CONNECTING THE BRAIN TO BEHAVIOR: THE NEUROPATHOLOGY OF AUTISM

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Autism spectrum disorders (ASDs) are pervasive developmental disorders characterized by impairment in social communication and social interaction, and restricted and repetitive patterns of behavior (American Psychiatric Association, 2013). It is estimated that 1 in every 68 individuals born in the United States has Autism (CDC, 2014). There have been many theories as to the underlying causes of autism ranging from genetic predispositions and environmental causes to early childhood trauma. The brain has been a prominent area for autism research, and many neurological structures and mechanisms have been studied in regards to their relationships with a diagnosis of autism as well as specific autism symptoms.

The cerebellum is thought of as the “error correction system” for fine motor control, balance, and coordination of the body. This particular brain region contains a specific cell type, the Purkinje cell. There is evidence that the number of Purkinje cells in those with autism is lower than the number in typically developing controls, which may contribute to symptoms observed in those on the spectrum (Blatt, 2012). Lower levels of Purkinje cells may lead to altered cognitive patterns including difficulty sequencing information, language processing difficulties, altered visuospatial abilities, executive function challenges, and visuospatial memory, and/or attentional problems (Blatt, 2012).

The limbic system is a group of brain structures important for memory, attention, emotions, perceptual awareness, thought and consciousness. The system includes two brain structures often associated with autism, the hippocampus and the amygdala (Silver & Rapin, 2011).

The hippocampus is largely known for its role in memory, but it also has functions associated with the regulation of behavior caused by emotional stimuli (Blatt, 2012). There is evidence suggesting structural abnormalities in hippocampal regions in some individuals with ASD (Groen, 2010). Researchers hypothesize that these abnormalities may impact a person’s ability to retain and recall memories as well as to respond to external stimuli in contextually appropriate ways (Blatt, 2012; Groen, 2010).

The amygdala is involved in processing emotions such as fear, anger, and pleasure. In patients on the autism spectrum, enlarged amygdala volumes have been associated with increased anxiety and increased social impairments, such as weakened social and communication skills (Groen, 2010).

The anterior cingulate cortex (ACC) is associated with learning and problem solving, error detection, executive functions, cognitive functions, and social-emotional responses (Blatt, 2012). In addition, it has been proposed that the ACC plays a role in the theory-of-mind circuit (Blatt, 2012). Theory-of-mind has been defined as the ability to make mental state inferences about others (Rojas, 2006; Kana, 2013). Thus, abnormalities in the ACC may be related to joint attention, social-emotional behaviors, social-communicative behaviors, and understanding the mental states of others.

Another neurological system with a possible link to autism spectrum disorders is known as the mirror neuron system. The mirror neuron system is composed of a network of neurological regions, which are activated during the observation and/or imitation of an action (Hadjikhani, 2006). Some researchers have found lower levels of
gray matter within this neurological system in patients with autism as compared to typically developing controls. As well, cortical thinning of the mirror neuron system has been associated with ASD symptom severity, as those with less gray matter may have less empathic behavior and imitative learning, as well as more difficulty relating to others (Hadjikhani, 2006). However, the topic of mirror neurons is still under investigation as other researchers have found that individuals with autism displayed normal fMRI responses in mirror system regions (Dinstein, 2010).

Although the neuropathology of ASDs is still largely unknown, the scientific community has made great strides in unlocking the secrets of these pervasive developmental disorders in recent years. We now know that there are strong correlations between areas of the brain and the presence of certain symptoms, which is useful knowledge as those with ASD may have a variety of symptoms of varying degrees. Continued research and discoveries will be beneficial for the ASD community, as more information may lead to more individualized and effective treatment.

References: