The Differences between ADHD Brains vs. Non ADHD Brains

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There are many common misconceptions between differentiating ADHD brains and non ADHD brains, the cause of which largely stems from the stigmatization of mental health disorders. Though it is still debated whether or not ADHD is classified to be a disorder of the brain, inaccurate assumptions are often formed, leading to much confusion in the understanding of the disorder. ADHD includes symptoms such as forgetfulness, hyperactivity, irritability, impulsivity, and difficulty paying attention to details. Researchers have gathered evidence through scrutinizing various brain images and identifying structural differences that strongly convey the substantial differences between people who have ADHD in comparison to those who do not. These differences will be investigated throughout this paper.

Today, the reports estimate approximately eleven percent of children and five percent of adults to be diagnosed with ADHD in the United States. Alongside this, there is increased difficulty while completing tasks such as listening during a class period or during brief moments of instructions. ADHD stands for attention deficit hyperactivity disorder, and is classified as a common neuropsychiatric disorder. ADHD is not a severely rare disorder, but still "affects more than one in 20 people under 18 years old" (Radboud University Nijmegen Medical Centre 2017). It is important to note that about two-thirds of the people diagnosed with ADHD early on such as during their childhood continue to experience the symptoms of ADHD as adults. The main part of the brain that researchers are examining is the basal ganglia, a part of the brain that controls emotion, voluntary movement, and cognition. Researchers have "... found that the caudate and putamen regions within the ganglia are smaller in people with ADHD" (Radboud University Nijmegen Medical Centre 2017). Both the putamen and caudate make up the dorsal striatum, a functional structure that is directly involved in the decision-making process. More specifically, the things that encompass this would be action selection and initiation. The basal ganglia makes up the caudate, putamen, globus pallidus in the cerebrum, the substantia nigra in the midbrain, and the subthalamic nucleus in the diencephalon. It is important to note that the basal ganglia is known for its prominent role in movement, a critical aspect to pay attention to because many people with ADHD have issues with staying still. Therefore, the basal ganglia can be used as a strong indicator and an identifier of those who have ADHD. To add on to this finding, international studies are interested in examining the differences in the brain structure and density involving 1,713 people with a diagnosis of ADHD and 1,529 without the diagnosis. The age ranges for this study was between four and 63 years old. The purpose of the MRI scan was to measure the overall brain volume of each person. The scientists took specific percentages of each region of the brain and measured the density of each person's brain. Alongside this, the size of the seven regions of the brain that were associated with a possible linkage to ADHD are: the pallidum, thalamus, caudate nucleus, putamen, nucleus accumbens, amygdala, and hippocampus. Through the analysis of measuring the regions, scientists can use the differences in brain volume percentages to better understand how an individual's brain with ADHD differs from an individual's brain without ADHD. Scientists put more emphasis on scrutinizing the differences in each individual brain region in order to get a better idea on which regions are affected the most and the correlation they share with ADHD.

The conclusive results from this study were that people with ADHD had slightly smaller overall brain volumes, thus not allowing for some expansion of certain brain regions and therefore limiting the ability to concentrate. Alongside this, the regions that reported differences in size were the caudate nucleus, putamen, nucleus accumbens, amygdala, and hippocampus. The list is notably narrowed down because these were the regions that reported the most significant differences and were shown to have slightly smaller volumes in people with ADHD as opposed to the other regions.
Another study identified specific locations of the differences in volumetric abnormalities within the basal ganglia through the use of LDDMM, which stands for large deformation diffeomorphic metric mapping. The anatomy of the basal ganglia is illustrated in Figure 1. The LDDMM mapping's purpose revolves around, "the effects of ADHD, sex, and their interaction on basal ganglia shapes" (Qiu 2009). The LDDMM mappings generated basal ganglia templates and Laplace-Beltrami basis functions in the template coordinates was used to demonstrate shape variations within each structure in relation to the template. The shape variations, "were modeled for each subject as a random field" (Qiu 2009). The results from this study encompassed that girls with ADHD did not depict any differences in terms of volume or shape. In contrast, "boys with ADHD showed significantly smaller basal ganglia volumes compared with typically developing boys, and LDDMM revealed the groups

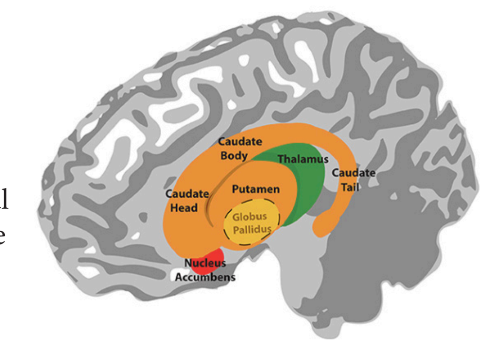

Figure 1: This image demonstrates the anatomy of the basal ganglia.

remarkably differed in basal ganglia shapes" (Qiu 2009). One study encompassed the stigma behind ADHD not being classified as a real disorder of the brain. The study makes the argument that ADHD should not be treated differently than other disorders because of the similarities that ADHD presents and the similarities it shares with other disorders such as learning disorders. The brain images were collected from 3,200 people. Roughly half of the participants had some sort of diagnosis to ADHD in the past and half of the participants were never diagnosed with ADHD. The National Institutes of Health (NIH) worked with ENIGMA Consortium, an international multidisciplinary group that specializes in psychiatric disorders, to conduct this study. In a like manner, figure 2 denotes an image that is superimposed on an ICBM (International Consortium for Brain Mapping) standardized anatomical template.

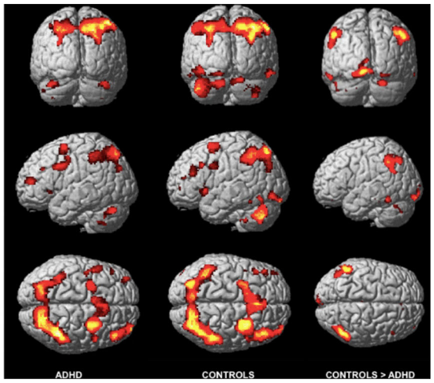

Figure 2. Differences in neural activity and functional brain patterns between controls and children who have never been medicated with ADHD.This image is superimposed on an ICBM (International Consortium for Brain Mapping).

One might wonder what these differences look like, and the answer is that on average, differences in brain volumes only range by a few percent between individuals who have ADHD with those who do not. ADHD is a disorder of the brain that primarily affects behavior and attention. Other brain disorders, such as bipolar disorder, affect mood. One study used an MRI scan, in which 455 people with ADHD received psychostimulant medication. Since there were[1] different volumes demonstrated within the five brain regions, it goes to say that ADHD is present regardless of the fact that people had taken medication. In essence, this suggests that differences in brain volumes had no correlation to the presence of psychostimulants.

[1] A psychostimulant medication is used to treat ADHD and narcolepsy. The purpose of psychostimulant is to increase alertness, attention, and energy.

Therefore, this study had a primary focus on measuring more of the effects of psychostimulants than ADHD. This finding presents the phenomenon that psychostimulants are not always proven to be effective as they have failed to produce any significant differences, if any. In terms of the amount of individuals who took them, there were 62 participants in each of the three trials. In a like manner, several studies encompassing the use of psychostimulants, used for treating individuals with depression, have shown how multiple trials and groups of participants have reported no significant differences with the use of psychostimulants (Candy 2008). It is important to weigh the benefits and costs before deciding if one should take psychostimulants. Not every individual who decides to take them will benefit and some ultimately face negative side effects such as mood swings and headaches. It is vital for an individual to note the progress he or she feels when taking psychostimulants. In order for this person to see if taking psychostimulants a good path for them to take, they should closely monitor their progress and check in with themselves everyday and then make the conclusion with their doctor on if they saw a consistent trend of improvement. As previously mentioned earlier in the article, the study conducted by a team of Dutch neuroscientists also analyzed over 3,200 MRI scans of the brains of people aged between four and 63 years old. Around half of the participants had a diagnosis of ADHD and the study analyzed overall brain volumes and inspected the regions most likely to be linked to ADHD. They meticulously differentiate between genetics and the differences between brain imaging. The study's results in brain scans "...revealed that five brain regions were smaller in people with ADHD" (Gregoire 2017). The study showed that the differences were more drastic in children in comparison to adults, leading the authors to derive that ADHD is associated with delayed brain development. The study illustrates that differences are seen to be much more significant in children rather than adults. This is because as an adult brain matures, the brain regions more closely resemble the brains of people who do not have ADHD. These differences become less and less distinct over time as opposed to the drastic differences seen between children with ADHD brains in comparison to children who do not have ADHD. Within the study, analyzing different brain volumes and different amounts of psychostimulants, 455 people with ADHD took a psychostimulant such (Adderall, for example), and then another 600 participants were not currently on any medication but had a history with taking the medication. The MRI imaging results demonstrated that the role of the stimulants did not at all correlate to the differences in brain volume. One researcher, Dr. Martine Hoogman, studying the effects of ADHD on the human brain, states her take on the role that the brain disorder plays in society: "The results from our study confirm that people with ADHD have differences in their brain structure and therefore suggest that ADHD is a disorder of the brain. We hope that this will help to reduce stigma that ADHD is just a label for difficult children or caused by poor parenting" (Paddock 2017). In essence, in today's world, mental health is constantly being stigmatized and overlooked.

In a like manner, brain disorders are being looked at as a rather secondary importance, which ignites the need for more conversations surrounding mental health. As seen in the studies described, certain paths and solutions work better for some than others. Individuals with ADHD must be mindful of this when deciding on their personalized path in order to treat what they are experiencing, because one solution cannot fix all issues. Solutions ought to be approached with the mindset of needing to make collective changes such as dietary selections, having a conversation with a doctor on if psychostimulants are a promising option, and prioritizing the amount of exercise that is sufficient on a daily or weekly basis. On top of making lifestyle changes, one must begin to make internal changes as well, and adapt positive thinking patterns in order to better cope with their disorder. Alongside this, it is important to remain optimistic in the midst of daily obstacles; as a society, we must work together to break down these barriers and pay closer attention to how we can accommodate those who need extra assistance.

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