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Marijuana's Impact on a Developing Brain

With the movement of cannabis legalization going on across the country, it is not hard to believe that the usage numbers for teenagers have continuously gone up. According to a study done in *Considering Cannabis: The Effects of Regular Cannabis use on Neurocognition in Adolescents and Young Adults*, "Cannabis is the second most used drug after alcohol, with 22.9% of high-school seniors and 20% of college students using in the past month" (Lisdahl et al. 2). As the stigma surrounding cannabis has drastically changed over the years, I still wanted to find out what the science says about the effect of weed on a developing brain, and what opinions smokers and non-smokers have on the effects as well. Using scientific research as well as interviews with young adults who either smoke weed or do not smoke weed, I will explore the positive or negative effects of marijuana on a developing brain.

Interviews with non-smokers:

During my research process, I was able to sit down with 6 students here at Montana State University who describe themselves as non-smokers. 4 out of the 6 have never tried cannabis, while two of them have said they have tried it a couple of times but did not enjoy the effects and had no plans of smoking again. While all had reasonings behind why they didn't smoke, some answers came up more than others. Owen Hunter, one of my interviewees stated that "during my upbringing with my family they always condoned it. With drugs in general. Honestly, I was scared of my father so whatever he said goes" (Hunter Personal Interview 1 May 2022). For the four that had never smoked before this idea of family structure seemed to

be a reoccurring theme. While some were raised in stricter households that condemned the idea of smoking, others had the opposite childhood. When asked about what his parents thought about the idea of smoking, Grant Davidson actually said his parents told him to “try it”. He continued on by saying that “the few times that I did smoke I would tell them. We had a good relationship when it came to me experimenting with things” (Davidson Personal Interview 1 May 2022). While learning a little about their past was intriguing, I was ultimately most interested in finding out if they thought cannabis usage in their teenage years had any negative or positive effects. When asked about said effects, Owen Hunter said “Yeah I definitely think there are negative impacts from smoking. I think it creates an addiction mindset, and I think the younger you are the more it will impact that addiction” (Hunter Personal Interview 1 May 2022). This idea of an addiction mindset and whether or not cannabis is in fact addictive sparked a lot of discussion in my interviews. Another major impact many of them agreed on was the idea of brain fog and memory loss surrounding youths who smoke regularly. Austin Wheeler was noted saying “I think it affects memory a lot, I think people who smoke a lot will forget a lot and have that mental fog” (Wheeler Personal Interview 1 May 2022). Grant Davidson, being one of the few in this interview list who has smoked before went on to say that “the brain fog for days after made me incompetent and it was super stress-inducing. I think people who smoke on a daily basis do tend to suffer from memory loss” (Davidson Personal Interview 1 May 2022).

Science on negative effects:

After hearing what my peers thought when it came to some of the negative effects of cannabis usage on a developing brain, I became increasingly interested in what the science had

to say. Based on my interviews and some preliminary research, the three main concerns of adolescent cannabis usage are addiction, the possibility of it being a gateway drug, and finally the cognitive effect on brain development which includes, mental illness as well as academic performance.

Addiction:

According to an article by the name of *Adverse Health Effects of Marijuana Use* "Evidence clearly indicates that long-term marijuana use can lead to addiction. Indeed, approximately 9% of those who experiment with marijuana will become addicted" (Volkow et al. 2). while this may seem like a low number at first, it actually increases by a scary amount when you consider those numbers being adjusted to those who started smoking as a teenager. According to the same article "The number goes up to about 1 in 6 among those who started using marijuana as teenagers and to 25 to 50% among those who smoke marijuana daily" (Volkow et al. 2). it is common in conversation about cannabis to hear both the terms addiction and dependence. Many don't realize that these two terms are not the same thing, yet they do have very similar underlying conditions that make them similar. According to the addiction center "dependence is characterized by the symptoms of tolerance and withdrawal" while "addiction is marked by a change in behavior caused by the biochemical changes in the brain after continued substance abuse" (Addictioncenter.com). These two terms while being quite close are still interpreted in a different light. Dependence seems to have a lighter connotation when brought up in a casual setting rather than addiction, yet both are not fun problems to have. This is especially the case if you are developing this dependence on a substance such as cannabis at a young age. "an estimated 2.7 million people 12 years of age and older met the

DSM-IV criteria for dependence on marijuana" (Volkow et al. 2). For reference, the DSM-IV stands for the Diagnostic and Statistical Manual of Mental Disorders. While the ability to develop a dependence on cannabis can happen at any age, it is increasingly more common in their younger years. "those who begin in adolescence are approximately 2 to 4 times as likely to have symptoms of cannabis dependence within 2 years after first use" (Volkow et al. 3).

Gateway drug:

Will smoking cannabis at a young age directly lead to using harder drugs later in life? Well according to science, it is a very wishy-washy yes and no. To begin to understand how and why cannabis became known as a gateway drug you have to travel back to the 1970s when the marijuana gateway hypothesis (also known as MGH) was first proposed. "the marijuana gateway hypothesis suggests that use of various classes of drugs follows a predictable pattern. Individuals who use illicit substances, such as tobacco and alcohol, are at a greater risk for use of marijuana. Subsequently, marijuana use presents an increased propensity of drugs use escalation to harder substances" (Jorgensen and Wells 2). It is incredibly important to start to understand MGH and why it came to be, as it is still used to this day. According to research done in part because of the MGH, there are two main explanations as to how and why cannabis can be considered a gateway drug to harder drugs. "The first of these explanations argue that marijuana causes future hard drug use by altering the individual user such that the user seeks out more potent intoxicating effects." (Jorgensen and Wells 6). "The second argues that use of marijuana increases associations with peers that also engage in drug use and thus the user learns about it and is influenced by the drug use of others" (Jorgensen and Wells 6). This is what I meant when I said the science was somewhat wishy-washy. While these explanations may be

true for some, it's hard to throw everyone who smokes weed at a young age in the same boat that they will all follow this path to hard drugs. While it may be easy to argue theories and such, numbers speak for themselves. According to research that has been done "individuals that initiate marijuana use before the age of 21 were 157 times more likely to engage in subsequent hard drug use" (Jorgensen and Wells 6). As we already know, gateway is the process of doing one thing that leads to another, and interestingly enough a recent study found that "only 1% of hard drug users aged 15-21 did not previously engage in marijuana use" (Jorgensen and Wells 8). While it shows that almost all heavy drug users used marijuana in the past, it does not necessarily mean that all young users of marijuana will use hard drugs.

Cognitive effects

While both addiction and gateway are critical topics when analyzing the negative effects of marijuana on teenagers and how it can impact their minds and body. The cognitive effects are arguably the most important to analyze as it directly deals with the long-term effects on the brain itself. There have been multiple tests that try and show the differences between adolescents who smoke versus those that don't smoke. In one recent study, it was found that "adolescent marijuana users demonstrated poorer performance on tests of attention, verbal learning/memory, sequencing, and psychomotor speed compared to non-using adolescents after approximately one month of abstinence" (Jacobus et al. 4). What I find interesting about this direct quote isn't necessarily that smokers tested lower than non-smokers, but the fact that this test was performed a month after the last time they had smoked. It starts to show that these effects don't just go away after a couple of days of not smoking, but in fact, can cause long-lasting cognitive issues. While this may be the case when it comes to smokers and non-

smokers, there are still negative effects that are highlighted in terms of teenagers that are in the group of heavy smokers versus occasional smokers. According to a recent study “heavy adolescent marijuana users demonstrated more preservative errors on problem-solving tasks compared to youths with minimal use” (Jacobus et al. 4). These types of cognitive effects are not only impacting day-to-day life for adolescent cannabis users but can also have serious impacts on their IQ which can result in lower performances in an academic setting. A study was conducted to see if early cannabis usage had any effect on IQ and according to the results “individuals who never regularly used cannabis had a slight increase (0.8 IQ point) in IQ from childhood into adulthood, while those diagnosed with cannabis dependence on at least three or more study occasions had an average loss of 5.8 IQ points” (Lisdahl et al. 4). If you smoke during or even after school you could be hindering your cognitive ability making it much harder for you to remember or even learn the information being taught in the classroom. “Marijuana use impairs critical cognitive functions, both during acute intoxication and for days after use, many students could be functioning at a cognitive level that is below their natural capability for considerable periods of time. (Volkow et al. 4). While many youths may consider it totally fine to smoke on the weekends, this study shows that in fact even when they may no longer be “high” those lasting’s effects of the drug could heavily impact their school performance that coming week. It is also important to note that these problems don’t stop once you’re done with high school. Studies have shown that “heavy marijuana use has been linked to lower income, greater need for socio-economic assistance, unemployment, criminal behavior, and lower satisfaction with life. (Volkow et al. 5). As we have learned adolescent cannabis use can impair many neurological functions that seriously inhibit school performance and brain development.

Yet when I spoke to my interview participants that had not smoked, many seemed to be worried about the mental health side of adolescent cannabis usage. The interviewees seemed to be concerned about the possibility of developing anxiety and depression as a direct correlation to smoking weed, and well "there is substantial research linking marijuana use in adolescents with symptoms and diagnoses of depression and anxiety in young adulthood" (Pedersen. et al). While anxiety and depression are two commonly linked problems with youth marijuana consumption, there have been many talks about the possibility of its linkage with early-onset psychoses. According to *the New England Journal of Medicine* "marijuana is also linked with psychoses (including those associated with schizophrenia), especially among people with preexisting genetic vulnerability" (Volkow et al. 4). It also goes on to say that "heavier marijuana use, greater drug potency, and exposure at a younger age can all negatively affect the disease trajectory (e.g., by advancing the time of a first psychotic episode by 2 to 6 years)" (Volkow. et al. 4). While these may seem like broad overarching concerns, it seems as if it would be quite useful to teach these possible effects to adolescents at a young age.

Interviews with smokers

I was lucky enough to sit down and chat with 5 of my peers here at Montana State who all claim to be avid weed smokers. The average age of first starting to smoke among my interviewees was 12-14 years old. Many of them had an older role model that influenced them to pick up the habit, whether it be an older friend, older brother, or even in one particular case a parent. All of them at one point in time in high school got caught by their parents, and while non-where too thrilled about the idea of their child smoking, they each had different reasons for their disproval. One of my interviewees, Jared Mizner had this to say about when he got

caught. “When they first caught me, they weren’t happy. Not because of weed itself, but because they thought my brain wasn’t fully developed. They told me that bipolar disorder runs in our family and they thought that smoking weed at such a young age would increase the chance that I develop bipolar disorder” (Mizner Personal Interview 1 May 2022). Well as we learned from the scientific research above, his parents may have been on to something. When asked the question of why they made it a habit most of them just said they enjoyed getting high, one interview was quite different though. Connor Lennehan explained his reasoning was more of “stress relief. A crutch suppressor. Once my grandfather passed away I was really sad and smoking took away that pain for a short while” (Lennehan Personal Interview 1 May 2022). While he admitted smoking helped his depression a lot during the time, he knew it wasn’t the best method available. When asked if they noted any positive effects of smoking at such a young age, Leo Cunningham noted that “it really helped me sleep. I used to toss and turn being stressed at night and weed gave me that instant relief. I also struggled throughout high school with periods of anxiety and once I smoked that anxiety went right out the door” (Cunningham Personal Interview 1 May 2022). These gentlemen that I interviewed continue to smoke to this day and say that they have felt no negative impact on their mental health, academic performance, or the cognitive effects that we have already discussed.

Science on positive effects

Many researchers have put time and effort into decreasing the notion that cannabis usage is bad, even when it pertains to a younger audience using it.

Addiction/Gateway

Earlier we used the MGH to explain why people may think of marijuana as a gateway drug, but that might not be as true as we thought "Research suggests that MGH arguments may not be as accurate as widely assumed" (Jorgensen Wells 3). It continues on to explain that "while there is an association between marijuana use and hard drug use, this can largely be explained by other risk factors or "third" variables" (Jorgensen and Wells. 3). So yes, doing one thing might lead to another, but it is not a definite thing that will happen. To easily explain that the same article gives us a sequence to explain how cannabis use and hard drug use don't necessarily go hand in hand. "tricycle to bicycle to motorcycle. Yet, not one would intuitively think that riding a tricycle causes riding a bicycle and that riding a bicycle causes riding a motorcycle. There are a host of other variables related to motorcycle riding that have not been taken into account" (Jorgensen and Wells 3). While this may seem a bit confusing I think it perfectly explains how there really is no concrete correlation between the two. It all depends on the individual, and most of the time there are a handful of other factors that lead to the usage of hard drugs besides early-onset marijuana usage. When it comes to addiction, it is more than likely the tests are being performed on lab rats as it is hard to find a parent willing to volunteer their child for such experiments. So, I carried on my research to find a test that would ultimately tell me is cannabis truly addicting? I was able to find a study done in *ScienceDirect* that concluded that "although MDMA, LSD, and THC are taken by abusers to experience fun or pleasure and although these drugs elicit molecular signs in rats which presumably correspond to such emotions, the substances are not highly addictive in a way that they do not cause the loss of a productive life" (Vourliotis et al 16). Let's ignore the MDMA and LSD part as it does not pertain to our research. We learn here that THC itself, the main ingredient in cannabis is in fact

not addictive. While again every user may be different, this does not exclude the fact that some people may have addictive personalities, but there seems to be no link that smoking weed at a young age will guarantee addiction for the rest of your life.

Cognitive effects

We spoke in length about the possibility that early-onset cannabis usage could lead to episodes of psychosis in adulthood. Well according to a study published in *ScienceDirect* "cannabis use by itself was not associated with increased odds of being classified as psychosis spectrum" (Jones et al. 2). While youths who may have a genetic predisposition to psychosis disorders might stay away from cannabis, there seems to be no clear-cut tie between the two. Many teenagers believe it is their best option to use marijuana rather than other drugs to help them with mental issues they may face. A study was conducted with 20 teenagers who say they use cannabis to manage health problems. "Six participants indicated they were using marijuana specifically to deal with depression. The use of marijuana to manage stress and anxiety was described by 12 teens in our sample. Nine teens in our sample described using marijuana to help them sleep." (Bottorff et al. 9). Many of these teens said they choose marijuana over pills as they think cannabis is less harmful and more helpful. When it came to being helpful in school it was interesting that "Three teens reported using marijuana to improve their concentration" (Bottorff et al. 9). while previous reports indicated that early age cannabis use can lead to decreased performance in school these three students have seen their academic performance increase dramatically since beginning to smoke. As we know, this research paper is simply about getting the facts out there. That being said, it is important to note that I was unable to find any science that refuted the notions of early-onset cannabis use causing memory loss,

brain fog, or any other impairments that previous studies have shown above indicate. With that being said, it is clear from my interviews that it is truly a person-by-person case. Most of the interviewees who smoke indicated that they never felt any type of memory loss or brain impairment of any kind, then yet again, maybe they just haven't noticed it yet.

Going into this process I had no idea what type of results and answers I would get. When studying such a controversial topic I knew I wouldn't be getting one solidified answer and honestly that is not what I was looking for. While we can use science to get the answers we search for, there is still so much unknown in the study of cannabis. While for some it may cause depression and anxiety, for others it may solve their symptoms of depression and anxiety. Maybe some will get addicted while others won't, and maybe some think it hurts their classroom performance, while others use it to improve theirs. People might read this paper and say "see I told you how bad marijuana is for a developing brain!". While others may look at this and go "uh I had it all wrong this really isn't bad for teenagers at all". The importance of doing this research is that afterward the conversation continues. Marijuana in our lifetime will only get bigger and bigger and educating our youth about the possible negative or positive effects that come from early-onset cannabis use is crucial.

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