Running Head: BIOLOGICAL BASES

Biological Bases of Behavior

Jane Doe

Sample UniversityIntroduction

The relationship of mind to body has been a matter of investigation and speculation for as long as there have been human beings. According to Andreassi (2000), "There is evidence that Stone Age cave people may have associated headaches, distressing thoughts, or evil spirits with the inside of the head, because skulls containing holes (trephined) have been found among the remains of cave dwellers" (p. 3). Even if these early humans were simply trying to relieve physical pain located in the head, it is certainly true that people have thought about the relationship of brain to body for as long as people have been writing down their thoughts. Egyptian papyri dating from the 16th century BCE, which may themselves have been copies of writings from 3,000 BCE show that the physicians of the time understood the brain to be the place where mental activity occurred.

Speculation concerning the biological bases of behavior continued as first philosophers and then psychologists tried to understand how the body might be related to internal experiences such as thoughts and feelings (Russell, 1975). Some materialist philosophers believed that everything was determined by the body while some idealist philosophers believed that everything was decided by the mind. Still others believed that there was an interaction. Most who believed in an interaction were somewhat vague about the mechanics of it (although Descartes, who was very specific, held that the pineal gland situated at the base of the brain near the spinal cord was the precise location of the interaction between body and spirit).

In modern times, the debate concerning the biological bases of behavior has become more sophisticated but no less contentious. Some medical doctors seem to believe that all mental illness is caused by brain disease or other physical problems while some psychologists feel that all mental illness is caused by emotional neurosis or trauma. Even those who share the same general orientation may not agree with one another about specific issues.

The lack of decisive data allows this situation to stay static. In many instances, there are no uncontested data to support or refute a particular position. In other instances, there are data that may be interpreted in different ways. As Feinberg and Farah (1999) note:

An important goal of cognitive neuroscience is to identify the causal chain of neural events, or the mechanisms, underlying cognition. The data of functional neuroimaging are correlational: a certain area is activated when a certain cognitive process is occurring. Neuroimaging can never disentangle correlation from causation; in other words, it can never tell us which brain areas are causally involved in enabling a cognitive process. Activated regions could play a causal role or could be activated in an optional or even an epiphenomenal way (p. 17).

In other words, even when there is a clear and incontestable correlation between a behavior and its biological substrate, it is still impossible to tell which, if either, factor is causal. The cognitive process may cause the neural event, the neural event may cause the cognitive process, there may be interactional causation, or they may both be caused by a third variable.

Given this level of uncertainty, it is not surprising that there is still considerable debate concerning the larger issues concerning the relationship of physiology to psychology. Nonetheless, at the more practical and less philosophical level, some things are known with a strong degree of certainty. Injury to certain specific areas of the brain does lead to loss of specific functions, leading to the conclusion that those areas of the brain are necessary, if not sufficient, for those functions (Andreassi, 2000). The introduction of certain chemical agents, as medications, does have specific effects on cognition and emotion, allowing us to know that the relevant neurotransmitters express certain mental illnesses, whether or not they cause them (Timmons and Hamilton, 1990).

This kind of knowledge can be extremely useful but may also be used in potentially destructive ways. Obviously, knowledge about specific parts of the brain can aid in helping people who have brain injuries while knowledge about the effects of specific chemical agents can be used to ease the symptoms of severe mental illness. But such knowledge can be and has been misused. For many years, a wide range of people — including those who were simply disobedient or disruptive rather than ill — were subjected to lobotomies; today, an increasing number of children are given psychotropic medications that have not been approved for children and might damage their growing brains.

It is very important for psychological professionals to have a basic knowledge of the issues concerning the biological bases of behavior, with a particular emphasis on the drugs that are so often used to abate or control the symptoms of common emotional problems. This paper provides an overview of key issues concerning brain and behavior, psychopharmacology, and the relationship between the fields of psychology and physiology.

Brain and Behavior

It was initially through observation of injury that behavioral scientists began to understand the roles of specific parts of the brain in specific elements of behavior. Through careful observation of happenstance, Broca discovered the section of the left frontal lobe that is responsible for speech production while Wernicke discovered the section of the left temporal lobe that is necessary for speech comprehension (Andreassi, 2000).

Much more has since been learned about the functions of the frontal lobes, which may be divided into the motor, premotor, and prefrontal segments (Benson and Miller, 1999). The prefrontal cortex serves as a conduit between the frontal cortex and other brain areas as well as between the frontal cortex and other parts of the body. We know that the prefrontal receives and passes along input from the limbic system, the hypothalamus, the reticular system, and sensorimotor neurotransmitter systems. However, much remains to be learned. As Kimberg, D'Esposito, and Farah (1999) note, "prefrontal cortex plays a crucial role in normal intelligent behavior. However, a more precise characterization of the functions of prefrontal cortex has been elusive." Functions such as sorting, sequencing, verbal fluency, context memory, associative learning have all been shown to be impeded by prefrontal damage. Yet, the precise role of the prefrontal cortex in such functions is not yet known. Such deficiencies in our knowledge highlight the fact that neurology and biopsychology are evolving rather than bodies of information. This should lead us to be cautious in our assessment and use of what we do believe that we know. So much remains unknown that it may turn out that we are mistaken about some things that we believe we know. We must remember that the scientists of previous eras, whose beliefs modern scientists have since disproved, themselves believed that they knew the truth about brain and behavior.

While the brain is the most relevant physiological substrate for mental functions such as cognition, memory, and emotion as well as for behavior related to such functions, it should be noted that there are other physiological regions and processes that apparently impact behavior. Andreassi (2000) discusses such factors as blood pressure and blood volume in relation to mental processes. Taylor, Klien, Lewis, Gruenwald, Gurung, and Updegraff (2000) discuss the role of hormones in stress reactions. Both blood pressure and hormones directly impact areas of the nervous system other than the brain.

Pharmacology

One of the most important and at times vexing issues for psychologists is psychopharmacology. Psychologists working in the clinical realm often must deal with clients taking psychotropic medications that may have been prescribed by medical doctors with little or no recent training in psychiatry or clinical pharmacology (Wiggins and Cummings, 1998). The psychologists must understand but usually cannot in any way control the medications taken by their clients. Behavioral pharmacology is of interest to other psychologists because of what evidence it provides concerning the biochemical bases of behavior.

According to Timmons and Hamilton (1990) changes in brain chemistry can produce changes in behavior; at the same time, changes in behavior or the environment can produce changes in brain chemistry. Thus, the abnormal brain chemistry associated with a mental condition such as depression or excessive anxiety may be the cause or simply a symptom of the basic problem. Regardless of the causality, the abnormal brain chemistry is associated with a particular mood or behavior, which may be altered by changing the brain chemistry. When the abnormal brain chemistry is the ultimate cause of the problem, restoring the brain chemistry to normal solves the problem. When the abnormal brain chemistry is a symptom of the problem, restoring the brain chemistry to normal can relieve troublesome emotions or behaviors in order to allow the person to discover and fix the underlying problem.

How can the brain chemistry be readjusted? To understand this, one must understand that the electrical action potential involved in the firing of neurons is actually a chemical process. There are a finite number of neurotransmitters, each of which matches up with its own receptors. This means that there are a finite number of things that can go wrong and that the each potential problem can, at least in theory, be solved by the introduction of the proper chemical agent. Put very simply, psychoactive medications activate or block neurotransmitters, as needed, in order to restore proper balance and neuronal activity. Over time, research has uncovered a number of substances that work for different symptom pictures. In some instances, the reason the medication has the effect that it does is very well understood while, in other instances, the mechanism of action remains a mystery. For example, the antidepressant medication bupropion turns out to be of great assistance in quitting smoking. While the action of the drug in relation to depression is well understood, the accidental effect of assisting in tobacco cessation is not at all understood.

Because of the fact that prescription privileges are reserved for medical doctors, most people do not realize that psychologists have participated in psychopharmacological research and practice for many decades. In fact, psychologists have always been at the forefront of research concerning psychoactive medications and continue to be responsible for monitoring the effects of medications on clients (Wiggins and Cummings, 1998). Often, mental health clients will see their therapists weekly or more often while only seeing their medical doctors once per month or less, making the role of the therapist in evaluating the effects of medication particularly critical.

In recent years, debates have been ongoing concerning the question of whether to extend prescription privileges for certain psychoactive medications to clinical psychologists who have received appropriate training in much the same way that prescription privileges for antibiotics and other common remedies have been extended to nurse practitioners who have received appropriate training (Barnett and Neel, 2000). In addition to facilitating treatment and recognizing that the psychologist is often the primary mental health care provider (with the non-psychiatrist medical doctor playing a supportive role), some have argued that extending prescription privileges to clinical psychologists would hasten the acceptance of integrative treatment approaches. Integrative treatment approaches recognize that mental health problems are most often caused by a constellation of factors, which may include both physical and environmental problems in addition to psychological problems. Integrative treatment approaches deliberately combine medical, psychological, and psychosocial treatments and are the logical extension of the recognition of the possibility of two-way causality between body and behavior.

Psychology and Physiology

The relations between the fields associated with psychology and those associated with physiology are complex. Most of the people studying the relationship between brain processes and mental or behavioral processes used to consider themselves biological psychologists but are now more likely to consider themselves neurologists (Davis, Rosenzweig, Becker, and Sather, 1988). The distinctions may not be merely semantic. While someone thinking of herself as a biological psychologist might be inclined to give equal credence biological and psychological hypotheses of causality, someone thinking of himself as a neurologist might be predisposed in favor of biological explanations. Given the complex and unsettled nature of the question, it would be preferable for scientists engaged in the study of brain and behavior not to be biased in either direction.

Kosslyn et al. (2002) are concerned to build bridges between psychology and biology. They assert that this will be more easily done if "researchers treat each participant as an individual but conceive of individual differences within the framework of a general characterization of the population as a whole" (p. 341). This will allow for recognition of both the psychological phenomenon of individual difference and the biological phenomenon of natural variation. Studying variation itself may help to untangle the multiple causes of individual differences, which must be assumed to include both biological and psychological factors.

It is important to build bridges between psychology (and other social sciences) and biology (and other physical sciences) because people are always influenced by both their bodies and their minds (as well as by their environments). Cacioppo, Berntson, Sheridan, and McClintock (2000) stress the importance of this, stating that "Social and biological explanations traditionally have been cast as incompatible, but advances in recent years have revealed a new view synthesized from these 2 very different levels of analysis" (p. 829). This new view is often referred to as social neuroscience.

According to Cacioppo, Berntson, Sheridan, and McClintock (2000), social neuroscience involves the study of the influence of social variables on biological processes that most people consider to be purely physical, such as genetics. Gene expression, for example, often depends upon environmental circumstances which themselves depend upon social factors. Similarly, disease expression is often closely tied to stress, which is a function of both external pressures and habitual responses to such pressures. In both of these examples, what happens within the nervous system can be directly influenced by social factors.

Social neuroscience shows that causality goes both ways when it comes to brain and behavior. To put it simplistically, brain damage can cause impaired behavior and impaired behavior can cause brain damage. More subtly, biological potentiality may be one determining factor in behavior while behavior may be one determining factory in biological actuality. The importance of this realization cannot be overstated, because it moves us past the overly simplistic, black and white thinking of the past.

Conclusion

Wiggins and Cummings (1998) assert that "relevant training in psychopharmacology should be an integral part of training of psychologists providing health care" (p. 549). Barnett and Neel (2000) agree, making a very strong argument that lack of such training will "render psychologists ill prepared to adequately meet patient treatment needs" (p. 619). This seems a very reasonable minimal suggestion. I would go a step further and mandate such training for all psychologists. Training in psychopharmacology can assist all students of psychology in learning about the biological bases of cognition, emotion, and behavior. Of course, students who intend to practice clinical or counseling psychology must have more than minimal knowledge in order to adequately work with clients who present with or hope to obtain prescriptions for psychoactive medications.

I would also argue that the time has come to extend prescription privileges to clinical psychologists who have a sufficient combination of training and experience. It is shocking that a new doctor fresh out of medical school with only the bare minimum training and no substantial experience in psychiatry has the power to prescribe powerful and potentially dangerous psychoactive substances that he or she has never seen in action while a clinical psychologist with 30 years of experience treating the most disturbed psychotic patients cannot prescribe the medications he or she is so intimately acquainted with. I agree with those who have argued that extending prescription privileges will also hasten acceptance and implementation of more integrated treatment approaches.

That would be an excellent outcome because, if nothing else, the study of the biological bases of behavior teaches us that we must consider all possible causes of and treatments for a given symptom, recognizing that both biological and psychological factors may be operating in a causal manner. We must bring our practice into alignment with our understanding of that concept.

References

Andreassi, J.L. (2000). *Psychophysiology: Human behavior and physiological response*. Mahwah, NJ: Lawrence Erlbaum.

Barnett, J.E. & Neel, M.L. (2000). Must all psychologists study psychopharmacology? *Professional Psychology: Research and Practice, 31*(6), 619-627.

Benson, D.F. & Miller, B.F. (1999) Frontal lobes I: Clinical and anatomic issues. In T.E. Fienberg (Ed.), *Patient-based approaches to cognitive neuroscience* (pp. 309-316). Cambridge, MA: MIT Press.

Cacioppo, J.T., Berntson, G.G., Sheridan, J.F. & McClintock, M.K. (2000). Multilevel integrative analyses of human behavior: Social neuroscience and the complementing nature of social and biological approaches. *Psychological Bulletin, 126*(6), 829-843.

Davis, H.P., Rosenzweig, M.R., Becker, L.A. & Sather, K.J. (1988). Biological psychology's relationships to psychology and neuroscience. *American Psychologist, 43*(5), 359-371.

Feinberg, T.E. & Farah, M.J. (1999).Historical perspective on cognitive neuroscience. In T.E. Fienberg (Ed.), *Patient-based approaches to cognitive neuroscience* (pp. 3-20). Cambridge, MA: MIT Press.

Kimberg, D.Y., D'Esposito, M. & Farah, M.J. (1999). Frontal lobes II: Cognitive issues. In T.E. Fienberg (Ed.), *Patient-based approaches to cognitive neuroscience* (pp. 317-326). Cambridge, MA: MIT Press.

Kosslyn, S.M., Cacioppo, J.T., Davidson, R.J., Lovallo, W.R., Spiegel, D. & Rose, R.(2002) Bridging psychology and biology: The analysis of individuals in groups. *American Psychologist, 57*(5), 341-351.

Russell, B. (1975). *A history of western philosophy*. New York: Simon and Schuster.

Taylor, S.E., Klien, L.C., Lewis, B.P., Gruenwald, T.L., Gurung, R.A.R., & Updegraff, J.A. (2000). Biobehavioral responses to stress in females: Tend-and-befriend, not fight-or-flight. *Psychological Review, 107,* 411-29.

Timmons, C.R. & Hamilton, L.W. (1990). *Principles of behavioral pharmacology.* New York: Prentice Hall.

Wiggins, J.G. & Cummings, N.A. (1998). National study of the experience of psychologists with psychotropic medication and psychotherapy. *Professional Psychology: Research and Practice, 29*(6), 549-552.