

BORDERLINE BIOLOGY

By Neil Bockian, Ph.D.

Author of

“New Hope for Borderline Personality Disorder”

Illinois School of Professional Psychology
A division of Argosy University, Chicago, IL

For

www.borderlinepersonality.ca & www.borderlinepersonality.org

Borderline Biology

Introduction

The degree to which Borderline Personality Disorder (BPD) is seen as a biological as opposed to a psychological phenomenon will impact in profound ways how people with the disorder see themselves, and how others—especially family members—see them. Some people believe that the symptoms of borderline pd are entirely learned, entirely a product of the environment. Most lay people who are not specifically educated on the matter believe that most of the symptoms of borderline pd are something the person who has the disorder can “overcome” through “will power,” or learn to stop doing through simple means. If you have the disorder, you may hold those beliefs yourself.

In fact, BPD is associated with a complex set of biological and environmental underpinnings. As will be seen, the disorder is inherited to a fairly high degree. Therefore, the person with borderline personality disorder is not on a level playing field with others. It is like playing baseball on a team in which some people are allowed 3 strikes to get a hit, others two, and some people just one strike. People who have more strikes to use will generally do better. The person with a borderline predisposition has impulsivity, memory problems, and hypersensitivities, much of which is probably inborn. There are three strikes against them—and yet they must still find a way to get a hit!!

The following article is designed to provide a set of guideposts through the complex landscape of understanding the biology of borderline pd. Some areas are fairly well documented, others are mostly conjecture. We need to know much more. However, what we do know is both intriguing and illuminating. Nearly any parent of more than one child knows that noticeable differences are present, practically from the moment of birth. One was a calm, easy child; another, a fussbudget; a third, a terror. These inborn characteristics are known as temperament. Biology has a powerful impact on our interests, talents, predilections, and personality.

There have been many exciting developments in the neurobiology of personality disorders in the past 10 to 15 years. Despite the parental observations noted above, it was not long ago that there was virtually no biological study of personality. Although many scientists believed that biological underpinnings would be found for depression, schizophrenia, and other disorders, personality was thought to be a function of the environment. In fact, the belief that biology plays only a minor role in personality is quite mistaken. Scientific evidence is mounting that biological factors are crucial.

Genetics

Before discussing the scientific findings regarding heritability, it would be worthwhile to explain some common techniques used to estimate the degree to which a characteristic is inherited. The method used in the studies I'll be reviewing is the “twin” method. Everyone knows that some twins are identical, and some are fraternal. Identical twins have the exact same genes, while fraternal twins share genes to the extent that any siblings do (about 50%). It stands to reason that if identical twins have a characteristic more than fraternal twins, much of the difference is due to genetics. For example, one study found that on a measure of borderline personality disorder, the correlation between identical twins was .70, while the correlation for fraternal twins was .39 (Coolidge, Thede & Jang, 2001). By using some calculations based on the difference between the two correlations, scientists can estimate the degree to which a characteristic is inherited (the “heritability;” see Nigg & Goldsmith, 1994).

Based on twin methodology, several studies have been conducted that estimate the heritability of borderline pd. A factor labeled “emotional dysregulation,” which corresponds to borderline PD, had a heritability estimate of 52% (Jang, Vernon & Livesley, 2000). Coolidge, Thede & Jang (2001), in their sample of children and adolescents, found that the heritability of borderline PD is 76%. A study using the Dimensional Assessment of Personality Pathology found that affective lability has a heritability of 38.4%, and identity problems, 39.7% (Jang, Livesley, Vernon & Jackson, 1996). These studies are consistent with the conclusions of psychiatrist Kenneth Silk (2000), who, based on his extensive review of the relevant literature, estimates that the contributions of genetics and environment are approximately equal in the development of personality disorders.

Knowing that there is a moderately high genetic loading for borderline pd has implications for understanding the remaining findings presented below. It increases the probability that the neurological and anatomical differences that we see are inborn. One could argue, for example, that problems in the frontal lobes of people with borderline pd are a result of their “borderline” behaviors: substance use problems, the stress of relationship difficulties, etc. But, since we know that about half of the disorder is from genetic factors, then it is likely that a good deal of the difficulties discussed below have at least a partial genetic contribution.

Theory and Research on Temperament

A substantial amount of research has been done on the nature of temperament, and which characteristics tend to be inherited. Independently, and based on quite different theoretical assumptions, two theorist/researchers came to nearly identical conclusions about important aspects of temperament, and their role in personality. Psychiatrist C. Robert Cloninger, M.D., a leading biological researcher, describes four different temperaments:

1. Harm avoidance
2. Novelty seeking
3. Reward dependence
4. Persistence.

Harm avoidance refers to the individuals level of fear and anxiety; those who are high on the dimension are fearful and shy, while those who are low on the dimension are outgoing, optimistic, and daring. Individuals who are high in *novelty seeking* have a strong need for stimulation, are easily bored, and tend to be more impulsive. *Reward dependence* is associated with the desire for rewards from others; people who are low in *reward dependence* are aloof and distant, while those who are high on the dimension are warm and attached. *Persistence*, as the name implies, refers to one’s tenacity in trying to achieve a goal; people who are high on this dimension are industrious and determined, while those who are low may be underachievers. Cloninger’s dimensions are nearly identical to a set of dimensions proposed by psychologist Theodore Millon, Ph.D., one of the members of the DSM-III and DSM-IV Task Force on Personality Disorders (see Millon, 1969, 1981, 1990, 1999; with Davis, 1996). Millon’s pain-pleasure dimension refers to the need to avoid pain (harm avoidance) as contrasted to the desire to obtain pleasure (similar to novelty seeking). The self-other dimension, which refers to whether one obtains rewards from the self or other people, mirrors Cloninger’s “reward dependence.” The active-passive dimension relates to whether one is active or passive in their interactions in the world, which is very similar to Cloninger’s persistence dimension. Taken together, the confluence of the two theories is striking. Millon’s work, which is based on years of painstaking analysis of psycho-

Borderline Biology

logical measurements, confirms the usefulness of his dimensional system. Cloninger and other researchers, meanwhile, directly measured the biological components of personality. They measured biological variables, such as genetics, neurotransmitter levels (such as serotonin and dopamine), and measured activity levels in the brain. The results are quite revealing. In one study, Cloninger and associates studied the human genome of 758 sibling pairs in 177 families. They analyzed 291 sites on the genes of these individuals. Specific gene combinations were associated with each of Cloninger's 4 dimensions. How powerful were the associations? Even though only a fraction of the genome was marked, the researchers accounted for 45 to 66 percent of the variance, depending on the dimension. In other words, nearly one-half to two-thirds of the variation of the measured scores on the dimensions was accounted for by the genetic code. If you knew the specific gene sequences identified by Cloninger and his associates, you could make reasonable estimates of the person's personality functioning, even if you knew very little about the person's upbringing.

Brain Activity, Brain Anatomy, and Neurological Functioning

We now have ways to scan the brain that are noninvasive. CT (Computed Tomography) scans are related to X-ray technology, and are able to show the basic structure of the brain. MRI (Magnetic Resonance Imaging) uses adjusted radio waves and powerful magnetic fields, and provides far more detailed images than the CT. PET scans (Positron Emission Tomography) detect the activity of glucose. Because glucose metabolism is a good measure of activity level, the PET scan gives a measure of the relative activity level of different areas of the brain. PET scans can also follow "tagged" molecules to assess their activity; for example, studies using specially tagged serotonin molecules can help illustrate what happens to serotonin in the brain. Unlike other scans, which look at brain structure, PET scans look at brain function or activity. Using these scans to compare people with borderline personality disorder to those without it, we can determine the structural and activity differences in the brain.

Peter Goyer and his associates studied a group of 17 patients who had a personality disorder diagnosis. Six of the patients had BPD, another 6 had antisocial personality disorder (which is associated with impulsivity and aggressiveness), and the remaining 5 had other personality disorders. An auditory stimulus was used to provoke a reaction in the brain, and then PET scans were taken. A moderately large correlation was found between a lifetime history of aggression and reduced activity in the orbital frontal lobes. Later work by Goyer and associates showed that these findings held up when gender and age were taken into account (see Goyer et al., 1994).

More recent work has supported these findings. Paul Soloff, M.D., and his associates (2000) used PET scans with five patients with borderline personality disorder and eight healthy controls. He had two conditions for each subject: placebo and fenfluramine (a serotonin-enhancing medication). In the placebo condition, control participants had greater activity in large portions of the prefrontal cortex, including the medial and orbital regions on both sides of the brain, the left superior temporal gyrus, and the right insular cortex. In response to fenfluramine, control participants had greater activity in the medial and orbital regions of the prefrontal cortex on the right side of the brain, and several areas on the left side of the brain, including the caudate body, parietal lobe, and the middle and superior temporal gyri. In no case was there increased activity in the brains of the subjects with BPD. Soloff concludes concisely, "Patients with BPD have diminished response to serotonergic stimulation in areas of the prefrontal cortex associated with regulation of impulsive behavior" (p. 540).

Further, in a study done by Marco Leyton, Ph.D., and his associates (2001), 14 participants with borderline personality disorder were compared to 11 individuals who had no current or prior psychiatric history using PET scans and MRI's. The individuals in the study were tested with a task that re-

Borderline Biology

quired restraining one's impulses. As expected, the individuals with borderline personality disorder were significantly more impulsive than the control subjects. Similar to the earlier studies, differences were found, especially in the serotonin-rich areas of the brain. Similar to Goyer et al.'s findings, there were lower levels of brain activity seen near the orbital frontal area (in the medial frontal gyrus, anterior cingulate gyrus, superior temporal gyrus, and corpus striatum). The authors concluded that low serotonin synthesis capacity in the relevant pathways of the brain may promote impulsive behavior in individuals with borderline personality disorder.

There are also interesting neuroanatomical differences between individuals with and without BPD. Twenty-one women with borderline personality disorder were compared to an equal number of women who had never had a psychiatric disorder (Driessen et al., 2000). Subjects were matched on several important demographic variables: gender, race, handedness, years of education (+/- 1 year), and age (+/- 3 years); in addition, analyses controlled for overall size of the brain, so one cannot conclude that group differences were due to one group being generally smaller or having smaller brains than the other group. The volume of the hippocampus, a part of the brain which is critical for memory, was found to be nearly 16 percent smaller in the borderline group. The average volume of the amygdala, [which is related to emotional functioning and social behavior], was over 7.5 percent smaller in the BPD group. The researchers tested whether these differences were related to prior abuse experienced by the individuals with borderline personality disorder. The evidence was unclear; further research is needed to determine if the smaller hippocampus and amygdala are related to abuse.

In sum, brain-scan studies show that individuals who have difficulty with impulse control and aggression have reduced levels of activity in their brains in a number of key locations. This effect held up whether one used lifetime history of impulsive/aggressive acts, or current impulsivity on an assigned task, to define impulsivity. Increases in aggression are associated with low level of activity in the frontal cortex, as well as reduced activity in several areas within the limbic system. Aggression has also been associated with low levels of serotonin. It is as if the frontal lobes are a fence, and the impulses are a wild horse. If the frontal lobes are impaired—if the fence is too low or too weak—then the wild horse will escape. Impulsivity and aggression are also associated with the limbic system, which is involved in the integration of the emotions with sensory information from the environment. The information is then sent to the frontal lobes, which get involved in the interpretation of that data. It is similar to an intelligence operation (spying) for a country. Like a spy, accurate data must be gathered, sent to headquarters, and interpreted in order to have an accurate picture of what is happening and to respond appropriately. If the data are gathered, but lost (similar to memory problems on the part of the person with bpd) then the data are useless. If the data makes it back to headquarters, but is misinterpreted (similar to cognitive impairments on the part of the person with bpd) then the information the spy retrieved is still not helping to produce better outcome. A spy who takes unwise, impulsive actions also imperils the mission. In the person with BPD, mild to moderate impairments in several systems that are involved in the gathering, delivery, and interpretation of data make mistakes more likely.

Other subtle processing problems have been found, based on four neuropsychological studies of individuals with borderline personality disorder. Consistently, researchers found that there were difficulties with visual discrimination and filtering, and difficulties with recall of complex material. There also appear to be problems in visuomotor integration and figural memory. These problems occur, on average, in a mild to moderate and diffuse way; that is, in most areas of neuropsychological functioning, individuals with borderline personality disorder have normal results. These problems are subtle, and could easily be missed in any given individual. Neurological examinations and EEG studies show a high rate of subtle neurological dysfunction in individuals with BPD (Zanarini et al., 1994).

Thus, brain functioning and learning style may contribute to many of the difficulties that we see in borderline personality disorder. For example, difficulties in visual discrimination and filtering are likely

Borderline Biology

to lead to difficulties interpreting information from the environment. When the person with BPD sees something, he may not be able to select what is important from what is unimportant (poor filtering), which makes the situation confusing. Filtering problems are associated with field dependence (being overly influenced by context, rather than one's "internal compass") and having poor boundaries, which are clinical features of borderline personality disorder. Diffuse dysfunction noted in the various studies may also be related to dissociation, which is common in individuals with borderline personality disorder, whether or not they have a history of abuse.

Individuals with BPD have been found to have difficulty with both verbal and visual memory, especially complex material. Difficulty with recall of complex material may make it difficult for people with BPD to learn from their experiences. This is consistent with the clinical observation that many people with BPD make the same mistakes over and over. Information that is not properly encoded will lead to misinterpretations indefinitely. It is like the student who does not properly hear or understand a lesson from class, and dutifully records the misinformation in her notes. She studies for the exam, and is able to produce what she had written in her notes. Of course, however, she still gets the item wrong on the exam. Encoding is a critical element of learning. Memory retrieval problems can lead to similar observed difficulties. In this case, the metaphorical student may have copied the information properly in her notes, but, try though she might, she is unable to recall it. The result on the exam is the same. We do not yet know if individuals with BPD have difficulty with retrieval, recall, or both; either way, it can create difficulties for the individual, especially if the problem is not recognized. Since memory seems to happen automatically, especially in social situations, many people assume that the person who makes certain kinds of errors was being willful, was not listening, or has a variety of character flaws. In fact, it could be that the individual has difficulty processing information. Processing problems can also impact an individual's self-image. Kathleen O'Leary, M.S.W., and Rex Cowdry, M.D., note that "such a memory deficit may contribute to difficulties borderline patients experience in maintaining a continuous sense of self and using the past to respond to present events and predict future consequences" (1994, p. 147).

Neuropsychological findings regarding individuals with BPD have important treatment implications. O'Leary and Cowdry note:

Regardless of etiology, a psychoeducational approach in treatment may be useful. It may prove therapeutic for a clinician to suggest that cognitive processing problems are part of this disorder, and that a patient may have "misread" a scene or "forgotten" some important elements in a story. As in all psychoeducational approaches that use a biological or neurological framework to understand a disorder, the goal is not to absolve patients of responsibility for their actions or lapses, but rather to increase patients' awareness of their own predilections so that they can cope with their vulnerabilities and change their behavior (1994, p. 149).

Using strategies such as performing self-ratings, taking notes, and journaling to enhance recall can improve the adjustment of the affected individual. In some cases, a therapist may want to use these strategies with the therapeutic relationship itself. For example, the client might take notes during a session, which is tape recorded. The client can then review his notes and compare it to the tape recording. This is laborious and would not be a routine treatment, but this can help to illustrate processing difficulties and misinterpretations in a useful and informative way.

So, what does it all mean? Summary and conclusions

Like most scientific research, the data can be interpreted in many ways. For all of the impressive findings above, someone could argue that the biology are the effects of having borderline personality disorder—that behaviors related to having borderline pd such as substance abuse or early traumatic

Borderline Biology

events cause the biological problems (such as serotonin imbalance and a smaller amygdala). As I've argued above, this seems unlikely, given the strong genetic loadings associated with the disorder. I'll share with you the scenario that I think is most likely.

Early in life, our biology has more of an impact on our behavior than our environment. Given parenting that is merely adequate, such as providing food and a moderate amount of affection, whether a baby is calm or cantankerous is primarily due to his inborn tendencies. The parents and baby form a relationship that is shaped by both the parents' personalities and that of the baby.

Raising a child with borderline tendencies is overwhelming for the parents. The child with borderline personality tendencies often is extremely hypersensitive. Gentle words are experienced as mortal stab wounds. The parents are completely bewildered. Some parents, depending on their level of mental health, may respond with harsh discipline, which is experienced by the child as abuse. Some parents are truly abusive, which, of course, makes everything worse.

For the child with borderline biology, life is difficult on many fronts. Given their hypersensitivity, they experience the world as harsh and painful. With their reduced serotonin levels, they lack the necessary equipment to adequately control their impulses. When they act impulsively, there are negative consequences—but what else can they do, given how they are? These interactions leave them feeling hopeless and depressed.

As life goes on, people with borderline personality disorder cannot “find themselves.” Their difficulty knowing who they are leads to further stress. A stable job and a committed relationship help most people to find secure niches—a sufficient income, friendly companionship, and mental stimulation. The person with borderline pd is at risk on all fronts, and almost constantly endure the stress of “starting over”—getting a new relationship, moving, and changing jobs. This worsens their innately fragile mental state, perpetuating the borderline pattern.

And so, the person with borderline personality disorder has a rough row to hoe. Biologically predisposed to impulsivity and hypersensitivity, they face challenges that most people never need to confront. Biological considerations explain one of the most puzzling phenomena in the borderline domain: why do people with borderline pd feel so “different?” The answer is that they are born with biological differences that make it difficult to fit in to American culture. We are expected to defer gratification, to constrain our impulses, to wait for years, perhaps even decades, to fulfill our desires. We are expected to be “tough enough” to endure the slings and arrows of our competitive culture. Yet, the biologically borderline are hard-wired to have great difficulties in both of these areas.

Understanding that this problem is about ½ biological and ½ psychological/environmental has important implications for how we should handle the problem of borderline pd. One is to note that the biological differences can often be corrected if caught early enough. Dr. Stanley Greenspan (Greenspan & Wieder, 1998) has designed a program of behavioral interventions that actually correct the neurochemical imbalances that underline emotional dysregulation (being emotionally out of control) if intervention begins very early on (e.g. under the age of 3, preferably beginning when the infant is just a few months old). Once the person is old enough that such early intervention is not possible, education is essential—the person with the disorder, and significant others in her/his environment, should understand the biological differences, and the challenges they present. Medication can help to partially correct some of the chemical processes that underlie borderline pd. Finally, psychotherapy will help the individual who has borderline pd to cope and to make relationship improvements.

References

- Coolidge, F. L., Thede, L. L. & Jang, K. L. (2001). Heritability of personality disorders in childhood: A preliminary investigation. *Journal of Personality Disorders*, 15: 33-40.
- Driessen, M., Herrmann, J., Stahl, K., Zwaan, M., Meier, S., Hill, A., Osterheider, M., & Petersen, D. (2000). Magnetic resonance imaging volumes of the hippocampus and the amygdala in women with borderline personality disorder and early traumatization. *Archives of General Psychiatry*, 57: 1115-1122.
- Goyer, P. F., Andreason, P. J., Semple, W. E.; Clayton, A. H.; King, A. C.; Compton-Toth, B. A.; Schulz, S. C. & Cohen, R. M. (1994). Positron-emission tomography and personality disorders. *Neuropsychopharmacology*. 1994 Feb Vol 10(1): 21-28.
- Greenspan, S.I. & Wieder, S. (1998). *The child with special needs*. Reading, MA: Perseus.
- Jang, K. L., Livesley, W. J., Vernon, P. A. & Jackson, D. N. (1996). Heritability of personality disorder traits: A twin study. *Acta Psychiatrica Scandinavica*, 94: 438-444.
- Jang, K.L. Vernon, P.A. & Livesley, W. J. (2000). Personality disorder traits, family environment, and alcohol misuse: A multivariate behavioural genetic analysis. *Addiction*, 95: 873-888.
- Leyton, M., Okazawa, H., Diksic, M., Paris, J., Rosa, P.; Mzengeza, S., Young, S. N., Blier, P. & Benkelfat, C. (2001). Brain regional alpha-[sup-1-sup-1C]Methyl-I-tryptophan trapping in impulsive subjects with borderline personality disorder. *American Journal of Psychiatry*, 158: 775-782.
- Millon, T. (1969). *Modern psychopathology: A biosocial approach to maladaptive learning and functioning*. Philadelphia: Saunders. (Reprinted 1985, Prospect Heights, IL: Waveland Press).
- Millon, T. (1981). *Disorders of personality: DSM-III: Axis-II*. New York: Wiley.
- Millon, T. (1990). *Toward a new personology: An evolutionary model*. New York: Wiley-Interscience.
- Millon, T. (1999). *Personality guided therapy*. New York: Wiley.
- Millon, T., with Davis, R. (1996). *Disorders of personality: DSM-IV and beyond*. New York: Wiley.
- Nigg, J. T. & Goldsmith, H. H. (1994). Genetics of personality disorders: Perspectives from personality and psychopathology research. *Psychological Bulletin*, 115: 346-380.
- O'Leary, K. & Cowdry, R. (1994). Neuropsychological testing results in borderline personality disorder. In K. R. Silk (Ed.) *Biological and neurobehavioral studies of borderline personality disorder*, 127-157. (Washington, DC: American Psychiatric Press).
- Silk, K. R. (2000). Overview of biologic factors. *Psychiatric Clinics of North America*, 23(1): 61-75.
- Soloff, P. H., Meltzer, C. C., Greer, P. J., Constantine, D. and Kelly, T. M. (2000). A fenfluramine-activated FDG-PET study of borderline personality disorder. *Biological Psychiatry*, 47: 540-547.
- Zanarini, M. C.; Kimble, C. R. & Williams, A. A. (1994). Neurological dysfunction in borderline patients and axis-II control subjects. In K. R. Silk (ed.) *Biological and neurobehavioral studies of borderline personality disorder*. Washington, D. C.: American Psychiatric Press: 159-176.