Short Communication

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The Neuroscience of Borderline Personality Disorder

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Borderline personality disorder (BPD) is a serious mental condition, with broad ramifications for individuals, families and society. It is characterized in the DSM-5 as "A pervasive pattern of instability of interpersonal relationships, self-image, and affects and marked impulsivity" [1], in ICD-10, a very similar condition is labeled Emotionally Unstable Personality disorder. The estimated prevalence of borderline personality in the United States is approximately 1.6% [1]. The rates in England and Norway are estimated at 0.7% and in Australia at 1.0%. Approximately 60-70% of individuals with borderline PD have attempted suicide, with 8-10% successfully completing suicide [2]. Estimates of the financial cost of borderline personality disorder exceed $53,000 per case per year [3]. These statistics are echoes of the emotional pain coused by the disorder; for each individual affected, numerous other lives are touched. There is also a troubling association between intimate partner violence and borderline personality disorder, thought to be mediated by attachment insecurity [4]. As a practicing clinician, I have witnessed first-hand the overwhelming anxiety of parents fearing for the lives of their children – an anxiety to which, as a clinician, I was not immune -- and of perplexed partners trying to connect steadily with an unstable loved one.

Current treatments that are efficacious or probably efficacious for borderline PD [5] address helping individuals with BPD develop self-regulation and interpersonal skills [6], understand and modify their core beliefs understand others' thoughts, feelings, and viewpoints more effectively [7] and resolve their internal conflicts. Thus, I believe the next major frontier of understanding and treating borderline personality disorder rests within neuroscience. That area is still in its infancy, but there are a number of studies with intriguing and provocative findings. The purpose of this brief overview is to increase attention to borderline PD to the neuroscience community.

Science is beginning to reveal details of predictable brain differences in individuals who have problems with impulsivity, emotion regulation, identity disturbance, and transient psychosis. Anatomically, one study showed that, controlling for overall brain volume, people with borderline PD had a 16.0% smaller hippocampus and a 7.5% smaller amygdala than control participants [8]. There is reduced activity in the orbital-frontal region of the brains of adults with borderline PD [9,10]. Neurochemistry also plays a role; Coccarro reviewed some 30 studies demonstrating a relationship between serotonin levels and impulsive aggression. A review of four neuropsychological studies suggests that people with borderline PD tend to demonstrate difficulties with visual discrimination and filtering, difficulties with recall of complex material, as well as problems in visuomotor integration and figural memory; they concluded 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" (p. 147). Neurological examinations and electroencephalogram studies have shown a high rate of subtle neurological dysfunction in individuals with borderline PD. Ruocco et al. found that individuals with lower levels of activation in the bilateral dorsolateral prefrontal cortex (DLPFC) reduced frequency of self-harm in response to dialectical behavior therapy (DBT) more than those with higher levels of activation; the lower activation group also was more likely to complete treatment. Further, reductions in self-harm were associated with increases in the right DPLC during/post treatment. If causal, then treatments that impact the DPLC could improve the success of treatment for self-harm, and the completion of DBT programs. Interleukin-6 was positively correlated to dissociation scores, and several markers were negatively correlated with dissociation. Flasbeck and associates also found a neurobiological connection to the inability to connect words to feelings; "Our findings reveal that lower right frontal EEG asymmetry is associated with alexithymia in patients with BPD. This finding is in accordance with neurophysiological models of alexithymia that implicate right hemisphere impairment in emotion processing, and could

suggest frontal EEG asymmetry as a potential biomarker of relevant psychopathology in these patients." [11].

Use of stimuli to prompt brain responses also makes important contributions to our understanding. People with borderline PD, experimentally exposed to a rejection condition, demonstrated greater left cortical activation relative to healthy control participants. This is consistent with approach motivation, and is consistent with the clinical observation that people with borderline PD respond to rejection by pursuing individuals who reject them, and also are hostile with them [12]. In a creative assessment of attachment in people with borderline PD, researchers assessed brain activity associated with transitional objects. Attachment anxiety was associated event related potentials [13]. A study using ERP's showed that a sample of girls/young women with borderline PD responded more strongly to negative words than healthy controls, and interpreted their results as indicating "individuals with BPD overrecruit frontolimbic circuitry in the presence of negative self-relevant information" [14]. The tendency of women with borderline PD to interpret happy faces as angry was associated with specific event related potentials (ERP's) in the occipital and temporo-occipital areas [15].

There are treatments that directly impact brain activity, such as neurofeedback (also called EEG biofeedback) and repetitive Transcranial Magnetic Stimulation (rTMS) which I believe should be researched for people with borderline PD. I and my colleagues and students have begun to gather brain maps (qEEG's) and other information on individuals with borderline personality disorder and plan to begin publishing our results shortly. Although there have been no studies of individuals with borderline PD, a small study suggests that individualized neurofeedback is helpful for individuals with antisocial personality disorder; 12 of 13 participants made substantial gains.

Finally, people with borderline personality disorder have a variety of strengths. It is so under-researched that it is difficult to find information on the topic; indeed, my search of both the PsycInfo and PubMed databases with the terms "strengths" and "borderline personality disorder" was essentially fruitless. Oldham and Morris described the "mercurial" style (a healthy form of borderline PD) as having characteristics such as romantic attachment, heart, passion, open-mindedness, and other positive qualities. A website dedicated to borderline PD listed many positive characteristics, including bold, compassionate, curious, creative, protective and intuitive (Strengths and qualities of BPD, undated) [16]. I have seen those characteristics in my borderline PD clients, even among those with other personality liabilities and substantial distress. Along those lines, I believe that assessing strengths in people with borderline PD should be given serious research attention.

I believe that we, as a community, need to think broadly about borderline PD. Researchers in several related areas can interconnect, in order to help solve the puzzle. For example, research in the following areas can bear upon the problem of borderline PD: impulsivity, impulsive aggression, consciousness, identity disturbance, executive function, substance use (e.g. the self-medication hypothesis) and psychosis. I believe we also need to think outside the boxes that diagnostic categories tend to create in our minds. What is the real underlying relationship between borderline personality disorder (which can be conceptualized as a conglomeration of dysregulation of affect, thought and behavior) and highly "comorbid" conditions such as depression, anxiety, and substance abuse? Neurobiological effects of trauma, genetics, and epigenetics are also relevant fields. Through research and collaboration [17], I believe great further progress can be made in ameliorating this complex and often perplexing.

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