal brain development. A third area is gene replacement therapy.

### Cognitive Neuroscience

Cognitive neuroscience is interested in the interaction or the relationship between the structural and physiological aspects of the brain, the neural transmitters, the receptors, and the mind (or human behavior). This area has a more narrow focus than that of psychotechnology.

In the past, our knowledge of what is happening in the brain was very limited. Some individuals were studied after death. Autopsies would compare brains of violent individuals, ill individuals, and others. Now we have a broad range of technologies routinely used in many applications. Many of these are used to see what is happening in the brain at that moment and to actually measure brain activity on a live individual under certain circumstances. These technologies are also used to study cognitive development in childhood to understand how the brain develops early on.

One area of recent work is imaging studies on people in deep-trance meditation to see what parts of the brain are operating. These studies are also used to study addiction. We can study individuals who are in the throes of withdrawal to see what is happening in the brain.

We have the technologies now that are giving us vast, new insights into how the brain works. The results, in turn, have implications as to how we view ourselves and others, as well as a number of social policy issues.

### *Connections to Behavior*

The brain mediates or has an impact on our entire behavior, every action and thought we have. Writing the book *Brain Policy* was very difficult in many ways because while I was writing it I was thinking about what was going through my own brain.<sup>3</sup> This experience raises questions for myself and for anybody who thinks about it as to what we are all about and what, at base, we are as humans. This type of research, particularly in the major areas of positron emission tomography (PET) scanning and some of the functional magnetic resonance imaging (MRI), is used extensively in behavior research and in cognitive neuroscience.

### *Violence, Aggression, Criminality, and Other Antisocial Behavior*

From PET scan and MRI research, we have clear evidence of the organic bases of criminality and antisocial behavior. Some studies have found that up to 95 percent of persons with uncontrollable rage (such as road rage and domestic violence) have some developmental or acquired brain disorder.

We are also finding that these disorders many times can be traced to specific regions of the brain that seem to play a role in the expression of violent or antisocial tendencies. For example, studies of violent men have found very high rates of brain injuries or trauma to the prefrontal cortex in the temporal lobes. These studies have also found smaller prefrontal areas.

More important is the impact of certain neurotransmitters acting on particular receptor sites. Key neurotransmitters here include serotonin, dopamine, and noradrenaline. Certain regions of the brain seem to be very active in a variety of ways when individuals express rage, antisocial behavior, violence, etc. Certainly we need more research here, and the research is coming. A recent *Scientific American* article, "The Neurobiology of Child Abuse," points out, based on PET scan studies, that the negative effects of child abuse on the functioning and actual development of the brain are long-term and enduring.<sup>4</sup> The impact of child abuse then is not simply behavioral; it actually changes the structure and functioning of the brain or of particular neurotransmitters and their receptor sites. Obviously this has serious political implications for how we deal with violent behavior (in this case, child abuse).

We also need more research on the effects of neurotoxin exposure, particularly for young children and perhaps even prenatally. We need research on prenatal and early childhood environment because none of the evidence suggests that we are born with this rage. It is an interactive model and it requires that we reevaluate how we examine the foundations of behavior. But we also have to look at how we might change that environment to maximize the potential of the brain of individuals, especially children.

Related research is based on the area of the brain called the amygdala, which is in the brain core area (the midbrain area). Cognitive neuroscientists say that this area receives signals of potential danger and then sets off a series of reactions in response to that danger. Here, in fact, would be the very basic primal survival mechanism of the brain, one that has been around as long as we have been humans. Imaging studies have found that when people are exposed to situations where they might be afraid or show hatred, the heightened activity is not in the neo-cortex. That is, it is not in that area of the brain where we rationally make decisions but rather in the amygdala, in the center brain area. In other words, hatred, violence, fear, aggression, and antisocial behavior are probably not amenable to

rational discourse, negotiation, or bargaining, strategies we take as a basis for much of our foreign policy and for our way of dealing with antisocial individuals.

Joseph LeDoux finds that one of the associations particularly difficult to unlearn is fear because fearful memories lurk deep within the brain in the amygdala.<sup>5</sup> This explains why it is very difficult to change phobias.

It is very important, especially in the area of violence and antisocial behavior, that we understand that changing such deep-rooted emotion is much more complicated than we thought.

This new knowledge of the brain has vast implications for the criminal justice system, for hate crime policies, and for foreign policy. Ethnic hatreds are not going to be overridden, according to this research, by rational discourse. Long-standing ethnic animosities are not going to be solved by having a couple of leaders come together and shake hands. These are patterns that are developed deep in the brain and early in childhood development, or early in brain development. (This idea also has implications for the war on terrorism.)

Another set of issues centers on addictive behaviors, which extract a huge social cost. Addiction affects all organs but it mostly affects the brain. Studies have been done (again, with PET scans and MRIs) with addicts in withdrawal. The major finding is that all abused substances, no matter what the mechanism, stimulate the brain's reward system and induce feelings of pleasure that can override even the basic survival activities. This explains why addicts are willing to substitute one substance for another.

When exposed to these addictive substances, tolerance builds up within certain neurotransmitters. If the brain is excessively stimulated over time, it learns to adjust and its functions change. The brain is then affected directly.

In terms of research the two most important areas are the biochemical and genetic bases of addiction. We must look at the impact of addictive substances on the brain and its functioning. These two areas of research are moving ahead very rapidly, but without much work in the area of social interpretation or analysis of the findings.

This raises questions concerning our anti-drug policy, the legalization of marijuana, our alcohol policy, and other issues. If the same things happen in the brain this also raises questions in other areas of behavior, such as eating, sex, gambling, and the Internet. Again, the questions focus on what is happening in the brain, as compared to the behaviors themselves.

### *Brain Differences by Sex*

Brain imaging studies are showing significant differences in the brains of males and females (on average and in normal distributions). One of the targets of research here is the hypothalamus (the regulatory center of primal activities) and its 12 nuclei. Some of the nuclei are larger in males than they are in females; some are spherical in males and elongated in females. There are also differences in metabolic activity: men have higher levels of activity in the temporal limbic region and women have higher levels of activity in the posterior cingulate gyrus region. The corpus callosum, which connects the two hemispheres, is much larger in women.

So there are sexual differences in the brain. Why does this matter? It matters in terms of any policies we establish, particularly in prescribing drugs. Drugs operate on different brains in men and women. We have to be very careful about psychotropic drugs in particular. This raises serious political issues. We cannot, according to the brain research, treat boys and girls the same. This applies to many areas. For example, some school systems have eliminated recess. Boys might need recesses because their brains might need that time off.

There are other promising research areas, such as the differences in brains of people with different sexual orientations. An early study by Simon LeVay found differences between homosexual men and heterosexual men in the nuclei in the hypothalamus.<sup>6</sup>

*Free Will*

Ultimately the work in cognitive neuroscience comes down to the question of free will and individual responsibility. Does our new knowledge that much of our behavior is being shaped by neurotransmitters and receptors mean that individuals are no longer responsible for their own actions? Should we assume that we no longer have free will?

Free will, or some concept like free will, is at the center of our retributive justice system. We use a model of rational choice theories. Democracy itself assumes that individuals have the capacity to make rational choices—not in the amygdala but in the neo-cortex, where we can think through rationally, thus making a choice.

This raises broad, theoretical, conceptual questions concerning free will and individual responsibility. Are we controlled by the actions of neurotransmitters and biochemical reactions? The evidence suggests that we certainly cannot dismiss this question. We have to at least deal with it.

*Are Our Institutions Keeping Up?*

Are we ready to face the issues? Are our government and political institutions at the stage where they can deal with the advances in cognitive neuroscience? I would say that few are able to deal with these consequences, particularly in terms of how we view human behavior.

The Decade of the Brain was tremendously successful, particularly because other sciences were brought in and technologies in imaging and computerization were utilized. But we have not kept up in terms of policy mechanisms that anticipate the implications beyond the technologies. We have little evidence that there is any anticipatory policy. Most policies tend to be reactive.

## Conclusion

The inclusion of the brain in a more interactive paradigm of human behavior threatens a prevailing and deeply entrenched social-environmental model. It poses threats to the environmental, social science model that we are born with a *tabula rasa*, that we are basically empty organisms that can be modified and shaped by our environment. We are much more than that. Environment is important but we cannot dismiss the findings of neuroscience that seem to be very uncomfortable with this model, which does not seem to fit our current theories.

Moreover, cognitive neuroscience challenges basic assumptions on both ends of the ideological spectrum. People on the left and the right are attempting to interpret the findings in the most favorable way for their particular ideology. As with many areas of technology, applications can be considered either good or bad depending on one's perspective.

We have a lot to work out here. We have seen a lot of ideological maneuvering, for example, in the reactions to the studies on the differences between the gay male brain and the straight male brain. The first reaction from the gay community was that they have been saying this for a long time—homosexuality is natural. The other side, in the extreme, said that we should have prenatal diagnosis and abort any homosexual.

Although cognitive neuroscience has not yet received the attention of the other areas of science—(such as genetic engineering and transplant surgeries), its policy implications warrant close scrutiny by independent scholars, think tanks, and policymakers. The implications are broad and serious. Too much is at stake to ignore the findings of cognitive neuroscience or to leave to chance how they are interpreted and applied.

## Endnotes

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