Risk-Taking Behavior in Young Adults: Brain Maturity and Hormones

Abstract

This study examines whether young adults partake in more risk-taking behavior due to the different maturation in the Subcortical region and the prefrontal cortex, along with the production of hormones. Data from sixty participants aged between fifteen to thirty-five were analyzed in an fMRI machine using the BART software. Then, finally, their saliva was swabbed and put into a hormone kit. Due to some limitations in our experiment, some of the data was flawed. That being said, due to general trends in the data, the fMRI scanning, and the hormone testing, we can still say that young adults do partake in more risk-taking behavior due to the reasons stated above. These findings show the need to spread and learn the differences in young adults' brains and understand why they may act differently from others, since this period is the foundation for their future health.

Introduction:

To understand why young adults act differently compared to adults, it's important to look into specific regions of the brain alongside with production of hormones during this period. Young adults' brains are in many ways different, specifically when comparing the maturation of the subcortical regions and the prefrontal cortex (PFC) with an adult human. In young adults, the subcortical regions mature faster than the PFC.

The subcortical regions, which include the amygdala, basal ganglia, and thalamus, are known as the core area for the reward center, as well as controlling emotional responses from a given environment. While the PFC, which is often divided into two regions, medial (mPFC) and lateral (lPFC), controls the emotional responses from the subcortical regions and inhibits impulses from the reward system.

Additionally, from the ages of eight to fourteen for young female adults and nine to fourteen for young male adults (typically when they go through puberty), hormone production is at its highest. These hormones can act as neurotransmitters and bind to different regions in the subcortical regions, leading to signaling cascades. These cascades can either amplify or reduce a system's function, which can lead to young adults' brains having more neuroplasticity, the brain's ability to change itself due to certain experiences by creating more neurobiological pathways, often leading to more risk-taking behaviors and mental disorders**.** Understanding and knowing the biological differences between young adults' and adults' brains is crucial since the adolescent period is the foundation of their future mental health.

Materials and Methods

***Participants**:*

Sixty individuals ranging from the ages of fifteen to thirty-five were selected across the United States for this experiment. In the group of sixty individuals, each age in the given range had three individuals. This was to ensure that there were multiple trials to obtain the most accurate results as possible. Each participant was given a consent form which detailed the experiment, equipment used, and ensured that each participant didn't have any medical health issues.

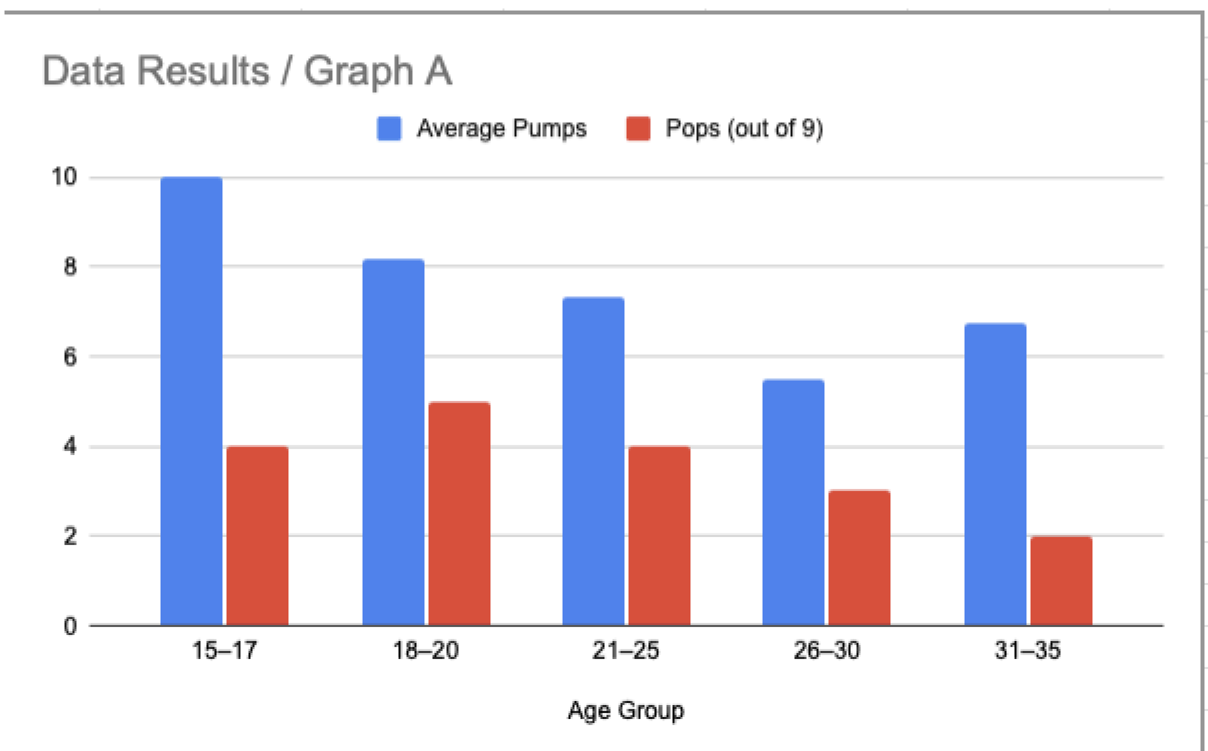
***Equipment and Software**:*

To understand the risk behavior tendencies in the participants, the software Balloon Analog Risk Task (BART) will be used. The software will be downloaded on a special tablet which will be added to a Functional Magnetic Resonance Imaging (fMRI). It will be positioned so that the participants will be able to see the tablet as they lie down and be able to interact with it. BART is a software that consists of a balloon. If the participant touches the screen, air will be pumped into the balloon, and the money count positioned on the bottom left will go up by 50 cents. However, if the participant clicks on the screen too many times, the balloon will pop, and all the money they had previously gotten will be lost. While the participants used the BART software, an fMRI machine was used to figure out which regions of the brain were most activated. The fMRI has the same design as a Magnetic Resonance Imaging (MRI) machine; however, the results will be interpreted differently. Once we obtain the 3D scan of the brain, we will look at which regions are "lighter" and use that to determine the results. Finally, once the BART simulation is completed and the participant is removed from the fMRI machine, their saliva will be taken. This is done to figure out if there's a correlation not just with the maturation of the subcortical regions and the PFC, but with the production of hormones. The saliva will then be put into a hormone testing kit. From the results of the fMRI, BART, and the hormone levels, we will determine if there's a correlation between hormones and age with risk-taking behavior.

Results

The purpose of this study was to figure out if the different rates of maturation in the Subcorital regions and PFC, combined with an increase in hormones in young individuals (ages 15-25), lead to an increase in risk-taking behavior, compared to older individuals (ages 26 and above). By using an fMRI machine, BART simulation, and saliva strips, we concluded that there is a correlation between the factors stated above and risk-taking behavior. Even though some of our results were affected due to limitations in our experiment, general trends in our results, the saliva strips, and fMRI results, we can still confidently say that young individuals are more prone to risk-taking behavior.

When the participants were placed into the fMRI machine, they used the BART software until they ended the software and collected the money, or the balloon popped. After the three participants in each age range completed this, the data were collected. Specifically, we looked at the average number of pumps and the number of pops for each age range (graph A).



Discussion

From the results, there is a general downward trend in the average number of pumps along with the number of pops. This suggests that younger individuals tend to engage in more risk-taking activity as they pumped the balloon more, knowing that it could pop. Furthermore, the results from the saliva test showed that the age group fifteen to twenty had the highest amount of hormones. This matches our data since this range had the most pumps and pops. The hormones act as neurotransmitters and could bind with different regions in the subcortical regions, leading to signaling cascades. This cascade creates more neurobiological pathways, often leading to more risk-taking behaviors. Furthermore, a type of hormone commonly made in this age range is dopamine, which affects the subcortical region. This drove them to seek rewards without thinking of the consequences of their actions, leading to this age range having more pumps and pops.

Once the experiment was over and the 3d images of the participant's brain were created from the fMRI machine, we noticed that once again it matched our data. Kids in the age range of fifteen to twenty mostly used their subcortical regions, while the age range of thirty-one to thirty-five mostly used their PFC. Since kids aged fifteen to twenty used their subcortical region, since their PFC has not matured fully, they were only able to think about the reward without thinking of the risks. This also led to them having the largest average pumps as well as pops.

However, when putting these values and calculating the p-value from an ANOVA test, we received a value greater than 0.05. This number isn't because the different maturation and hormones don't affect risk-taking behavior; it's due to the limitations of the experimental design.

Limitations of the Experiment

A reason for having a p-value greater than 0.05 was due to some experimental flaws. First, there was the sample size. For this experiment, each age in the given range only had 3 participants. These participants came from widely different backgrounds and cultures, which could affect the results since each person has a different brain structure. Furthermore, three participants for each age aren't enough to capture the variability of a larger population as a whole. More participants for each age must be used. Finally, another reason could be the combination of the male and female sexes. According to the National Library of Medicine, " females reach peak values of brain volumes (PFC) earlier than males.” Since both sexes were used in this experiment without accounting for the brain development differences, some of our data is based purely on biology, which therefore altered our results.

Subjects

Pros

For the experiment, individuals whose ages ranged from fifteen to thirty-five were used. The reason for this was due to direct relevance, since the research question is directly related to young adult health. Furthermore, this experiment was done to spread awareness of young adults' brains and to foster future research on this topic of interest.

Cons:

Using humans, however, has some issues. Humans are a very diverse species. This can lead to many variables and variants that could obscure results, such as genetics, lifestyle, and environment. These variables are one of the main reasons why the p-values in this given experiment were greater than 0.05.

Conclusion

In conclusion, this research paper focuses on figuring out if there’s a correlation between the different maturations in the Subcortical region and the PFC, along with the production of hormones with risk-taking behavior in young adults. The findings from this experiment show that there is a correlation and the importance of understanding young adults' brains. However, this experiment also shows the importance of understanding limitations in experiments and how they can impact findings. In the future, alterations for this experiment are needed. It’s important to gather more information on young adults' brains and understand their differences. The specific alterations needed to take into account are the diversity of subjects, sex, and experimental size.

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