

Marijuana VS. Caffeine; Widely Used Substances with Addictive Qualities

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Abstract

I wanted to find out if marijuana and caffeine addictions the same type of addiction. Marijuana and caffeine addictions were looked at for both substances are widely used and not regularly associated with addiction. I wanted to find out how much of each drug it took to become addicted and what made the substance addictive. After finding out how the substance was addictive I wanted to be able to classify what type of addiction each substance produced. I did this by analyzing many different articles and compiling my findings. My hypothesis was that both drugs produce physical addictions. Instead it was found that marijuana addictions are different than caffeine addictions. Marijuana addictions may start by being psychologically addictive and after continual usage develops into a physical addiction, whereas caffeine is physically addictive.

Introduction

Many people suffer through their addictions every day. When an individual starts consuming a drug it is possible that they are unaware that the substance they are consuming can become very addictive. Substances like marijuana and caffeine are widely used. Marijuana being the most widely used illicit drug (Blum, et al., 2000; Elkashef, et al., 2008; Filbey, et al., 2009; Volkow, et al., 2014; Hanson, 2009). Caffeine is used by most of the general population making it the most widely used and accessible drug in the world (Greenberg, 2010; Vandrey, Budney, Kamon, & Stanger, 2005). Where these two substances are used so often one may not realize that they possess addictive qualities when consumed. Within this article I will cover what type of addiction both substances produce by going over how an individual may become addicted, how much of the substance it takes for an individual to become addicted, and what withdrawal effects an individual may experience once the individual becomes addicted and stops use of the

substance. After this I will then compare the two different substances in order to find the difference and similarities between the two drugs as well as decide whether the drugs are psychologically addictive or physically addictive. Knowing whether these drugs are addictive psychologically or physically may help find treatments for the individuals experiencing these addictions for withdrawal effects an individual will experience can effect quality of life. My hypothesis is that these drugs create physical addictions, however some individuals can be affected psychologically as well.

Addictions

First I would like define the term addiction as it is being used in this paper. Addiction is characterized by an incapability to consistently stop use, impairment in behavioural control, craving, diminished recognition of significant problems with an individual's behaviours and interpersonal relationships. Addictions can become stronger with continual use of a substance (American Society of Addiction Medicine, 2011).

Psychological Addiction

Psychological addiction is when an individual becomes dependant or starts to crave the pleasurable effects of a substance or behaviour. For example, an individual feels as though they need to have sex in order to relieve stress even though the individual does not receive any withdrawal symptoms when they do not have sex. They still rely on having sex to relieve that stress even though they do not physically need sex to relieve that stress.

Physical Addiction

A physical addiction is when an individual continues use of a substance in order to avoid withdrawal symptoms. For instance, an individual smokes cigarettes on a daily basis, and when they do not smoke they experience withdrawal symptoms of irritability, headaches and increased

stress among other withdrawal symptoms. Because of these symptoms the individual continues to smoke in order to alleviate the change in normality.

Marijuana Addiction

The age of initiation to start smoking marijuana is always increasing. The mean age of these people is currently about 17.4 years old (Elkashef, et al., 2008). Among the people just starting to smoke marijuana one out of every twelve of these people are likely to become addicted to the substance (Sofuoglu, Sugarman, Carroll, 2010). This is a low rate of about 8% of people that will become addicted (which is lower than other illicit substances). Even though it is such a low percentage about 20,000 to 30,000 of new marijuana smoking individuals will become addicted in America every year because of how many people smoke marijuana on a daily bases (Elkashef, et al., 2008; Sofuoglu, et al., 2010). With such a large number of people becoming addicted to marijuana, treatment needs to be available for anyone trying to seek help for relapse is possible with marijuana addictions.

The Effects of Marijuana on the Brain

Marijuana produces feelings of increased appetite, ability to sleep, relax, and relieve pain. (Elkashef, et al., 2008; Hanson, 2009; Montagne, 2008; Vandrey, et al., 2005). It is able to create these effects through the release of tetrahydrocannabinol (THC) that is produced from marijuana (Elkashef, et al., 2008). The THC that is released from marijuana gets released from the lungs into the bloodstream and then to the brain. (Elkashef, et al., 2008). In Elkashef and colleagues (2008) study they stated that THC also metabolizes quickly but is slowly eliminated through excretion. Where it is slowly eliminate the body has to store the THC until it becomes excreted and does so by storing it in the fat tissues of the body. THC has the ability to be absorbed quickly into the bloodstream which brings the THC to the brain which creates the experience of being

“high” almost immediately after smoking (Hanson, 2009). When marijuana is eaten it takes longer for the THC to go into the bloodstream of an individual and therefore takes longer to take effect (Hanson, 2009). When THC arrives at the brain it activates different areas within the brain through the activation of CB1 receptors that can be found on cells in the hippocampus, prefrontal cortex, anterior cingulate, basal ganglia, and cerebellum, but also in the spinal cord, and peripheral tissue (Sofuoglu, et al., 2010). Sofuoglu and colleagues (2010) say that THC binds to the CB1 receptors activating the cells that they are located on which releases the neurotransmitters GABA, glutamate, norepinephrine, and acetylcholine. It is the reaction of the CB1 receptors with THC that allows to release neurotransmitters that creates the effects one experiences while intoxicated with marijuana (Elkashef, et al., 2008; Filbey, et al., 2009; Sofuoglu, et al., 2010). For instance, acetylcholine (ACh) is the reason why an individual’s attention, working memory, motivation, and reward functions are altered (Sofuoglu, et al., 2010). The bloodstream helps bring the THC to the brain letting the THC bind with receptors influencing what an individual experiences and how they experience everything.

The area seen with the most activation when marijuana is consumed would be the reward circuits of the brain consisting of the ventral tegmental area (VTA) to striatal areas along with the prefrontal cortex (PFC) (Filbey, et al., 2009). These areas are activated because of the release of dopamine that happens when an individual consumes marijuana from the CB1 receptors bonding with the THC letting the cells release neurotransmitters that was brought to the brain through the bloodstream (Elkashef, et al., 2008; Filbey, et al., 2009; Hanson, 2009; Volkow, et al., 2014). The release of dopamine activates the reward center within the brain, therefore when one intakes THC they will attribute positive qualities towards the substance that contains the THC. The body would feel rewarded after an individual consumed marijuana.

(Elkashef, et al., 2008; Filbey, et al., 2009; Hanson, 2009; Volkow, et al., 2014). The reward circuit may be due to positive effects that it provides, especially for people suffering with issues like anorexia, insomnia, severe pain, and stress. The relief of these issues may also be a reinforcement for use of the drug. Once an individual experiences positive encounters with the drug multiple times an individual may associate the good feelings to the drug. Once an individual associates positive qualities to marijuana it would begin to react like a reward to them. An individual believing that marijuana helps them would produce a feeling of being rewarded for the individual whenever they consumed marijuana. After this association occurs the chances of the individual becoming addicted to the substance increases for whenever they are effected by something negative they will look towards the drug to produce the rewarding qualities they received when it been first used.

Once an individual continually uses marijuana and then stops consumption for a few days the same areas as well as other areas in the reward-related regions of the brain activate at the mere presentation of drug-related stimuli (Filbey, F. M., et. al., 2009). According to Filbey and colleagues these areas include the ventral tegmental area (VTA), the dorsal anterior cingulate cortex (ACC), cerebellum, thalamus, pre- and post-central gyri, inferior frontal gyrus/ insula, thalamus, amygdala, fusiform gyrus, inferior parietal lobe and superior temporal gyrus. When an individual experiences activations in these regions it creates a craving within the body making the individual want to use the substance they have abstained from for multiple days. When the inferior frontal gyrus/ insula shows increased activation it usually results in increased motivation, therefore when it activates in the presence of drug-related stimuli it will also increase an individual's motivation to use the drug once again (Filbey, F. M., et. al., 2009). This could help an individual sustain a new addiction or cause an individual to relapse and start using marijuana

again. The activation of other areas within the reward-based processes (like the amygdala and dorsal anterior cingulate cortex) will activate an increase in emotional processing making it even harder to stop use of marijuana in a psychological sense (Filbey, F. M., et. al., 2009). Even if one no longer experiences withdrawal symptoms one can still stay addicted or relapse just because of the activation in the areas like the amygdala and the ACC. Once the addiction process has begun it becomes more and more difficult to break the addiction for the brain associates the behaviour with reinforcement. This makes an individual feel as if they need marijuana in order to cope with behaviours they are no longer used to coping with on their own. This shows that marijuana is a psychological addiction than has the possibility to develop into a physical addiction.

Amount Required to Become Addicted

In order for an individual to start experiencing withdrawal effects one must smoke marijuana multiple times a day over a period of a few weeks (Hanson, 2009). Most individuals start to smoke and continue to smoke marijuana for the pleasurable effects that it produces (CITE). In order to experience the effects one must become intoxicated by the substance. Every individual is different and will require different amounts of marijuana in order to become intoxicated by the substance. The weight, height, and body type of each individual will change the amount needed in order to become intoxicated. Different types of marijuana have different levels of THC content within them, making each time one smokes a little bit different. The amount needed every time may change for one also learns the best ways to handle the smoke to gain the most THC out of every puff. Along with the different toxicity levels of each amount of marijuana they get will change how much is needed for the individual to become intoxicated (Ramesh, Haney, Cooper, 2013). Ramesh and colleagues found that individuals have a negative correlation with the amount of smoke inhaled and marijuana potency. This shows that an

individual automatically changes the amount of smoke they inhale depending on how potent the marijuana is. The higher the potency, the less smoke inhaled and the lower the potency the more smoke inhaled. Because of all these factors it is difficult to discover how much marijuana is required in order to become psychologically addicted to the substance. From individual reports all of the individuals that are physically addicted to marijuana seem to have one thing in common, they all smoke multiple times throughout the day every day (Filbey, et al., 2009). They seem to maintain a high throughout the day making it so that they are always intoxicated and do not spend much of the day sober (Hanson, 2009). From this we can gather that marijuana can initially be a psychological addiction but develop into a physical addiction after consistent use. I have also found that an individual only needs to become intoxicated from the substance multiple times (and those times do not have to be in succession) in order to become psychologically addictive. The addiction can then develop into a physical addiction but the amount needed daily is enough for the individual to maintain a “high” throughout the day, being considered a chronic user.

Marijuana Withdrawal

Once physically addicted to marijuana an individual can experience many withdrawal symptoms; however the amount of marijuana consumed will affect the strength of the withdrawal symptoms in a positive correlation. This shows that the more weed consumed more consistently will increase the negative effects of the withdrawal symptoms. When an individual experience a physically addicted to marijuana and starts to depend on the substance when the substance is taken from them the individual will experience withdrawal symptoms (Elkashef, et al., 2008; Filbey, et al., 2009; Hanson, 2009; Volkow, et al., 2014). This is due to the body becoming used to the effects that the drug produces. Once an individual becomes dependant on

marijuana to create certain experiences when marijuana is no longer consumed those benefits are taken away. The body is no longer used to functioning without the effects of the drug therefore one may experience difficulties in part-taking in those experiences while being sober. One becomes used to experiencing life in a certain way, they need to be intoxicated in order to feel normal and deal with their surroundings so when that drug is no longer present they can no longer cope with day to day activities that they are now used experiencing with marijuana. This can be caused from the body being used to the effects that the drug has on the body. Marijuana effects to hormones and cognitive processing within the body; therefore when the individual no longer consumes the drug they are no longer experiencing the effects within the body. When the body is used to the effects of marijuana it no longer produces the hormones that is produced when an individual is intoxicated and is used to functioning in an altered cognitive state (Hanson, 2009). Hanson (2009) then explains that because the body is used to functioning in this altered state and no longer produces its substances when it no longer receives the substance the body no longer has everything that it needs to continue function regularly and because of this we experience withdrawal symptoms. For instance, dopamine is released when an individual smokes marijuana therefore if the body became used to marijuana producing dopamine within the body all the time the body will no longer produce dopamine until it realizes that it is no longer receiving it from the substance. Withdrawal effects do wear off over time; for marijuana this time is estimated to be 28 days according to multiple different studies (Elkashef, et al., 2008; Filbey, et al., 2009; Hanson, 2009; Volkow, et al., 2014). The withdrawal effects an individual feels when they are no longer consuming marijuana once again suggests that marijuana becomes a physical addiction. When an individual experiences withdrawal effects they usually experience anxiety, decreased appetite/weight loss, irritability, restlessness, sleep problems, and strange

dreams. They also experience an increased craving for marijuana. Some individuals also experience depression, excessive sweating, loose stools, decreased mood, shakiness, anger/aggression, a general “blah” feeling and described their mental state as “inner unrest” however these were reported less frequently (Elkashef, et al., 2008; Filbey, et al., 2009; Hanson, 2009; Volkow, et al., 2014). These symptoms are the opposite of the effects of marijuana so it is expected that when an individual becomes used to marijuana to feel normal, when marijuana is taken away the individual will experience the opposite of what the substance provides. The body no longer provides the hormones and the same level of cognitive functioning as it used to. Therefore it became used to the change in state leaving the body in a worse state than they were originally felt when the individual who had become dependent on marijuana no longer consumes the substance. Once again the individual does not experience these withdrawal effect unless they are a chronic user showing that marijuana addictions start psychologically but can develop into a physical addiction.

Caffeine Addictions

Many individuals become addicted to caffeine for it is one of the most accessible drugs in our society and is consumed by more than 85% of Americans (Lane, & Phillips-Bute, 1998). It is a lot easier to become addicted to caffeine than it is to become addicted to marijuana. Therefore a lot more people suffer from caffeine addictions than from marijuana addictions. This may be due to how accessible caffeine is and how widely accepted the daily use of caffeine has become.

The Effects of Caffeine on the Brain

Caffeine is similar to marijuana with how the substance affects the brain, however it does not affect as many areas as marijuana does. Caffeine affects the A1 and A2A adenosine receptors (Diukova, A., et. al., 2012). The caffeine binds with the receptors which effects neuronal activity.

This is what creates the feeling of being more alert but because the cerebral blood flow (CBF) is reduced (Diukova, A., et al., 2012). Caffeine also has another effect on the body for it also releases neurotransmitters like dopamine, acetylcholine and noradrenaline. However, unlike marijuana dopamine does not become influenced in chronic users and therefore the body will always keep creating its own dopamine instead of depending on caffeine to create it (Daly, J. D., & Fredholm, B. B., 1998). The neurotransmitter levels one experiences from caffeine depends on the amount of habitual caffeine consumed, with a positive correlation. This shows that the more habitual caffeine consumed the higher the neurotransmitter levels in an individual's body. fMRI tests conducted have shown that caffeine activates the bilateral medial frontal cortex as well as the right anterior cingulate (Diukova, A., et. al., 2012). These areas control tasks like motivated attention, error detection, planning and problem solving (Diukova, A., et. al., 2012). After consuming coffee individuals report that they improve in these types of tasks (Daly, J. D., & Fredholm, B. B., 1998). Caffeine only activates a few areas of the brain, however Diukova and colleagues found that when an individual is used to a daily caffeine intake and does not consume caffeine over a period of a few days the frontal cortex is activated when an individual completes a verbal working memory task but not in individuals who do not consume caffeine. Caffeine does have an effect on an individual's body and mind even if one is not completely aware of the changes.

Amount Required to Become Addicted. The amount of caffeine required to become addicted does have its individual differences based on the size of the individual however it has been found that an individual can become addicted to caffeine if they drink about 100-200 mg of caffeine per day (Daly, & Fredholm, 1998; Marsh, Snell, Allen, & Wakefield, 2001). That is about the same

amount as one coffee per day for at least two days in a row. This is strong evidence that caffeine is a physical addiction.

Caffeine Withdrawal. After consuming at least 100-200 mg of caffeine a day for a few days in a row one will become dependent on the substance. If an individual stops use of caffeine once they become dependent on it they are likely to experience withdrawal symptoms. The symptoms for the withdrawal effect an individual in a similar way as marijuana in a sense that they do the exact opposite of the drug itself. These withdrawal symptoms are headaches, anxiety, muscle tension, general malaise, fatigue, drowsiness, increased work difficulty, decreased feelings of well-being/contentment, decreased sociability/friendliness/talkativeness, blurred vision and flu-like symptoms (Marsh, 2001; Schuh, & Griffiths, 1997). Individuals have also reported that they experience an increase in work difficulty (Marsh, 2001; Schuh, & Griffiths, 1997) Schuh and Griffiths (1997) did a study to see if withdrawal effects contribute to caffeine addictions. They had two groups, with one being a control group. The control group took capsules that contained their regular amount of caffeine intake and therefore were unaffected. The other group took placebo pills, therefore they were no longer receiving their daily caffeine intake. Both groups had their diet restricted and saliva tested in order to make sure they were no consuming caffeine outside of the study. There was 3 days, a week a part from each other where they gave the subjects the pills. Each day at the end of the day of taking these pills Schuh & Griffiths (1997) gave the subjects a questionnaire. This questionnaire consisted of questions asking them if they would take the medication again for varying amounts of money. They had found that individuals would rather not take any money to take the placebo pills again. This shows that the subjects did not want to experience the withdrawal effects again no matter how much money they received by doing so. This is further proof that caffeine is a physical addiction.

Marijuana vs. Caffeine

Marijuana addictions seem to start as a psychological addiction and can develop into a physical addiction after a large amount of consistent consumption. From a medical perspective marijuana is prescribed in order to alleviate unwanted conditions. Many people may also self-medicate themselves with marijuana for it is widely known that marijuana alleviates pain, stress, insomnia. It is also known that marijuana increases appetite which can be used to help individuals with eating disorders. From the relief marijuana provides individuals seem to smoke more to experience the relief until the individual starts to become used to the effects of marijuana and need to start smoking more in order to feel the same effects until, eventually, they smoke marijuana multiple times throughout the day. The increased intake can be due to the increase in tolerance that occurs after continual consumption. One may continue use of marijuana in order stay in a state of normality because they are so used to the effects. This is how marijuana develops into physical addiction. Caffeine starts off as a physical addiction unlike marijuana. Caffeine also does not require a lot of use from the substance in order to become physically addicted, unlike marijuana. When both substances are consumed in large amounts both have equally terrible withdrawal effects. Caffeine does not change an individual's cognitive function abilities by much however it does provide a variety of good moods as well as energy, alertness, and an increased ability to concentrate (Schuh, Griffiths, 1997). Individuals who become used to caffeinated beverages will begin to dislike decaffeinated beverages purely because they do not provide the caffeine needed in order to avoid withdrawal effects (Lane, & Phillips-Bute, 1998). The fact that this occurs proves that this addiction is also more physical based than psychological, even though it activates different receptors in the body and different functions within the brain.

Conclusion

Overall both drugs produce different effects and effect different areas within the brain. They both have qualities that show physical addictions however, marijuana addictions usually start by being psychologically addictive. With marijuana an individual does not experience withdrawal symptoms if they are not a chronic user. Chronic users usually start with a psychological dependency for they begin to smoke marijuana regularly to experience its pleasurable effects that it produces. As their tolerance increases so does the amount of marijuana the individual consumes in order to experience the effects that marijuana produces. Eventually the individual may start consuming large quantities of marijuana becoming a chronic user. For caffeine one can experience withdrawal symptoms after multiple days of caffeine consumption in succession. To avoid or alleviate the withdrawal effects many individuals would prefer to continue their consumption of caffeine proving that caffeine is a physical addiction. As a future study I would like to investigate the effect of psychological dependency on drugs that show more signs of physical dependency in order to determine if treating someone with a psychological method would help deter a physical dependency. My hypothesis that caffeine addictions were physical addictions was correct. However, my assumption that marijuana addictions were also purely physical was incorrect for marijuana addictions are psychological but can develop into physical.

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